Title: Epidural Anesthesia for External Cephalic Version

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Introduction: External cephalic version (ECV) can decrease the need for cesarean section in patients with a fetus in breech position at term. The procedure, however, is painful and usually requires the use of intravenous tocolytics to relax the uterus and optimize success. Other complications associated with cephalic version include fetal bradycardia that may require emergency cesarean delivery. Our purpose was to study the success rate of ECV, ritodrine requirements, degree of patient discomfort, incidence of emergency cesarean section and maternal/fetal outcome with and without epidural block for ECV.

Method: With approval of the institutional committee for human studies, 78 gravidas were recruited over a 3 year period and alternately assigned to ECV with or without epidural anesthesia. To be included in the study, patients must: A) have attained a gestational age of at least 36 weeks; B) have adequate amniotic fluid on ultrasound; C) show no evidence of macrosomia; D) have a reactive nonstress test; and E) have no contraindications to β mimetic therapy or epidural anesthesia. Those undergoing epidural anesthesia received 3% 2-chloroprocaine (31) or 1.5% lidocaine (7) in a volume necessary to attain an anesthetic level of T-4 to T-8 (16.9 ± 3.6 ml). ECV was carried out with ultrasound guidance. Ritodrine was administered to all patients receiving no anesthesia and only to those patients receiving epidural anesthesia when attempts at ECV were not initially successful (12).

Results: In the epidural anesthesia group 29 of 38 (76.3%) attempts at ECV were successful, with 3 requiring tocolysis, compared with 23 of 38 (60.1%) in the unanesthetized group (p = 0.2), all of whom received tocolytics. Two emergent cesarean sections were performed for persistent fetal bradycardia in the group receiving epidural anesthesia, compared with 1 emergent cesarean section in the group receiving no anesthesia. There was no difference in the procedure time in the combined anesthesia and version times, between the two groups (62.5 ± 19 minutes for the EA group and 68.7 ± 16.9 minutes for the control group, p = 0.23). Visual analog pain scores (0 - 10) were 1.8 and 7.6 (p < 0.05) for the epidural group and the unanesthetized group respectively.

Conclusion: These results suggest that ECV under epidural anesthesia provides a high degree of maternal comfort and cooperation, allows ideal operating conditions in the event an emergent cesarean section is required, and may decrease the need for intravenous tocolytics prior to attempted version. There is no difference in the rate of successful ECV or total procedure time with or without epidural block. A larger series may reveal an increase in emergency cesarean section under general anesthesia in the non anesthetized group.

Reference
A SUPERIOR NEW EPIDURAL CATHETER: MATERIAL COMPOSITION AND DESIGN

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Introduction. Continuous epidural anesthesia is an effective and safe form of anesthesia for obstetrics. The development of the epidural catheter and improvements in its design is a major contributor to the success of this form of anesthesia1,2,3. However, a causal relationship exists between the material composition and design of epidural catheters and the incidence of complications4,5,6. There are several potential complications associated with the insertion of an epidural catheter such as paresthesia and/or nerve trauma, blood vessel puncture, and dural puncture. We compared the incidence of complications, quality of analgesia and the associated technical characteristics of two commonly used epidural catheters with a newly designed dual-durometer catheter.

Methods. After Institutional approval and obtaining informed consent, a continuous lumbar epidural anesthetic was administered in a standardized manner to 789 patients, utilizing one of three epidural catheters. (Portex® closed end multipore catheter, n=205; Portex® open end catheter, n=276; Arrow® dual-durometer catheter, n=306). At the time of epidural placement and during all subsequent reactivations, the incidence of complications, quality of analgesia and technical characteristics of each catheter were recorded.

Results. The Arrow® dual-durometer catheter was associated with significantly less paresthesias than the two Portex® catheters 28% vs. 6% (*p<0.0005). The Arrow® catheter was also associated with significantly less resistance during insertion of the catheter through the needle, and during all subsequent injections through the catheter (*p<0.0005). During this study epidural venous puncture was noted in 0.6% of Arrow® catheters and 2.5% of Portex® catheters. In a subsequent series of over 1000 additional epidural blocks using the Arrow® catheter, there have been NO instances of epidural venous cannulation or accidental migration of the catheter into an epidural vein. Quality of analgesia as assessed by the patient and investigators was similar in all groups.

Discussion. The material composition and design of epidural catheters is directly associated with the incidence of complications, such as blood vessel puncture and paresthesias. The newly developed polyurethane Arrow® dual-durometer catheter is composed of a softer material. Those patients receiving epidurals utilizing the Arrow® catheter reported less paresthesias than the patients in the other two groups. Anesthesiologists administering the epidural block associated the Arrow® catheter with superior technical characteristics, and to date, only two epidural venous perforations.

References,
TITLE: THE USE OF A SPINAL FIELD BLOCK BEFORE EPIDURAL ANALGESIA FOR LABOR

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Introduction The spinal field block (SFB) has been reported to decrease acute and chronic back pain associated with spinal and epidural anesthesia in surgical patients (1). We examined, in a randomized, blinded fashion, the efficacy of the SFB in reducing both the pain of epidural needle insertion and the incidence of long term lumbar pain in parturients requesting epidural analgesia for labor.

Methods The protocol was approved by the Research Ethics Committee at Women's College Hospital. After informed consent, 60 parturients requesting epidural analgesia for labor were randomly assigned to either the control group (Group C) or the study group (Group S). Before epidural needle insertion, patients in Group C received 1.5% lidocaine as an intradermal wheal and subcutaneous infiltration along the needle track. Patients in Group S receive the same treatment plus a SFB with 1.5% lidocaine, performed according to a previous protocol (1). A visual analog scale (VAS) was used by a blinded observer to quantitate back pain on needle insertion. The patient was again interviewed 48 to 72 hours post delivery concerning back symptoms, using the VAS. Six weeks post partum, a structured telephone interview was conducted. The patient was asked to rate the amount of back discomfort experienced at that time from 0 (none) to 10 (the worst pain ever). The sample size was determined using previous experience with the VAS on needle insertion. Data were analyzed using Mann-Whitney and Fisher's Exact tests as appropriate. A p value of < 0.05 was considered statistically significant.

Results Three patients were eliminated from the study because of a break in protocol. There were 27 in Group C and 30 in Group S. The patients in both groups were demographically similar. There were no statistically significant differences between the groups in the amount of pain felt at the time of needle insertion, before discharge from hospital or six weeks after delivery. Four patients complained of severe pain (VAS=10) on needle insertion (3 in Group C, 1 in Group S). Only two patients reported prolonged back pain (score=8)—both in Group S.

Discussion The SFB did not increase the comfort of the patient receiving epidural analgesia for labor. This may be because of the pain of the additional injections used to perform the block. The cause of prolonged back pain after epidural is multifactorial. It was postulated that inflammation and aseptic periostitis or osteochondritis caused by local trauma may be reduced by SFB by inducing sympathetic blockade and promoting an increase in local blood flow (1). However, other causes of back pain would not be decreased using this technique. Pregnancy itself may contribute to low back pain because of mechanical and hormonal factors. We conclude that there is no advantage to the use of a SFB before epidural analgesia for labor pain.

References
Title: UTILIZATION OF INTENSIVE CARE RESOURCES BY OBSTETRIC PATIENTS

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Introduction. Few investigations have documented the utilization of intensive care units for critically ill parturients, and limited data exist to define and characterize this group of patients. This study examines the use of intensive care units by pregnant patients over the preceding seven years and reports the fetal and neonatal mortality associated with these pregnancies.

Methods. The study population was defined as those pregnant patients who were admitted to intensive care units from January 1, 1983 to December 31, 1990. To be included, ICU admissions had to occur between a gestational age (EGA) of 16 weeks and 2 weeks post delivery. The medical record of each patient was examined for maternal demographic data, admission diagnoses, therapeutic interventions, and outcome. When available, the birth and neonatal records were examined for fetal morbidity and mortality.

Results. Thirty-five pregnancy-associated ICU admissions were identified. A total of 15,323 deliveries occurred during the same period. The ICU admission incidence was 0.2%. Of the 35 cases, 27 (77.1%) were transferred from another hospital and 25 (71.4%) ultimately delivered at our medical center. The EGA at the time of ICU admission was 31.8 ± 6.0 (mean ± SD) weeks. Patients stayed in the ICU an average of 4.8 ± 4.4 (mean ± SD) days (range 1-20). Hypertensive disorders of pregnancy and maternal medical problems coincidental with pregnancy accounted for respectively, 31.4% and 34.3% of the ICU admissions. Eleven (31.4%) of the patients were diagnosed as having adult respiratory distress syndrome. Sixteen (46%) patients required mechanical ventilation. The duration of ventilation was 4.93 ± 4.21 (mean ± SD) days, (range 1-15). Transfusion therapy was employed for 54.3% (n=19) of the patients. Four maternal deaths occurred in ICU settings. There were four fetal/neonatal deaths. Arterial catheters were placed in 68.5% of the patients, central venous catheters in 57.1% and pulmonary artery catheters in 42.9%.

Discussion. This study demonstrates that approximately one pregnant patient is admitted to an intensive care unit for every 500 deliveries. Nearly all of these patients have a life-threatening illness and most require intensive care support for longer than 48 hours. The maternal and neonatal mortality rate for these patients exceeds 10%.
Title: PITOCIN ON MYOCARDIAL CONTRACTILITY

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INTRODUCTION: Pitocin is commonly used during the third stage of labor and to control postpartum hemorrhage. Occasionally, hypotension is observed following a bolus injection of pitocin. It is usually attributed to the decrease of peripheral vascular resistance. Nonetheless, its direct effects on myocardial contractility has not been characterized. The study was designed to investigate the direct effects of pitocin on myocardial contractility in isolated rabbit hearts.

METHODS: Eight New Zealand white rabbits were anesthetized with 45 mg/kg i.v. pentobarbital. The heart was immediately removed via mid sternotomy. The first septal perforator of the left coronary artery was cannulated and perfused with warmed (37°C) oxygenated (bubbled with a gas mixture of 95% O2-5% CO2) Kreb-Ringer bicarbonate buffer (KRB) solution at a rate of 1 mg/gm/min. The septum was then dissected out and suspended from a Grass FT03 tension transducer. The other two corners of the septum were fixed with tension by two opposing clamps through which a 5-volt electrical stimulation was given at 1.2-1.5Hz. Resting muscle tension was adjusted to 3-5 gm. The peak developed tension (PDT) and the maximal acceleration (dT/dt) were recorded. The septum was allowed to contract isometrically for at least 30 min until a fully stable contraction was reached. Perfusion with pitocin was then started at concentrations of 0.001, 0.01, 0.1, 0.5, 1 unit/ml diluted in the oxygenated KRB. Each dosage was given for 5 min and plain oxygenated KRB solution was given in between as the control for 10 min. Each prepared septum served as its own control. The PDT and dT/dt were calculated at the end of perfusion as % of control values. The results were analyzed statistically by Student's t-test for paired data. The study was approved by our institutional animal research committee.

RESULTS: Pitocin infusion exerted a significant dose-related negative inotropic effect on isolated myocardial septum at concentrations of 0.1, 0.5 and 1 unit/ml (Fig. 1). Similar pattern of changes were noted in dT/dt (Fig. 2).

DISCUSSION: In the past, many of the complications observed following oxytocin bolus were the result of contamination with ADH or ergot alkaloid. Modern synthetic pitocin is highly purified and usually do not introduce the risk of augmented vasoconstriction. On the contrary, high doses of pitocin can cause a direct relaxant effect on vascular smooth muscle and thus decrease systemic vascular observed clinically. Our study showed that pitocin in high doses was also a myocardial depressant. The mechanism deserves further study. We suggest that precautions should be taken in administration of pitocin, particularly in hypovolemic patients and patients with blunted compensatory reflexes due to deep anesthesia. Bolus via central line should be avoided.

REFERENCES:
**Title:** VASOPRESSIN DILATES CEREBRAL ARTERIES IN FETAL SHEEP

**Authors:** C Tong, JC Eisenach

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**Introduction.** During fetal asphyxia distribution of cardiac output changes, with blood flow increasing to the brain and decreasing to the periphery. Preliminary work in adult dog and sheep have demonstrated that vasopressin (AVP), secreted during stress states, may constrict peripheral, but dilate cerebral arteries, favoring this redistribution of flow. In this study we examined the effects of AVP on the fetal basilar and femoral arteries *in vitro.*

**Methods.** The protocol was approved by the Animal Care and Use Committee. Basilar (n=8) and femoral (n=5) arteries were obtained from near-term fetal lambs. Adhesive connective tissue was removed and arteries cut into 4 mm long rings. Rings were placed in oxygenated tissue chambers filled with Krebs' solution, stretched to their optimal length-tension relationship, then exposed to cumulative doses of AVP. Some femoral rings were rubbed with stainless steel wire to remove endothelium. The small size of basilar arteries precluded such treatment. Rather, some basilar arteries were pretreated with NMLA, an inhibitor of endothelium-derived relaxing factor (EDRF) synthesis. Effects of AVP on vessel tension were compared to maximal contraction.

**Results.** AVP produced dose-dependent contractions in femoral arterial rings with and without endothelium. In contrast, AVP produced dose-dependent relaxation in fetal lamb basilar arterial rings, (Figure 1) and these relaxations were likely due to EDRF release (e.g. pretreatment with NMLA abolished the relaxation response).

**Discussion.** These data in sheep demonstrate that AVP causes peripheral vasoconstriction and cerebral dilation in the fetus, as has been previously demonstrated in adult sheep and dog.(1) This effect may be one of the important mechanisms in maintaining cerebral perfusion during periods of stress *in utero.* Future studies will examine the effects of local anesthetics (known to alter endothelium-dependent vascular relaxation)(2) on these responses.


Title: Phenylephrine for Maternal Hypotension Following Spinal Anesthesia for Cesarean Delivery: Effects on maternal and neonatal catecholamine concentrations

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Introduction: Phenylephrine and ephedrine were compared in the treatment of maternal hypotension following spinal anesthesia for cesarean delivery in 40 healthy parturients. The protocol was approved by our institutional review board. Informed consent was obtained from all of the study patients.

Methods: All parturients received 2000 ml of intravenous Ringer's lactate prior to induction of spinal anesthesia. 0.75% hyperbaric bupivacaine (1.2-1.4 ml) mixed with 0.2 µg of fentanyl was used for obtaining bilateral fourth thoracic dermatomal sensory anesthesia. Patients in group 1 (n=20) were treated with ephedrine 1 ml (5 mg) intravenous boluses while patients in Group 2 (n=20) were treated with phenylephrine 1 ml (40 µg) for any decreases in baseline systolic blood pressure and they were kept above 100 mm Hg in all instances until delivery. Maternal venous blood was drawn once at the time of insertion of the intravenous catheter (MV1) and again at the time of delivery (MV2). Umbilical vein (UV) and artery (UA) blood were also collected at the time of delivery from double clamped cord. Blood samples were analyzed for catecholamine (epinephrine and norepinephrine) and blood gas values. Apgar scores were determined by pediatricians. Data was analyzed using either student's t-test or linear regression analysis where appropriate. A P value of less than 0.05 was considered to be statistically significant.

Results: Maternal characteristics, incidence of nausea or vomiting and Apgar scores were not different between the groups. UA pH was lower in the ephedrine group (7.28 vs 7.732) and pCO2 and base excess were higher in the same group compared to the neosynephrine group (pCO2 = 59.9 vs 50.1, BE 2.2 vs 0.9). UV and UA norepinephrine concentrations were significantly higher in the ephedrine group compared to the neosynephrine group (UV 1837 ± 2672 pg/ml vs 395 ± 470 pg/ml, UA 6858 ± 3689 pg/ml vs 1674 ± 944 pg/ml). There was a correlation between higher catecholamine concentrations and lower UA pH with increasing uterine-incision to delivery interval in both groups.

Discussion: Phenylephrine in small doses (40 µg/ml) appears to be as effective as ephedrine in maintaining maternal blood pressure as well as neonatal acid-base values in healthy parturients. However, significantly lower norepinephrine concentrations were observed in neonates of the mothers who were treated with neosynephrine to maintain maternal blood pressure. Although catecholamine is important at the time of delivery for maintaining neonatal well being, the optimum concentration necessary for this is not known. One interesting question can be raised regarding the choice of vasopressor (ephedrine vs neosynephrine) in a situation of fetal distress where significantly high catecholamine concentrations in the neonate can be expected. Further studies are needed to answer this question.
Title: POSSIBLE PHYSIOLOGICAL ROLE OF CALCITONIN GENE-RELATED PEPTIDE (CGRP) IN HUMAN UTERINE ARTERY

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Introduction. CGRP is a potent vasodilator in humans and animals. It has been found at relatively high concentrations in the urogenital tract of animals and in the uterus of humans. The concentration in plasma has been reported to be significantly increased throughout pregnancy with the highest concentration being found close to term. Thus, it seems possible that CGRP plays a role in regulating uterine vascular tone. The purpose of this study was to characterize the vasoactive properties of CGRP and to determine the endogenous levels of CGRP in uterine arteries from pregnant patients (P arteries) and nonpregnant patients (NP arteries).

Methods. The use of uterine arteries from patients undergoing hysterectomy was approved by the Institutional Review Board. Ring sections (2 mm, length) of uterine arteries (ascending branch) were mounted in 5 ml-volume chambers and suffused at a constant flow rate (4 ml/min) with a peristaltic pump. The suffusate was oxygenated Krebs-bicarbonate solution (pH 7.4, 37° C). Changes in isometric tension were measured by a force-displacement transducer and recorded. The arterial rings with 1 g resting tension were allowed to equilibrate for about 1 hour before commencement of the experiment. All drugs, except CGRP and its antagonist, were prepared daily from powder forms.

Results. CGRP (1nM-0.1μM) did not affect the tension of (P) and (NP) arteries that had no apparent active tone. When the uterine arteries were contracted by norepinephrine (NE) (1μM), CGRP (0.1nM-0.1μM) produced a concentration-dependent relaxation. The concentrations of CGRP that produced 50% inhibition of the NE-induced contraction were 0.9±0.7nM (n=7) and 4.8±0.2nM (n=8) in (P) and (NP) arteries, respectively. The relaxant effect of CGRP was inhibited by hCGRP (8-37), a CGRP antagonist (1μM), but not by propranolol (1μM), a beta adrenergic antagonist, by indomethacin (5μM), an inhibitor of cyclooxygenase, by methylene blue (10μM), an inhibitor of guanylate cyclase, or by the removal of the endothelium. The endogenous levels of CGRP were 273.8±63.7 pg/mg protein (n=9) and 109.5±24.8 pg/mg protein (n=19) in (P) and (NP) arteries, respectively (p=0.006).

Conclusions. These results show that CGRP acts as a very potent dilator of human uterine arteries and that the sensitivity to the vasodilatory effect of CGRP is enhanced by pregnancy. Although the results do not reveal a mechanism for the relaxing effect of CGRP, presumably it is a direct effect that is not mediated by beta adrenergic receptors, vasodilator prostanoids, increased levels of cyclic-GMP, or endothelium-derived relaxing factor (EDRF). The potent vasodilatory effect of CGRP and the elevated endogenous concentrations in (P) arteries are consistent with the view that CGRP has a physiological role in dilating the uterine vasculature during pregnancy. (Supported in part by a Pharmaceutical Manufacturers Association Research Starter Grant.)

References.
THE EFFECTS OF SEVOFLURANE ON UTERINE BLOOD FLOW AND FETAL WELL BEING IN SHEEP

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Introduction. Sevoflurane (Sevo) is a new halogenated inhalational anesthetic agent which provides a smooth and rapid induction and fast recovery (1). This study was undertaken to evaluate the effects of Sevo on uterine blood flow (UBF) and fetal well being in chronically instrumented pregnant ewes.

Methods. Pregnant sheep in the third trimester of gestation were operated on under halothane anesthesia. The maternal and fetal carotid artery and jugular vein were catheterized and an electromagnetic flow probe was placed on the branch of the uterine artery perfusing the pregnant horn. One to four days later a tracheostomy was performed under general anesthesia. On the day of the study each ewe was exposed to Sevo or Isoflurane (Iso) at 0.5, 1.0, and 2.0 MAC concentrations, given in random sequence. MAC of Sevo was determined to be 1.92 per cent in preliminary studies, while that of Iso is 1.01 per cent, according to the published data (2). Inhaled and exhaled concentrations of both agents were monitored with a Datex Gas Analyzer. Each desired MAC concentration was maintained for 15 min, at which time maternal and fetal arterial pH and blood gases were determined. Maternal and fetal blood pressure (BP) and heart rate (HR), as well as UBF were recorded continuously. ANOVA and Student's t tests were employed for statistical analyses, p < 0.05 being considered significant.

Results. Six ewes, (123-143 days gestation) have been studied so far. Since the value for UBF varied from 200 to 575 ml/min, with a mean (± SE) of 390±37 ml/min, changes in UBF were expressed as the proportional change from baseline. UBF increased 18 to 23% from baseline with Sevo, while with Iso the increase was 4 to 7%. Maternal BP began to increase in both groups at 0.5 MAC, and at 1.0 MAC the increase was significant, but returned to baseline at MAC 2.0. HR for both agents remained unchanged throughout. The fetal BP in both groups remained stable until MAC 2.0 when it began to decrease, but not significantly. Baseline values for blood pH and gases were similar in both groups, with mean values for maternal pH, 7.53±0.01; pCO2 29±1.0 mmHg, pO2 104±4 mmHg. Mean values for fetal pH were 7.35±0.02; pCO2, 44±1.5 mmHg; pO2, 16±1 mmHg. Maternal pH began to decrease and pCO2 increase as MAC increased; at 2.0 MAC Sevo pH and pCO2 were 7.47±0.03 and 38±3 mmHg respectively. Fetal pH remained essentially unchanged throughout anesthesia with both agents, while pCO2 tended to increase towards MAC 2.0.

Discussion. These data suggest that Sevo may be a useful anesthetic agent for obstetrics. There appear to be no adverse effects on the hemodynamic or cardiovascular state. The increased UBF may be advantageous for the fetus.

References.

Supported in part by Maruishi Pharmaceuticals Inc.
Title: EVALUATION OF BLEEDING TENDENCIES IN PREGNANT, LABORING WOMEN WITH PRE- ECLAMPSIA

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Introduction: Women with pre-eclampsia frequently require epidural anesthesia which is contraindicated in the presence of coagulopathy. Although platelet count may be in the acceptable range, platelet function abnormality may exist in some women. The present study was undertaken to compare coagulation profile in a group of pre-eclamptic patients to a group of normal patients.

Methods: After approval by the Institutional review Board and informed consents, forty-five women in labor were studied. Eighteen had mild pre-eclampsia, 8 had severe pre-eclampsia based on the criteria by the American College of Obstetricians and Gynecologists and 19 were normal patients. Blood samples were drawn for measurement of fibrinogen levels, prothrombin time, activated clotting time and platelets. At the same time a bleeding time was measured using a modified Ivy bleeding time technique. Data were analyzed for statistical significance using analysis of variance or chi-square when appropriate. A P value of < 0.05 was considered statistically significant.

Results: Platelet counts were significantly lower and bleeding time (>12 min) was significantly prolonged in severe pre-eclamptic patients compared to normal patients (table 1). As seen in table 2, 29%, 33% and 17% of patients with platelet count over 150,000 had abnormal bleeding time. All patients, in the severe pre-eclampsia group, with platelet count below 150,000 had abnormal bleeding time.

Discussion: Our results indicate that a large percentage of patients with adequate platelet count (>150,000) including normal patients have prolonged bleeding time. Since performing bleeding time is time consuming, impractical and subjective and since there is no evidence in the literature or in our practice showing that a pre-eclamptic patient with adequate platelet count developed epidural hematoma, we do not recommend performing bleeding time routinely in pre-eclamptic patients with adequate platelet count.
Title: COAGULATION STUDIES IN THE PARTURIENT: HOW DO WE PRACTICE?

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Introduction: Controversy exists among obstetric anesthesiologists regarding which laboratory tests are appropriate for evaluation of potential coagulopathies in the obstetric population prior to placement of a regional anesthetic. Specifically, the preeclamptic patient may manifest a variety of coagulation disorders. This survey sought to delineate current practice among obstetric anesthesiologists at academic institutions, and to examine how patient pathology and operative urgency affected their choices.

Methods: A 21-question survey regarding evaluation of coagulation status in parturients was sent to all anesthesia training programs in the United States. The first part of the survey explored required laboratory tests prior to induction of a regional anesthetic in specific clinical situations for two degrees of urgency (elective vs emergent). The second part explored institutional characteristics and the utilization of regional anesthesia. Specific tests that guide clinical practice, and exceptions under which these guidelines may be violated were elicited.

Results: There were 73 respondents to the survey of 113 programs (64%). Four responses were eliminated: two did not practice obstetric anesthesia, and two precluded interpretation. Of the 69 programs, 5 had <100 deliveries per month, 25 had 100-250, 27 had 250-500, and 11 had >500. Regional anesthesia is utilized in the majority of cesarean sections, but only 50% of vaginal deliveries are conducted with a regional anesthetic. Tests felt to be necessary in the preeclamptic patient, mild and severe, are shown in Figures 1 and 2, respectively. As severity of disease increases, the number of studies requested to evaluate coagulation status also increases. Given comparable disease severity, most programs require fewer tests to evaluate coagulation in an urgent setting than an elective setting. In the mild preeclamptic, an H/H and platelet count were the only tests required by 57% of programs; in an urgent delivery setting, only 28% required the same tests. Utilization of regional anesthesia for both vaginal and cesarean deliveries increased with program size except for the largest programs (>500 deliveries per month), when utilization of regional anesthesia for c/s fell considerably.

Discussion: Parturients may develop a coagulopathy which is a strong relative contraindication to regional anesthesia. The frequent utilization of regional anesthesia in obstetrics requires that parturients at risk be evaluated for coagulopathy, but these results indicate that there is no consensus as to what is appropriate, even among leaders in the field. Further, testing felt to be "necessary" is dependent on the urgency of the delivery setting. Such disparities likely reflect poor characterization of coagulation disorders in the parturient, and a historically low rate of complications from regional anesthesia in this population. The drop in utilization of regional anesthesia in the largest programs was unexpected. This may be due to the greater number of high risk OB patients in these centers, who may have contraindications to placement of a regional anesthetic; alternatively, it may reflect the difficulty of providing anesthesia services to such a large OB population.
A common complaint of parturients having regional anesthesia for Caesarean delivery is shortness of breath and chest pressure or pain. These complaints are similar to those made by symptomatic cardiac patients with myocardial ischemia. Palmer and coworkers (1) found that electrocardiographic changes occurred in 47% of the parturients. This study determined serum creatine kinase (CK) total and the isoenzyme CK-MB levels in 12 parturients at and following Caesarean delivery. The approval of the Institutional Research Review Board was secured, and informed consent was obtained. All patients had an ASA physical status of Class 1 or 2 and were prehydrated with 1500 cc of dextrose-free lactated Ringers. A 20 gauge closed-tip catheter was placed at the L2-L3 or L3-L4 interspace. Incremental doses of either 2% xylocaine with epinephrine (1/200,000) or 0.5% bupivacaine were administered to achieve a T-4 sensory block. Maternal systolic, diastolic and mean arterial blood pressure, heart rate and heart rhythm were continuously monitored. Patients with any significant coexisting disease which could affect the outcome of this study were excluded. Blood samples were drawn from an arm vein in 10 cc tubes before the beginning of the surgical procedure for control, at delivery, and at 4, 12, and 24 hours post partum. For each patient, CK and isoenzymes levels were determined by column chromatography. An immunoassay (Roche) was then performed for confirmation of the CK-MB isoenzyme. Data were analyzed using the Wilcoxon Signed Rank test, Mann-Whitney U test, ANOVA with a Neuman-Keuls test and a negative inference test. Significance was p<0.05. Ten patients complained of chest pain, discomfort and pressure, while 6 patients had ST segmental depression. Although the total CK activity in 2 patients was elevated, CK-MB activity in all 12 patients was negative. These negative results were significant. At the time of delivery, the systolic blood pressure was significantly lower than at the control and was probably due to the normal blood loss experienced by these patients at the time of delivery. This acute volume depletion together with the fundal pressure applied by the surgeon was the most likely cause of the observed tachycardia and the rate related ST depression of the electrocardiogram. The evidence that the ST depression was rate related was based upon the data that those patients who did not develop ST depression had a heart rate significantly lower than those who did have ST depression, and as the heart rate returned to the baseline, the ST depression quickly disappeared. The data from this study demonstrate that no cardiac injury occurs in parturients undergoing Caesarean delivery despite the complaint of chest pain, discomfort and pressure.

Title: Hemodynamic changes during epidural and spinal anesthesia for elective cesarean section: correlation with umbilical artery pH.

Authors: SC Robson, R Boys, C Rodeck, B Morgan


Introduction: The hemodynamic changes associated with epidural and spinal anesthesia for elective cesarean section represent the major hazard of these techniques for mother and fetus. This study was undertaken to determine the effects of epidural and spinal anesthesia on maternal cardiac output (CO) and umbilical artery (UA) Doppler flow velocity waveforms and to investigate the relationship between hemodynamic changes and neonatal acid base status.

Methods: Thirty two healthy women undergoing elective cesarean section at term were studied. Sixteen women were randomized to receive epidural anaesthesia (20 ml 0.5% bupivacaine plain [100 mg] with 0.1 ml 1:1000 adrenaline) and sixteen to receive spinal anaesthesia (2.5 ml 0.1% bupivacaine heavy [12.5 mg] with 0.1 ml 1:1000 adrenaline). Both groups were preloaded with Ringer's lactate solution (RLS 1 litre) and an infusion of ephedrine (60 mg in 1 litre RLS) was commenced at the time of injection of bupivacaine, the rate being titrated against systolic blood pressure (BP). Cardiac output was measured in the left semi-lateral position using cross-sectional and continuous wave Doppler echocardiography at the aortic valve. Umbilical artery pulsatility index (UAPI) was determined using continuous wave Doppler. Measurements were performed prior to anaesthesia and after preloading in both groups and then at 10, 20 and 30 min after bupivacaine in the epidural group (E) and at 5, 10 and 15 min after bupivacaine in the spinal group (S).

Results: The mean values of mean arterial pressure (MAP), CO and UAPI are shown below;

<table>
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<tr>
<th>Group</th>
<th>Basal</th>
<th>Post Preload</th>
<th>Time after injection of bupivacaine (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MAP (mm Hg)</td>
<td>6.50</td>
<td>7.83*</td>
</tr>
<tr>
<td></td>
<td>CO (l/min)</td>
<td>6.96</td>
<td>7.90*</td>
</tr>
<tr>
<td></td>
<td>UAPI</td>
<td>0.80</td>
<td>0.77</td>
</tr>
<tr>
<td>E</td>
<td>84.6</td>
<td>86.3</td>
<td>75.9*†</td>
</tr>
<tr>
<td>S</td>
<td>88.7</td>
<td>88.6</td>
<td>72.7*†</td>
</tr>
</tbody>
</table>

*p<0.01 vs basal, †p<0.01 vs post preload.

Hypotension (fall in systolic BP >20%) occurred in 5 subjects in E and 11 subjects in S (p<0.05). The total dose of ephedrine administered was greater in S (median 30 mg vs 6 mg, p<0.001). UA pH was lower (mean 7.22 vs 7.27, p<0.05) and the UA base excess higher (mean -6.2 vs -3.6, p<0.01) in S. Relative to basal values, the maximum change in MAP and CO after injection of bupivacaine was greater in S (median -31.2% vs -13.9% [p<0.01], mean -14.8% vs +14.7% [p<0.001] respectively). No significant correlation was found between the maximum change in systolic or MAP and umbilical artery pH (r=0.14, r=0.19 respectively). In contrast umbilical artery pH correlated with the maximum change in CO (r=0.54, p<0.001) and UAPI (r=-0.72, p<0.001).

Conclusion: Spinal anaesthesia for elective cesarean section is associated with a greater reduction in CO and a lower UA pH than epidural anesthesia. pH at delivery correlates with the changes in CO and UAPI but not with changes in BP.
Title: DOES PRE-CURARIZATION AFFECT POST-OPERATIVE MYALGIA IN CESAREAN SECTION?

Authors: S.K. Pasricha, M.D., D.V. Subedar, M.D.*, K. Shibutani, M.D. and J. Duval, M.D.

Affiliation: Department of Anesthesiology, New York Medical College, Valhalla, N.Y. 10595

The term parturient patients have a very low incidence of fasciculation to intubating dose of succinylcholine. Hence a pre-curarizing dose of a non-depolarizing agent is often omitted while administering general anesthesia for cesarean section. This study was undertaken to see if pre-curarization makes any difference in the incidence of postoperative myalgia (POM) with the approval by our Institutional Review Board.

Material & Methods: Seventy-five term parturients undergoing cesarean section under general anesthesia were included in the study. Twenty-nine patients were randomly selected and were given atracurium 4 mg I.V. followed four minutes after by bolus of 100-120 mg of succinylcholine for intubation. Forty-six patients were not given any precurarization. A dose of 4-5 mg/kg pentothal was immediately followed by 1-1.5 mg/kg succinylcholine for intubation. An independent observer evaluated the patients post-operatively for myalgia for 4 days. The site and severity of myalgia was noted. Myalgia was scored on a scale from 0 to 4 depending on severity: 0 = no muscle pain, 1 = slight muscle pain, 2 = moderate muscle pain, and 3 = severe muscle pain. Pain secondary to surgical incision, injection or infusion, or positioning were excluded from the study.

Results: Out of 46 patients who received no pre-curarization, post-operative myalgia occurred in 21 patients (45%). In the remaining 29 patients who received pre-curarization, post-operative myalgia occurred only in 5 cases (17%). Furthermore, this myalgia was of a lesser intensity and duration. Data is shown in Table 1.

Conclusion: Earlier studies have shown that the overall incidence of fasciculation and post-operative myalgia is low in parturient subjects as compared to the general population. Our results indicate that the pre-curarizing dose of atracurium may benefit patients in further decreasing the incidence of post-operative myalgia (17% vs 45%).


Table 1.

<table>
<thead>
<tr>
<th></th>
<th>No POM</th>
<th>FCM</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Precurarization</td>
<td>25 (54.3)</td>
<td>21 (45%)</td>
</tr>
<tr>
<td>Precurarization</td>
<td>24 (83%)</td>
<td>5 (17%)</td>
</tr>
</tbody>
</table>
Title: Plasma free and total concentrations of lidocaine and bupivacaine in mother and fetus following epidural administration, singly or together.

Authors: S. Fletcher, P. Howell, B. Morgan, R. Carson & F. Reynolds

Affiliation: St. Thomas' Hospital & Queen Charlotte's Hospital, London, U.K.

Introduction In the search for the perfect epidural local anesthetic solution for Cesarean section, bupivacaine alone and with epinephrine have been compared with lidocaine plus epinephrine and with a combination of the three agents (1). The effect on free and total plasma concentrations of bupivacaine and lidocaine of these drug combinations has been measured in 46 mothers and babies.

Method After ethical approval and informed consent, mothers undergoing elective Cesarean section were randomly allocated to receive 2+18 ml of either bupivacaine 0.5% plain (B) (n=13) or with epinephrine 5 µg/ml (BE) (n=11), lidocaine 2% with epinephrine 5 µg/ml (LE) (n=11) or a 50:50 mixture of BE+LE (BLE) (n=11). Epinephrine was added fresh to the preservative free solution. Further doses of the same solution were given at 20 mins if needed. Venous blood samples were taken from the mother 10, 20, 40, 60 & 120 minutes after the main dose, and also from the mother and umbilical cord at delivery. Part of each plasma sample was ultrafiltered under reduced pressure through dialysis membrane, and lidocaine and bupivacaine concentrations were measured by GLC in plasma and ultrafilrate samples. Results were analysed by GLIM using analysis of covariance.

Results There was no significant difference in age, weight, volume of local anesthetic solution or dose-delivery interval between the groups. When corrected for dose there was no difference in maternal concentrations of lidocaine and bupivacaine between the groups and no plasma concentrations were considered toxic. Protein binding of bupivacaine was unaffected by lidocaine or epinephrine but lidocaine binding was higher in BLE than LE (table). Binding of both drugs was higher in mother than fetus. Adding epinephrine to bupivacaine had no significant effect on total or free Cmax or fetal concentrations, mean fetal concentration being slightly higher with epinephrine. Use of the BLE combination achieved a significant reduction in the total (P<0.01) but not free bupivacaine Cmax (table) and in total and free fetal levels (P<0.01). Fetal/maternal (F/M) ratios are similar to those previously reported and were significantly higher in BE than in B (table). There was no difference in free F/M ratios between bupivacaine and lidocaine.

Table  Protein binding%  Cmax ng/ml  F/M ratios (Mean ± SD)
<table>
<thead>
<tr>
<th></th>
<th>Maternal</th>
<th>Fetal (40 mins)</th>
<th>Total</th>
<th>Free</th>
<th>Total</th>
<th>Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bup</td>
<td>93±3.9</td>
<td>87±6.6</td>
<td>836±330</td>
<td>50±29</td>
<td>0.22±0.05</td>
<td>0.55±0.27</td>
</tr>
<tr>
<td>BE</td>
<td>93±4.0</td>
<td>81±11</td>
<td>685±224</td>
<td>51±30</td>
<td>0.30±0.08</td>
<td>1.33±1.15</td>
</tr>
<tr>
<td>BLE</td>
<td>95±2.5</td>
<td>87±5</td>
<td>424±171</td>
<td>30±20</td>
<td>0.27±0.10</td>
<td>0.73±0.38</td>
</tr>
<tr>
<td>Lid</td>
<td>62±11</td>
<td>42±10</td>
<td>2050±600</td>
<td>780±331</td>
<td>0.54±0.15</td>
<td>0.84±0.24</td>
</tr>
<tr>
<td>BLE</td>
<td>73±10</td>
<td>55±12</td>
<td>1403±363</td>
<td>418±147</td>
<td>0.44±0.10</td>
<td>0.70±0.23</td>
</tr>
</tbody>
</table>

Discussion Clinically, the anesthesia provided by BE was the most satisfactory of the four treatments (1), the addition of lidocaine in no way enhancing the block. Bupivacaine cardiotoxicity is associated with accidental intravenous injection, and plasma concentrations resulting from correct placement would appear well below the toxic threshold of 1-6 µg/ml for mild CNS symptoms and 3-5 for convulsions (2). Toxic free levels are as yet poorly documented. However mixing lidocaine with bupivacaine does reduce bupivacaine dose requirement and plasma concentrations and though CNS toxicity of the two drugs is likely to be additive, presumably cardiotoxicity is not. Epinephrine appears to enhance fetal bupivacaine uptake, as previously predicted (3), hence it offers no protection to the baby.

References
Title: The Anitmetic Efficacy of Prophylactic Metoclopramide for Cesarean Delivery

Authors: Lussos S*, Bader AM, Thornhill M, Datta S

Affiliation: Brigham and Women's Hospital, Harvard Medical School, Boston MA

Introduction: Peripartum emetic symptoms have been reported to occur in as many as 40% of parturients undergoing elective cesarean section under regional anesthesia(1). Prevention of hypotension has been associated with some reduction of these symptoms(1). Metoclopramide given post-delivery has also been shown to significantly reduce emetic symptoms(2). In the present study, the maternal and neonatal effects of prophylactic metaclopramide administered prior to induction of spinal anesthesia were studied.

Methods: Approval was obtained from the hospital's Human Subjects Committee and 42 parturients scheduled for elective cesarean section under spinal anesthesia were studied. After 1500-2000cc of prehydration were administered, patients were randomized in a double-blind fashion to receive either 2cc (10mg) of metoclopramide or 2cc of saline intravenously. Spinal anesthesia was then performed in the standard fashion using hyperbaric bupivacaine and fentanyl. Ephedrine was used to maintain systolic blood pressure above 100 torr. The occurrence of nausea and or vomiting was recorded throughout the perioperative period until the patient was admitted to the recovery room. Neonatal acid-base status and neurobehavioral exams (ENNS) were obtained. Data were analyzed using ANOVA and Chi-square as appropriate; P values less than 0.05 were considered significant.

Results: Demographic characteristics and operative parameters were similar for the two groups. Patients in the group receiving metoclopramide had a significantly lower incidence of nausea and vomiting both pre- and post-delivery (Table 1). There were no significant differences in neonatal acid-base values or neurobehavioral exams.

Discussion: Metoclopramide administered prior to induction of spinal anesthesia for elective cesarean section significantly reduces perioperative emetic symptoms without apparent adverse effects on mother or neonate.

<table>
<thead>
<tr>
<th></th>
<th>METOCLOPRAMIDE</th>
<th>SALINE</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NAUSEA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-delivery</td>
<td>(0/21) 0%</td>
<td>(13/21) 62%</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Post-delivery</td>
<td>(3/21) 14%</td>
<td>(13/21) 62%</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td><strong>VOMITING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-delivery</td>
<td>(0/21) 0%</td>
<td>(6/21) 27%</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Post-delivery</td>
<td>(1/21) 5%</td>
<td>(5/21) 24%</td>
<td>NSD</td>
</tr>
<tr>
<td><strong>TOTAL N/V</strong></td>
<td>(3/21) 14%</td>
<td>(17/21) 81%</td>
<td>P&lt;0.05</td>
</tr>
</tbody>
</table>

EPIWIRAL.

BIJTORPEUIOL DOES NIX BBDDCE SIDE-EFFECTS

PROH RPIwRliL HORPBINR POST CAESAREAN SECTION

ADTBOPS: GABBLING DR, BOBRR C, BOWLL P, KOZAK S, PJI

AFFILIATION: DRPARTBRNT Oy ANAESTBRSIA, DNIVBRSITT OF BRITISB COLDBBIA AND GRACE NOSPITAL,
4490 OAR STREET, VANCOOVW, BRITISH COLORBIA, V6B 3V5 CANADA

INTRODUCTION: Pruritis, nausea and respiratory depression are among the potential undesirable side-effects of epidural morphine (EM). The opioid agonist-antagonists can be successful in treating these when given systemically by infusion or by the epidural route. This study was designed to test whether epidural butorphanol (EB) in various doses could effectively reduce or eliminate the side-effects of EM without affecting pain relief after C-section.

METHODS: With institutional approval and patient consent women presenting at term for elective C-section under epidural anaesthesia were randomly assigned to one of four groups. All patients had a standard epidural technique to produce a T4 sensory level. Gp A patients received 3mg EM and 1mg EB in 5ml. Gp B 3 mg EM and 2mg EB; Gp C 3mg EM and 3mg EB; Gp D 3mg EM and 2ml W saline. The opioid(s) was injected 20 minutes after delivery. Each patient completed 10cm visual analogue scales (VAS) for pain, satisfaction, nausea, itch and sedation pre-anesthetic, 2, 8, and 24 hours after the opioid(s) was given. They also did a non-steady state CO2 challenge test at the same time intervals. Minute ventilation (MV) and end-tidal CO2 (ETCO2) were recorded after breathing room air and then 5% CO2 in air. Patients were coached and wore nose clips throughout the test. This was a double-blinded investigation. Statistical analyses were performed on data collected and included Chi-square analysis, one-way analysis of variants and repeated measures ANOVA.

RESULTS: Demographically the 4 groups, A (n-10), B (n=20), C (n=13) and D (n=20) were comparable in terms of age, height, weight, gestation, volume of local anaesthetic and height of sensory level achieved. There were no significant differences between any of the groups at any of the assessments in pain scores or nausea, itch, and satisfaction scores. Gps A, B, and C all had significantly higher sedation scores throughout the study compared to control Gp D (Table 1). CO2 challenge test data were converted to ml increase (or decrease) in MV per 1 Torr increase in ETCO2 and expressed as % change (+ or -) from the baseline (pre-epidural). There were no significant differences seen in this data between groups at any point in the study (see Table 2). There were no significant differences between groups in terms of time to first treatment of pain, nausea or itch. 27 women remain to be studied for a total of 100 patients.

CONCLUSIONS: Epidural butorphanol in doses of 1-3 mg failed to impart any advantage to women receiving 3mg epidural morphine post Caesarean section in terms of reducing side-effects. Some patients enjoyed the sedation that invariably occurred after EB while others felt that it affected their interaction with the newborn. These early results differ from the findings of a similar, smaller study where the authors concluded that EB can reduce the side-effects from EM.


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**TABLE 1. MEAN VAS SCORES**

<table>
<thead>
<tr>
<th></th>
<th>PAIN</th>
<th>NAUSEA</th>
<th>ITCH</th>
<th>SEDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>GROUP</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>A</td>
<td>3.65</td>
<td>3.25</td>
<td>4.25</td>
<td>3.75</td>
</tr>
<tr>
<td>B</td>
<td>3.65</td>
<td>3.25</td>
<td>4.25</td>
<td>3.75</td>
</tr>
<tr>
<td>C</td>
<td>3.65</td>
<td>3.25</td>
<td>4.25</td>
<td>3.75</td>
</tr>
<tr>
<td>D</td>
<td>3.65</td>
<td>3.25</td>
<td>4.25</td>
<td>3.75</td>
</tr>
</tbody>
</table>

---

**TABLE 2. CO2 CHALLENGE TEST DATA.**

**a) MEAN PERCENTAGE CHANGE FROM BASELINE (PRE-EPIDURAL):**

<table>
<thead>
<tr>
<th>TIME</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-4.1</td>
<td>-3.2</td>
<td>-4.3</td>
<td>-3.5</td>
</tr>
<tr>
<td>2</td>
<td>-4.1</td>
<td>-3.2</td>
<td>-4.3</td>
<td>-3.5</td>
</tr>
<tr>
<td>8</td>
<td>-4.1</td>
<td>-3.2</td>
<td>-4.3</td>
<td>-3.5</td>
</tr>
<tr>
<td>24</td>
<td>-4.1</td>
<td>-3.2</td>
<td>-4.3</td>
<td>-3.5</td>
</tr>
</tbody>
</table>

**b) CHANGE FROM BASELINE: NO. OF PATIENTS**

<table>
<thead>
<tr>
<th>TIME</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>+1</td>
<td>+2</td>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>2</td>
<td>+1</td>
<td>+2</td>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>8</td>
<td>+1</td>
<td>+2</td>
<td>+1</td>
<td>+2</td>
</tr>
<tr>
<td>24</td>
<td>+1</td>
<td>+2</td>
<td>+1</td>
<td>+2</td>
</tr>
</tbody>
</table>

Chi-square analysis P = 0.5.
Title: Improved Satisfaction with Patient-Controlled Epidural Analgesia (PCEA) During Labor.

Authors: Ronald Price, MD, Mathew B. Weininger, MD, Laurence S. Reisner, MD, Alonzo Henry, MSIV.

Affiliation: Department of Anesthesiology, UCSD Medical Center, San Diego, California 92103.

Introduction: While continuous epidural analgesia (CEA) during labor provides complete pain control, many patients prefer to have some sensation of contractions and appreciate having control over their own analgesia. This level of patient control and satisfaction is difficult to obtain utilizing constant infusion techniques. Patient-controlled epidural analgesia (PCEA) during labor provides safe, effective pain control, and may decrease total drug use [1]. Previous randomized, single-blind studies of CEA vs. PCEA during labor failed to demonstrate differences in either analgesia or patient satisfaction. The use of single-blind data may significantly influence outcome since close supervision and adjustment of CEA could mimic PCEA. We, therefore, compared CEA to PCEA in a randomized, double-blind study.

Methods: Thirty-five ASA I primigravida female subjects were randomized to 4 treatment groups. Each subject received a constant background epidural infusion of study drug via an IVAC 560, and an intermittent bolus of study drug from a Harvard PCA pump connected to a hand-held trigger device. The IVAC 560/Harvard PCA Pump setup was prepared with the appropriate study drug, infusion rate, and intermittent bolus information by an individual not participating in data collection. Following signs of active labor and the need for labor analgesia, a lumbar epidural catheter was placed and attached to the IVAC 560/Harvard PCA Pump setup. Data were collected at 30-min intervals prior to complete cervical dilation. Pain and patient satisfaction were scored using visual analog scales (0-10 cm). Two-way analysis of variance followed by Newman-Keuls tests were utilized. In addition, data from Groups 2-4 were lumped to represent all patients receiving active drug via PCEA and these were compared with Group 1 (CEA) patients. Data were expressed as mean±sem and p<0.05 was considered significant.

Table:

<table>
<thead>
<tr>
<th></th>
<th>CEA</th>
<th>PCEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>27 ± 1</td>
<td>24 ± 1</td>
</tr>
<tr>
<td>Height (in)</td>
<td>64 ± 1</td>
<td>65 ± 1</td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>176 ± 20</td>
<td>170 ± 7</td>
</tr>
<tr>
<td>Apgar (5 min)</td>
<td>9 ± 0</td>
<td>8.9 ± 0.1</td>
</tr>
<tr>
<td>Labor Duration (hr)</td>
<td>12 ± 2</td>
<td>16 ± 2</td>
</tr>
<tr>
<td>Total Bupiv use (mg/hr)</td>
<td>20 ± 3</td>
<td>18 ± 2</td>
</tr>
<tr>
<td>Avg Pain Score (cm)</td>
<td>2.8 ± 0.7</td>
<td>1.9 ± 0.1</td>
</tr>
</tbody>
</table>

Results: Statistical analysis was performed on all patients completing at least 3 hr of data collection. Groups were similar in age, height, weight, and labor duration (Table). There were no significant differences in pain scores, motor block, sensory block, or total drug delivered between CEA and PCEA. However, patients were more satisfied with PCEA than CEA (Figure; *=P<0.05), particularly among Group 2 patients. Drug use and patient satisfaction were frequently negatively correlated.

Discussion: Patients using PCEA during labor readily accepted partial control of their pain management. We conclude that patients were more satisfied with PCEA than CEA while pain scores and total drug use remained comparable. It remains to be seen if altering drug dose and/or bolus interval will influence pain scores or total drug use during PCEA. PCEA appears to be an excellent modality for labor analgesia.


Footnotes: 1 CEA-Group 1: Bupivicaine (B) 0.125% 12 cc/hr + bolus Normal Saline (NS); PCEA-Group 2: B 0.125% 4 cc/hr + bolus B 0.25%; Group 3: B 0.125% 4 cc/hr + B 0.25% & Fentanyl (F) 2 μg/cc; Group 4: NS 4 cc/hr + B 0.25% & F 2 μg/cc. 2 PCEA setup: 3 cc bolus dose, 10 min lockout interval, 15 cc hourly limit. 3 Cervical dilation>3 cm and pain score >5.
Title: Nalbuphine is Better Than Naloxone for Treatment of Side Effects After Epidural Morphine

Authors: SE Cohen M.D., EF Ratner M.D., JH Archer M.D., TR Kreitzman M.D.

Affiliation: Stanford University School of Medicine, Stanford, California 94305

Introduction: Prophylactic administration of nalbuphine and naloxone have been advocated to prevent the side effects accompanying epidural morphine analgesia. However, since only 40-50% of patients require treatment, many would receive therapy unnecessarily. This study was designed to compare the efficacy of naloxone and nalbuphine given therapeutically to patients when they developed symptoms.

Methods: After approval of the study by the Human Subjects Committee, informed consent was obtained from patients undergoing non-emergency cesarean section with epidural anesthesia. All subjects received epidural morphine, 5 mg, immediately after delivery. If treatment was subsequently requested for nausea, vomiting, or pruritus, subjects received in a randomized, double-blind manner either naloxone, 0.2 mg iv (group 1, n = 17) or nalbuphine 5 mg iv (group 2, n = 20). Up to two additional doses of the same drug were offered for persistent symptoms at no less than 30 min intervals. Before, and 30 min after, study drug administration the following assessments were made: incidence of vomiting; severity of nausea and pruritus (none, mild, moderate, or severe); and degree of sedation and pain (verbal scales of 0-10). Overall pain relief and efficacy of treatment were evaluated the following day. Data were analyzed using Student's t test, Mann Whitney U test, Wilcoxon Signed Rank and Chi square tests as appropriate. P < 0.05 was considered significant.

Results: The groups were similar with respect to age, weight, height, time of first study drug administration (313 min), severity of symptoms, and scores for sedation and pain before treatment. Dose 1 of nalbuphine decreased the incidence of vomiting (p < 0.01) and the severity of nausea and pruritus (p < 0.001), whereas naloxone caused no significant changes. Sedation scores increased slightly with nalbuphine (p < 0.05) and remained unchanged with naloxone, whereas pain scores increased after naloxone (p < 0.01) and were unchanged after nalbuphine. Fifteen patients in group 1, and 12 in group 2, received a second dose, and 7 and 4, respectively, a third dose. Pruritus improved significantly following Dose 2 of both drugs (p < 0.05), and nausea tended to improve after nalbuphine (p = 0.09). The third dose resulted in statistically insignificant changes in both groups. Sedation and pain scores did not change markedly after the second and third doses of study drug. Overall pain relief scores were high in both groups (NS between groups), but patients receiving nalbuphine reported better overall relief of side effects (p < 0.05).

Discussion: Nalbuphine was clearly superior to naloxone for the treatment of side effects following epidural morphine. However, supplemental therapy may be needed for persistent symptoms as repeated doses appear less effective than the initial dose.
Title: EPIDURAL FENTANYL AND LIDOCAINE FOR CESAREAN SECTION: WHEN SHOULD FENTANYL BE GIVEN?

Authors: Breen TW*, Janzen JA

Affiliation: Department of Anaesthesia, The University of Calgary and Foothills Hospital, Calgary, Alberta

Introduction: Epidural fentanyl added to local anesthetics improves the quality of anesthesia when fentanyl is given both before1, and after delivery of the infant2. Maternal and neonatal outcomes were examined when fentanyl was given with lidocaine while establishing epidural anesthesia, and when fentanyl was given following delivery.

Methods: Following ethics committee approval and informed consent a randomized, prospective, double-blind study was undertaken. 59 ASA I-II patients scheduled for elective cesarean section were enlisted. Following a test dose of lidocaine 2% with epinephrine 1/200,000 each patient received a study drug, either fentanyl 75 μg (Group I, n=29) or saline 1.5 ml (Group II, n=30). Incremental doses of lidocaine were given until a T4 sensory block was obtained. Surgery commenced and following delivery each patient received the other study drug, diluted to a 10 ml volume. Analysis of maternal outcome included: (1) speed of onset of sensory blockade, (2) intraoperative pain, shivering, nausea/vomiting and sedation scores, and (3) the need for supplemental analgesics. Neonatal outcome was measured by cord pH and Apgar scores. Parametric data was analyzed using Student's t-test, nonparametric data using contingency tables. Statistical significance was assumed if p < 0.05.

Results: Patient demographic characteristics were similar in both groups. The hypothesis that giving fentanyl with lidocaine speeds the onset of block, decreases the dose of lidocaine used, decreases pain from incision to delivery, and decreases shivering, was not substantiated. In Group II 7/30 infants had one minute Apgar scores < 7, compared to 0/29 in Group I (p = 0.03). Cord pH values and 5 minute Apgar scores were similar.

Discussion: This study fails to demonstrate any benefit to mother or baby from giving fentanyl with epidural lidocaine. Perhaps the fentanyl must be diluted into a larger volume to show positive effects. It might be prudent to give epidural fentanyl following delivery of the infant, at least until a true advantage is shown for earlier administration.

References:
Title: Intrathecal Fentanyl Does Not Improve Intrathecal Morphine Analgesia After Cesarean Section

Authors: Boerner TF*, Norris MC, Leighton BL, Arkoosh VA, Witkowski TA and Torjman M

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Introduction: Intrathecal morphine provides effective post cesarean section analgesia, but patients may suffer pain before morphine takes effect. Fentanyl, a more lipophilic narcotic, provides pain relief with a rapid onset but relatively brief duration. We designed this study to determine if adding fentanyl to intrathecal morphine and bupivacaine would improve patient comfort intra- and postoperatively without causing an unacceptable increase in narcotic side effects.

Methods: Forty-two healthy term parturients scheduled for elective cesarean section under spinal anesthesia consented to be in this IRB approved investigation. In a randomized, double-blind sequence, women received spinal anesthesia with 12 mg hyperbaric bupivacaine, 0.15 mg morphine and either 0.2 ml saline (21 patients) or 0.2 ml (10 μg) fentanyl (21 patients). We obtained visual analog scores for pain, itching and nausea at skin incision, delivery, peritoneal closure, 1, 1.5, 2, 3, 4, 6 and 24 hours post-induction. Level of sensory blockade was recorded at the above times until regression to L2. We noted use of supplemental analgesic or antiemetic medication. Groups were compared via analysis of variance for repeated measures.

Results: There were no differences between groups in demographic variables nor in time to skin incision, delivery and closure. The groups did not differ in time to first postoperative narcotic or antiemetic nor in the number of patients requiring such medication. Total postoperative pain medication did not differ between groups. Pain, nausea and itching did not vary between groups. The time to onset of T4 sensory blockade was significantly faster (Figure) in the fentanyl group (8.3±4.3 min) than the saline group (13.1±4.4 min). There was no difference in time to regression of sensory blockade to L2.

Discussion: Despite the more rapid onset of block, since there is no difference in analgesic potency, we doubt that the addition of intrathecal fentanyl to intrathecal morphine is of clinical benefit.
TITLE: Epidural Morphine vs Butorphanol Following Caesarean Section: Comparison of PCA Use Post-Operatively.

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INSTITUTION: Department of Anesthesiology, Tulane University Medical Center, 1430 Tulane Avenue, New Orleans, LA 70112-2699.

INTRODUCTION: Epidural opioids have become popular for post-operative analgesia in the post-Caesarean patient. Morphine and butorphanol have been reported to give excellent analgesia when evaluated by subjective data (visual analogue scores). This clinical study compares the effectiveness of epidural morphine, butorphanol or placebo when evaluated by objective means, i.e. patient controlled analgesia.

MATERIALS AND METHODS: After obtaining institutional approval and informed consent, a double blinded and randomly assigned study was conducted using 46 ASA I and II patients scheduled for elective Caesarean. Operative anesthesia was obtained using 2% lidocaine with epinephrine, 1:200,000 sufficient to achieve a T4 level. Study drugs were administered only after the umbilical cord was clamped. No other medications were administered intraoperatively. In the recovery room, the epidural catheter was discontinued. The administration of morphine was continued using a PCA pump after adequate analgesia was obtained with loading doses of IV morphine. Blood pressure, heart rate, respiratory rate, Bennett Patient Satisfaction Scale, and the presence of any side effects were evaluated for a twenty four hour period. The patients' use of the PCA was also recorded.

RESULTS: Analysis of the data of the hourly mean PCA morphine use and the 24 hour total PCA morphine use revealed no statistical significance between the butorphanol and placebo groups. The epidural morphine group had statistically less PCA morphine use (see Table). There were no statistical differences between the ages, heights, weights, nor duration of surgery for the three groups. Satisfactory analgesia was obtained for all groups.

<table>
<thead>
<tr>
<th>Epidural Drug Group</th>
<th>Mean PCAIV MSO4(mg)/hour</th>
<th>Mean Total PCAIV MSO4(mg)/24 hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1: Morphine</td>
<td>1.02 ±0.58*</td>
<td>29.7 ±14.58*</td>
</tr>
<tr>
<td>Group 2: Butorphanol</td>
<td>1.75 ±0.61</td>
<td>56.25 ±31.43</td>
</tr>
<tr>
<td>Group 3: Placebo</td>
<td>2.12 ±0.84</td>
<td>52.66 ±26.32</td>
</tr>
</tbody>
</table>

*Statistically significant p <0.01 when compared to the other two groups

CONCLUSION: Palacios et al and others have reported satisfactory post-operative analgesia in the post-Caesarean patient by assessment of visual analog pain scales and additional pain medication supplied at the patient's request. In our study, patients in groups 2 and 3 administered IV morphine to supplement their analgesia in doses that did not differ significantly on a per hour and twenty four hour basis. We conclude that 4 mg of epidural butorphanol does not differ from placebo in decreasing the requirement of postoperative PCAIV morphine in the post-Caesarean section patient.

Introduction: Following cesarean delivery, epidural morphine usually provides 24 hours of excellent analgesia and patient satisfaction. A small percentage of patients, however, receive little or no benefit. Although neuraxial administration of opioids is a potent and widely used method for postoperative analgesia, treatment failures persist. To determine their etiologies, and to develop methods for prevention, early detection and alternate treatment, an analytical review of U. of C. hospital records (for parturients receiving epidural morphine after cesarean delivery in a prospective, IRB-approved study from 8/88 to 11/91) was performed.

Methods: During the stated time period, 603 postcesarean patients ranked their overall analgesia and satisfaction (0=none, 1=fair, 2=good, 3=very good or excellent) during an interview 24 hours after epidural morphine (5mg) administration. Chart review was performed on all 32 patients (Failure group) with a score of 0 or 1 for either analgesia or satisfaction, and on 46 randomly selected patients (Success group) with scores of 2 or 3 for both analgesia and satisfaction. Preoperative criteria selected for analysis were patient weight, history of drug abuse [DA], and omission of current methadone therapy [METH]. Intra-operative criteria included: length of catheter in the epidural space; volume of local anesthetic required to achieve a T4 sensory level; incomplete epidural anesthesia requiring use of general anesthesia [GA]; time of epidural morphine administration; time, specific type and volume of the last local anesthetic dose; and OR end time. Postoperative criteria were as follows: pattern of supplemental opioid administration following epidural morphine administration (0-2hrs=early transitional pain [ETP], 2-20hrs=absent analgesia [AA], 10-20hrs=brief duration of analgesia [BDA], and 20-24hrs=late transitional pain [LTP]); and frequency of side effects (pruritus resolving with treatment, prolonged pruritus refractory to IM nalbuphine or IM diphenhydramine [PRU], nausea, vomiting, urine retention, respiratory depression and endometritis). Groups were compared using chi-square analysis with continuity correction (P<.05 considered significant [*]).

<table>
<thead>
<tr>
<th>Results</th>
<th>DA</th>
<th>METH</th>
<th>GA</th>
<th>ETP*</th>
<th>BDA</th>
<th>AA*</th>
<th>LTP*</th>
<th>PRU*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failure</td>
<td>9.4%</td>
<td>6.2%</td>
<td>3.1%</td>
<td>56%</td>
<td>22%</td>
<td>15%</td>
<td>53%</td>
<td>19%</td>
</tr>
<tr>
<td>Success</td>
<td>4.4%</td>
<td>0%</td>
<td>0%</td>
<td>13%</td>
<td>8.7%</td>
<td>0%</td>
<td>17%</td>
<td>2.2%</td>
</tr>
<tr>
<td>P</td>
<td>.673</td>
<td>.322</td>
<td>.854</td>
<td>&lt;.001</td>
<td>.189</td>
<td>.021</td>
<td>.002</td>
<td>.034</td>
</tr>
</tbody>
</table>

ETP, AA, LTP and PRU relate significantly to poor analgesia and satisfaction scores among postcesarean patients receiving epidural morphine. Note that METH, GA and AA occurred only in the Failure group, and that 60% of patients with AA also met METH or GA criteria. The Failure group was also remarkable because the incidence of AA was only 15%, compared to over 50% for ETP and LTP. ETP in both groups was associated with the use of epidural chloroprocaine (67%). For every patient with ETP, duration of the final dose of epidural local anesthetic was not sufficient to extend anesthesia 2 hrs after epidural morphine administration.

Discussion: Pre-, intra-, and postoperative factors contribute to the failure of epidural morphine to provide adequate analgesia and satisfaction after cesarean delivery. Analysis of these results suggests 6 management considerations: 1. Some patients with a history of drug abuse have increased requirements for postoperative analgesia. 2. Patients receiving daily methadone therapy should continue to receive a dose on the day of surgery. 3. An epidural catheter inadequate for surgical anesthesia is probably inadequate for postoperative analgesia. 4. To avoid ETP, continue epidural anesthesia for 2 hrs following epidural morphine administration. 5. Because transitional pain (ETP and/or LTP) occurs in the majority of patients in the Failure group, supplemental forms of analgesia (i.e., intravenous patient-controlled analgesia) may be useful. 6. Since persistent pruritus (refractory to IM nalbuphine and IM diphenhydramine) decreases satisfaction, consider low dose IV naloxone (40-80 μg/hr).
Title: INTRATHECAL FENTANYL SUPPLEMENTATION FOR CESAREAN SECTION UNDER EPIDURAL ANESTHESIA

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Affiliation: Department of Anesthesiology, New York University Medical Center, New York, New York, 10016

Introduction: Acute tolerance to narcotics occurs following a single injection of narcotic. This study evaluates the efficacy of prior intrathecal injection of fentanyl (μ-agonist) in reducing the side effects of a subsequent injection of 5 mg of epidural morphine (EM). The report also assesses the effect of intrathecal fentanyl on shivering associated with lumbar epidural anesthesia.

Methods: The protocol was approved by the Institutional Review Board and informed consent was obtained from 36 women undergoing elective cesarean section. In Group I (n=21) a #17G Hustead needle was introduced into the epidural space at the L3-L4 interspace. A #24G 120mm Sprotte spinal needle was then introduced through the Hustead needle to perform dural puncture and fentanyl 25 μg was injected intrathecally. The spinal needle was withdrawn and an epidural catheter was inserted into the epidural space. Epidural anesthesia was induced to T4 level with lidocaine 2% with epinephrine 5μg/ml. Three hours later, EM was given. In Group II (n=15), patients received only EM and no intrathecal fentanyl. Shivering was assessed on a four point scale: 0, +, ++ and ++++. A blinded observer used a visual analog scale (VAS, 0-100 mm) to assess nausea, pruritus, and surgical pain immediately after surgery and 24 hours later. The results were expressed as mean ± 1 SE and analyzed using X² analysis and Mann-Whitney rank-sum test.

Results: VAS scores were lower in Group I than in Group II for nausea and pain, but higher for pruritus immediately after surgery. However, 24 hours later, Group I had lower VAS scores for nausea and pruritus than Group II (p<0.05) with no significant difference in pain. The incidence of post-epidural shivering was less in Group I (p<0.03). The antishivering effect lasted 83±15 minutes.

Legend: F - fentanyl; C - controls. * - p<0.05

Discussion: Our data show prior use of intrathecal fentanyl decreases the side effects of EM. The data also demonstrate the antishivering efficacy of intrathecal fentanyl. Epidural fentanyl has been shown to prevent shivering.

ON THE VASCULAR MECHANISM OF EPHEDRINE'S BENEFICIAL EFFECT ON UTERINE PERFUSION DURING PREGNANCY

C Tong*, JC Eisenach

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Introduction: Ephedrine is preferred over pure $\alpha$-adrenergic drugs for the treatment of regional anesthesia-induced hypotension in obstetrics because ephedrine improves uterine blood flow to a greater degree. Whether this difference is due to differences in vascular or cardiac effects of these agents is unclear, since both ephedrine and phenylephrine have been recently shown to increase cardiac output in hypotensive pregnant women. This study examined the effects of pregnancy and vascular endothelium on the constricting effect of ephedrine and the $\alpha$-adrenergic agonist, metaraminol, in uterine and femoral arteries.

Methods: The protocol was approved by the Animal Care and Use Committee. Uterine and femoral arteries were obtained from pregnant (0.7-0.9 gestation) and nonpregnant ewes. Arteries were dissected free of adhesive tissue, cut into 4 mm long rings, and mounted in tissue chambers filled with oxygenated Krebs' solution. For some rings, endothelial cells were removed by gently rubbing the intimal surface. Rings were stretched to their optimum length-tension relationship, then exposed to either ephedrine or metaraminol ($10^{-10}$ - $10^{-3}$ M). Some rings were pretreated with indomethacin, propranolol or phentolamine. Data were calculated as % of contraction to KCL, and expressed as mean ± SEM.

Results: Ephedrine and metaraminol produced dose-dependent, endothelium-independent contractions of all rings. In all cases metaraminol was more potent (by $EC_{50}$ analysis - data not shown) and efficacious (by maximum effect - Fig 1). Pregnancy did not alter metaraminol's effect, but decreased ephedrine's, and this decrease was more marked in uterine than in femoral vessels (Fig 1). Constriction produced by both agents was antagonized by phentolamine, but not by indomethacin or propranolol.

Discussion: Pregnancy has been shown to alter regional vascular reactivity to a variety of receptor-selective agents, in some cases due to alterations in receptor number and in others due to alterations in receptor function. These data suggest that both ephedrine and metaraminol produce their effects by actions on $\alpha$-adrenoceptors, and support the uterine perfusion-sparing property of ephedrine during pregnancy. The dramatic alteration in effect of ephedrine, but not metaraminol, on uterine artery during pregnancy may be due to differences in action at different $\alpha$-adrenoceptor subtypes.
CALCIUM CHLORIDE ADMINISTRATION DURING HEMORRHAGIC HYPOTENSION DOES NOT INCREASE MATERNAL BLOOD PRESSURE OR UTERINE BLOOD FLOW IN HYPERMAGNESEMIC GRAVID EWES

Authors: Vincent RD, Chestnut DH, Sipes SL, Thompson CS, Bleuer SA, Debruyn CS, Chatterje P
Institution: Departments of Anesthesia and Obstetrics and Gynecology, University of Iowa College of Medicine, Iowa City, Iowa 52242

Introduction: Magnesium sulfate (MgSO4) worsens maternal hypotension during hemorrhage in pregnant sheep.1 This may result from MgSO4-induced relaxation of vascular smooth muscle and interference with compensatory cardiovascular responses to hemorrhage. Calcium chloride (CaCl2) causes inhibition of MgSO4-induced vasodilation in vitro and might reduce the magnitude of hypotension during hemorrhage in hypermagnesemic animals.2 The purpose of this study was to determine whether CaCl2 administration during hemorrhagic hypotension improves maternal and fetal hemodynamic measurements in hypermagnesemic pregnant sheep.

Methods: The protocol was approved by the Animal Care Committee. Mixed breed ewes were obtained from a commercial breeder at 118 d of timed gestation (term = 145 d). At 120 d, surgical instrumentation was performed during general anesthesia. Each animal recovered at least 3 d before experimentation. The experimental sequence included: 1) T=0: MgSO4 4 g iv; 2) T=5: Infusion of MgSO4 4 g/h iv; 3) T=90: Maternal hemorrhage 20 ml/kg over 55 min.; 4) T=147 min: CaCl2 10 mg/kg iv (CaCl2 group) or normal saline 0.1 ml/kg iv (NS-Control group); 5) T=160: Reinfusion of collected maternal blood over 1 h. Both experiments were performed in each animal (n=6) in random order, but only one experiment was done each day. Statistical analysis was by repeated measures ANOVA. P < 0.05 was considered significant.

Results: Maternal mean arterial pressure (MAP) and uterine blood flow (UBF) measurements in the CaCl2 group were not significantly different from those in the NS-Control group following the iv bolus of either CaCl2 or NS at 147 min (figures). Further, fetal PO2, pH, and base excess were similar in the two groups at all measurements after the iv bolus of CaCl2 or NS.

Discussion: CaCl2 administration did not improve MAP and UBF, or fetal oxygenation and acid-base status during hemorrhage in hypermagnesemic pregnant sheep.

References:

Supported in part by NIH Grant GM 40917
Title: COCAINE INDUCED HYPERTENSION IN THE EWE AND RESPONSE TO TREATMENT WITH LABETALOL

Authors: Hughes SC*, Vertommen JD, Rosen MA, Messer CP, Espinoza MI, Parer JT, Shnider SM

Affiliation: University of California, San Francisco, Department of Anesthesia

Introduction: As the increase of cocaine abuse in the United States has occurred, its use in women of reproductive age has also increased. Acute effects of cocaine abuse in the parturient include hypertension, placental abruption, fetal distress leading to cesarean section, and reports of rupture of maternal intracranial aneurysms, and peripartum seizures. Cocaine administered to the pregnant ewe increases maternal mean arterial pressure (MMAP) and reduces uterine blood flow (UBF). A previous study demonstrated that hydralazine in the ewe to control blood pressure, while successful, did not improve UBF and increased maternal heart rate (MHR) by 121%. The purpose of this study was to determine the effects of treatment of cocaine-induced maternal hypertension with labetalol on the maternal-fetal cardiovascular systems, blood gas analysis and acid base status, UBF, and catecholamine response.

Methods: We studied the chronic maternal-fetal sheep preparation (120 days gestation). MMAP, UBF, MHR, fetal mean arterial pressure and heart rate were recorded. Fetal and maternal arterial samples were obtained for cocaine levels, acid-base status, and catecholamine analysis. Intravenous cocaine was given for 55 min to the ewe to induce and maintain both increased MMAP and reduced UBF. The control group (n=11) received cocaine alone, while the study group (n=10) also received labetalol starting 15 min after the cocaine administration. Both drugs were discontinued 55 min after the start of the cocaine, followed by a 35 min recovery period. Statistical analyses were performed using repeated measures ANOVA and Dunnett t-testing (P<0.05).

Results: Cocaine administration resulted in a 32 ± 13(SD)% increase in MMAP and a 26 ± 21% reduction in UBF. In the group given labetalol and cocaine MMAP was restored quickly to baseline values, but UBF remained reduced 37 ± 16(SD)% and in the recovery period 22 ± 16(SD)%: MHR increased significantly (14 ± 21%) in the control group but labetalol restored MHR to baseline values. FHR and FMAP increased significantly in both groups. Labetalol reduced FHR below baseline values but had little effect on FMAP. Fetal pH and O2 saturation declined significantly in both groups after cocaine administration and remained reduced in the recovery period. Maternal and fetal cocaine and catecholamine levels will be reported.

Discussion: Hydralazine is often used in the hypertensive parturient and does control cocaine induced maternal hypertension. However, in the ewe, this results in a potentially catastrophic increase in MHR. Labetalol brings about a more rapid control of blood pressure as well as good control of MHR. The UBF is not improved, however, and the fetal status continued to show the effects of decreased UBF. While the applicability of this data to humans is difficult, labetalol would seem preferable to hydralazine to treat the parturient acutely intoxicated with cocaine. Further investigation is necessary.

Title: INFLUENCE OF SURGICAL TECHNIQUE ON THE INCIDENCE OF VENOUS AIR EMBOLISM AND PAIN DURING CESAREAN SECTION

Authors: Bromage, P.R.*, Fagraeus, L., Hohman, W.A.

Affiliation: Departments of Anesthesiology and Obstetrics & Gynecology, Medical Center of Delaware, Christiana Hospital, Newark, Delaware 19720 and Thomas Jefferson Medical College, Philadelphia, Pennsylvania

A number of reports have indicated that subclinical venous air embolism (VAE) may occur in 10-65% of patients during cesarean section (CS) delivery, with a remote potential for life-threatening events, but none of these reports have examined the influence of surgical technique on the incidence of VAE. We undertook a prospective study of 192 cesarean sections performed under epidural or subarachnoid anesthesia with precordial Doppler monitoring to determine if the incidences of VAE and intraoperative pain were affected by exteriorizing the uterus for repair(1,2), rather than leaving the uterus in situ for repair(3). Doppler sound changes existing for ten seconds or longer were taken as positive evidence of VAE. Randomization was achieved by the personal preference of individual surgeons with customary operating times ranging between 20-60 minutes. Data were tested by Chi-square with Yates' correction, or Fisher's exact test as appropriate.

Results:

Positive Doppler sound changes were observed in 34 of the 192 patients (i.e. 17.9%). One hundred and thirty-nine uteri were exteriorized and 31 of these exhibited positive Doppler sound changes (i.e. 22.3%). Fifty-three uteri were repaired in situ, and three of these had positive Doppler changes (i.e. 5.7%). This difference is significant (p < 0.025). Intraoperative pain in the presence of segmental blockade to T5 or higher occurred in 24 exteriorized uteri (17.3%) and in four left in situ (7.5%)(N.S.). The two phenomena of VAE and intraoperative pain were not statistically related. The incidence of pain or VAE was three times greater when the uterus was exteriorized than when it was left in situ (0.001 < p < 0.005).

Conclusions:

We conclude that exteriorization of the uterus for repair after CS is three times more likely to be accompanied by intraoperative complications than uterine repair in situ. We suggest that these studies be repeated in other centers with a view of discouraging exteriorization, if our findings are confirmed.

References:

Title: ST SEGMENT CHANGES DURING CESAREAN SECTION
Authors: Goldstein MJ*, Zakowski MI, Ramanathan S, Turndorf H
550 First Ave., New York NY 10016

Introduction: Up to 47% of patients undergoing cesarean section (CS) may have ECG changes suggestive of myocardial ischemia. These changes are reportedly associated with chest pain, shortness of breath, and nausea. We studied the ST-segment changes (continuous Holter monitoring) during CS with special reference to these symptoms, hemodynamic changes and any possible venous air emboli.

Methods: With institutional review board approval, 57 ASA I(E) and II(E) patients for cesarean section gave consent. Patients had pre- and post-operative 12 lead ECG. A Holter cardiac monitor (QMED) was used to monitor leads II and V5 continuously starting 2 hours before and ending at 4 hours after surgery. Patients received spinal (n=13) or epidural anesthesia (n=43) to a T4 level. Blood pressure was monitored every 5 min. A precordial Doppler sensor was used to detect atrial air bubbles. In addition, creatine phosphokinase myocardial fraction (CPK-MB) was measured postoperatively. Statistical analysis was done using t-test and X2 analysis.

Results: Twenty nine episodes of ST-segment depression occurred in 14 patients. No episodes of ST segment elevation occurred. Most ST-changes occurred intraoperatively during uterine closure (Fig 1). ST-changes occurred in 28% of patients in the epidural group and 15% of patients in the spinal group (p, N.S.). All CPK-MB fraction results were negative for patients with ST depression and all postoperative ECG were normal. Nausea, vomiting, chest pain, shortness of breath and air emboli occurred more frequently without ST-changes than with ST changes (p, N.S.,Fig 2). No definite relationship could be demonstrated between BP and ST-segment changes. However, 9 episodes of ST-changes were associated with HR increase of 15% or greater.

Discussion: ST depression occurs in 25% of patients undergoing cesarean section. However, they are not associated with any specific symptoms, air emboli, permanent ECG change, or evidence of myocardial damage. Further work is needed to determine if tachycardia causes ST-segment changes.

<table>
<thead>
<tr>
<th>ST SEGMENT CHANGES</th>
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<tbody>
<tr>
<td>MINUTES FROM INDUCTION</td>
</tr>
<tr>
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<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th>ST dep</th>
<th>Normal ST</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea</td>
<td>4</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td>Vomiting</td>
<td>3</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>Chest pain</td>
<td>3</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Air emboli</td>
<td>1</td>
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MATERNAL AND FETAL EFFECTS OF CONTINUOUS INTRAVENOUS PROPOFOL ANESTHESIA IN THE PREGNANT EWE

Alon E, Parer JT, Gillie MH*, Ball RH, Johnson JL, Shnider SM

Departments of Anesthesiology and Obstetrics, Gynecology & Reproductive Sciences, University of California, San Francisco

Introduction: Propofol is undergoing extensive evaluation in animals and humans, however little is known of its effects on uterine blood flow, fetal cardiovascular and acid-base variables. The present study was undertaken to evaluate the effects of maternally administered continuous intravenous propofol for induction and maintenance of anesthesia, compared to the technique using thiopental, isoflurane, and nitrous oxide.

Methods: The protocol was approved by the Committee on Animal Research. Studies were performed on eleven ewes near term gestation (120 days) 48 hours after preparatory surgery for placement of catheters and flow probe. Animals were randomized to receive one of two techniques for anesthetic induction and maintenance: Group 1, thiopental 5 mg/kg/body weight for anesthetic induction and isoflurane 1% inspired for maintenance; Group 2, propofol 2 mg/kg/body weight for anesthetic induction and propofol 150 µg/kg/min for maintenance; Group 3, propofol 2 mg/kg/body weight for anesthetic induction and propofol 300 µg/kg/min for maintenance. Animals in all groups received succinylcholine 1.5 mg/kg to facilitate tracheal intubation and 50% nitrous oxide in oxygen after tracheal intubation, and were mechanically ventilated to maintain normocarbia for the two hour anesthetic maintenance period. Maternal mean arterial pressure (M-MAP), maternal heart rate (M-HR), uterine blood flow (UBF), fetal mean arterial pressure (F-MAP) and fetal heart rate (F-HR) were continuously monitored. Frequent fetal and maternal arterial blood samples were obtained to evaluate acid-base status. Maternal anesthetic depth was assessed by evaluation of eyelash reflex, spontaneous swallowing and chewing, and response to noxious stimuli (nerve stimulator and tail clamp). Results are presented as mean values, and percentage change from the control values obtained before induction of anesthesia. Statistical analyses were performed using Student's t-test and ANOVA. A p<0.05 was considered significant.

Results: During induction of anesthesia, M-MAP and M-HR increased approximately 50% in all three groups. Although M-MAP rapidly normalized during maintenance of anesthesia in all groups, M-HR remained elevated. During anesthetic induction with thiopental and tracheal intubation, UBF decreased 50% and then rapidly increased approximately 25% above control values during anesthetic maintenance with isoflurane and nitrous oxide. However, during anesthetic induction with propofol and tracheal intubation, a decrease in UBF was not observed for either Group 2 or 3, and UBF remained at control values during the two hour anesthetic maintenance. No clinically significant changes were found in F-HR, F-MAP, fetal acid-base status or oxygenation. Spontaneous movements, positive eyelash reflexes and responses to noxious stimuli occurred significantly more often in Group 2 compared to the other two groups.

Discussion: These results suggest induction and maintenance of anesthesia with intravenous propofol has no adverse maternal or fetal effects, presuming the applicability of these data to humans. For the pregnant ewe, it appears that 150 µg/kg/min is an insufficient dose to maintain anesthesia.
WHICH VASOPRESSOR SHOULD ONE GIVE TO TREAT HYPOTENSION DURING MAGNESIUM SULFATE INFUSION AND EPIDURAL ANESTHESIA?

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Affiliation: Departments of Anesthesia and Obstetrics and Gynecology, University of Iowa College of Medicine, Iowa City, IA 52242

Introduction. Parturients receiving magnesium sulfate (MgSO4) often become candidates for epidural anesthesia. Recently we1 observed that MgSO4 worsened maternal hypotension during epidural lidocaine anesthesia in gravid ewes. Ephedrine is the preferred vasopressor for treatment of hypotension in obstetric patients. Recently some have suggested that one may safely treat maternal hypotension with phenylephrine.2 Magnesium sulfate may alter the response of systemic and/or uterine vessels to endogenous and exogenous vasopressors.3 The purpose of the present study was to determine whether ephedrine or phenylephrine is more appropriate for treatment of hypotension during epidural anesthesia in hypermagnesemic gravid ewes.

Methods. The protocol was approved by the Animal Care Committee. Experiments were performed in eight chronically instrumented ewes between 0.8 and 0.9 of timed gestation. The protocol included the following: 1) 60 minutes for baseline measurements; 2) at time zero, administration of MgSO4 4 g i.v. over five minutes; 3) at five minutes, intravenous infusion of MgSO4 at 4 g/h; 4) at 150 minutes, epidural administration of 2% lidocaine, sufficient to result in a mid-thoracic sensory level; 5) at 165 minutes, bolus administration of ephedrine 2.5 mg, phenylephrine 50 μg, or normal saline (NS) 2.5 ml, followed by intravenous infusion of the same agent for 30 minutes. In the ephedrine and phenylephrine experiments, the infusion of vasopressor was adjusted to maintain maternal mean arterial pressure (MAP) as close as possible to baseline. In the control experiments, the animals received NS at a rate of 2.5 ml/min, and there was no other effort to restore MAP to baseline. Statistical analysis was by repeated measures ANOVA. P < .05 was considered significant.

Results. At 165 minutes the median sensory level was T-7 in the ephedrine group, T-8 in the phenylephrine group, and T-7 in the control group.

Discussion. Ephedrine effectively restored maternal MAP and uterine blood flow (UBF) during epidural lidocaine anesthesia in hypermagnesemic gravid ewes. In contrast, phenylephrine restored maternal MAP but not UBF.

References.

Supported in part by NIH GM40917.
Progesterone Mediated Potentiation of Spinal Opiates

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Introduction  Pregnancy is associated with an increased sensitivity to general and local anesthetic agents. Increases in progesterone and endogenous opiates have been implicated. In fact, Datta et al. found that experimental treatment with progesterone decreases the MAC of halothane in rabbits. Furthermore, in vitro studies show that metabolites of progesterone inhibit nerve-cell excitability by potentiating GABA-mediated increases in chloride-ion conductance. Therefore, we tested the ability of intrathecally administered progesterone to produce analgesia and to potentiate the analgesic effects of spinal opiates in rats.

Methods  Female Sprague-Dawley rats were implanted with chronically indwelling 28 gauge spinal catheters and used for all studies. The ability of progesterone to potentiate the analgesic effects of intrathecal sufentanil was measured by first determining a subanalgesic dose of intrathecal sufentanil for each animal in the absence of progesterone treatment. Next, this same dose of intrathecal sufentanil was administered following acute treatment with intrathecal progesterone (or its metabolites) and analgesia reassayed to detect potentiation. Analgesia was measured using the tail-flick technique. In all experiments, progesterone and its metabolites were dissolved in 10 μl of 9% cyclodextran prior to intrathecal injection. Cyclodextran had no effect on the tail-flick assay or the analgesic effect of intrathecal sufentanil. Bicuculline (50 pmole) was administered intrathecally and picrotoxin (1 mg/kg) was administered intraperitoneally.

Results  Pilot studies showed that up to 50 μg of intrathecal progesterone had no analgesic effect using the tail-flick assay (n=15). Therefore, we tested the ability of progesterone to potentiate the analgesic effects of a subanalgesic dose of sufentanil. Animals first pretreated with 10 μg, 20 μg or 40 μg of intrathecal progesterone (n=5, for each dose) and then given a subanalgesic dose of sufentanil now displayed near maximal analgesia. In contrast, animals not pretreated with progesterone showed no analgesia (n=15). No behavioral or motor effects were noted following progesterone treatment. CSF progesterone levels were within physiologic range. Furthermore, 40 μg of progesterone administered intramuscularly did not potentiate sufentanil analgesia. Interestingly, 1 μg, 5 μg or 10 μg of a major progesterone metabolite, 5α-Pregnane-3α-OL-20-one, (n=5, for each dose), also potentiated sufentanil analgesia when administered intrathecally. Finally, two drugs that block GABA-mediated increases in chloride ion conductance, picrotoxin and bicuculline, each blocked progesterone mediated potentiation of sufentanil analgesia.

Conclusion  These results demonstrate that intrathecal progesterone potentiates the analgesic effects of neuraxial opiates. Increased progesterone levels during pregnancy may potentiate the analgesic effect of endogenous opiates and may help to explain the decreased analgesic requirements in these patients.

References
Title: Microcatheter Continuous Spinal Anesthesia: Possible Mechanism for Permanent Neurological Injury

Authors: Ross BK, Heath CH, Coda B

Affiliation: University of Washington Department of Anesthesiology

Seattle, Washington

Introduction: Continuous spinal anesthesia (CSA) has numerous advantages to the anesthesiologist, however, it has been plagued with the problem of a relatively high incidence of post dural puncture headache (PDPH) in selected patient populations. To decrease the incidence of PDPH, manufacturers (Kendall, TFX) have developed exceedingly small catheters for CSA. Kendall has recently reported episodes of permanent neurological injury following the use of their microcatheter. The purpose of this report is to discuss the circumstances of these injuries and to investigate a possible mechanism of injury.

Methods: A model of the spinal canal was fabricated. The model was placed in the upright position, filled with 'mock' CSF, warmed to 37°C and three injections each of 100mg/2ml were made using a 26g Quincke spinal needle, Burron epidural 18g catheter, Kendall 28g microcatheter, or 32g TFX microcatheter. CSF specimens were obtained 5 minutes following injection and lidocaine concentrations were determined directly using radiolabelled lidocaine or indirectly using methylene blue mixed with the lidocaine prior to injection.

Results: The lidocaine concentrations using the three catheters are shown in figures 1 & 2. In figure 1 the injections were made with the catheter tips pointing up, while in figure 2 the catheter tips were pointing down. The concentrations of lidocaine were significantly higher in the sacral distribution when the injections were made through the microcatheters; when the injection rates were very slow; or when the catheter tips were pointed (down) caudally. The concentrations of lidocaine were lower and more evenly distributed when the drug was injected rapidly or when the catheter tips pointed (up) cephalad.

Discussion: The exceedingly slow injection rates through microcatheters allows very little mixing in the CSF and very high sacral concentrations of lidocaine. These concentrations of drug are consistent with concentrations resulting in permanent neurologic injury published in the literature.

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Fig. 1

Fig. 2

Fig 1&2. Concentrations of lidocaine in the upright spinal model following 2ml injections with the Burron epidural catheter over 10 and 30 seconds and the Kendall and TFX catheters as fast as injections could be made. Fig 1 the catheter tips pointed (up) cephalad, fig. 2 the tips pointed (down) caudal. Arrow denotes site of injection.
Title: EFFECT OF RAPID IV CRYSTALLOID INFUSION ON PLACENTAL IMPLANTATION SITE OXYGEN DELIVERY IN THE PREGNANT EWE

Authors: Harris AP*, Crino JP

Affiliation: Department of Anesthesiology and Critical Care Medicine, The Johns Hopkins Medical Institutions, Baltimore, MD 21205, and Department of Obstetrics, Gynecology, and Reproductive Sciences, The University of Texas Medical School at Houston, Houston, TX

Introduction. Acute intravascular volume expansion has been shown in preliminary studies to increase total uteroplacental blood flow significantly in the pregnant ewe. Since acute volume expansion can decrease the oxygen-carrying capacity of blood concurrently, and some components of uterine blood flow do not supply the placental implantation site (i.e., myometrial flow), we undertook the current study to investigate the effect of acute volume expansion on oxygen delivery to the placental implantation site.

Methods. Six chronically instrumented near-term ewes were studied. A maternal left ventricular, femoral arterial and venous, and a fetal pedal arterial catheter were placed 5 days prior to study. On the day of the experiment, baseline maternal and fetal hemodynamic measurements were made, including arterial blood gases, maternal cardiac output (CO, cardiac green technique), maternal hemoglobin concentration (Hgb), and maternal organ blood flows using the radioactive microsphere technique. A total of 2.0-2.5l normal saline was infused over 40 minutes, and the measurements repeated. Oxygen delivery to the placental implantation site (ODplac) was calculated. All values are mean ± SEM. The t-test for paired comparisons was used to calculate a p value.

Results.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Post-infusion</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal MAP (mmHg)</td>
<td>92 ± 4</td>
<td>100 ± 3</td>
<td>0.001</td>
</tr>
<tr>
<td>CO (l/min)</td>
<td>10.0 ± 0.9</td>
<td>10.5 ± 1.0</td>
<td>NS</td>
</tr>
<tr>
<td>Hgb (g/dl)</td>
<td>8.4 ± 0.6</td>
<td>7.8 ± 0.5</td>
<td>0.12</td>
</tr>
<tr>
<td>Myometrial BF (ml/min/100g)</td>
<td>43 ± 4</td>
<td>42 ± 6</td>
<td>NS</td>
</tr>
<tr>
<td>Placental implantation site (ml/min/kg fetus)</td>
<td>177 ± 16</td>
<td>211 ± 22</td>
<td>0.08</td>
</tr>
<tr>
<td>ODplac (ml O2/min/kg fetus)</td>
<td>20 ± 1</td>
<td>22 ± 2</td>
<td>NS</td>
</tr>
<tr>
<td>Skeletal muscle BF (ml/min/100g)</td>
<td>6.4 ± 1.6</td>
<td>8.5 ± 1.9</td>
<td>0.05</td>
</tr>
<tr>
<td>Skin BF (ml/min/100g)</td>
<td>5.6 ± 1.2</td>
<td>7.7 ± 1.6</td>
<td>0.06</td>
</tr>
<tr>
<td>Renal BF (ml/min/100g)</td>
<td>553 ± 50</td>
<td>684 ± 38</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Discussion. Although rapid IV crystalloid infusion increased mean arterial blood pressure and renal blood flow, oxygen delivery to the placental implantation site remained essentially unchanged. Earlier studies which demonstrated dramatic increases in uteroplacental blood flow with crystalloid infusion cannot be extrapolated to have proven fetal benefit, since the increase in placental flow may be partially negated by a decrease in oxygen carrying capacity by a hemodilution effect.

Title: COMBINED SPINAL AND EPIDURAL BLOCK FOR CAESAREAN SECTION
Author: LES H.S. CARRIE MB CHB, FFARCS, DA
Affiliation: NUFFIELD DEPARTMENT OF ANAESTHETICS AND JOHN RADCLIFFE HOSPITAL, OXFORD, ENGLAND

History
Curelaru in 1979 published the first description of a technique combining spinal and epidural block, his technique employing separate interspaces for insertion of the spinal and epidural needles. Brownridge reported the use of this same technique for Caesarean section in 1980. The first use of a single interspace, spinal needle through epidural needle technique (the method to which the term "combined spinal-epidural (CSE) is now usually applied) was by Coates for orthopaedics in 1982. In 1984 Carrie and O'Sullivan reported the use of this technique for Caesarean section.

Advantages of CSE Technique
The rapidly increasing popularity of combined spinal-epidural anaesthesia derives from the deficiencies of epidural and spinal block when employed alone. Epidural anaesthesia is slower in onset than spinal anaesthesia and despite various adjuncts to improve its efficiency, is much less reliable in this respect than spinal block. Potentially toxic doses of local anaesthetic drug are likely to be approached or even exceeded when epidural anaesthesia is used for Caesarean section, especially with a recalcitrant block or where an epidural block already in use for labour is extended for Caesarean section. Doses of local anaesthetic drug required for spinal anaesthesia never approach toxic levels. Classically, postdural puncture headache (PDPH) has been quoted as an argument against the use of spinal anaesthesia, especially in obstetric patients. The production of high-quality, fine gauge spinal needles, and recently the renewed interest in "pencil-point" or atraumatic-tipped needles has almost eliminated this disadvantage of spinal anaesthesia. Hypotension, an inevitable risk with any local anaesthetic block high enough for Caesarean section, is reputed to be more likely with spinal than with epidural block of similar extent, probably because of its speed of onset. CSE may make it possible to reduce the incidence of hypotension. The main disadvantage of spinal block is that it is generally regarded as a non-continuous technique.

Equipment
The can be divided into "needle-through" and "needle-alongside or double-lumen" types. The important factor in the first type is not the basic length of the spinal needle shaft but the distance by which it protrudes past the tip of the epidural needle. Cutting-tipped and pencil-point spinal needles may be used. Manufacturers now making matching needles for the technique including Becton Dickinson, Braun (Burron), Portex and Vygon. Double-lumen examples include the Eldor needle and other prototypes.

Hazards
The two main potential hazards of the technique are control of spread of the spinal solution already injected should difficulty arise in passing the epidural catheter and insertion of the epidural catheter through the hole in the dura mater. Some of the special needles designed for the technique incorporate features designed to avoid these problems.

Summary
The CSE technique allows a degree of flexibility in the administration of combinations of intrathecal and/or epidural local anaesthetic and/or opioid or other drugs for labour, Caesarean section and postoperative pain relief unattainable by either spinal or epidural injection alone.

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References
Title: SUBSTANCE P LEVELS ARE DECREASED IN PREGNANCY

Authors: Mouton S, M.D., Kambam J.R., M.D., Naukum R, B.S., Sastry B.V. Rama, D.Sc Ph.D., Steve Blanks, CRNA

Affiliation: Department of Anesthesiology, Dept. of Pharmacology
Vanderbilt University, School of Medicine, Nashville, TN 37232-2125

Introduction: Pregnancy is associated with alterations in central nervous system responses to anesthesia. The minimum alveolar concentration (MAC) of inhaled anesthetics is reduced in pregnancy [1], as well as requirements for local anesthetics [2,3,4]. Hormonal changes in pregnancy, such as increased progesterone levels, endorphin levels, have been implicated [5] as factors responsible for the decreased drug requirements in pregnancy. Substance P is a neurotransmitter of the tachykinin peptide family that is involved in the transmission of nociceptive information [6]. Substance P is present in both central and peripheral nervous systems and seems to be connected with the system of endogenous opiates and the system of catecholamines. Since alterations in beta-endorphins in pregnancy have been previously described (4,7), the purpose of this study was to determine alterations in Substance P in pregnant and non-pregnant patients.

Methods: With prior approval from our Institutional Review Board, 19 adult unpremedicated female patients between the age of 18-40 years, (ASA Physical Status I) undergoing elective laparoscopic gynecological procedures, and 23 pregnant patients at or near term were included in the study. Blood was collected for SP levels from the non-pregnant patients prior to induction of anesthesia for surgery. Blood collection from the pregnant patient was performed prior to induction of epidural anesthesia for labor.

Blood was collected into EDTA containing test tubes and kept on ice to prevent the proteolytic degradation of peptides. Blood was centrifuged and plasma was separated and stored at -70°C until extraction. SP levels were determined using a radioimmunoassay, obtained from Incstar (Stillwater, MN). Details of this method were published recently [8]. Data were analyzed using unpaired Student’s t-test.

Results:

<table>
<thead>
<tr>
<th></th>
<th>non-pregnant</th>
<th>pregnant</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Mean age (yrs)</td>
<td>29.78</td>
<td>26.1</td>
</tr>
<tr>
<td>SP pg/ml</td>
<td>182 ± 107</td>
<td>28 ± 15*</td>
</tr>
</tbody>
</table>

Discussion: The explanation for the extreme difference in SP levels in pregnant and non-pregnant patients may be related to the alteration in central nervous system physiology related to the pregnant state. SP is a neurotransmitter involved in the nociception of pain. In pregnant patients, plasma endorphin levels are elevated [7] near term. It is possible that the endorphin levels are involved in the suppression of SP release in pregnant patients. Such a reduction in release of SP may play a role in the sensitivity of the pregnant patient to local and inhalation anesthetics. One can conjecture that the increase in progesterone in pregnancy, in association with increased endorphin levels, decreased SP, all contribute to the physiologic adaption to pain associated with parturition. Reduction in SP in patients with chronic pain has recently been described [9].

References:
Title: LIPID SOLUBILITY DETERMINES ANALGESIC POTENCY OF \( \alpha_2 \)-ADRENERGIC AGONISTS IN SHEEP

Authors: B Bucklin, JC Eisenach

Affiliation: Section of Obstetric Anesthesia, Wake Forest University Medical Center, Winston-Salem, North Carolina 27103

Introduction. The relationship between analgesic potency after intrathecal (IT) administration and lipid solubility is complex. In rats there is an inverse correlation between intrathecal potency and lipid solubility for opioids whereas there is a direct correlation between IT potency and lipid solubility for \( \alpha_2 \)-adrenergic agonists. Since IT analgesics act by diffusing from CSF to the spinal cord dorsal horn, sheep may be a more appropriate study model due to a greater similarity of spinal cord size and structure with humans. This study evaluated antinociception in sheep produced by IT injection of \( \alpha_2 \)-adrenergic agonists of differing lipid solubility (dexmedetomidine > clonidine > ST-91).

Methods. Following approval by the Animal Care and Use Committee, 5 sheep were anesthetized and midcervical IT catheters inserted via a laminectomy. After a minimum of 48 hrs, antinociception was measured as withdrawal to a mechanical stimulus to the forelimb, as validated by others. Fifteen min after baseline readings and a saline control injection (.4ml), cumulative dose responses were determined on separate days for dexmedetomidine, clonidine, and ST-91. Each dose (.4ml + .4ml saline) was separated by 15 min and preceded by analgesia testing. The order of drug tested was random, and the investigator was blinded to drug used in each experiment. Pressure at time of withdrawal was converted to Newtons, and data expressed as Maximum Possible Effect (MPE).

Results. Saline injection did not alter withdrawal threshold. Clonidine and dexmedetomidine produced dose dependent increases in withdrawal threshold, whereas ST-91 did not (Figure 1).

Discussion. These data are similar to those of IT injection of dexmedetomidine and clonidine in rats, suggesting a direct correlation between lipid solubility and analgesic potency for \( \alpha_2 \)-adrenergic agonists. ST-91 decreases in blood pressure and produces antinociception in rats, while it does not affect blood pressure in sheep, nor does it produce antinociception in this species. These data suggest that this poorly soluble \( \alpha_2 \)-adrenergic agonist may be unable to reach hemodynamic and analgesic sites of action in the larger spinal cord of sheep, and perhaps of humans.
Introduction. Animal studies suggest that intrathecally administered opioids produce analgesia ultimately by causing calcium-dependent adenosine release. This analgesia is reversed by adenosine antagonists in animals. The present study was undertaken to test the hypothesis that intrathecal administration of the opioid, fentanyl, causes adenosine release into CSF in humans.

Methods. After IRB approval, we obtained informed consent from 15 ASA Class I or II women scheduled for inpatient gynecologic surgery or elective cesarean delivery under spinal anesthesia. Upon insertion of the spinal needle into the spinal canal, 1 ml of CSF was aspirated and 20 mcg (0.4 ml) fentanyl injected. Additional 1 ml samples of CSF at 2, 4 and 6 minutes following the fentanyl injection were obtained. Local anesthetic was then injected and the remainder of the surgical case proceeded as usual. Respiratory rate was measured every hour for 6 hours postoperatively. The CSF samples were stored at -70 degrees Celsius prior to analysis for adenosine by HPLC.

Results. Although measurable levels of adenosine were obtained, there was no significant change in CSF adenosine levels up to 6 minutes in either the saline control or fentanyl groups.

Discussion. This is the first study in humans to examine the hypothesis that opioids cause adenosine release in the spinal cord. We chose fentanyl because of its rapid analgesic action when injected intrathecally. The exact time course of opioid-induced adenosine release is not known. We were able to demonstrate measurable levels of adenosine but did not show an increase. The sample time course may have been too short and further studies using a continuous spinal technique and sampling up to 30 minutes are currently underway. These data will be available for presentation in May 1991.

Supported by grants from the Medical Research Council of Canada to J.S.

Title: PRELIMINARY CHARACTERIZATION OF $\alpha_2$-ADRENOCEPTORS IN THE SHEEP SPINAL CORD BY AUTORADIOGRAPHY

Authors: B Bucklin, JC Eisenach, R Booze

Affiliation: Section of Obstetric Anesthesia, Wake Forest University Medical Center, Winston-Salem, North Carolina 27103

Introduction. $\alpha_2$-Adrenergic receptors have been shown to play an important role in nociceptive processing. Several $\alpha_2$-receptor subtypes have been characterized by pharmacologic, biochemical, and genetic analyses. Although the presence of $\alpha_2$-adrenergic receptors in the spinal cord can be demonstrated functionally and autoradiographically, these studies have been unable to quantify and specifically localize these receptors. Quantification and localization of these receptors and their subtypes will be important in further characterization of nociceptive processing and drug development. Therefore, we characterized the $\alpha_2$-binding conditions of [3H]-clonidine with sheep spinal cord tissue sections by high resolution autoradiographic techniques.

Methods. Following approval by the Animal Care and Use Committee, an adult sheep was anesthetized. Cervical spinal cord was removed and stored at -80 C. Serial sections of 25 microns thickness were thaw-mounted onto chrome-alum/gelatin-subbed slides, incubated in 50mM Tris-HCl(pH7.5) for 30 min at room temperature and then incubated at varying concentrations of [3H]-clonidine (1nM to 10nM) for 15 min at room temperature. Non-specific binding was defined as binding which was not inhibited by 10 µM idazoxan. Analysis of the saturation experiments was performed using EBDA, and saturability of binding was determined by LIGAND. Localization of $\alpha_2$-receptors in the sheep spinal cord was performed using [3H]-clonidine(5nM) as the ligand. Non-specific binding was defined as mentioned previously. Films were developed at 4, 8, and 12 weeks of exposure to compare quality of exposure.

Results. [3H]-clonidine bound to a single population of binding sites over the concentration range studied. Non-regression linear analysis determined the binding to be saturable and of high affinity ($K_d=5nM$). The amount of non-specific binding was low. Images obtained at 4 weeks exposure were of highest quality, and showed localization of $\alpha_2$-adrenoceptors to the superficial dorsal horn of the spinal cord.

Discussion. These preliminary studies define the binding conditions necessary for localization of $\alpha_2$-adrenergic receptors and demonstrate a high density of specific binding sites in the dorsal horn of the cervical spinal cord. Future studies will include characterization of $\alpha_2$-adrenergic receptors in the intermediolateral cell column of the thoracic spinal cord as well as definition of $\alpha_2$-adrenoceptor subtypes at sites of hemodynamic control and analgesia.

Supported in part by grant GM35523 from the N.I.H.
Opioid Receptor Binding Affinity of 2-Chloroprocaine
Coda BA1, MD, Hill HF3, PhD, Ross B1, MD, PhD, Chavkin C2, PhD
Departments of 1Anesthesiology and 2Pharmacology, University of Washington, Seattle, WA 98195 and 3Fred Hutchinson Cancer Research Center, 1124 Columbia Street, Seattle, WA 98104

Background: Epidural 2-chloroprocaine (2CP) can decrease analgesic effectiveness of subsequently administered epidural fentanyl. Furthermore, epidural 2CP did not antagonize epidural butorphanol, suggesting that the apparent antagonism of epidural fentanyl was a mu opioid receptor specific effect. To investigate this hypothesis, we measured the ability of 2CP and lidocaine to displace specific radioligands from mu and kappa binding sites in vitro.

Methods: Cerebral cortex samples from male Hartley guinea pigs were homogenized in 0.32 M sucrose, then centrifuged and resuspended twice in Tris-HCl for use in binding studies. We used [3H]-DAGO and [3H]-U69,593 as specific mu and kappa ligands respectively, and measured % binding of radioligands in the presence of a range of concentrations of 2CP, lidocaine, or fentanyl. We calculated EC50 values for each drug from % radioligand binding vs. log concentration of unlabelled drug.

Results: 2CP's EC50 for [3H]-DAGO binding inhibition was 1.44±0.36 mM, while its EC50 for [3H]-U69 inhibition was 177±47 μM. EC50 values for lidocaine at both mu and kappa sites were in the mM range. Fentanyl had an EC50 value of 13.3±2.9 nM for [3H]-DAGO and >2μM for [3H]-U69.

Discussion: The relative affinity of 2CP for kappa vs. mu opioid receptors is approximately 6. The EC50 for [3H]-U69 binding inhibition is lower than the mean CSF 2CP concentration measured after epidural administration (765μM), while the EC50 for [3H]-DAGO binding inhibition is twice that value. Lidocaine had no significant mu or kappa opioid affinity at clinically relevant concentrations.

Regardless of the nature of the interaction that may exist between 2CP and either mu or kappa agonists, it is unlikely that the apparent antagonism of epidural fentanyl by 2CP is due to simple competitive inhibition at central mu receptors in light of their low affinity for 2CP.

References:
Title: PHARMACOKINETIC AND -DYNAMIC STUDIES OF INTRATHECAL, EPIDURAL, AND INTRAVENOUS DEXMEDETOMIDINE

Authors: B Bucklin, JC Eisenach, B Tucker

Affiliation: Section of Obstetric Anesthesia, Wake Forest University Medical Center, Winston-Salem, North Carolina 27103

Introduction. Studies of α₂-adrenergic agonists, specifically clonidine, have revealed profound antinociceptive properties as well as hemodynamic effects. Although clonidine has been effective in treating chronic pain syndromes, its use in acute pain is less certain, due to large dose requirements and hemodynamic side effects. Dexmedetomidine, a more potent and specific α₂-adrenergic agonist may produce analgesia with fewer side effects. Although dexmedetomidine is currently being evaluated for potential clinical use, dural transfer and elimination from CSF have not been evaluated. This study examines the pharmacokinetics and pharmacodynamics of intrathecal(IT), epidural(EP), and intravenous(IV) dexmedetomidine in sheep CSF and plasma.

Methods. Following approval by the Animal Care and Use Committee, 6 non-pregnant ewes were anesthetized and arterial, venous, lumbar epidural and intrathecal catheters inserted. Forty-eight hrs later, each ewe received, on separate days and in random order, dexmedetomidine 100 μg by IT, EP, or IV injection. Plasma and CSF samples were obtained at specified intervals for pharmacokinetic analysis. Mean arterial pressure(MAP) and heart rate(HR) were recorded at each sampling time and blood was obtained for blood gas analysis. Plasma and CSF concentrations will be determined by mass spectrometry.

Results. Maximal hemodynamic effects were observed within 30 min of injection. IT and EP administration decreased MAP, whereas there were no statistically significant changes in HR. (Figure 1) Pharmacokinetic data (including availability of dexmedetomidine in CSF after EP administration) will be available at the time of presentation.

Discussion. These data agree with the clonidine pharmacodynamic data obtained in sheep: the blood pressure lowering effect is greater for IT than EP administration, reflecting a local action of drug on spinal sympathetic outflow. However, the lack of significant changes in heart rate in this study may relate to pharmacokinetic differences between dexmedetomidine and clonidine. Although these pharmacodynamic data support the use of epidural dexmedetomidine, neurotoxicity studies are needed to determine the safety of spinal administration.

Supported in part by a grant from Farmos Pharmaceutical Co.
Introduction: By detecting the loss of resistance to injection of air or saline, anesthesiologists can identify the epidural space. In animals, epidural air persists for up to 24 h, often near the exit of nerve roots. Recently, Dalens et al. suggested that epidural air bubbles may impede the access of local anesthetic to nerve roots, causing a patchy distribution of sensory blockade. In contrast, other investigators suggest that epidural injection of saline may impair sensory blockade by diluting subsequently injected local anesthetic. We designed this study to investigate further these hypotheses.

Methods: After approval by our IRB, we obtained oral consent from 50 ASA I-III laboring parturients. In a random order, we identified the epidural space with the loss of resistance technique injecting 7 ml of either air or preservative-free saline. Subsequently, a polyamid catheter was passed 2 cm into the epidural space and secured. With all patients supine with left uterine displacement and 30° head up tilt, we injected 0.25% bupivacaine as follows: 0 minutes: 3 ml; 3 minutes: 5 ml; 4 minutes: 4 ml. In 29 of the women, a blinded observer measured loss of temperature discrimination to alcohol and asked about the quality of pain relief (excellent, good, fair or poor) every 5 minutes for the first 30 minutes after injection. In all patients we evaluated the extent of sensory blockade and the quality of analgesia at 30 minutes. Using the Mann-Whitney U-test, we compared the onset, duration and quality of sensory blockade in the two groups.

Results: The two patient groups did not differ in age, height, weight, gravidity, parity or previous number of epidurals. We found no significant differences in onset of sensory blockade (Figure), quality of analgesia, total number of spinal segments blocked, the incidence of “patchy” block or the duration of blockade between the two groups.

Conclusion: Using 7 ml of either air or saline to identify the epidural space alters neither the onset nor the quality of sensory blockade in laboring parturients. Based on these findings, we doubt that epidural air is a significant cause of patchy distribution of sensory analgesia in laboring parturients. Similarly, the volume of saline used in this study neither augments nor inhibits the onset of sensory analgesia.

References:
Title: Skin Surface Warming Prior to Epidural Block Blunts Anesthetic-Induced Hypothermia.

Authors: BGlosten, J Hynson, DI Sessler, J McGuire

Affiliation: Departments of Anesthesia at The University of Chicago, and The University of California, San Francisco

Introduction: Hypothermia occurs commonly during epidural anesthesia.1,2 Recent data support the hypothesis that hypothermia results from redistribution of body heat from the core to the periphery during sympathetic blockade.3 Warming the periphery, therefore, should limit anesthetic-related hypothermia. We tested the hypothesis that skin-surface warming prior to inducing epidural anesthesia blunts hypothermia.

Methods: After approval by the local IRB and written informed consent, lumbar epidural catheters were placed in 7 healthy, nonobese, minimally clothed subjects. The subjects reclined on a padded OR table during the study. Monitors included the following: core temperature (tympanic membrane), skin temperature (10 sites), ECG, blood pressure, pulse oximetry, and anesthetic level to pinprick. The subjects received two epidural injections of 40 ml 1.5% lidocaine during the study day. One epidural injection followed a 2-hour control period in which the subject rested uncovered in a cool room. The other epidural injection followed a 2-hour period in which the subjects were covered with a Bair Hugger® forced air warming mattress set on “medium” (38°C). The order of preanesthetic conditions was alternated between subjects. Before beginning the second anesthetic study period, complete resolution of the previous epidural anesthetic was confirmed by the absence of anesthetic level, ability to ambulate, and return of toe skin temperature to baseline values. Differences between the two anesthetics with respect to preanesthetic temperatures and maximum decreases in core temperature were determined using Student’s t test for paired data. P < 0.05 was considered statistically significant.

Results: Midthoracic levels of anesthesia were achieved after all epidural injections (levels ranged from T5-2 after the control period, and from T9-2 after the warm period). Skin surface temperatures were significantly higher after the warm period than after the control period, but core temperatures were similar after the warm and control periods (Table). Decreases in core temperature during epidural anesthesia were smaller after the warm period than after the control period (P = 0.019)(Figure).

Conclusion: Actively warming the skin before inducing epidural anesthesia lessened anesthetic-related hypothermia. This finding supports body heat redistribution as the etiology of hypothermia from anesthesia. Although multiple factors contribute to intraoperative hypothermia, warming the patient prior to inducing anesthesia should help limit anesthetic-related hypothermia.

<table>
<thead>
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<th>TABLE</th>
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<td></td>
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<tr>
<td><strong>Skin temp</strong></td>
</tr>
<tr>
<td>control before anes.</td>
</tr>
<tr>
<td>warm before anes.</td>
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<tr>
<td><strong>Core temp</strong></td>
</tr>
<tr>
<td>control before anes.</td>
</tr>
<tr>
<td>warm before anes.</td>
</tr>
<tr>
<td>* P &lt; 0.05</td>
</tr>
</tbody>
</table>

References:
1. Anesthesiology 71: A838, 1989
2. Regional Anesthesia 14:48-52, 1989
3. Anesthesiology 73: A967, 1990

Maximum decrease in core temperature after epidural anesthesia in 7 subjects.
Title: DOES EARLY ADMINISTRATION OF EPIDURAL ANESTHESIA PROLONG LABOR OR INCREASE THE INCIDENCE OF CESAREAN SECTION FOR DYSTOCA?

Authors: Chestnut DH,* Vincent RD, Choi WW, Ostman LP, Bates JN, Laszewski LJ, Wenstrom K

Affiliation: Departments of Anesthesia and Obstetrics and Gynecology, University of Iowa College of Medicine, Iowa City, IA 52242

Introduction. In a retrospective study, Thorp et al. concluded that epidural anesthesia increased the incidence of cesarean section for dystocia in nulliparous women. Some obstetricians contend that this problem results from administration of epidural anesthesia before 5 cm cervical dilation. The purpose of the present study was to determine whether early administration of epidural anesthesia prolongs labor and/or increases the incidence of cesarean section for dystocia.

Methods. The protocol was approved by the institutional review board. Informed consent was obtained from healthy, nulliparous women with a singleton fetus in vertex presentation, who requested epidural anesthesia during spontaneous labor at term. A patient was randomized only after the following conditions were met: 1) the patient requested pain relief; 2) an epidural catheter had been placed; and 3) the cervix was ≥3 but <5 cm dilated. Five min after randomization, patients in the early group received 3 ml of 1.5% lidocaine with epinephrine, followed by 0.25% bupivacaine as needed. Patients in the late group received nalbuphine 10 mg intravenously. Late-group patients could receive a second dose of nalbuphine ≥1 h after the first dose. Late-group patients did not receive epidural anesthesia until they achieved a cervical dilation of ≥5 cm, or until ≥1 h after the second dose of nalbuphine. Patients in both groups received a continuous epidural infusion of 0.125% bupivacaine after 5 cm cervical dilation. Statistical analysis was by chi square, Student t-test, and Mann-Whitney U-test as indicated. P < .05 was considered significant.

Results. The two groups were similar with regard to maternal characteristics. Epidural bupivacaine provided analgesia which was clearly superior to that provided by intravenous nalbuphine (figure). The table includes other results. Continuous variables are expressed as mean ± S.D.

<table>
<thead>
<tr>
<th></th>
<th>Early (n=49)</th>
<th>Late (n=46)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical dilation at randomization (cm)</td>
<td>3.6 ± 0.6</td>
<td>3.6 ± 0.6</td>
<td>NS</td>
</tr>
<tr>
<td>Cervical dilation at epidural test dose (cm)</td>
<td>3.6 ± 0.6</td>
<td>5.2 ± 1.0</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Randomization to epidural test dose (min)</td>
<td>5 ± 1</td>
<td>149 ± 119</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Randomization to complete dilation (min)</td>
<td>354 ± 186</td>
<td>416 ± 225</td>
<td>NS</td>
</tr>
<tr>
<td>Patients who required oxytocin augmentation</td>
<td>11 (22%)</td>
<td>13 (28%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

Method of delivery

- Vaginal: 42 (86%) vs 40 (87%) NS
- Cesarean for dystocia: 5 (10%) vs 3 (7%) NS
- Cesarean for fetal distress: 2 (4%) vs 3 (7%) NS

Occiput posterior/transverse at delivery

- 9 (18%) vs 4 (9%) NS

One-min Apgar score ≥ 7

- 35 (71%) vs 32 (70%) NS

Five-min Apgar score ≥ 7

- 49 (100%) vs 46 (100%) NS

Umbilical arterial blood pH

- 7.25 ± .07 vs 7.23 ± .07 NS

Umbilical venous blood pH

- 7.32 ± .06 vs 7.31 ± .08 NS

Discussion. This is an ongoing study. The present results suggest that administration of epidural anesthesia between 3 and 5 cm cervical dilation does not prolong labor. It is premature to make any conclusion as to whether early epidural anesthesia affects the incidence of cesarean section.

Reference:

The effect of analgesic intervention on maternal temperature progression during labor is unclear. A recent study reported a significant rise in both oral and vaginal temperature when epidural analgesia was used for labor\(^1\). However, vaginal temperature may rise in response to epidural-induced increases in vaginal blood flow. We therefore measured both oral and tympanic membrane (TM) temperature throughout labor, with and without epidural analgesia. The effect of the addition of an epidural opioid (fentanyl) on these findings is also addressed.

**Methods:** Fifty-three term parturients in active labor with no clinical signs of infection, and no pregnancy-related complications gave institutionally approved informed consent. Each patient chose either parenteral narcotics or epidural analgesia for labor. The epidural patients were randomly divided into two groups: both groups received a continuous epidural infusion of 0.25% bupivacaine solution maintained at 10 cc/hr. In one group (n=20) fentanyl, 2 mcg/cc, was added to the infusion, while the other group (n=20) received no epidural narcotics. Patients choosing only parenteral narcotic analgesia served as a control group (n=13). Oral and TM temperatures were recorded immediately prior to epidural placement (or when the control patients reached 3 cm cervical dilation with regular contractions), then hourly until delivery. Ambient room temperature was regulated at 20-22°C throughout the study. One-way and two-way ANOVA and Chi-squared tests were used to analyze characteristics of the three groups.

**Results:** The oral and TM temperature readings were well correlated (r=0.62, p<0.001). Mean maternal temperature did not differ between groups during the first four hours; however, at five hours and thereafter, mean TM temperature was significantly higher in both epidural groups than in the control group, and mean TM temperature within both epidural groups was significantly higher than the pre-epidural temperature. The addition of fentanyl to the epidural infusion did not alter the progression of temperature readings. No rise in temperature over time was observed in the parenteral narcotic group. There was a weak but significant correlation between fetal heart rate (FHR) and maternal temperature (r=0.22, p<0.01). No patients showed signs of infection, sepsis or chorioamnionitis.

**Discussion:** Our results confirm a small, but consistent elevation in maternal temperature during labor in parturients receiving epidural analgesia which is not observed in patients receiving only parenteral narcotics. We chose to measure TM temperature because it more accurately reflects core temperature. It is possible that patients receiving only parenteral narcotics lose more heat to the environment than do epidural patients, owing to pain-induced perspiration and hyperventilation. Furthermore, patients in the parenteral narcotic group often ingested ice chips, which may lead to lower temperature readings. The elevation in temperature in the epidural group, although statistically significant, never exceeded 1°C. The precise mechanism for this observation is unclear, and further studies are warranted.

**References:**
Title: Comparison of Fentanyl, Meperidine, and Sufentanil for Intrathecal Labor Analgesia.
Authors: Honet JE*, Arkooch VA, Huffnagle HJ, Norris MC, Leighton BL
Affiliation: Department of Anesthesia, Thomas Jefferson University, Philadelphia, PA

Objective: To compare and contrast the analgesic potency, duration, hemodynamic and other side effects of fentanyl, meperidine and sufentanil for continuous intrathecal labor analgesia.

Methods: Forty-six healthy laboring term parturients gave written informed consent to participate in this IRB approved study. Patients, as determined by a table of random numbers, received either fentanyl 10 μg, meperidine 10 mg, or sufentanil 5 μg via an indwelling lumbar intrathecal catheter. Patients received an additional injection of study drug if they remained in pain after 15 minutes. Those women still in pain at 30 minutes received bupivacaine 2.5 mg. When pain recurred, we repeated the above dosing protocol until they required bupivacaine or delivered.

At baseline and every five minutes for thirty minutes after the initial injection of narcotic, patients rated their pain, nausea, and pruritus on 10 cm horizontal visual analog scales (VAS). They continued to rate these variables every thirty minutes until they requested additional pain relief. Concomitantly we measured blood pressure (BP) and evaluated sensory (alcohol) and motor (Bromage scale) blockade. Before and 15 minutes after each reinjection, we obtained VAS, and measured BP, sensory and motor blockade.

We used product limit survival analysis to compare the duration of analgesia after the first dose of narcotic and the total duration of effective narcotic analgesia. We defined the total duration of effective narcotic analgesia as the time from initial study drug injection until the patient either delivered or required injection of local anesthetic for pain relief. Analysis of variance for repeated measures compared the changes in VAS, BP and sensory and motor blockade over time.

Results: The patient groups did not differ in age, height, weight, parity, time to delivery, method of delivery, or incidence of headache. None of the drugs caused any significant hemodynamic change. Some patients in each group developed detectable sensory changes, no patient developed any evidence of motor blockade. 80% of the women in the fentanyl group, 100% in the meperidine group and 93% in the sufentanil group initially developed adequate analgesia with intrathecal narcotics alone. The table depicts the first dose and total duration data. Meperidine caused significantly more nausea than fentanyl or sufentanil. Significant pruritus occurred in all groups.

<table>
<thead>
<tr>
<th>Drug</th>
<th>N</th>
<th>Median (min)</th>
<th>Mean ± SE (min)</th>
<th>Range (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>15</td>
<td>60.0</td>
<td>71.5 ± 9.6</td>
<td>0 - 130</td>
</tr>
<tr>
<td>Meperidine</td>
<td>15</td>
<td>91.6</td>
<td>94.8 ± 10.7</td>
<td>35 - 160</td>
</tr>
<tr>
<td>Sufentanil</td>
<td>16</td>
<td>97.5</td>
<td>104.7 ± 8.5</td>
<td>0 - 165</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug</th>
<th>N</th>
<th>Median (min)</th>
<th>Mean ± SE (min)</th>
<th>Range (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fentanyl</td>
<td>15</td>
<td>150.0</td>
<td>182.0 ± 42.5</td>
<td>0 - 360</td>
</tr>
<tr>
<td>Meperidine</td>
<td>15</td>
<td>270.3</td>
<td>240.2 ± 30.1</td>
<td>35 - 480*</td>
</tr>
<tr>
<td>Sufentanil</td>
<td>16</td>
<td>228.5</td>
<td>241.8 ± 27.6</td>
<td>0 - 545*</td>
</tr>
</tbody>
</table>

* Potential range of analgesia unknown as patients delivered while still comfortable with narcotic.

Conclusion: All three narcotics provide adequate analgesia for most patients in labor. The lack of detectable motor or autonomic blockade resulting from the drugs and doses studied may prove a significant advantage over epidural analgesia. Meperidine and sufentanil although not statistically different appear superior to fentanyl in terms of the duration of effective narcotic analgesia.
Sequential fetomaternal temperature change during epidural analgesia.

G Samsoon, R De Boest, B Morgan, GM Hall.

Introduction: Epidural analgesia during labour is associated with an increase in maternal temperature. However, the evidence for fetal temperature changes is more tenuous. This study was therefore undertaken to determine sequential temperature changes during epidural analgesia.

Method: Primiparae with epidural analgesia in labour were studied and compared to a control group using TENS and Entonox for analgesia.

Maternal temperature was monitored with a tympanic temperature probe inserted in the ear canal (El lab) which was secured and left in situ for continuous monitoring until delivery. Fetal temperature was monitored continuously with a fetal scalp temperature probe. This consisted of a thermocouple, type T, made of Cu-CuNi, (range 25-45°C, accuracy ± .08°C) inserted in a modified Copeland fetal scalp electrode so that the thermocouple probe rested on the fetal scalp.

Measurements of maternal and fetal temperatures were made before initiation of epidural analgesia. An epidural infusion of 10-20ml 0.1% bupivacaine plain was used to maintain sensory analgesia at T<sub>S</sub><sup>10</sup> dermatomal level. Both control and epidural groups received 1ml/kg/hr or a balanced salt solution during the study. Ambient temperature was maintained at 24 ± 1°C.

The study was approved by the hospital ethical committee.

Results: Twenty-one mothers were studied, 15 in the epidural group, 6 in the entonox/TENS group. All had labours lasting more than 4 hours.

Baseline mean maternal core temperature was 36.6 (SD 0.5)°C in both groups. There was a positive gradient of 0.4-0.7°C between fetal and maternal temperatures. This gradient remained more or less the same throughout labour. There was a significant rise in maternal and fetal temperature throughout labour in the epidural group. The increase in temperature, 0.2°C/hr throughout labour was present in all 15 mothers in the epidural group.

Mean maternal core temperature in the entonox group showed a 0.1°C drop in the first two hours and returned to baseline afterwards. Similarly the fetomaternal temperature gradient remained constant during the whole duration of labour.

<table>
<thead>
<tr>
<th>Time</th>
<th>Epidural Temperature Mean (SD)</th>
<th>Control Temperature Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 h</td>
<td>36.6 (+.5)</td>
<td>36.6 (+.5)</td>
</tr>
<tr>
<td>2 h</td>
<td>37.1 (+.5)</td>
<td>36.5 (+.5)</td>
</tr>
<tr>
<td>4 h</td>
<td>37.3 (+.8)</td>
<td>36.6 (+.5)</td>
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<table>
<thead>
<tr>
<th>Time</th>
<th>Epidural Temperature Mean (SD)</th>
<th>Control Temperature Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 h</td>
<td>37.3 (+.6)</td>
<td>37.2 (+.6)</td>
</tr>
<tr>
<td>2 h</td>
<td>37.6 (+.6)</td>
<td>37.1 (+.4)</td>
</tr>
<tr>
<td>4 h</td>
<td>38.1 (+.4)</td>
<td>37.1 (+.6)</td>
</tr>
</tbody>
</table>

Conclusion: This study shows conclusively that epidural analgesia during labour is associated with a rise in maternal core temperature. There is invariably a rise in fetal temperature so that the fetomaternal gradient is maintained. Depending on baseline maternal temperature and duration of epidural analgesia some parturients will invariably become pyrexial with concurrent fetal pyrexia. One may speculate that this may be due to decreased heat loss during labour.

The short or long term effects of such pyrexia in the fetus is unknown in man but in an animal study the fetus was compromised following maternal pyrexia.<sup>2</sup>

References:
TITLE: AN IN-VITRO ASSESSMENT OF AMNIOTIC FLUID REMOVAL FROM HUMAN BLOOD THROUGH CELL SAVER PROCESSING

Author: Thornhill ML*, O'Leary AJ, Lussos SA, Rutherford C, Johnson MD

Affiliation: Department of Anesthesiology, Perfusion, and Hematology, Brigham & Women's Hospital, Harvard Medical School. Boston, Massachusetts 02115.

Introduction:

Major obstetric hemorrhage accounts for approximately 13.4% of maternal mortality in the United States. The risks associated with transfusion of non-autologous bank blood include infection (e.g., hepatitis and AIDS), transfusion reaction, and Rh sensitization. Massive intraoperative obstetrical hemorrhage may risk amniotic fluid contamination from the surgical field. Amniotic fluid (AF) may contain lanugo hair, vernix caseosa, meconium, and fetal cellular debris. These may potentially cause cardiovascular collapse and/or DIC if significant quantities enter the maternal circulation. Patients with clinical symptoms of Amniotic Fluid Embolism (AFE) tend to have higher quantities of fetal debris in their circulation than non-affected patients. By using the cell saver wash cycle AF debris may be effectively reduced or eliminated. This in-vitro study was designed to determine if the Shiley Dideco 795 P Cell Saver could adequately clear gross amniotic fluid from human blood.

Methods:

Sterile amniotic fluid was obtained from healthy ASA I and II parturients undergoing elective cesarean sections. Amniotic fluid in concentrations of 20% and 33% were mixed with fresh whole blood from patients with hemochromatosis. Samples were passed through a 40 micron cardiomyotomy filter, primed at 300cc/min, and washed with 2 liters of normal saline using the Shiley Dideco 795 P cell saver. Pre and post wash samples were tested for alpha fetal protein (AFP) concentrations (Kallestad AFP DS Radaimmunoassay - with a maximum sensitivity of 2.2 international units per liter). Cell smears for fetal squamous cells were performed using Giemsa Wright staining.

Results:

Seven pre-wash samples with 20% and 33% AF had AFP levels which ranged from 36-75 international units per liter. All post-wash samples had alpha fetal protein levels of zero. Pre-washed Giemsa-Wright Staining had cell concentrations ranging from 41-59 squares per 5 microliter, whereas post-wash cell concentrations ranged from 3-16.5 squares per 5 microliters. No trophoblasts, lanugo hair, or vernix caseosa were seen.

Conclusion:

We conclude that when AFP and fetal debris are used as markers for AF, cell saver processing appears to completely remove AFP and reduce the quantity of fetal debris. Presently, it is unclear which markers or substances within AF are the etiologic triggers responsible for the signs and symptoms of AFE.

The use of propofol, a new I.V. agent, has been extensively evaluated in surgical but not in obstetric patients. The purpose of this study, approved by our institutional human investigation committee, is to determine the safety and efficacy of propofol given for induction, or for induction and maintenance, of general anesthesia for cesarean section.

Methods. Healthy (ASA class I or II) women presenting for elective cesarean section at term of pregnancy, having signed an informed consent, are randomly assigned to one of 3 groups: Group A and B patients receive an induction dose of propofol 2.5 mg/kg, i.v. (over 20-30 sec), while group C patients get ketamine 0.5 mg/kg, i.v., followed by thiopental 4.0 mg/kg, i.v. After endotracheal intubation, facilitated by i.v. succinylcholine, anesthesia is maintained in group A patients with a continuous infusion of propofol at a rate of 0.15 mg/kg/min, supplemented by nitrous oxide 50% in oxygen until delivery, and 70% in oxygen after delivery. Group B and C patients receive isoflurane 0.5%, throughout, supplemented by nitrous oxide 50% in oxygen until delivery, and 70% thereafter. After delivery, all patients receive morphine sulfate in increments of 3-5 mg, i.v., as required.

Maternal heart rate, arterial blood pressure, ECG, arterial blood oxygen saturation (pulse oximetry) and end-tidal CO₂ are monitored throughout. To evaluate the newborn's condition, umbilical artery and vein samples are obtained for blood gas/pH analysis and Apgar scores are assessed at 1, 2 and 5 minutes post-delivery. Time to sustained respirations is also recorded. After completion of surgery, maternal recovery is assessed based on orientation, response to verbal commands, and a digit symbol substitution test. Ten Group A and 10 group B patients will have venous blood samples collected at intervals for the analysis of propofol levels. Umbilical cord samples will also be obtained at delivery for the same purpose.

Results. Fifty nine patients have been studied so far: 20 group A, 20 Group B, and 19 group C. The Kruskal-Wallis test showed no significant differences between the 3 groups. Measured parameters included mean maternal age, induction to delivery (10-11 min), and uterine incision to delivery (98-107 sec) intervals. There were 5 depressed newborns in group A (Apgar score of 6 or less at 1 min), 6 in group B, and 4 in group C. All infants were vigorous at 5 min. The mean time to sustained respirations varied between 16 and 37 sec. Umbilical vein and artery pH and blood gas tensions were normal in all 3 groups. There were no adverse delayed effects noted in the neonates. The time interval between discontinuation of anesthesia and the mother's response to verbal commands ranged between 10 and 17 min.

Conclusion. These preliminary data suggest that propofol may be a suitable induction as well as maintenance agent in general anesthesia for elective cesarean section.
Title: Abnormal Maternal and Fetal Glycolysis in Diabetic Parturients
Authors: Grant GJ*, Ramanathan S.
Affiliation: New York University Medical Center, 560 1st Ave, N.Y., N.Y. 10016

INTRODUCTION: This study evaluates to what extent hyperglycemia per se contributes to maternal and fetal metabolic abnormalities in patients with insulin-dependent diabetes mellitus (IDDM) in the peri-operative period.

METHODS: The protocol was approved by the Institutional Review Board. Patients gave informed consent. The study group included 20 term parturients with well-controlled IDDM (Class B-F). Non-diabetic patients with iatrogenic hyperglycemia (n=15), and normoglycemic patients (n=15) were used as controls. Diabetic patients received glucose-insulin infusion to maintain capillary glucose (Chemstrip) at 70-120 mg/dl. All patients were given 1200 ml Ringers lactate. Hyperglycemic controls also received 20 g glucose i.v. For cesarean section, bupivacaine epidural anesthesia to T4 level was used. At delivery, maternal venous and neonatal umbilical venous and arterial (UV and UA) blood samples were collected for glucose, lactate and pyruvate measurements. Results were expressed as mean ± 1 SE. For statistical analysis, ANOVA and protected least significant difference method (PSD) were used.

RESULTS: No intergroup differences were noted in maternal or neonatal pH or gas tensions. Maternal glucose was the highest in the hyperglycemic controls and the lowest in the normoglycemic controls. The most striking metabolic abnormality was a significant reduction in maternal and neonatal blood pyruvate (see figures) and 35% incidence of neonatal hypoglycemia in the IDDM group (p<0.05).

DISCUSSION: Glucose infusion usually increases blood pyruvate levels due to increased glycolysis. However, in patients with IDDM, the pyruvate level is reduced inappropriately for the level of glucose, signifying impaired glycolysis. In fact, the enzyme pyruvate kinase has been shown to be reduced in placentae of patients with IDDM, and in the fetal lungs in animals with alloxan diabetes. Impaired glycolysis is implicated in neonatal hypoglycemia.

References:

Legend: D - diabetics; H - iatrogenic hyperglycemics; N - normoglycemics;
* - different from groups H and N; @ - different from groups D and N;
O - different from group N; # - different from H; p < 0.01 for all comparisons.
Title: Placental Transfer of Lidocaine During Maternal Hypoxia
Authors: Waters JJ*, Ramanathan S.
Affiliation: Dept of Anesthesiology, New York University Medical Center, 560 First Avenue, New York, New York, 10016

Introduction: Maternal hypoxia may suddenly develop as a complication of epidural anesthesia. We have studied how maternal hypoxia affects placental transfer of lidocaine (Lido) in the isolated human placental cotyledon.

Methods: Placentae were obtained from 8 healthy term pregnant women. The placental cotyledon, and the fetal umbilical vein (UV) and artery (UA) were cannulated and perfused with diluted plasma (1:3) containing 5μg/ml of Lido. The maternal cotyledon was perfused at 900 ml/min and the fetal UA at 300 ml/min. The following were measured: lactate, pyruvate, glucose, Lido (radioimmunofluoroscent assay), pH, PCO2, PO2, albumin, globulin in the maternal inflow and outflow and in the fetal UV outflow; fetal perfusion pressure (FFP) and UV outflow rate (UVFR). Fetal/maternal (F/M) Lido ratio was calculated by dividing UV outflow Lido concentration by maternal Lido concentration. The net amount of Lido transferred to the fetus was derived by multiplying UVFR by UV Lido concentration. Protein bound fraction (PBF) of Lido was done by centrifugation dialysis. The placenta was first perfused with normoxic perfusate (pH 7.36, PCO2 38 mm Hg, PO2 196 mm Hg) for 30 min followed by hypoxic biophase (pH 7.38, PCO2 36, PO2 29) for 30 min. Measurements were made at the end of each period. Results were as expressed as mean±1 SE and analyzed using t-test.

Results: The UVFR and FPP decreased significantly from 4.2±0.1 ml/min and 47±4 mmHg respectively during normoxia to 3.4±0.3 ml and 38±5 mm Hg during hypoxia (p<0.01). During hypoxia, F/M ratio for Lido decreased 18% from the normoxic ratio (Fig). The net Lido transfer into the fetal circulation decreased 33% during hypoxia (Fig). Lido PBF did not differ either in the maternal or fetal circulation (69%±0.03). No other measurements changed significantly during hypoxia.

Discussion: Data show that during maternal hypoxia both F/M ratio and total fetal transfer of Lido decrease. Maternal hypoxia causes placental vasodilatation as evidenced by falling FFP. The diminished UVFR further suggests a stagnant circulation within the placenta. The decreased transfer may be due to diminished passage of Lido across the placenta and/or retention within the placenta.
Title: CIRCULATORY RESPONSE TO INCREASED INTRACRANIAL PRESSURE AFTER \( \alpha \)-ADRENERGIC AND VASOPRESSIN BLOCKADE IN FETAL SHEEP

Authors: Harris AP*, Takahashi H, Koehler RC, Jones Jr MD, Traystman RJ

Affiliation: The Departments of Anesthesiology/Critical Care Medicine and Pediatrics, The Johns Hopkins Medical Institutions, Baltimore, MD 21205

Introduction. Difficult labor is associated with elevated fetal plasma levels of catecholamines and arginine vasopressin (AVP). In fetal sheep, cerebral compression without decreased \( PaO_2 \) increases mean arterial pressure (MAP) and progressively increases plasma catecholamines and AVP\(^1\). We evaluated the contributory role of the \( \alpha \)-adrenergic system and AVP in producing peripheral vasoconstriction and preserving cerebral \( O_2 \) consumption (CMRO\(_2\)) during cerebral compression by studying the response to increased intracranial pressure (ICP) during \( \alpha \)-adrenergic and AVP blockade in fetal sheep.

Methods. Near-term fetal sheep were catheterized for blood flow measurements (radio-labelled microspheres 2 days prior to the experiment. Three groups were studied: control \((n=5)\); \( \alpha \)-adrenergic blockade (phentolamine 2 mg/kg + 1.5 mg/kg/hr, iv; \( n=6)\); combined \( \alpha \)-adrenergic + AVP V1 receptor blockade (phentolamine+Manning compound 10 \( \mu g/kg\), iv; \( n=7)\). After baseline measurements, ICP was elevated (by ventricular infusion of mock cerebrospinal fluid) to baseline MAP of each animal over a 2 min period and then kept fixed for 30 min. Blood flows were measured at 3, 15, and 30 min following ICP elevation. Data were analyzed by ANOVA with repeated measures and Dunnett's test \((p<.05)\).

Results. MAP increased during the first 6 min in all groups (Figure). In the control group, MAP increased further and stabilized by 16 min, whereas in both blocker groups MAP returned to baseline levels. At 30 min in the control group, decreases in blood flow occurred in small intestine, skin and kidney. One animal in the \( \alpha \)- and two in the AVP-blocker groups experienced cardiovascular collapse prior to 30 min. In the remaining animals, intestinal and skin blood flow were not significantly changed from baseline. Renal blood flow was higher during cerebral compression in the combined blockade group compared to \( \alpha \)-blockade alone. In the control group, the increase in MAP maintained cerebral blood flow (CBF) at a level sufficient to preserve CMRO\(_2\) \((4.0 \pm .4\) to \(3.3 \pm .4\) ml \( O_2/min/100g\)), but with \( \alpha \)-adrenergic blockade, CBF fell to near-zero levels (Figure).

Discussion. We conclude that the \( \alpha \)-adrenergic and AVP pressor systems are critical for producing peripheral vasoconstriction, thereby preserving CMRO\(_2\) during persistent elevation of ICP in the fetal sheep. Other systems (e.g. \( \beta \)-adrenergic system) may be recruited during brief, transient ICP elevations, but in the absence of \( \alpha \)-adrenergic tone, the response is short-lived.

Reference: \(^1\)Harris et al: Circ Res 1989; 64:991-1000 (Supported by HL-38285)
Title: Effects of Cerebrospinal Fluid on Hemostasis

Authors: Nancy Sarvet-Habar,* Commo DiPazio, and Norman Blaas

Affiliation: Department of Anesthesiology Medical College of Virginia Richmond, VA and University of Virginia Charlottesville, VA

Introduction. Dural puncture headache, one of the most frequent complications of spinal anesthesia, is commonly treated with an epidural blood patch. This treatment is based upon a hypothesis that the blood which is placed in the epidural space coagulates and "plugs" the rent in the dura. We have examined in vitro some of the hemostatic consequences of mixing blood with cerebrospinal fluid in an attempt to better understand this phenomenon.

Methods. Samples of CSF were obtained from the hospital laboratory from patients who had undergone diagnostic lumbar punctures and who were shown to be free of infection or CNS pathology and in whom the CSF cell counts were normal. These samples were then pooled. Aliquots of CSF were then divided among test tubes and varying amounts of fresh whole blood from nonpatient volunteers were added to yield different concentrations of blood. The time for clot formation was measured. The same assessments were also made using normal saline as a diluent.

Results. The mean clotting time of undiluted blood was 378 ± 16 (SEM) seconds. The mean increase in percent clotting time for each group was calculated and Student's t tests were performed to evaluate significance. The percent prolongation of the clotting time is shown below:

<table>
<thead>
<tr>
<th>Diluent</th>
<th>75% blood</th>
<th>50% blood</th>
<th>25% blood</th>
</tr>
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<tbody>
<tr>
<td>CSF (n=9)</td>
<td>31 ± 6.7</td>
<td>62 ± 5.0</td>
<td>98 ± 11</td>
</tr>
<tr>
<td>Saline (n=10)</td>
<td>41 ± 11</td>
<td>67 ± 12</td>
<td>157 ± 17</td>
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</table>

(p<.05)

Discussion. As expected, the progressive dilution of blood with either CSF or with saline prolonged the time for clot formation and a linear relationship was seen. This might explain the frequently noted observation that epidural blood patches have a lower rate of clinical success during the first 24 hours when leakage of CSF is presumed to be the greatest than after 48 hours. There may be excessive dilution of the blood thus preventing formation of an effective patch. Our study would also explain the clinical observation that epidural blood patching can be more successful when larger volumes of blood are used.

CSF has a procoagulant effect when comparing similar dilutions of blood with saline. However, this effect is statistically significant only at low concentrations of blood. The procoagulant effect may not be clinically important because it is the dilutional effect which exerts the predominant influence on the clotting time. This procoagulant effect has been examined by Khodadoust who noted that application of either aqueous humor or CSF to an earlobe puncture site shortened the bleeding time. He also observed that CSF and aqueous humor shortened prothrombin and partial thromboplastin times.

References.
Title: CARDIAC TOXICITY OF CALCIUM CHANNEL BLOCKERS IS POTENTIATED BY MAGNESIUM SULFATE

Authors: Kuritzman J, Thorp JM, Jr, Haley LG, Spielman FJ, Cefalo RC, Mueller R

Affiliation: Departments of Obstetrics and Gynecology and Anesthesiology, University of North Carolina, School of Medicine, CB# 7570, Chapel Hill, North Carolina 27599-7570

Introduction. Magnesium sulfate is commonly used to prevent seizures and to decrease uterine activity. Recently, calcium channel blockers have been added to tocolytic and anti-hypertensive regimens. We designed our experiment to: (1) analyze the dose-dependent effects of two calcium channel blockers [Verapamil (Ve) and Nifedipine (Ni)] on cardiac function, (2) explore the additive effect of magnesium sulfate (Mg).

Methods. Forty Sprague-Dawley rats were heparinized and anesthetized. Their hearts were excised, attached to a Langendorff apparatus, and perfused with Krebs solution. A balloon tipped catheter was placed into the left ventricle. Left ventricular systolic pressure (LVSP), heart rate (HR), and contractility (dP/dt) were measured. Dose response curves were generated for Ve, Ni, Mg. At 15 minutes, the hearts were randomly assigned into four groups: 1) Ve added at concentrations of 2, 4 and 6 x 10^{-6} M, 2) Mg concentration at 5mEq/L and Ve added as in Group 1, 3) Ni added at concentrations of 4, 8 and 12 x 10^{-6} M, 4) Mg concentration at 5mEq/L and Ni added as in group 3.

Results. Baseline measurements were similar in all hearts. There were dose dependent significant decreases in LVSP, HR and contractility in Groups 1 and 3 relative to baseline. These dose dependent decreases were potentiated significantly by increasing Mg concentrations in Groups 2 and 4 when compared to similar doses in Groups 1 and 3. Although these findings were elicited in an isolated perfusion model, the concept of potentiated myocardial depression should be kept in mind when using Mg with a calcium channel blocker in the gravid patient.

Discussion. This study demonstrates independently, both Ve and Ni produce myocardial depression in the isolated rat heart model. Furthermore, the combined effect of each of these drugs plus Mg produce a greater degree of myocardial depression than either Ve or Ni alone. This effect is likely the result of calcium channel antagonism by Ve, Ni, and Mg.

References.
Title: Pregnancy-Related Differences in Cocaine Pharmacokinetics and Hemodynamics in Rats

Authors: Morishima HO*, Masaoka T, Cooper TB, Miller ED, Jr

Affiliation: Depts. of Anesthesiology & Psychiatry, College of Physicians & Surgeons, Columbia University, New York, N.Y. 10032

Introduction: Pregnancy may influence the pharmacokinetics, pharmacodynamics, and possibly toxicity of cocaine. The purpose of this study was to test the above hypothesis in chronically catheterized Sprague-Dawley rats.

Methods: Fifteen term pregnant (P) and 18 nonpregnant (NP) female rats were used. Arterial pressure and heart rate were monitored throughout the study. Cocaine (5mg/kg) was infused intravenously over a 15 min period to the adult animals. Cardiac output and organ blood flow were measured using the microsphere method, prior to and at the end of cocaine infusion, at which time blood was also withdrawn. Fetal blood was obtained by cardiac puncture immediately following hysterotomy. Several organs were removed from the adult and fetus (F). Cocaine concentrations in all blood and tissue samples were determined, using a gas chromatographic procedure. In a separate study, blood was obtained from 7 P and 7 NP rats for colorimetric measurement of plasma cholinesterase activity. ANOVA and Student's t test were performed, where applicable, for statistical analyses. A p value of less than 0.05 was considered significant.

Results: Arterial blood pressure rose progressively during cocaine administration; at the end of the infusion, the increase from the baseline was statistically significant in the P group, and was associated with a fall in cardiac output from 32.5±1.3 to 26.2±1.8 ml/min/100g in the P group (p < 0.05), and from 30.5±1.1 to 27.2 ± 1.4 ml/min/100g in the NP group. In general, after cocaine infusion regional blood flow tended to be reduced; the decrease was statistically significant in the brain in both P and NP animals, and in the heart and placenta in the P group. There was a striking reduction (50%) in placental blood flow, from 1.42±0.16 to 0.72±0.17 ml/min/g. The mean plasma cocaine concentration in the P group was significantly lower, 1,656±126 ng/ml vs. 2368±108 ng/ml in the NP animals. Overall tissue concentrations were also lower in the P group, but the tissue to plasma concentration ratios were greater than those in the NP group. Cocaine concentration in F plasma was 366±21 ng/ml, with a fetal to maternal ratio of 0.23±0.05. Drug concentrations in the F brain and heart were 11 and 8 times lower than corresponding maternal values. Plasma cholinesterase activity in P and NP animals was 2,194±157 and 1,441±69 mU/ml (p < 0.05), respectively.

Discussion: These observations indicate that pregnancy enhances the hemodynamic effects of cocaine. The lower blood and tissue drug concentrations in P rats were probably due to the higher volume of distribution and plasma cholinesterase activity. The overall values for the tissue to plasma concentration ratios of the drug in the P was higher than those in the NP animals, indicating that pregnancy increases tissue uptake of cocaine. Placental transfer of cocaine was limited, probably due, in part, to a severe reduction in the placental blood flow induced by the drug.

Supported in part by NIDA Grants RO1 DA06648, and RO3 DA04579, and NIMH Grant MH CRC 30906.
TITLE: DESFLURANE ANALGESIA IN OBSTETRICS: MATERNAL AND NEONATAL EFFECTS

AUTHORS: F Swart, MD, TK Abboud, MD, J Zhu, MD, M. Donovan, MD, E desilva, MD, A Justice, MD, K Schaefer, MD, K Tolliver, MS

AFFILIATION: Department of Anesthesiology, Los Angeles County-University of Southern California, Los Angeles, California 90033

Introduction: The use of subanesthetic concentration of inhalational anesthetics such as isoflurane or nitrous oxide is effective in providing pain relief during delivery and is safe for the mother and the baby(1). Desflurane is a new inhalation agent that produces anesthesia rapidly and undergoes minimal metabolism. We investigated the use of desflurane in subanesthetic doses for analgesia during the second stage of labor.

Methods: Approval of the Institutional Review Board and informed consents were obtained. Thirty healthy parturients undergoing normal vaginal delivery were randomly assigned to receive either desflurane 0.5-2.5% and oxygen (n=15) or nitrous oxide 30-60% and oxygen (n=15). Both patient and obstetrician were unaware of which drug was being administered. Analgesia was assessed using a scale of 0 (no relief) to 4+ (excellent analgesia). Blood loss was estimated and neonates were evaluated by Apgar scores at 1 and 5 min, cord acid base status and the Neurologic and Adaptive Capacity Scores (NACS) at 2 hr and 24 hr of age. Maternal blood and urine were obtained before administration of the anesthetic and 12 to 24 hours later to determine the hematological and the biochemical profile. Data were analyzed for statistical significance using student’s t-test or chi-square when appropriate. Significance was accepted at P<0.05.

Results: Both desflurane and nitrous oxide received similarly high analgesia scores from mothers, anesthesiologists and obstetricians. Blood loss did not differ between the two groups. All neonates were vigorous at 5 min and had normal acid base status. NACS scores were equally high for the two groups of neonates and did not differ significantly. Serum electrolyte levels and renal function in the mother as assessed by determination of serum BUN, creatinine and uric acid concentrations as well as by urine osmolality and Na⁺ and K⁺ concentrations were not significantly affected by the analgesic.

Discussion: Results from our study show that desflurane in subanesthetic doses, combined with oxygen, is a safe and effective inhalation analgesic agent for normal vaginal deliveries. Newborns were vigorous and no evidence of excessive blood loss was noted in the parturients. Desflurane has the advantage of permitting delivery of almost 100% oxygen, which may be advantageous if complications of delivery occur.

Reference:
THEOPHYLLINE FOR POST-DURAL PUNCTURE HEADACHE

Schwalbe SS, Schiffmiller NW, Marx GP

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Introduction: Intravenous caffeine sodium benzoate has been used in the treatment of post-dural puncture headaches (PDPH). Oral caffeine preparations have been tried, but the relief obtained was only transient. We evaluated the ability of theophylline, a methylxanthine with a longer duration of action than caffeine, in its ability to relieve a post-dural puncture headache.

Methods: The study protocol was approved by our institution's Committee for Clinical Investigations, and written informed consent was obtained from patients entered in this study. Postpartum women with a clinical diagnosis of PDPH occurring within 72 hours of either a known "wet tap" or a spinal anesthetic, were considered for inclusion in the study. These women were asked to evaluate the severity of their pain on a 10 cm visual analogue scale (VAS). In a randomized, double blind fashion, they then received one dose of either theophylline 300 mg in a sustained release tablet or a placebo. The patients were then asked to reevaluate the severity of their headaches four hours and twenty four hours following the administration of the medication. Narcotic analgesics and caffeine containing beverages were avoided for the first 4 hours. VAS scores at 4 and 24 hours were compared to the initial scores using Friedman's nonparametric method.

Results: Forty four patients have been studied, 22 in the theophylline group and 22 in the placebo group. Of these, 26 had received spinal anesthesia (22 ga. Quincke needle) and 18 had a dural puncture during an attempted insertion of an epidural anesthetic (17 ga. Touhy needle). Thirty five of these women received their anesthetic for a cesarean section, nine received analgesia for labor and vaginal delivery. The initial VAS scores in the theophylline and placebo group were not significantly different (p > 0.6) and the median score was the same in both groups. Improvement was seen in the 4 and 24 hour scores of both sets of patients, however, the women who received theophylline did significantly better at both 4 hours (p < 0.003) and at 24 hours (p = 0.0001). After 24 hours, only one patient (5%) in the theophylline group required any further treatment for her headache, while in the placebo group 5 patients (23%) opted for an epidural blood patch and an additional 4 women (18%) required narcotic analgesics. No side effects related to the theophylline or placebo were noted in either group.

Discussion: Theophylline, administered orally in a single dose, appears to be an effective, safe means of treatment for a PDPH. The mechanism of action is not a placebo effect, and may be related to a vasoconstrictive effect on the cerebral vasculature. For some patients, this may represent a simple, noninvasive alternative to intravenous caffeine or an epidural blood patch, particularly in the outpatient setting.

References:
A CLINICAL AND LABORATORY STUDY TO COMPARE THE ADDITION OF 0.2 MG MORPHINE, 0.2 MG EPINEPHRINE OR COMBINATION TO HYPERBARIC BUPICAVACAIN FOR SPINAL ANESTHESIA IN CESAREAN SECTION

E. Abouleish M.D., N. Rawal, M.D. Ph.D., B. Toban-Randall, M.D., M. Rivera-Weiss, M.D., B. Meyer, M.D. N. Rashad, M.D., Ph.D.

Anesthesia Depts, Univ. of Texas at Houston, 6431 Fannin 5.020, Houston, Tx. 77030, Baylor College of Medicine at Houston, Orebro Hospital in Sweden

INTRODUCTION: The addition of 0.2 mg epinephrine to hyperbaric bupivacaine for cesarean section was found to improve the quality of subarachnoid block. Also, the addition of 0.2 mg preservative-free morphine to the same drug for the same surgical procedure was found to improve the operative analgesia and produce an extended postoperative pain relief. The questions we addressed in this study are:

1. Which one produces a better intraoperative analgesia: 0.2 mg epinephrine or 0.2 mg morphine?
2. What is the effect of the addition of both epinephrine and morphine on the subarachnoid block?
3. Does the addition of either morphine, epinephrine or both have any significant effect on bupivacaine serum level in the mother or fetus; does vasoconstriction play a role in improving the spinal block produced by bupivacaine?

MATERIAL: The study was approved by the Human Research Committees of the medical school and hospital, and a written informed consent was obtained from all patients.

This was a prospective randomized double-blind study in which neither the patient, the anesthesiologist performing the block and collecting the intraoperative data, the obstetrician, the neonatologist, the nurse collecting the postoperative data nor the pathologist measuring serum levels of bupivacaine were aware of the nature of the injectate. Originally, 90 patients were randomized into 3 groups of 30 each. However during the course of the study some of these were eliminated because of patient's change of mind or presence of a bloody tap during the attempted lumbar puncture. The final total was 71; 21 in the Morphine Group, 21 in the Epinephrine Group and 29 in the Combination Group. The intraoperative and postoperative analgesia, the side effects, the rate of speed and recovery from sensory and motor blockade and the neonatal condition were determined.

For the laboratory section of the study, we collected blood samples from the mothers at 10 minutes from the anesthetic I.T. injection, at the time of delivery, and at 1 hour after I.T. injection; also blood was collected from a segment of umbilical vein and artery at the time of delivery. A Control Group, for only the laboratory section of the study, was added where only I.T. bupivacaine was used. Although this Control Group was known to the anesthesiologist, the pathologist was still unaware of the nature of the injectate. Isocratic high-pressure liquid chromatography was used to determine serum bupivacaine, with a sensitivity level of 20 ng/ml.

RESULTS: Will be presented and discussed.
INTRODUCTION: Increased amplitude of upper facial electromyography (FEMG) has been used to detect periods of inadequate anesthesia during surgery. This technique has not been used for objective measurements of pain responses in conscious patients. The purpose of this study was to examine the consistency of FEMG in assessing severe parturient pain.

METHODS: Twelve patients were studied with informed consent and Institutional Review Board approval and were healthy ASA I or II patients who requested epidural analgesia for labor. FEMG was obtained with surface electrodes using an Anesthesia and Brain activity Monitor (ABM-100, DATEX, Helsinki, Finland). The ABM provided successive 10 second averages of FEMG amplitude in the 70-300 Hz bandwidth. The digitized values were stored in comma-delimited ASCII (LOTUS 1-2-3) files. All patients were in active labor. A Verbal Assessment pain Score (VAS, 0=no pain, 10=worst pain ever experienced) was obtained from each patient prior to epidural placement. Epidural dosing with 0.5% bupivacaine with 2.5 mcg/ml of sufentanil x 4 ml followed by 0.25% bupivacaine was done until a VAS score of 0 was noted. The FEMG values prior to epidural placement were compared to those when the VAS was 0.

RESULTS: Prior to onset of labor pain the FEMG amplitude was [3.5 (2.7-4.3) mcV] with a coefficient of variation of 26%. During peak contraction a uniform large increase in FEMG amplitude occurred [11.6 (9.2-14.1) mcV; CV 23%]. The mean FEMG increase was significant (paired two-tailed Student's t-test=10.4, P<.0001). Dramatic decreases in the elevated FEMG amplitude were useful in objectively assessing the efficacy of epidural analgesia.

DISCUSSION: Rapid decreases in FEMG amplitude objectively assessed the efficacy of epidural analgesia. Ongoing research is being conducted to determine if FEMG can increase the effectiveness of the management of parturient pain.

REFERENCES:
**INTRODUCTION:** Cerebrospinal fluid (CSF) has no buffering capability.\(^1\) At pH 7.4 precipitation of local anesthetics mixed with CSF does not occur with the exception of etidocaine.\(^2\) This study was designed to determine if varying CSF pH affected the incidence of precipitation when CSF was mixed in vitro with 1% etidocaine.

**METHODS:** Institutional Review Board approval and informed consent were obtained from 35 ASA I or II parturients who requested SAB for postpartum tubal ligation. Using a 25-gauge spinal needle, a subarachnoid block (SAB) was performed and a four quadrant aspirate (0.3 mL/quadrant) was done. Etidocaine 1% (0.25 mL) was immediately added to the CSF, and this mixture was placed in a vacuum test tube in the following ratio: 0.25 mL etidocaine/0.5 mL CSF. The pH of each remaining CSF sample was determined at 120 sec in order to standardize the time of pH measurement using an ABL 30 (Radiometer, Copenhagen) blood gas analyzer. For the basis of comparison, the samples of CSF were separated into 4 groups based on pH determinations. Group I, pH 7.20-7.40; Group II, pH 7.41-7.60; Group III, pH 7.61-7.80; Group IV, pH > 7.80. Following mixture, each test tube was inspected for the incidence of precipitation by an independent observer using 20X magnification. Statistical analysis was done using the \(X^2\) test and Yates correction for continuity. A \(P < 0.05\) was considered significant.

**RESULTS:** The CSF pH range was 7.27-7.79 (mean 7.32 \pm 0.36). The etidocaine pH was 4.56 \pm 0.11. The frequency of precipitation was as follows (N/%): Group I, 7/100; Group II, 16/100; Group III, 9/100; Group IV, 3/100.

**DISCUSSION:** The CSF pH in the range studied (7.27-7.79) did not affect the incidence of precipitation when mixed with 1% etidocaine. Local anesthetics can appear rapidly in the CSF following epidural injection.\(^3\) If in vivo precipitation of etidocaine occurs when mixed with CSF, further in vitro pharmacokinetic studies which can elucidate the mechanism by which epidurally administered etidocaine diffuses intraneurally and the actual mass of local anesthetic available to exert pharmacodynamic effects are indicated.

**REFERENCES:**
Regional Anesthesia in Women with Chorioamnionitis

Authors: Bader A, Gilbertson L*, Kirz L, Datta S

Affiliation: Department of Anesthesia, Brigham and Women's Hospital; Harvard Medical School, Boston, MA 02115

Introduction: A controversy exists regarding the use of regional anesthesia in patients with chorioamnionitis. Should the patient be bacteremic at the time the anesthetic is performed, the concern is that bacteria will seed the epidural or subarachnoid space. The present study attempts to evaluate the outcome of the parturient with chorioamnionitis based on the type of anesthetic administered. This study includes information on antibiotic administration, placental pathology and blood culture results to determine if any patients were indeed bacteremic at the time the anesthetic was administered.

Methods: Human Subjects Committee approval was obtained. Data was collected retrospectively by chart review of all obstetrical deliveries over a one year period. The diagnosis of chorioamnionitis was made by the obstetrician based on temperature, white blood cell count (WBC) and other symptoms. Placental pathology, blood culture results, antibiotic administration, and postpartum complications were also recorded.

Results: 319 women with the diagnosis of chorioamnionitis were identified out of a total of 10,047 deliveries during the time period studied (3.2%). 8 of these patients had blood culture results consistent with bacteremia. Delivery information is noted in Table I. None of the bacteremic patients had received antibiotics prior to administration of the anesthetic. No patients, including those identified as bacteremic, had infectious complications related to anesthetic technique. Mean temperature and WBC measured in patients who had received blood cultures were not significantly different between the groups (Table II).

Discussion: Although the total number of patients in this study is small, there is no evidence that regional anesthesia is detrimental to patients with chorioamnionitis. Parameters such as WBC and temperature elevation may not be predictive in identifying the subgroup of patients expected to be bacteremic.

<table>
<thead>
<tr>
<th>TABLE I</th>
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</thead>
<tbody>
<tr>
<td>CESAREAN DELIVERY (N=140)*</td>
</tr>
<tr>
<td>ANESTHETIC</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>BACTEREMIA</td>
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<tr>
<td>POSTOP COMP IN BACTEREMIC PATIENTS **symptoms of G- sepsis in one patient ***symptoms of staph sepsis in one patient</td>
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<tr>
<th>TABLE II</th>
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<tr>
<td>BACTEREMIC GROUP</td>
</tr>
<tr>
<td>POS BLD CX (N=8)</td>
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<tr>
<td>WBC</td>
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<td>TEMP</td>
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A COMPARISON OF TWO PREPARATIONS OF 0.5% BUPIVACAINE PLUS ADRENALINE WITH 2% LIGNOCAINE PLUS ADRENALINE FOR EPIDURAL CAESAREAN SECTION.

Authors: Brighouse Diana H*, Mettam Ian, Carrie Len S C.
Affiliation: Nuffield Department of Anaesthetics, John Radcliffe Hospital, Oxford OX3 9DU, UK

Introduction: It has been claimed that 0.5% bupivacaine + adrenaline provides epidural analgesia of superior quality for Caesarean section compared with 2% lignocaine + adrenaline. This contradicts the clinical impression of many anaesthetists. This study examines the hypothesis that freshly prepared 0.5% bupivacaine + adrenaline differs from a similar commercially prepared solution. Such a difference might be expected given the large pH difference between the commercial (pH 3.62) and freshly prepared (pH 5.23) solutions.

Methods: ASA status I or II patients requesting epidural analgesia for elective Caesarean section were randomly allocated to one of three groups. Group A received a commercially prepared solution of 0.5% bupivacaine + 1:200,000 adrenaline. Group B received a freshly prepared solution of 0.5% bupivacaine + 1:200,000 adrenaline. Group C received a freshly prepared solution of 2% lignocaine + 1:200,000 adrenaline.

All patients were given 20ml local anaesthetic in 10ml increments via a lumbar epidural catheter. Sensory block was assessed at five minute intervals using ethyl chloride spray. Further increments of local anaesthetic were given as required to achieve a bilateral sensory block from T4 to S5. Times to readiness for surgery, onset of surgery, delivery, and end of surgery were recorded. Maternal blood pressure, neonatal Apgar scores, total dose of local anaesthetic and need for supplementary analgesia were also recorded.

Results: 27 patients have been studied to date, (8 in group A, 9 in group B, 10 in group C: demographic data comparable between groups.) Time to onset of surgical analgesia did not differ significantly between groups (mean group A 26.6 mins, group B 24.0 mins, group C 26.0 mins.) Total doses of local anaesthetic used for each group were also similar. Quality of analgesia was superior in group C, and did not differ between groups A and B.

Conclusions: There was no difference in time of onset and total volume of local anaesthetic between the three solutions investigated. The difference in pH does not explain the discrepancy in clinical findings of various authors. Lignocaine with adrenaline appeared to provide substantially better analgesia than either preparation of bupivacaine with adrenaline.

References:
Title: ANALGESIA AFTER CAESAREAN SECTION: KETOROLAC AND PAPAVERETUM COMPARED

Author: Cartwright D P

Affiliation: Derby City Hospital, Uttoxeter Road, Derby, England.

Introduction: Caesarean section is a major procedure after which pain relief is required. Epidural narcotics have been used for this purpose, but the majority of patients still receive the traditional intramuscular injection of a narcotic. Narcotics can induce drowsiness, nausea and vomiting and can interfere with the mother's care of her infant. Ketorolac is a non-steroidal anti-inflammatory drug with potent non-narcotic analgesic properties and 30mg of ketorolac has been shown to be as effective as 12 mg morphine in treating post-operative pain, with a low incidence of adverse clinical effects.

Methods: This study is designed to compare the safety and efficacy of intramuscular ketorolac with papaveretum an opiate analgesic commonly used for the management of pain following caesarean section. Patients were randomly allocated to receive either ketorolac 30mg or papaveretum 20mg, in a double-blind fashion, by intramuscular injection for pain relief following caesarean section under regional anaesthesia. Analgesia was given postoperatively on demand and pain severity assessed by visual analogue scoring and subjective questioning at intervals following administration of the drug. Pain relief, vital signs and sedation were also assessed.

Results: Thirty five patients have been studied to date, in this ongoing trial. Nineteen patients received an epidural block, and 16 a spinal block. The median length of surgery was 40 minutes, and median blood loss was estimated at 400 ml in each group. Seventeen patients in each group were available for data analysis. Baseline median pain score was similar in both groups and after administration of first postoperative analgesia median pain scores fell in both groups, falling slightly faster in the papaveretum group, but at one hour the median pain score was lower in the ketorolac group. Fifteen patients withdrew from the study because of inadequate analgesia in the first three hours (7 papaveretum, 8 ketorolac), and in the first two hours more patients in the papaveretum group requested extra analgesia than in the ketorolac group. Further analgesia was required at an average of 4.75 hours in the ketorolac group, and at 4.1 hours after papaveretum.

Discussion: This ongoing study shows that the treatment of pain following caesarean section is still not entirely satisfactory. The traditional method using intramuscular opiates leads to a significant number having pain relief which is inadequate in degree and duration. Ketorolac may be a suitable alternative; its onset time is slightly shorter, and its duration longer. In addition, the incidence of nausea, vomiting and sedation was lower in the ketorolac group, and was particularly appreciated by those subjects who had received papaveretum in the past. This factor alone makes consideration of the use of NSAID's worthwhile in the treatment of post caesarean section pain.

Reference: Intramuscular Ketorolac tromethamine as compared to morphine sulphate in postoperative pain. O'Hara D A Anesthesiology 1986;65:A187
TITLE: MODERATE DOSE INTRATHecal MORPHINE FOR POST CESAREAN SECTION PAIN

AUTHORS: V.C. Cases-Cristobal, M.D., W. E. Ackerman, M.D., M.M. Juneja, M.D., and B.M. Rigor, M.D.

AFFILIATION: Division of Anesthesiology, Santo Tomas University Hospital, Manila, Philippines and the Department of Anesthesiology, University of Louisville, Louisville, Kentucky.

INTRODUCTION: Intrathecal morphine (0.25 mg) provides excellent analgesia in post cesarean section patients. However, this dose has been associated with inconsistent analgesia. The use of 0.8 mg intrathecal morphine was reported to be efficacious in the postoperative management of upper abdominal surgery pain. The purpose of this study was to assess the efficacy of 0.6 and 0.8 mg intrathecal morphine in post cesarean section patients.

METHODS: Institutional Review Board Approval and patient informed consent were obtained from 44 ASA I patients who requested spinal anesthesia (SAB) for cesarean section. Each patient was randomly assigned to one of two groups. SAB was performed at L2-3 or L3-4 interspace using 23 or 25 gauge spinal needles. Group I received preservative free 0.6 mg (0.8 ml) saline (0.8 ml). Group II received 0.8 mg (0.8 ml) preservative free morphine in a double blind fashion. Each patient subsequently received 10 mg of tetracaine. Intraoperative monitoring consisted of blood pressure, pulse and respiration. Postoperative hourly respiratory rate monitoring was done for 24 hours. A verbal assessment pain score (VAS) (0-10) was used. Duration of analgesia was defined from the time of morphine administration until the patient experienced any pain (VAS > 0). Statistical analysis consisted of the Student's t-test and X² test. A p < 0.05 was considered significant.

RESULTS: There were no demographic differences between groups. In Group I 16.7% had pain relief greater than 72 hours while in Group II 50% had pain relief greater than 72 hours. There were no significant differences in side effects. Pruritus: Group I, 46%; Group II, 50%. Nausea/emesis: Group I 4%, Group II 5%. No patient in either group reported a headache.

DISCUSSION: It is concluded that 0.8 mg of intrathecal morphine provided better analgesia in parturients after cesarean section with no significant difference in side effects when compared with 0.6 mg.

REFERENCES:
Authors: Shaul Cohen, M.D.*, N Singer, M.D. and D Amar, M.D.
Affiliation: Albert Einstein College of Medicine, Bronx, NY 10461

Introduction: It has been suggested that continuous spinal anesthesia is associated with a low incidence of post-dural puncture headache (PDPH) in non-obstetric patients[1]. Placement of spinal catheters for a short duration (<24hrs) in obstetric patients did not reduce the incidence of PDPH[2]. To determine whether continuous spinal block for more than 24 hrs is effective in preventing PDPH, we retrospectively reviewed our incidence of PDPH following consecutive accidental dural punctures in parturients who received either a continuous spinal block or a single injection.

Methods: 63 obstetric patients who had an accidental dural puncture following epidural block from January 1987 through July 1990 at Weiler Hospital of Albert Einstein College of Medicine were reviewed. Epidural block for labor or cesarean deliveries was attempted using 17 gauge Touhy needles and 19 gauge epidural catheters. Three groups were identified. Group I (n=24) patients had a dural puncture on the first attempt of epidural block, but a successful epidural block on a repeat attempt. Group II (n=26) patients had a dural puncture with immediate conversion to continuous spinal block lasting <24hr. Group III (n=13) patients had an immediate conversion to spinal block lasting >24hr. Parturients were followed for 2-5 days and by phone for a week. PDPH was treated as per conventional practice.

Results: There were no demographic differences among the groups. No parturient in Group III developed PDPH. The incidence of PDPH for Group I or II was higher than for Group III. There was no difference between Group I and II with regard to requests for blood patch.

Conclusions: Our results strongly suggest that continuous spinal block for more than 24hr following accidental dural puncture in parturients is an adequate method of PDPH prophylaxis.


Table 1. Duration of intrathecal catheter stay

<table>
<thead>
<tr>
<th></th>
<th>Total L/D C/S</th>
<th>Duration (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n) (n) (n)</td>
<td>Mean SD Range</td>
</tr>
<tr>
<td>Group I</td>
<td>24 9 15</td>
<td>0 0 0</td>
</tr>
<tr>
<td>Group II</td>
<td>26 9 19</td>
<td>0.3* 4.7 2-22</td>
</tr>
<tr>
<td>Group III</td>
<td>13 0 13</td>
<td>37 9.7 24-54</td>
</tr>
</tbody>
</table>

*p < .001 Group II vs III

Table 2. PDPH: incidence and treatment

<table>
<thead>
<tr>
<th></th>
<th>PDPH</th>
<th>Conserv Rx</th>
<th>Blood Patch</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n) (%)</td>
<td>(n) (I)</td>
<td>(n) (I)</td>
<td>(n) (I)</td>
</tr>
<tr>
<td>Group I</td>
<td>10 41.7</td>
<td>3 30</td>
<td>7 70</td>
</tr>
<tr>
<td>Group II</td>
<td>12 46.1</td>
<td>6 50</td>
<td>6 50</td>
</tr>
<tr>
<td>Group III</td>
<td>0* 0</td>
<td>0 0</td>
<td>0 0</td>
</tr>
</tbody>
</table>

*p < .01 Group III vs. Group I or II.
Title: EPIDURAL BLOCK - A COMPARISON BETWEEN GRAVITY CONTROLLED FLOW AND BOLUS INJECTION

Authors: Shaul Cohen, MD*, David Amar, MD
Affiliation: Albert Einstein College of Medicine, Bronx, NY 10461

Introduction: We reported the safety of gravity administration in a retrospective study [1]. This study was designed to determine whether administration of local anesthetic solution into the epidural space by gravity is associated with fewer adverse effects than the traditional bolus injection.

Methods: Following IRB approval, 600 healthy consenting parturients receiving an epidural block for vaginal or elective cesarean delivery were randomized into two groups: Group I (n=300) received the local anesthetic solution by gravity. Group II (n=300) received the study solution by traditional bolus injection. Following a standard loss of resistance method, a test dose of 3ml 2% chloroprocaine with epinephrine 20mcg was administered. For labor, two doses of 7ml bupivacaine 0.03% with sufentanil 1mcg/ml and with epinephrine 2mcg/ml were administered. For C/S two doses of 6ml lidocaine 2% with sufentanil 1mcg/ml and with epinephrine 2mcg/ml were administered. The above solutions were administered by gravity in Group I and by bolus in Group II. Patients were questioned regarding signs of intravascular or intrathecal injection. Baseline and maximal changes in heart rate and blood pressure, as well as, blood and CSF return from the Tuohy needle were recorded following each dose. Presence of sedation, nausea, vomiting, pruritus and shivering were noted.

Results: While four patients who received a bolus injection of the local anesthetic solution had signs of systemic toxicity, no patient in the gravity group had this adverse reaction. This only approached significance (p=0.062, Fisher's exact test). Group I had less sedation, nausea and less hemodynamic changes when compared with Group II.

Conclusions: When compared with the traditional bolus injection, gravity administration of local anesthetic solution during epidural block in obstetrics was associated with: no signs of systemic toxicity, a lower incidence of hypotension or tachycardia, as well as, less sedation and less nausea.


Table 1. Adverse Effects

<table>
<thead>
<tr>
<th>L/D (n=374)</th>
<th>C/S (n=214)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (n=189)</td>
<td>Group II (n=185)</td>
</tr>
<tr>
<td><strong>Systemic Tox.</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Hypotension</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Sedation</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Nausea</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Vomiting</strong></td>
<td>1</td>
</tr>
<tr>
<td><strong>Pruritus</strong></td>
<td>10</td>
</tr>
<tr>
<td><strong>Shivering</strong></td>
<td>16</td>
</tr>
</tbody>
</table>

Group I: Gravity administration; Group II: Bolus injection
* p<.01 Group I vs. II, Chi-square test.

Table 2. The duration of each local anesthetic administration and the change in heart rate from baseline after each dose.

<table>
<thead>
<tr>
<th>Duration (sec)</th>
<th>Change in HR (BPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I (n=298)</td>
<td>Group II (n=290)</td>
</tr>
<tr>
<td>Group I (n=298)</td>
<td>Group II (n=290)</td>
</tr>
<tr>
<td>Mean SD</td>
<td>Mean SD</td>
</tr>
<tr>
<td><strong>Test Dose</strong></td>
<td>29.1</td>
</tr>
<tr>
<td><strong>1st Dose</strong></td>
<td>34.1</td>
</tr>
<tr>
<td><strong>2nd Dose</strong></td>
<td>34.9</td>
</tr>
</tbody>
</table>

* p<.001 Group I vs. II, Chi-square test.
INTRODUCTION: 2-Chloroprocaine's (2-CP) rapid plasma enzymatic degradation makes it the safest local anesthetic for both mother and fetus; however, its short duration and abrupt termination of effect necessitate reinjection every 35 to 40 min. Tetracaine has been reported to prolong the action of both ester and amide local anesthetics. This study was performed to assess the duration of action, effectiveness and side effects of the addition of tetracaine to 2-CP with epinephrine for cesarean section (C/S).

METHODS: Institutionally-approved written informed consent was obtained from each patient. Forty healthy term patients scheduled for elective C/S were randomly assigned to receive epidural anesthesia with 3% 2-CP alone (C-Group; n=20) or with 0.13% tetracaine (CT-Group; n=20). Epinephrine 3.3 μg/ml was added to both solutions. Local anesthetic was injected in divided doses over 10-15 min to produce a T₆ level of sensory blockade. All patients received epidural morphine, 3.5 mg, at skin closure for postoperative pain relief. Discomfort was assessed five times during surgery with a visual analogue scale (VAS). Sensory block level was determined at 5 min intervals during surgery and at 15 min intervals during recovery. Surgical pain and T₆ block regression were treated as necessary with epidural local anesthetic (3% 2-CP [plain] after 30 ml of study solution) and IV fentanyl during surgery. Duration of action was considered to be the time from test dose to pain medication or T₆ block regression. Neonatal status was assessed with Apgar scores and umbilical blood gas tensions. The Chi square, Fisher's exact, and Student t-test were used for statistical analysis as was the 2-factor ANOVA with repeat measures on one factor and Bonferroni corrected paired and unpaired t-tests. P < 0.05 was considered significant.

RESULTS: The groups were comparable in age, height, weight, parity, initial epidural dosage, block level, time from test dose to T₆ level and duration of surgery. Epidural anesthetic duration of action was 26 mins longer in the CT-Group (119±33) compared to the C-Group (93±26; p=0.009). VAS scores and need for supplemental medication during surgery and in the recovery room did not differ significantly between groups. Side effects were comparable and neonatal status was good in both groups.

DISCUSSION: The addition of 0.13% tetracaine to 2-CP with epinephrine 1:200,000 increased the duration of analgesia by approximately 25 min as determined by need for pain medication or regression of sensory block to T₆. However, almost 50% of patients who had surgical pain required repeat local anesthetic administration with a T₆ or higher block level suggesting that a 2 dermatone regression is not a reliable indicator of duration of effective surgical anesthesia. Less than 50% of patients in the C-Group required repeat epidural drug despite the long time from test dose to skin closure (92±20 min). Nine patients in the C-Group and 5 patients in the CT-Group required additional epidural drug administration because of surgical pain supporting the clinical practice of epidural reinjection of 2-CP at a fixed interval.
Title: PAIN MANAGEMENT AFTER CESAREAN SECTION: SUFENTANIL EPIDURAL PCA VS. MORPHINE INTRAVENOUS PCA

Authors: Grass JA*, Harris AP, Sakima NT, Zuckerman RL

Affiliation: Department of Anesthesiology and Critical Care Medicine, The Johns Hopkins Medical Institutions, Baltimore, MD 21205

Introduction. Epidural PCA (EPI-PCA) may combine the superior quality of analgesia that has been shown with epidural morphine with the greater patient satisfaction of IV-PCA. This prospective randomized study was designed to compare analgesia, side effects, and satisfaction of sufentanil EPI-PCA with morphine IV-PCA.

Methods. After IRB approval, 50 healthy term parturients (25 per group) without history of substance abuse were randomized to receive either EPI-PCA or IV-PCA as outlined below upon complaint of pain in the recovery room. Surgical anesthesia was 2% lidocaine via epidural catheter inserted at L2-3 or L3-4 in both groups. Patients rated pain and sedation on a 10 cm visual analog scale (VAS) at baseline, and 30 min, 2 hrs, and 6 hrs thereafter on the day of C/S, and at 9:00 A.M. and 5:00 P.M. on postoperative day (POD) 1 and 2. Global VAS pain with movement scores were obtained at 5:00 P.M. on POD 1 and 2. A satisfaction questionnaire was administered at 5:00 P.M. on POD 2. Side effects were recorded each day. Statistical analysis was by analysis of variance, chi-square, and unpaired t-test where appropriate. P < 0.05 was considered significant.

Results. Pain scores at 30 min and 2 hrs and pain with movement on POD 2 were all lower in the EPI-PCA group. Sedation was less in the EPI-PCA group at 2 hrs and on POD 2. The incidence of pruritus requiring treatment was greater in the EPI-PCA group on the day of C/S, whereas vomiting was more frequent in the IV-PCA group. Both groups rated satisfaction with their pain therapy equally very high.

Discussion. Both sufentanil EPI-PCA and morphine IV-PCA provided very satisfactory analgesia after C/S. Superior analgesia in the recovery room period with less sedation with EPI-PCA may have implications with respect to early maternal-neonatal bonding. Better pain relief with movement may have an impact on speed of recovery, morbidity, and associated costs.

Title: PATIENT-CONTROLLED EPIDURAL ANALGESIA RESULTS IN SHORTER HOSPITAL STAY AFTER CESAREAN SECTION

Authors: Grass JA*, Zuckerman RL, Tsao H, Sakima NT, Harris AP

Affiliation: Department of Anesthesiology and Critical Care Medicine, The Johns Hopkins Medical Institutions, Baltimore, MD 21205

Purpose. Bellamy¹ and Lamer² documented a reduction in length of hospital stay (LOS) in patients treated with epidural narcotics after knee surgery and radical retropubic prostatectomy. The purpose of this study was to compare LOS in patients who underwent C/S under epidural anesthesia and received patient-controlled epidural analgesia (PCEA) with patients who had C/S under epidural anesthesia and received IM narcotics prior to the initiation of the pain service at our institution.

Methods. Hospitalization data was reviewed on all patients undergoing C/S under epidural anesthesia during a 3 month period and compared to the hospitalization data on all patients undergoing C/S under epidural anesthesia with subsequent PCEA during the following 5 month period. PCEA was available 24 hours/day with the only limitation occurring when demand exceeded the number of PCA pumps available.

Patients who received PCEA were given our standard sufentanil regimen outlined here. The loading dose was administered in 10 ml NS at umbilical cord clamp with subsequent concentration 2 mcg/ml. PCEA was continued until the third postoperative day unless the patient was ready for earlier discharge. LOS was defined as the number of hospital days beginning on the day of C/S until the day of discharge, which was excluded in accordance with hospital billing practice. Unpaired t-test and Chi-square were used for statistical analysis. Values are expressed as mean ± S.D.

Results. 121 women underwent C/S under epidural anesthesia with subsequent IM analgesia during the 3 month period prior to initiation of the pain service. 222 women had C/S under epidural anesthesia after initiation of the pain service. Of these 222 patients, 176 (79%) received sufentanil PCEA for an average duration of 3.1 days postoperatively. The average LOS for 121 patients in the IM group was 5.00 ± 2.57 days vs 4.26 ± 1.23 days for the 176 patients in the sufentanil PCEA group (p<0.01). 41% of the IM group patients were hospitalized 5 or more days compared to 29% for the PCEA group (p<0.05). 23% of the PCEA group patients were hospitalized ≤3 days compared to only 11% of the IM group (P <0.05).

Discussion. We found a significant reduction in LOS after C/S in patients receiving sufentanil PCEA. Stenkamp et al found no difference in LOS after C/S in a similar retrospective review of patients managed with single bolus epidural morphine compared to IM analgesia.³ The longer duration of administration of PCEA in the postoperative period may account for the significant impact on LOS. Although this review was retrospective, it indicates that better pain management may have an impact not only on the comfort and satisfaction of the patient but also her speed of recovery and duration of hospitalization and associated costs.

INTRODUCTION The clinical impression exists among physicians and nurses who attend women in labor that administration of sodium citrate is often followed by nausea and vomiting. Information on the incidence of vomiting has not been located, nor has the issue of residual gastric contents after vomiting been addressed. It may be that clinically significant amounts of low pH stomach contents remain in these women. In such patients H2 blockers might be helpful as a gastric volume of 0.4 ml kg\(^{-1}\) with a pH of less than 2.5 has been associated with pulmonary aspiration syndrome. We are investigating the incidence of vomiting following sodium citrate administration and the residual volume and acidity of gastric contents.

METHODS Approval for this study was obtained from the MUSC Institutional Review Board. Thus far we have surveyed 60 patients on the Labor and Delivery Ward. Thirty six (36) patients with expected vaginal delivery and twenty four (24) patients presenting for emergency Cesarean section were observed for age, parity, medical & obstetrical problems, ingestion of water or ice, and episodes of vomiting. Patients for an emergent section received 30 cc sodium citrate (Bicitra) within 30 min. of surgery. The volume and pH of gastric contents in patients who had general anesthesia was obtained following orogastric suctioning. The pH was measured with a Corning Model 1200 pH meter.

RESULTS

<table>
<thead>
<tr>
<th>TABLE I. Incidence of vomiting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
</tr>
<tr>
<td>age of patients</td>
</tr>
<tr>
<td>gravidity</td>
</tr>
<tr>
<td>parity</td>
</tr>
<tr>
<td>all patients</td>
</tr>
<tr>
<td>PO sodium citrate</td>
</tr>
<tr>
<td>PO water/ice</td>
</tr>
<tr>
<td>pitocin use</td>
</tr>
<tr>
<td>nalbuphine analgesia</td>
</tr>
</tbody>
</table>

DISCUSSION Analysis of data accumulated to date reveals the odds ratio favoring vomiting is greatest in those patients who receive po sodium citrate for antacid prophylaxis. Gastric volumes are consistently more alkaline than 2.5 and average 0.5 ml kg\(^{-1}\), however, we continue to accumulate information on residual gastric volume and the direct effects of sodium citrate on vomiting.
Title: GENERAL VERSUS REGIONAL ANESTHESIA FOR PLACENTA PREVIA: MATERNAL AND NEONATAL EFFECT

Authors: L Houpt, MS, TK Abboud, MD, J Zhu, M.D.

Affiliation: Department of Anesthesiology, Los Angeles County-University of Southern California Medical Center, Los Angeles, California 9003

Introduction: Patients with placenta previa undergo cesarean sections. However, little is written about the comparative effects of general versus regional anesthesia on the maternal hemodynamic parameters and the neonatal outcome. The present study is undertaken to compare the effects of general, spinal or epidural anesthesia for cesarean section in patients with placenta previa on the mother and the neonate.

Methods: The study was approved by the Institutional Review Board. Patients records with placenta previa between 1989 and 1991 were retrospectively reviewed. All charts were reviewed for the anesthetic management including the anesthetic technique, estimated blood loss and fluid replacement, perioperative vital signs and neonatal outcome. Data were analyzed for statistical significance using analyses of variance or chi-square when appropriate. A P value of < 0.05 was considered statistically significant.

Results: Data are presented in the table. Patients undergoing general anesthesia had higher incidence of blood loss, hysterectomy and more prolonged hypotension compared to the spinal or the epidural anesthesia group. Neonatal outcome as determined by Apgar scores at 1 and 5 min was significantly better for the regional anesthesia groups compared to the general anesthesia group.

Discussion: Data from the present study indicate that regional anesthesia for cesarean section in patients with placenta previa is safe and is associated with less blood loss and better neonatal outcome.

<table>
<thead>
<tr>
<th></th>
<th>General n=60</th>
<th>Epidural n=30</th>
<th>Spinal n=30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary C/S</td>
<td>39/60 (65%)</td>
<td>21/30 (70%)</td>
<td>19/30 (63%)</td>
</tr>
<tr>
<td>hysterectomy</td>
<td>15/60 (25%)</td>
<td>2/30 (7%)</td>
<td>1/30 (3%)</td>
</tr>
<tr>
<td>Blood loss (ml)</td>
<td>1681±148*</td>
<td>1041±129</td>
<td>988±109</td>
</tr>
<tr>
<td>Hypotension (%)</td>
<td>43</td>
<td>47</td>
<td>57</td>
</tr>
<tr>
<td>Duration of Hypotension (min)</td>
<td>22±2*</td>
<td>10±1</td>
<td>14±2</td>
</tr>
<tr>
<td>Apgar Scores &lt; 6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 min</td>
<td>53*</td>
<td>15</td>
<td>14</td>
</tr>
<tr>
<td>5 min</td>
<td>17*</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Values are Mean ±SEM
* P < 0.05 Compared to the Other Two Groups
RESISTANCE TO EPIDURAL INFUSION CANNOT BE MEASURED THROUGH A STANDARD EPIDURAL CATHETER

Authors: Niall Hughes MB, FFARCSI, Mark D. Johnson MD, Sanjay Datta MD, and James Philip ME(E), MD

AFFILIATION: Brigham and Women's Hospital, Department of Anesthesia, Boston MA 02115

Introduction: Continuous Epidural Infusion (CEI) is performed through a long narrow-bore catheter. During drug infusion, the epidural catheter behaves as a large series hydraulic resistor [1]. Because attempts to measure epidural space resistance and pressure may be hampered by the effect of high catheter resistance, we determined measurement limitations imposed by the epidural catheter.

Methods: Institutional approval and informed consent was obtained. Seven full-term ASA 1 patients receiving lumbar epidural anaesthesia for labor had CEI (10 mL/hr) using an IVAC-560 pressure monitoring volumetric infusion pump. Infusion pressures (P) at zero flow (P0) and 2 flow rates, F = 10 mL/hr (P10), and F = 1 mL/hr (P1) were measured hourly during CEI for labor. When P10, P1, and P0, were available we calculated resistance, Rtot as the slope of the least-squares regression line and the correlation coefficient r. When only 2 values for pressure were available, we calculated Rtot = ΔP/ΔF = P10-P0/10 (1 patient). Pressure was measured with the patient in the right lateral position with zero reference at the level of the lumbar spine. Resistance units (RU) were mmHg/L/hr. Pressures were measured between contractions throughout CEI during a 2 to 9 hour period. Without a patient connected, catheter resistance (Kendall 5117 19G x 36") was measured in 5 catheters, 4 with 10 measurements and one with 3 measurements at flows of 0 and 10 mL/hr. Finally, epidural resistance was computed as Repi = Rtot - Rcath and the null hypothesis Repi >= 0 was tested.

Results: (1) P0 averaged 14 mmHg and did not change over time. P10 averaged 23 mmHg and did not change over time. (2) Total resistance (Rtot) averaged 960 ± 180 RU (3) Epidural catheter resistance (Rcath) was 983 ± 119 (SD) RU (4) Computed epidural resistance (Repi) averaged -23 RU and was not significantly greater than zero.

Discussion: Epidural space inflow resistance has been measured through a 17G needle at a flow of 275-500 mL/hr in normal, non-pregnant patients and found to be 43 ± 6 RU [2]. Here, the high resistance of the epidural catheter (Rcath= 1000 RU) obscured the resistance of the epidural space. In addition, the low flow employed would only have produced a pressure rise of \( P = R F = (43) (.010) = 0.43 \) mmHg even if catheter resistance were absent. Thus, Rcath accounted for essentially all of the 10 mmHg rise in P10 above P0.

Conclusion: If epidural resistance is to be monitored, (1) measurements must be made at high flow and thus intermittently, and (2) epidural catheters of lower resistance must be used.

References:
1. Rocco AG, Scott DA, Boas RA, Philip JH. The epidural space behaves as a Starling resistor and inflow resistance is higher in spinal stenosis than in disc disease. Anesthesiology 73: 816 (Abstract).
Title: EPIDURAL CLONIDINE FOLLOWING CESAREAN SECTION: EFFECT OF PRIOR LOCAL ANESTHETIC

Authors: M Huntoon*, JC Eisenach, P Boese

Affiliation: Section of Obstetric Anesthesia, Wake Forest University Medical Center, Winston-Salem, North Carolina 27103

Introduction. Epidural clonidine produces analgesia following cesarean section which is brief following a bolus, and can be prolonged with addition of a continuous infusion. Preliminary studies of various dosing regimens have produced conflicting data, and the most appropriate dosing schedule has not been defined. Also, whether 2-chloroprocaine (2CP), which has recently been shown to antagonize epidural opioid analgesia, affects epidural clonidine analgesia is unknown. The purposes of this study were to further define clonidine bolus and infusion regimens for analgesia following cesarean section and to examine the influence of 2CP on clonidine analgesia.

Methods. Following written informed consent and IRB approval, 54 women scheduled for repeat elective cesarean section were studied. Patients were randomly assigned to receive 3% 2CP or 0.5% bupivacaine for anesthesia, and within each group were assigned to receive saline or clonidine (400 µg or 800 µg) upon request for analgesia in the recovery room, followed respectively by 24 hr infusion of saline, or clonidine (40 µg/hr). Supplemental analgesia was provided with iv PCA morphine, and pain, sedation, nausea, pruritus, respiratory rate, blood pressure, and heart rate were monitored for 24 hrs.

Results. Compared to their respective saline groups, both low and high dose clonidine regimens produced analgesia throughout the 24 hr period, whereas 2CP inhibited clonidine analgesia for 8 hrs in the high dose and 24 hrs in the low dose clonidine groups (P<0.05). Clonidine produced sedation, and mild hypotension (average maximum decrease in blood pressure = 15 mm Hg). One patient received atropine for asymptomatic bradycardia and 2 received iv fluids for asymptomatic hypotension in the clonidine groups, whereas one required observation for respiratory depression in the saline group.

Discussion. The apparent antagonism of clonidine analgesia by 2CP suggests that this effect may have a similar mode of action as that occurring at the opiate receptor. This antagonism can apparently be overcome by increasing clonidine dose, but these data suggest prolonged analgesia can be obtained with less drug using the low dose clonidine bolus-infusion regimen described following bupivacaine epidural anesthesia.

Supported in part by a grant from Fujisawa Pharmaceutical Co.
Title: Incidence of Post Dural Puncture Headache in the Obstetric Patient: 25 Gauge Whitacre vs 26 Gauge Quincke Tip Needles - A Preliminary Report

Authors: Hurley RJ, Hertwig LM, Johnson MD, Datta S

Affiliation: Department of Anesthesia, Brigham and Women's Hospital, 75 Francis Street, Boston, MA 02115

Introduction: Post dural puncture headache (PDPH) was first described by Bier in 1899 and it continues to be a problem after subarachnoid anesthesia to this day. The obstetric patient is known to be at high risk for PDPH. Recently, a 25 gauge, Whitacre tip, disposable spinal needle became available for clinical use. This study, approved by the hospital's IRB, reports the incidence of PDPH following subarachnoid anesthesia in patients using 25 gauge Whitacre or 26 gauge Quincke point spinal needles.

Methods: 2398 patients received subarachnoid anesthesia for cesarean or vaginal delivery from October 1, 1988 to January 31, 1991. 26 g Quincke point spinal needles were used exclusively from October 1, 1988 to September 17, 1989. At this time, sterile 27 g Quincke point needles were taped to stock 27g spinal kits and the staff and residents were encouraged to use them. In September, 1990, the 26 g needles were included in the kit and 25 g Whitacre point needles were attached as previously described. Most blocks were performed by residents in training under the direct supervision of the attending anesthesiologist. Quincke point needles were inserted with the bevel parallel to the longitudinal axis of the body. No attempt was made to orient the orifice of the Whitacre needle in any particular direction. Post operative visits were made by a nurse employed for this purpose. Data were examined by chi square analysis (with Yate's correction) to evaluate statistical significance. A P value of < 0.05% was considered significant.

Results: Data from the study in progress are presented in the chart below. (The 27 g data is presented separately.)

<table>
<thead>
<tr>
<th>Group</th>
<th>PDPH</th>
<th>No PDPH</th>
<th>Total</th>
<th>%PDPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - 26 g Q (10/1/88-1/31/91)</td>
<td>58</td>
<td>1131</td>
<td>1189</td>
<td>4.9</td>
</tr>
<tr>
<td>B - 25 g W (9/18/90-1/31/91)</td>
<td>5*</td>
<td>391</td>
<td>396</td>
<td>1.3</td>
</tr>
</tbody>
</table>

* denotes a statistically significant reduction in PDPH when compared to group A (P<0.05)

Discussion: The idea that a conical or pencil point needle might prove less traumatic to the dura and produce less cerebrospinal fluid leakage and, therefore, lower PDPH was first proposed by Greene in 1923. Hart and Whitacre reported on the use of a 20 g pencil point needle in 1951. Recently, a 25 g disposable Whitacre point spinal needle was introduced. It is our intention to continue this evaluation of the Whitacre needle for a full year. However, the results to date indicate that PDPH can be significantly reduced by the use of these needles for the obstetric patient.

References:
2. Greene HM. A technique to reduce the incidence of headache following lumbar puncture. Northwest Med 22:240, 1923
Incidence of Post Dural Puncture Headache in the Obstetric Patient: 26 vs 27 Gauge Quincke Tip Needles

Authors: Hurley RJ, Hertwig LM, Osthheimer GW, Datta S

Affiliation: Department of Anesthesia, Brigham and Women's Hospital, 75 Francis Street, Boston, MA 02115

Introduction: Post dural puncture headache (PDPH) is a common complication of subarachnoid anesthesia and the obstetric patient is known to be at high risk for its occurrence. Many studies have shown decreasing PDPH rates with smaller needles gauges.1,2 Recently, a 27 gauge Quincke tip, disposable spinal needle was introduced. This study, approved by the hospital's IRB, reports the incidence of PDPH following dural puncture of obstetric patients with 26 and 27 gauge spinal needles.

Methods: 1955 patients received subarachnoid anesthesia for cesarean or vaginal delivery from October 1, 1988 to September 17, 1990. 26 gauge Quincke point spinal needles were used exclusively from October 1, 1988 to September 17, 1989. At this time, sterile 27 gauge Quincke point needles were taped to the stock 26 gauge spinal kits and the staff and residents were encouraged to try them. Most blocks were performed by residents in training under the direct supervision of the attending anesthesiologist. Inserting the bevel parallel to the longitudinal dural fibers is our standard of practice. Postoperative visits were made by a nurse employed by the obstetric anesthesia service exclusively for this purpose. Data were examined by Chi square analysis (with Yate's correction) to evaluate statistical significance. A P value of < 0.05 was considered significant.

Results: Data from this study are presented in the chart below.

<table>
<thead>
<tr>
<th>Group</th>
<th>PDPH</th>
<th>No PDPH</th>
<th>Total</th>
<th>%PDPH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A - 26 g (10/1/88-9/17/89)</td>
<td>48</td>
<td>976</td>
<td>1024</td>
<td>4.9</td>
</tr>
<tr>
<td>B - 26 g (9/18/89-9/17/90)</td>
<td>9</td>
<td>143</td>
<td>152</td>
<td>6.3</td>
</tr>
<tr>
<td>B - 27 g (9/18/89-9/17/90)</td>
<td>21*</td>
<td>758</td>
<td>779</td>
<td>2.8</td>
</tr>
</tbody>
</table>

* denotes a statistically significant reduction in PDPH when compared to group A. (P<0.05)

Discussion: Many factors may be involved in the development of PDPH but certainly needle diameter has been shown to be relevant. However, needle gauges are misleading. 26 and 27 g needles may look similar, but the 27 g (outside diameter (OD) = 0.016 inches) actually represents a 21% reduction in cross sectional area from the 26 g (OD = 0.018 inches). The use of 27 gauge disposable spinal needles significantly reduced the incidence of PDPH in this obstetric population.

References:
1. Vandam LD, Dripps RD. Long term follow-up of patients who received 10,098 spinal anesthetics JAMA 161:586, 1956
TITLE: THE USEFULNESS OF CONTINUOUS SPINAL ANESTHESIA FOR CESAREAN DELIVERY IN PREECLAMPTIC PATIENTS.

AUTHORS: Shreeniwas Jawalekar, M.D.*
William White, B.A., CRNA

AFFILIATION: Anesthesiology, C.A.M.C., W.C. Division, 800 Pennsylvania Avenue, Charleston, WV 25302

Introduction. Continuous spinal anesthesia (CSA) has certain advantages which make it a useful technique in high risk patients.1 CSA has been used successfully for cesarean delivery.2 Our experience with 10 cases of CSA for cesarean delivery in preeclamptic patients is reported.

Methods: After Institutional Review Board approval and informed consent, 10 patients who underwent cesarean delivery with CSA were studied. Lumbar puncture was performed at L2-3 or L3-4 with patients in sitting position using a 22-gauge needle inserted with bevel parallel to dural fibers. A 28-gauge catheter was placed in the subarachnoid space and advanced cephalad for 3 cm. The patients were positioned for delivery with left uterine displacement. Surgical anesthesia was achieved with incremental doses of intrathecal lidocaine and fentanyl. Preservative-free morphine was given intrathecally for postoperative pain control. The following observations were recorded: fluid preload, time from injection of local anesthetic to incision, dose of lidocaine, blood pressure changes, incidence of postdural puncture headache (PDPH), and Apgar scores.

Results: In all cases the spinal block was successful. The mean (150± SD) preanesthetic fluid load was 275± mL of Ringer’s lactate. There was no incidence of high spinal or abrupt fall in blood pressure. The mean time from injection of local anesthetic to incision was 9.6 (±3.4) minutes. The mean dose of lidocaine required before delivery was 24 (±11.0) mg and that of fentanyl was 13.5 (±5.8) mcg. None of the patients complained of PDPH. Mean Apgar scores at 1 and 5 minutes were 7.7 (±1.3) and 8.8 (±0.8).

Conclusions: CSA provided safe and effective surgical anesthesia for the patients in this study. A combination of local anesthetic and narcotic was used for subarachnoid block. The requirements for lidocaine were surprisingly low. Mini-dose morphine provided excellent postoperative analgesia. PDPH did not occur.

Title: Comparison of lidocaine/fentanyl/morphine to lidocaine/morphine for post-op analgesia after cesarean section.

Authors: Johnson C', Booton D, Hunter J, Hsick E, Beever S and Kocher J.

Affiliation: Departments of Anesthesia, Carle Clinic, University of Illinois College of Medicine, Urbana and Hutzel Hospital, Wayne State University, Detroit, Michigan, USA.

Introduction: Lidocaine 5% in D75%W is frequently used for spinal anesthesia for cesarean section. Since lidocaine is a short acting local anesthetic, and intrathecal morphine peak analgesia can take as long as 60 minutes, could there be a brief period where the patient would have inadequate post-operative analgesia? The purpose of this study was to look at whether there was in fact a "window" of pain with the lidocaine/morphine mixture; and if so, did the addition of fentanyl to the lidocaine/morphine mixture abolish this "window".

Methods: After approval by the IRB, the charts of 27 ASA II term parturients were reviewed. All patients had cesarean section. All patients received lidocaine 5% D75W appropriate for patient height. Group 1 (n = 15) received in addition to lidocaine, fentanyl, 12.5 µg to 30 µg plus morphine, 0.20 mg to 0.5 mg. Group 2 (n = 12) received only morphine 0.20 mg to 0.5 mg and lidocaine. All patients were pre-hydrated. A 25G or 26G spinal needle was used at either the L2-3 or L3-4 interspace. All patients were placed in LUD, given oxygen, and monitored appropriately. Ephedrine 5 mg IV prn was given for maternal hypotension. Duration of post-operative analgesia was measured from the time the patient entered the Post-Anesthetic Care Unit (PACU), to the time the patient first complained of pain. Results of duration of analgesia and side-effects were obtained via chart review. The study period ended the moment the patient complained of pain post-operatively. Respiratory function was monitored post-operatively with pulse oximetry, and frequent nursing assessment for the first 24 hours. Respiratory depression was defined as a respiratory rate < 10/min. or O₂ saturation < 95%. Testing for statistical significance was done using the Wilcoxon Rank Sum method.

Results: None of the patients in Groups 1 or 2 developed respiratory depression. One patient in Group 1 complained of pain in the PACU and received morphine 1 mg IV and was pain free for the next 18 hours, and no patients in Group 2 had pain in the PACU. There was no statistical difference between the two groups in lidocaine or morphine dose, or duration of analgesia (Table 1).

Discussion: The purpose of this study was to determine if there was inadequate analgesia in the immediate post-operative period when morphine was used alone with lidocaine, and if, indeed, a "window" of inadequate analgesia did exist, could it be prevented with the addition of fentanyl to the morphine/lidocaine mixture. The results demonstrated that a "window" of inadequate analgesia secondary to delayed morphine onset does not exist.

Table 1: Lido-Fent-MS Comparison

<table>
<thead>
<tr>
<th>Lido (mg)</th>
<th>Fent (mcg)</th>
<th>MS (mg)</th>
<th>Pain In PACU</th>
<th>Analgesia (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>70.3 ± 5.5</td>
<td>19.0 ± 7.4</td>
<td>0.3 ± 0.09</td>
<td>1</td>
</tr>
<tr>
<td>Group 2</td>
<td>67.9 ± 5.4</td>
<td>0.29 ± 0.06</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

References


Title: THE INCIDENCE OF POSTDURAL PUNCTURE HEADACHE IN OBSTETRICAL PATIENTS COMPARING THE 24-GAUGE AND 22-GAUGE SPROTTE NEEDLES

Authors: Loeman Hi, MD, Sears DH, MD, O'Donnell LA, MD, Reisner LS, MD, Jassy LJ, MD, Harmon TW, MD, O'Donnell KE, MD, Kelleher JP, MD, Santos GC

Affiliation: Scripps Memorial Hospital, Chula Vista, CA. 92012
Mercy Hospital & Medical Center, San Diego, CA. 92103
Sharp Memorial Hospital, San Diego, CA. 92123
DOSD Medical Center, San Diego, CA. 92103

Introduction: A common complication of spinal anesthesia in the obstetrical patient is a postdural puncture headache (PDPh). The shape and gauge of the spinal needle have both been shown to influence the incidence of PDPh. The Sprotte needle is a recently introduced spinal needle with a blunt ogival tip. Cesarini et al. reported a 0% incidence of PDPh using the 24g Sprotte needle in cesarean section patients, compared to a 14.5% incidence using the 25g Quinke needle. Sears et al. reported a 0% incidence of PDPh in a series of 130 cesarean section patients using the 24g Sprotte needle. The 22g Sprotte needle has the same shape tip as the 24g but a larger diameter, which many anesthesiologists find easier to use. Thus far it has not been determined if use of this larger diameter Sprotte needle results in an increased incidence of PDPh. This prospective study, currently in progress, is designed to compare the incidence of PDPh between the 24g and 22g Sprotte needles.

Methods: With institutional human subjects review committee approval and informed consent, 112 ASA I and II cesarean section and postpartum tubal ligation patients were randomly assigned to one of two groups and received spinal anesthesia via midline dural puncture with either the 24g or 22g Sprotte needles. Patients were followed throughout their hospital course and were contacted by telephone one week or more after discharge by an investigator who did not know the type of needle used. If no complaints were reported, patients were specifically questioned about the occurrence of postural headache. Statistical analysis was performed using a Chi-square test.

Results:

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>24g Sprotte</td>
<td>22g Sprotte</td>
</tr>
<tr>
<td>Number</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PDPh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number Requiring Blood Patch</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

There was no statistically significant difference in PDPh incidence between the two groups. Headaches developed within 48 hours and lasted less than 72 hours. The headaches were characterized as mild and did not limit the patients' daily activities. Treatment consisted only of oral analgesics.

Discussion: Our preliminary data indicate that the 22g Sprotte needle, like the 24g Sprotte, results in a low incidence of PDPh in obstetrical patients. If further study shows no significant difference between the two needles, those results would suggest that the larger 22g Sprotte needle may be used without risking an increased incidence in PDPh.

References:

Title: Vertebral Osteomyelitis After Spinal Anesthesia and Subsequent Epidural Blood Patch  

Authors: C H Leicht, MD, MPH and S H Sykes, MD  
Institution: Departments of Anesthesiology, Mayo Clinic, Rochester, MN and Naval Hospital, San Diego, CA

Introduction: Complications of regional anesthesia associated with obstetric anesthesia are indeed rare. However, we report a case of vertebral osteomyelitis associated with multiple attempts at spinal anesthesia for cesarean section and subsequent epidural blood patch for post-lumbar puncture headache. In our review of the literature, no similar case of vertebral osteomyelitis has been reported.

Case Report: A 29 yo G2P1 female at 37 wk gestation age underwent spinal anesthesia for an emergent cesarean section at an affiliated hospital in the Philippines. Utilizing aseptic technique, 70 mg xylocaine was administered spinally after multiple attempts to obtain CSF in both lateral and sitting positions. The cesarean section proceeded without further incident. Postoperatively, the patient developed a severe postural headache poorly responsive to fluids and analgesics. On the third postoperative day the patient received an epidural blood patch which alleviated her symptoms. Gradually over the next month the patient developed severe back pain eventually preventing ambulation and weight bearing which required hospitalization. On admission she was afibrile, had normal vital signs, a WBC count of 12,300, a sed rate of 54, a normal neurologic exam but severe tenderness in her lumbar region. Radiographs and CT scan of her lumbar spine were normal but a radionucleotide study showed increased uptake in the body of L2 vertebrae. A diagnosis of osteomyelitis was entertained and the patient was transferred to our facility for further workup and treatment. At our facility, further blood and urine cultures were obtained and were negative. A MRI scan demonstrated cortical disruption on the posterior aspect of the inferior end plate of the L2 vertebral body. The body itself was abnormal, suggesting a diffuse infiltrative process replacing the normal marrow. Both findings felt to be consistent with osteomyelitis. No paravertebral or epidural masses or abscesses were identified. Aerobic, anaerobic, fungal and AFB cultures obtained by CT directed biopsy were negative. However, based on the unequivocal MRI scan, increased WBC count, history and physical findings, the patient was started on a 30 day course of IV antibiotics, which resulted in resolution of symptoms and normalization of WBC counts and sedimentation rates. Copies of relevant radiologic studies will be presented.

Discussion: In our case report, two commonly used anesthetic techniques may individually or together have been responsible for vertebral osteomyelitis. With modern techniques, spinal anesthesia has a well documented history of safety and rarely is the cause of serious sequelae. Vandam and Dripps in over 10,000 spinal anesthetics, Noble and Murray in over 78,000 spinal anesthetics and Moore in over 11,000 spinal anesthetics, reported no case of osteomyelitis as a complication of spinal anesthesia. Sadove in 1961 reported 3 cases of meningitis (presumably 2nd to reusable needles) as the only complications in 20,000 spinal anesthetics. Epidural blood patch is a recognized treatment for severe and persistent headache following lumbar puncture. Abouleish reported no infection in 118 epidural blood patches for postlumbar puncture headaches. Residual complications are few and permanent complications rare; however, vertebral osteomyelitis should probably be included in the list of rare but potential complications of lumbar regional anesthesia.

References:
**Title:** Sodium Thiopental(STP) for EEG Burst Suppression as an Adjunct to Anesthesia for Aortic Valve Replacement During Pregnancy  
**Author:** CH Leicht MD, MPH*, WJ Durkan MD, SW Noltner MD, K Difeley MD  
**Affiliation:** Departments of Anesthesiology, Mayo Clinic, Rochester, MN and Naval Hospital San Diego, CA

**Introduction:** Open heart surgery for reoperative aortic valve replacement, because of Björk-Shiley valve thrombosis in the second trimester of pregnancy, has not been previously reported, nor has the use of STP for EEG burst suppression in such a case been reported.

**Case Report:** A 25-year-old woman, G 1, P 0, presented at 22 weeks gestation with a past medical history including ligation of a patent ductus arteriosus at age 3, an aortic valve commissurotomy for congenital aortic stenosis at age 7 and aortic valve replacement with a #21 Björk-Shiley prosthesis at age 19. The patient was transferred to our institution for possible surgical intervention when her estimated aortic valve gradient increased from 39 to 104 mmHg and vegetations were noted on the prosthetic valve. Because of the increasing aortic valve gradient and the increasing risk of thrombotic and embolic events, the decision to proceed with aortic valve replacement was made at 25 weeks gestation. Prior to arrival in the operating room, the patient received morphine and scopolamine, intramuscularly, and sodium citrate, orally. Monitors included: EKG, arterial BP, pulmonary artery mixed venous oxygen saturation catheter, transesophageal echocardiography and compressed spectral array EEG, continuous external fetal cardiotachometry and tocodynamometry. A modified rapid sequence intubation technique was performed using lorazepam, ketamine, sufentanil and succinylcholine. Anesthesia was maintained with a continuous sufentanil infusion supplemented with isoflurane. Muscle relaxation was provided with vecuronium. Thiopental infusion was titrated to achieve burst suppression before aortic cannulation and was continued throughout cardiopulmonary bypass (CPB). Parameters maintained during CPB included core temperature at greater than 33°C, mean arterial pressure (MAP) at 60 - 70 mmHg, uncorrected pH at 7.40 and uncorrected PCO2 at 34 mmHg. The patient had an extremely stable intraop and postop course and 13 weeks later uneventfully delivered a healthy baby.

**Discussion:** We chose techniques which preserved physiologic maternal homeostasis as much as possible during CPB in order to optimize the fetal condition and yet not compromise myocardial preservation. Open heart cases in our institution are generally performed with moderate hypothermia (28°C), moderate bypass perfusion flow (70 ml/kg/min), low perfusion pressure (50 mmHg) and normal uncorrected PCO2 (40 mmHg). However, in order to preserve optimal fetal conditions, we kept this patient's temperature at greater than 33°C, used high bypass perfusion flow (6 l/min) and maintained MAP at 60 - 70 mmHg. The patient's myocardium was preserved by direct means, including blood cardioplegia, cooling jacket and topical iced saline. The myocardial temperature was less than 10°C during valve replacement. The patient's arterial blood gas values were maintained to optimize uterine blood flow and oxygen delivery to the fetus (uncorrected pH at 7.40 and uncorrected PCO2 at 34 mmHg). Direct myocardial electrical defibrillation was performed after rewarming and did not have any effect on the fetal heart rate pattern. Vogel et al. showed no fetal effect with electrical cardioversion of 100 watt-secs to a perturbing in atrial fibrillation. A major consideration was cerebral protection for the patient during aortic valve replacement. Since we avoided hypothermia and desired to protect the brain, we employed a sodium thiopental infusion shortly after induction. We titrated the infusion via compressed spectral array EEG monitoring to burst suppression prior to aortic cannulation and continued the infusion throughout CPB. The decreased MAC during pregnancy may account for the smaller than expected amount of thiopental (650 mg) needed for burst suppression.

**Recommendations:** Full use of direct myocardial preservation techniques should be employed for the patient undergoing valve replacement, since indirect techniques, including low bypass perfusion flow, low perfusion pressure and hypothermia, are best avoided. Anesthesiologists need to consider pharmacologic methods, for example barbiturate induced EEG burst suppression, as an alternative to systemic hypothermia to provide cerebral protection in the pregnant patient undergoing open heart surgery.

**References:**  
Title: SUBARACHNOID ANESTHESIA FOR CESAREAN SECTION
Authors: Lucy SJ,* Naugler MAK
Affiliation: Department of Anaesthesia, St. Boniface General Hospital, Winnipeg, Manitoba

Introduction. Though regional anesthesia is preferred for cesarean section, subarachnoid anesthesia has fallen out of favor in many centres because of concerns about hypotension and post dural puncture headache (PDPH). However, spinal anesthesia has the advantage of faster onset, lower drug requirements, excellent nerve blockade and a lower incidence of shivering.1 The purpose of this study was to compare our experience with these techniques for cesarean section.

Methods. The charts of 200 consecutive patients who underwent cesarean section under regional anesthesia, (100 each spinal and epidural), from January to mid-July 1990 were reviewed. Data collected included incidence of failure, time from induction of anaesthetic to skin incision (T-I time), control and lowest mean blood pressure, requirement for supplemental analgesics, Apgar Scores, incidence of PDPH and requirement for epidural blood patching.

Results. There were no significant differences in the failure rate, requirement for supplementation, Apgar scores, incidence of PDPH or blood patches. In both groups the mean blood pressure decreased significantly after induction but there were no significant differences between the two groups of the control and lowest mean blood pressures or the use of vasopressors. Spinal anesthesia was significantly faster in onset with a mean T-I time of 22.1 ± 7.6 minutes (range 7 - 47 minutes) versus 39.8 ± 11.8 minutes (range 20 - 84 minutes) in the epidural group.

Discussion. A spinal technique can provide anesthesia for cesarean section effectively and reliably. Small gauge needles greatly reduce the incidence of PDPH. Excessive blood pressure decreases can be prevented by aggressive pre-anesthetic hydration and by prophylactically wrapping the lower extremities. The rapid onset of spinal anesthesia may allow regional anesthesia when time and circumstances would ordinarily preclude an epidural.

References.

Title: Species- Gender- and Pregnancy- Related Differences in Plasma Cholinesterase Activity: Preliminary Report

Authors: Masaoka T, Khan K, Jamdar SC, Morishima HO*

Affiliation: Department of Anesthesiology, College of Physicians & Surgeons, Columbia University, New York, NY 10032

Introduction: Cholinesterase (ChE) activity in the plasma is a reflection of the rate of hepatic synthesis of the enzyme. The normal range of ChE activity is wide, but is remarkably stable in any one healthy subject. Over 100 substances have been known to be hydrolyzed by ChE, e.g.: cocaine, procaine, 2-chloroprocaine, codeine, caffeine, and succinylcholine. Since numerous animal models have been used to study the pharmacological effects of drugs, which are hydrolyzed by this enzyme, we have been examining the hypothesis that the species, gender or age, as well as pregnancy, may influence plasma ChE activity.

Methods: So far, plasma or sera from adult males and nonpregnant females belonging to 12 commonly used mammalian species, as well as from pregnant animals from 9 species have been studied. Blood samples were obtained by venopuncture, or through a chronically implanted catheter in the awake state (man, baboon, rabbit, horse, dog, cat, sheep, goat and cattle), or by cardiac puncture (guinea pig, rat and mouse) under light sedation (halothane inhalation, for 10-15 sec). Blood was immediately centrifuged to separate serum or plasma. In our preliminary study, there was no difference in ChE activity between sera and plasma. ChE activity was determined by means of a colorimetric method (1), using propionylthiocholine as the substrate. ANOVA and Student's t tests were performed, where applicable, for statistical analyses. A p value of less than 0.05 was considered significant.

Results: Marked differences of plasma ChE activity were found among the 12 species, ranging from above 5000 mU/ml in the primate (man and baboon) to as low as 200-300 mU/ml in sheep, goat and cattle. Gender differences were significant in guinea pig, rat and horse; the values for females being higher. Pregnancy reduced enzyme activity in the human, 3264.0±167 mU/ml vs. 5296.0±418 mU/ml, while in the pregnant rat ChE activity was significantly higher than in the nonpregnant animals (2194±157 vs. 1441±69 mU/ml). Neither gender nor pregnancy influenced plasma ChE activity in sheep, goat and cattle.

Discussion: This basic information indicate that differences in plasma ChE activity related to species, gender and pregnancy have to be taken into account when pharmacokinetics and toxicity of drugs, which are hydrolyzed by this enzyme are evaluated.


Supported in part by NIDA Grants R01 DA06648, and R03 DA04579.
Title: Prophylactic ephedrine during bupivacaine-fentanyl spinal anesthesia for cesarean section: maternal and fetal effects.

Authors: Moore CH, Wilhite AO, Leich JK, Blass NH

Affiliation: Department of Anesthesiology, Medical College of Virginia, MCV Station, Box 695, Richmond, Va. 23298

Introduction: The use of iv or im prophylactic ephedrine to reduce the incidence of maternal hypotension during spinal anesthesia for cesarean section has been advocated by many authors. Shearer et al.1 recently reported iv ephedrine prophylaxis to be ineffective in reducing the incidence of maternal hypotension. Additionally, they found a low umbilical artery (UA) pH in patients receiving iv ephedrine prophylaxis. The purpose of this investigation was to evaluate: (1) the incidence of maternal hypotension, and (2) the fetal effects, evidenced by "apgar's" and acid-base status, following the administration of prophylactic ephedrine 10mg iv or 25mg im, or no ephedrine prophylaxis.

Methods: After obtaining approval from the university's human subjects committee, fifty-eight ASA class I or II parturients who had requested spinal anesthesia for elective cesarean delivery were randomly assigned to receive either: 10mg iv ephedrine at the time of subarachnoid injection, 25mg im ephedrine 15-30 minutes prior to the subarachnoid injection, or no ephedrine prophylaxis. All patients received 9mg hyperbaric 0.75% bupivacaine, 25 mcg of fentanyl and either 100mcg epinephrine (EPI), 200 mcg (EPI) or no (EPI) (epinephrine was randomly assigned as part of another study protocol). Prior to the placement of the block all patients were acutely hydrated with 2000ml of RL solution. Immediately after the placement of the spinal medication all patients were placed supine, and left uterine displacement was maintained at 15 degrees by means of a wedge. Maternal hypotension was defined as a SBP below 100 mm Hg. Incremental doses of ephedrine 10 mg iv and fluids were given to maintain a SBP above 100. Sensory level and BP were recorded every minute for 10 minutes and then every five minutes there after. Skin and uterine incision to delivery time were recorded and UA pH samples were obtained from a doubly clamped segment of umbilical cord. The frequency of maternal hypotension was analyzed using Chi-Square analysis and differences in UA pH values were analyzed by means of ANOVA. A p value < 0.05 was considered significant.

Results: Two patients in the im group failed to receive their block within 30 minutes from the im injection and were excluded from the study. The incidence of hypotension was greatest in the no ephedrine group and lowest in the iv ephedrine group (table). Statistically significant difference in the frequency of hypotension was only observed between these two groups. There was no difference in the mean UA pH between the two ephedrine groups. However, the non ephedrine group had a significantly lower mean UA pH (table). The groups did not vary in 1 and 5 minute apgar scores (mean scores 8.9), or on other variables.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>no bp drop</th>
<th>bp drop</th>
<th>mean UA pH ± sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>no ephed.</td>
<td>21</td>
<td>7 (33%)</td>
<td>14 (67%)</td>
<td>7.238± 0.066</td>
</tr>
<tr>
<td>iv ephed.</td>
<td>20</td>
<td>15 (75%)</td>
<td>5 (25%)</td>
<td>7.289± 0.047</td>
</tr>
<tr>
<td>im ephed.</td>
<td>15</td>
<td>8 (53%)</td>
<td>7 (46%)</td>
<td>7.301± 0.027</td>
</tr>
</tbody>
</table>

Discussion: We did not find any adverse effects following the use of prophylactic ephedrine. Prophylactic im ephedrine may have been less effective due to the variability of im absorption. The results of this study support the use of prophylactic iv ephedrine.

References:
Title: The influence of maternal weight and low dose prophylactic ephedrine during bupivacaine-fentanyl spinal anesthesia for cesarean section: maternal and fetal effects.

Authors: Moore CH, Wilhite AO, Pan P, Leich JK, Blass NH

Affiliation: Department of Anesthesiology, Medical College of Virginia, MCV Station, Box 695, Richmond, Va. 23298

Introduction: Many authors have advocated the use of low dose iv prophylactic ephedrine to reduce the incidence of maternal hypotension during spinal anesthesia for C-section. However, the relationship between hypotension, ephedrine prophylaxis and maternal body size has not been well studied. The purpose of this investigation was to evaluate the influence and interaction of maternal weight and iv ephedrine prophylaxis in relation to: (1) the incidence of maternal hypotension, and (2) the fetal effects, evidenced by "apgar's" and acid-base status; during spinal anesthesia for C-section.

Methods: After obtaining approval from the university's human subjects committee, seventy ASA class I or II parturients who had requested spinal anesthesia for elective cesarean delivery were randomly assigned to receive either: 10mg iv ephedrine at the time of subarachnoid injection, or no ephedrine prophylaxis. All patients received 9 mg hyperbaric 0.75% bupivacaine and 25 mcg of fentanyl. Prior to the placement of the block all patients were acutely hydrated with 2000ml RL solution. Immediately after the placement of the spinal medication all patients were placed supine, and left uterine displacement was maintained at 15 degrees by means of a wedge. Maternal hypotension was defined as a SBP below 100 mm hg or a decrease in SBP of 30% or more. Incremental doses of ephedrine (10 mg iv) and fluids were given to maintain a SBP above 100. Sensory level and BP were recorded every minute for 10 minutes and then every five minutes there after. Skin and uterine incision to delivery time were recorded and UA pH samples were obtained from a doubly clamped segment of umbilical cord. For analysis the subjects were divided into 3 maternal weight groups. Group I consisted of subjects weighing < 180 lb. GroupII was comprised of subjects who weighed between 180 and 230 lb. Subjects weighing greater than 230lb were included in group III. The frequency of maternal hypotension was analyzed using Chi-Square analysis and differences in UA pH values and other variables were analyzed by means of ANOVA. A p value < 0.05 was considered significant.

Results: The frequency of maternal hypotension was greatest in groups II and III (no ephed). Group I (no ephed) had the lowest frequency. IV ephedrine prophylaxis reduced the incidence of hypotension in all three weight groups (table). However, statistically significant differences exist only in group II (p = 0.005, table) (group III did not contain enough subjects to test for significance). Within all weight groups the mean UA pH was higher in the ephedrine subgroups (table), but only in group II was there a statistically significant difference (p = 0.001). However, in group III, patients who became hypotensive and received prophylactic ephedrine, had lower UA pH values than those patients who did not receive prophylaxis. One and five minute apgar scores did not differ (mean scores 8.9).

Discussion: The increased frequency of hypotension seen in the heavier weight groups may be related to the lower ml/kg fluid preload they received. The lower UA pH seen in group III patients who received iv prophylaxis, may have resulted from ephedrine induced vasoconstriction in the presence of a low fluid volume. IV prophylactic ephedrine was very effective in reducing the incidence of maternal hypotension, and normal UA pH was maintained even if hypotension developed, when fluid preload was large. The results of this study support the use of generous fluid pereload (>25ml/kg) and iv prophylactic ephedrine, especially in patients weighing over 180lbs.
Title: Safety and Efficacy of Continuous Infusion Intrathecal Meperidine During Labor

Authors: A Nelson, MD, TK Abboud, MD, J. Zhu, MD, A Reyes, MD, J Bloom, MS, P Lindsay, MS, K Yaker, MS, N Aikins, MS

Affiliation: Department of Anesthesiology, Los Angeles County-University of Southern California Medical Center, Los Angeles, California 90033

Introduction: Intrathecal meperidine during labor provides fast and good analgesia with minor side effects and intermediate duration of action. The present study is undertaken to evaluate the safety and efficacy of intrathecal meperidine when given by a continuous infusion through the microspinal catheter.

Methods: Fifteen healthy parturients at term were studied after approval by the Institutional Review Board and informed consents. 32G spinal catheters were inserted via 25 or 26G needle at L2-3 or L3-4 interspace. When patients requested pain relief, 15 mg preservative-free, undiluted meperidine was given followed by a continuous infusion of 5 mg in 1 ml volume per hour. Analgesia was evaluated using the Visual Linear Analog Scale. Motor block, fetal heart rate, uterine activity, duration of labor, maternal vital signs and the incidence of side effects were also noted. Prophylactic 0.25 mg Droperidol was given to the last 7 patients in the study. Neonates were evaluated by Apgar Apgar scores at 1 and 5 min, cord acid base status and the Neonatal Adaptive Capacity Scores (NACS) at 2 and 24 hours of age. Data were analyzed for statistical significance using student’s t-test and chi-square when appropriate. A P value of < 0.05 was considered statistically significant.

Results are presented in the table. Intrathecal meperidine provided good and continuous analgesia of fast onset. Side effects were minor. These included hypotension, motor weakness, nausea, vomiting and pruritus. All neonates were vigorous at 5 min and had good Apgar scores, cord acid base status and NACS scores.

Discussion: Results from the present study indicate that continuous infusion of intrathecal meperidine provided fast and good analgesia during labor. Side effects were minor and rare with the exception of hypotension which occurred frequently but was promptly corrected by intravenous ephedrine. None of the patients who received prophylactic Droperidol had any nausea or vomiting. Advantages of intrathecal meperidine during labor include: fast onset, less motor weakness and lack of toxicity or total spinal anesthesia.

<table>
<thead>
<tr>
<th>Table</th>
<th>Onset of Analgesia (min)</th>
<th>X±EM</th>
<th>6±0.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (min):</td>
<td>1st stage</td>
<td>348±70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2nd stage</td>
<td>90±18</td>
<td></td>
</tr>
<tr>
<td>Total Dose(mg)</td>
<td>49±7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Side Effects(%):</td>
<td>hypotension</td>
<td>7(47)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>motor weakness</td>
<td>2(13)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nausea/vomiting</td>
<td>2(13)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pruritus</td>
<td>1(7%)</td>
<td></td>
</tr>
<tr>
<td>Apgar Scores(%):</td>
<td>6 or less:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 min</td>
<td>1(7%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 min</td>
<td>0(0%)</td>
<td></td>
</tr>
</tbody>
</table>
Title: Intrathecal Meperidine Analgesia During Labor: Maternal and Neonatal Effects

Authors: A Nelson, MD, TK Abboud, MD, J Zhu, MD, A Reyes, MD, J Bloom, MS, X Yaker, MS, P Lindsay, MS, N Akins, MS

Affiliation: Department of Anesthesiology, Los Angeles County-University of Southern California Medical Center, Los Angeles, California 90033

Introduction: Intrathecal morphine during labor provides good and long lasting pain relief but is associated with frequent side effects. The present study was undertaken to evaluate the safety and efficacy of intrathecal meperidine during labor given through microspinal catheters.

Methods: Fifteen healthy parturients at term were studied after approval by the Institutional Review Board and informed consents. 32G spinal catheters were inserted via 25 or 26G needles at L2-3 or L3-4 interspace. When patients requested pain relief 15 mg preservative-free undiluted meperidine was given. Analgesia was evaluated using the Visual Analog Scale. Motor block, fetal heart rate, uterine activity, duration of labor, maternal vital signs and the incidence of side effects were also noted. Prophylactic Droperidol 0.25 mg was given to the last 5 patients in the study. Neonates were evaluated by Apgar Scores at 1 and 5 min, cord acid base status and the Neonatal Adaptive Capacity Scores (NACS) at 2 and 24 hours of age. Data were analyzed for statistical significance using Student’s t-test and chi-square when appropriate. A P value of < 0.05 was considered statistically significant.

Results are presented in the table. Intrathecal meperidine provided good analgesia of fast onset and a duration of 133±8 min. Twelve patients delivered spontaneously, one had forceps delivery and two patients delivered by cesarean section. Side effects were rare and minor, these included hypotension, motor weakness, nausea or vomiting and pruritus. None of the patients who received prophylactic Droperidol had any nausea or vomiting. All neonates were vigorous at 5 min and had good Apgar scores, cord acid base status and NACS scores.

Discussion: Results from the present study indicate that intrathecal meperidine provides fast and good analgesia during labor with minor side effects. Findings from the present study might have their application in cases of unintentional wet tap during epidural analgesia for labor where a small dose of meperidine given intrathecally can provide fast and good analgesia.

<table>
<thead>
<tr>
<th>Table</th>
<th>Onset of Analgesia (min)</th>
<th>7±1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duration (mean±SEM): (min)</td>
<td>Analgesia 133±8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1st stage 428±69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd stage 77±14</td>
</tr>
<tr>
<td></td>
<td>Total dose (mg)</td>
<td>35±4.0</td>
</tr>
<tr>
<td></td>
<td>Side Effects (%)</td>
<td>hypotension 2 (13%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>motor block 1 (7%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nausea/vomiting 6 (40%)*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pruritus 2 (13%)</td>
</tr>
<tr>
<td></td>
<td>Apgar Scores (%)</td>
<td>6 or less: 1 min 2 (13%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5 min 0 (0%)</td>
</tr>
</tbody>
</table>

*These patients were not given prophylactic Droperidol.
The goal of obstetrical analgesia is to provide the advantages associated with pain relief while avoiding adverse effects on the fetus and the normal course of labor and delivery. This report examines the influence of specific pain management techniques on outcome at our institution from 1984 to the present.

4286 laboring patients were included in this evaluation. In 1984, labor epidural anesthesia was accomplished with intermittent doses of bupivacaine 0.375% (6-8 ml.) with 1:200,000 epinephrine. In 1986, bupivacaine 0.25% (8-10 ml.) was used. The remaining patients from 1989 and 1990 represent the current practice of administering intermittent doses of bupivacaine 0.125% (15-20 ml.) with fentanyl 100 μg. Supplemental lidocaine (or 2-chloroprocaine) was used for inadequate sacral analgesia at delivery. These epidural techniques were compared to concurrent laboring, non-epidural patients. Patients receiving no analgesia were considered the control groups. The data was then compared to reflect the influence of epidural anesthetic technique on outcome. The parameters studied include fetal head position prior to delivery and the incidence of instrumented or cesarean delivery. Data were analyzed using ANOVA and Chi-square, p<0.05 was considered significant.

<table>
<thead>
<tr>
<th>No labor analgesia</th>
<th>Bupivacaine 0.125%</th>
<th>Bupivacaine 0.25%</th>
<th>Bupivacaine 0.375%/Epi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>1699</td>
<td>1477</td>
<td>206</td>
</tr>
<tr>
<td>Malposition</td>
<td>57 (3.9%)</td>
<td>62 (4.7%)</td>
<td>36 (19.1%)*†</td>
</tr>
<tr>
<td>Instrumented</td>
<td>136 (9.9%)</td>
<td>482 (36.9%)†</td>
<td>79 (46.5%)††</td>
</tr>
<tr>
<td>Delivery dose</td>
<td>-</td>
<td>259 (19.8%)</td>
<td>94 (55.3%)*</td>
</tr>
<tr>
<td>Cesarean</td>
<td>196 (11.5%)</td>
<td>169 (11.4%)</td>
<td>35 (17.0%)*†</td>
</tr>
</tbody>
</table>

* p < 0.05 when compared to bupivacaine 0.125%
† p<0.05 when compared to no labor analgesia

The results indicate epidural anesthesia with bupivacaine 0.375% or 0.25% was associated with a significantly higher incidence of fetal head malposition and instrumented and cesarean deliveries. However, labor and delivery anesthesia with bupivacaine 0.125% shows no effect on malposition or the incidence of cesarean delivery. Adverse effects resulting from bupivacaine 0.375% and 0.25% may be secondary to the increased need for supplemental dosing before delivery and the resultant blockade of the musculature prior to full rotation of the fetal head. Conversely, maintaining both thoraco-lumbar and sacral analgesia with a larger volume of bupivacaine 0.125% eliminates the need for supplemental delivery doses in the majority of patients while avoiding significant motor blockade. In conclusion, these data suggest that the effects of epidural anesthesia on outcome may relate to anesthetic effects on the normal rotation of the fetal head.
Nausea and vomiting (NAV) during cesarean section is common and is distressing to patients. Vomiting may make the surgical procedure more difficult to perform, can cause extrusion of abdominal contents, thereby making abdominal closure difficult. Vomiting can also lead to inadvertent perforation of the viscus and increase the risk of aspiration. Anxiety, inadequate sensory level, hypotension, hypoxia, viscerale traction, and narcotic supplement have been considered contributing factors to NAV during cesarean section. Alan Santos, et al have shown that 2.5 mg of I.V. droperidol is effective in reducing NAV when administered to patients during cesarean section with spinal anesthesia. The use of 1.25 mg of droperidol has been shown to increase postoperative sedation and dizziness. An ultra low dose of droperidol (0.5 mg) has been shown to be effective in reducing the incidence of nausea and vomiting. We evaluated ultra low dose of droperidol (0.625 mg) in term parturients undergoing cesarean section using regional anesthesia.

Material and Methods: After obtaining approval by the Institutional Review Committee, 38 ASA I and II patients were taken into the study. All patients were n.p.o. for at least 8 hours and were given 30 cc of 0.3 of sodium citrate by mouth preoperatively. After prehydration with 1500 cc of dextrose free electrolyte solution, either epidural anesthesia in the routine manner using 3% 2-chloroprocaine, 0.5% bupivacaine or 1.5 - 2% lidocaine; or spinal anesthesia with tetracaine 8-10 mg with or without epinephrine made hyperbaric with 10% dextrose was given. Sensory level of at least T4 was achieved. We treated a decrease in systolic blood pressure of more than 15% or less than 100 mmHg with additional I.V. fluids, increased left uterine replacement and 5-10 mg of I.V. ephedrine as necessary. Immediately following cord clamping, the parturients received either no droperidol (n=14, Group A) or 0.625 mg, or droperidol (n=24, Group B) intravenously depending upon the anesthesiologist’s choice. Intravenous fentanyl and midazolam was supplemented as needed, by the anesthesiologists. If other adjuvants (e.g. ketamine or nitrous oxide) were required, the subjects were eliminated from the study. The patients were questioned regarding nausea and observed for retching and vomiting.

Results: Two patients (14%) in Group A (no droperidol) developed nausea and vomiting while 8 patients (33%) in Group B (droperidol 0.625) developed NAV. GHI square analysis yielded P<0.01 indicating a statistically significant difference as shown in Table 1.

Table 1. Incidence of Nausea & Vomiting under Regional Anesthesia for Cesarean Section

<table>
<thead>
<tr>
<th>Number of Patients</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAV</td>
<td>NO NAV</td>
</tr>
<tr>
<td>Group A (No Droperidol)</td>
<td>2</td>
</tr>
<tr>
<td>Group B (Droperidol)</td>
<td>8</td>
</tr>
<tr>
<td>Total Number of Patients</td>
<td>10</td>
</tr>
</tbody>
</table>

Discussion: Our study indicates that ultra-low dose of droperidol did not reduce NAV as compared to the no droperidol group. Unexpectedly, the droperidol group had higher incidence of NAV which may be due to patient selection bias. Patients with no anxiety and discomfort may have been judged by anesthesiologist not to require droperidol. This group theoretically would have a lower risk of NAV than that of the droperidol treated group. Higher dose of droperidol may be required to further decrease the incidence of NAV during cesarean section. Further double blinded prospective studies are needed to determine the exact dose needed.

References:
Obstetric anesthesia has been the object of public concern and patient advocacy from its introduction in the 1840's to the present. The first obstetric anesthesia given in the United States was administered to Fanny Appleton Longfellow on April 7, 1847, in Cambridge, Mass. (1) The attending physician was Dr. Nathan C. Keep, assisted by the patient's husband, Henry Wadsworth Longfellow. Ether anesthesia was used, and for the next several decades general anesthesia was the only feasible means for relieving labor pain. Eventually regional anesthesia emerged as the preeminent method, but at the turn of the century "Dammerschlaf" was developed in Germany. This method, despite concerns for safety, caught on rapidly and was popular with both physicians and patients. This technique generated a virtual cult and the National Twilight Sleep Association was formed in 1915, pressuring physicians and patients alike to use the method. Rallies were held in department stores (such as Gimbels - "Between the marked down suits and the table linens") and neighborhood theaters to indoctrinate American women of all classes to the benefits of Twilight Sleep which promised to bestow a "new motherhood" upon the world. (2) Militant rhetoric ("If you want it you will have to fight for it, for the mass of doctors are opposed to it") reflected its grassroots, lay-person orientation. Controversy continued, particularly in regard to safety, and the eventual realization of its neonatal effects resulted in its abandonment. The death of one of its lay leaders, Mrs. Francis X. Carmody, during childbirth doomed the movement.

The work of Grantly Dick-Read and Fernand Lamaze in the 1930's and 1940's gave rise to the "natural" method of childbirth. Lamaze borrowed heavily from the Pavlovian method which he observed in the Soviet Union. Despite their pharmacology, there are striking parallels between Twilight Sleep and psychoprophylaxis. Both methods were begun by physicians but were endorsed by militant lay groups claiming widespread popular support. Both nearly became cults. Both emphasized the idea of patient control (consumerism) rather than physician control of the birth process. Both were institutionalized. Both were manifestations of the Women's Movement. These concepts will be enlarged and discussed. Furthermore, the rhetoric of psychoprophylaxis will be explored - the espousal that childbirth may be a painless process, that inability to deliver comfortably without anesthesia constitutes failure, that the medical profession is resistant to it, and that it is suitable for all women. Lastly, the paradox of the lack of popular support for epidural anesthesia, in our view, clearly superior, but under physician rather than lay control, will be discussed.

Title: ADDING BUTORPHANOL TO SPINAL NARCOTICS DECREASES ANALGESIA AND INCREASES ITCHING AFTER C-SECTION

Authors: Pue AF, Poeltler DM, Weiss ME

Affiliation: Departments of Anesthesiology, Perinatal Research, and Perinatal Nursing Sharp Memorial Hospital Women's Center, San Diego, CA 92123.

INTRODUCTION. The use of spinal and epidural narcotics for postoperative analgesia after c-section has become common practice. However, the frequent negative side effects of itching, and nausea & vomiting (N&V) often counterbalance the positive analgesic effects. A paper presented at S.O.A.P. 1990 (1) reported that the addition of 3 mg of butorphanol to epidural morphine completely eliminated itching and N&V without decreasing analgesia. It was proposed that mu antagonist action of butorphanol decreased the side effects, while kappa agonist action provided analgesia. The purpose of this retrospective study was to see if adding butorphanol to spinal narcotics would have a similar good effect of decreasing side effects without decreasing analgesia.

METHOD. For over a year one of the authors had been using exactly the same anesthetic technique and postoperative orders when using spinal narcotics for c-sections. The anesthetic dose was 75mg of lidocaine, 25µg of fentanyl, and .3mg of morphine mixed in the same syringe. For 18 hours after delivery the patients were treated according to a standard set of postoperative orders. These orders were already familiar to the Post Anesthesia Care Unit (PACU) and Post Partum Unit (PPU) nurses. For pain the PACU nurses could give I.V. fentanyl. The PPU nurses could give I.V. butorphanol for up to eight hours and then P.O. Percocet. After September 1990 .3mg of butorphanol was added to the spinal narcotic mixture. No other changes were made in the anesthetic technique or the postoperative orders. Examination of medical records was approved by the Institutional Review Committee. We compared the group of patients that received butorphanol with a group from April-September 1990 that did not receive butorphanol. For the 18 hours covered by the standard orders we looked at the time to the first treatment and the number of treatments given for pain, itching, and N&V and the total doses given for pain.

RESULTS. There were 30 patients in both the spinal narcotic alone (SN) group and the spinal narcotic plus butorphanol (SN/B) group. Both groups were comparable for age, parity, gestational age, and mean body mass index. There was no difference in the incidence of intraoperative I.V. medication, hypotension, or low APGAR scores. There were no low temperatures, SaO2's, or respiratory rates. There was no difference in PACU sedation scores or the time to discharge from the hospital. Comparing the means of the two groups, the SN/B group received more I.V. pain treatments and larger I.V. pain doses than the SN group. The SN/B group received more itching treatments and started them earlier than the SN group. There was no difference in the time to first pain or N&V treatments, the number and doses of P.O. pain treatments, or in the number of N&V treatments.

DISCUSSION. It appears that spinal butorphanol is not a useful adjunct to spinal narcotics for postoperative analgesia after c-section. In this study it was associated with increased treatments for pain and itching and no change in the treatments for nausea and vomiting.

Title: PROPOFOL AS AN INDUCTION AND MAINTENANCE AGENT FOR CESAREAN SECTION: MATERNAL AND NEONATAL EFFECTS

Authors: M Richardson, MD, TK Abboud, MD, J Zhu, MD, M Donovan, MD, E deSilva, MD, M Song, MS, C Gottschling, MS, M Homyak, MS, L Houpt, MS, K Tolliver, MS

Affiliation: Department of Anesthesiology, Los Angeles County-University of Southern California Medical Center, Los Angeles, California 90033

Introduction: Propofol, a new intravenous anesthetic agent, appears to possess properties that might make it suitable for obstetric anesthesia. These include rapid awakening time which allows early maternal-infant bonding and minimal side effects which include nausea, vomiting, respiratory and cardiovascular depression. The purpose of this study is to compare maternal and neonatal effects of general anesthesia with Propofol to those with thiamylal/isoflurane during cesarean section.

Methods: After approval by the Institutional Review Board and informed consents thirty patients scheduled for cesarean section were studied in a randomized manner. Group I (n=15) received propofol 2 mg/kg induction, followed by 0.05-0.2 mg/kg/min maintenance infusion. Group II (n=15) received thiamylal 3-4 mg/kg induction followed by isoflurane 0.25-0.75% maintenance. Both groups received 50-70% N₂/O₂ and succinylcholine. Maternal hemodynamic values were continuously recorded. Neonates were evaluated by Apgar scores, cord acid base status and the Neonatal Neurologic and Adaptive Capacity Scores (NACS). Maternal blood loss, awareness and overall quality of recovery were noted. Data were analyzed for statistical significance using student's t-test or chi-square when appropriate. Significance was accepted at P<0.05.

Results: Maternal hemodynamic values and blood loss were similar in both groups. Neonatal outcome, as ascertained by Apgar scores, cord acid base status and the NACS, were similar in both groups with the exception of 1 min Apgar scores which were significantly better for the Propofol group. None of the patients in any of the groups experienced any side effects.

Discussion: Data from the present study indicate that propofol compares favorably to thiamylal/isoflurane anesthesia for cesarean section. The rapid recovery, lack of neonatal depression, lack of excessive uterine bleeding indicate that propofol may provide significant clinical benefits in obstetrical anesthesia.
Title: Changes in Cardiac Output and Umbilical Artery Pulsatility Index during Spinal Catheter Anesthesia for Elective Caesarean Section

Authors: SC Robson, G Samsoon, R Boys, C Rodeck, B Morgan


Introduction: Subarachnoid administration of incremental doses of bupivacaine via an indwelling spinal catheter is a relatively new method of regional anesthesia for elective cesarean section. This study was undertaken to investigate the maternal and fetal haemodynamic consequences of this technique.

Methods: Twenty women admitted for elective cesarean section were studied. Subjects were preloaded with one litre of Ringer lactate solution (RLS) given over 15 min. With the subjects in the left lateral position, a 32G spinal catheter was inserted into the subarachnoid space through a 26G spinal needle. One ml of 0.5% (5 mg) heavy bupivacaine was injected down the catheter and repeated doses of 0.5 -1.0 ml were administered at 5-10 minute intervals until a block to T4 was obtained. Intravenous ephedrine (60 mg in 1 litre RLS) was commenced at the time of the initial injection of bupivacaine and the rate titrated against the systolic blood pressure (BP). Cardiac output (CO) was measured in the left semi-lateral position using cross-sectional and continuous wave Doppler echocardiography at the aortic valve. Umbilical artery pulsatility index (UAPI) was recorded using continuous wave Doppler. Measurements were performed prior to anaesthesia and after preloading. Following the initial injection of bupivacaine, measurements were repeated every 5 min until surgical anesthesia was obtained.

Results: The mean total dose of bupivacaine administered was 2.3 (SD 0.8) ml. Two subjects developed hypotension (fall in systolic BP > 20%). The mean dose of ephedrine given was 22.4 (SD 9.4) mg. The median time from the initial injection to commencement of surgery was 33 min. Median UA pH at delivery was 7.27 (Range 6.98-7.32) with 2 fetuses having a pH < 7.20. The mean hemodynamic results in the 20 subjects are shown below:

<table>
<thead>
<tr>
<th></th>
<th>Basal</th>
<th>Post Preload</th>
<th>Time after initial injection of bupivacaine (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>MAP (mm Hg)</td>
<td>92.7</td>
<td>95.8</td>
<td>90.6</td>
</tr>
<tr>
<td>SV (ml)</td>
<td>84.0</td>
<td>94.8*</td>
<td>84.0†</td>
</tr>
<tr>
<td>Heart Rate (b/min)</td>
<td>79.9</td>
<td>81.9</td>
<td>89.7*†</td>
</tr>
<tr>
<td>CO (l/min)</td>
<td>6.67</td>
<td>7.76*</td>
<td>7.49</td>
</tr>
<tr>
<td>UAPI</td>
<td>0.80</td>
<td>0.78</td>
<td>0.80</td>
</tr>
</tbody>
</table>

* p<0.01 vs basal, † p<0.01 vs post preload.

Relative to basal values, the maximum change in mean BP and CO after injection of bupivacaine was -9.5% and -0.3% respectively. Five women required further bupivacaine ≥ 20 min after the initial dose. No significant differences in hemodynamic measurements were found after 15 min in this group.

Conclusion: Subarachnoid administration of bupivacaine via a spinal catheter for elective caesarean section resulted in minimal alterations in maternal and fetal hemodynamics.
Title: Induced Uterine Relaxation during Cesarean Section using Ritodrine and Nitroglycerin

Authors: Rolbin SH*, Cole AFD, Farine D, Kapala D

Affiliation: Department of Anaesthesia, and Obstetrics and Gynecology, Mount Sinai Hospital, University of Toronto, Toronto, Canada

Introduction: Beta-mimetic drugs are widely used to inhibit labor. Recently intravenous nitroglycerin has been used to relax the uterus to assist the manual extraction of the retained placenta (1, 2). Over a number of years our obstetricians and anesthesiologist have used these drugs for uterine relaxation in patients undergoing Cesarean delivery for breech presentation (with and without labor) or for the premature infant. This report presents our experience with this therapeutic manoeuvre.

Method: Institutional review board approval was obtained and all cesarean sections in 1990 were reviewed.

Results: Uterine relaxation was induced in 35 patients – 26 ritodrine and 9 nitroglycerin – all breech presentations.

The dose and timing of the drug administered was determined by the clinical situation and pattern of practice. Bolus doses of ritodrine ranged from 1 to 10 mg and were given between 1 to 14 minutes prior to delivery. Nitroglycerin dosage was between 100 to 1,000 ugm (micrograms) and was between 1 to 17 minutes prior to delivery. Uterine tone was satisfactory in all patients. Significant blood loss or hypotension were not recorded. No patient received a blood transfusion.

There were no low Apgar scores at 5 minutes of age in babies weighing >1500 gms. There were 7 babies weighing < 1500 gms and one died of severe RDS within 12 hours of birth.

Conclusion: We report the first series of 35 patients who received uterine muscle relaxant during cesarean delivery under epidural anesthesia. The obstetricians were satisfied with uterine relaxation and side effects were not increased. Ritodrine and nitroglycerin were comparable. One case reviewed, suggested that had myometrial relaxation not been used, the infant might have been severely damaged or even died. Uterine relaxation appears to be a promising therapy for assisting with cesarean delivery in these complex situations. Further investigations are needed to establish the effectiveness, dosage and side effects of ritodrine and nitroglycerin for the reduction of uterine tone and also to assess effects on the newborn.

Reference:
Title: Uterine Muscle Relaxation Can be Life Saving: A Case Report

Authors: Rolbin SH, Hew E, Bernstein A

Affiliation: Mount Sinai Hospital, University of Toronto, Toronto

Introduction: Uterine relaxation may be required in complicated obstetrical situations. Classically amyl nitrite, diethyl ether and halogenated hydrocarbons have been used. Recently, betamimetic drugs are being used (1,2,3).

There are reports of manual extraction of retained placenta using intravenous nitroglycerin to relax the uterus (4,5), but no one to our knowledge, has used it at cesarean delivery to induce rapid uterine relaxation as a life-saving manoeuvre.

Case Report: The patient presented with a double footling breech in active labor. A cesarean section was done under epidural anesthesia. At delivery, the baby's head was trapped in the hypertonic upper segment. While we did not document the duration of these events it became obvious that the baby was in jeopardy. The anesthesiologist gave 500 ugm of nitroglycerin intravenously. This dose was repeated because the head remained trapped. It was only then that the uterus became sufficiently relaxed to allow delivery of the head. The patient remained asymptomatic although her blood pressure did fall to 70/30 but this responded to 36 mg of ephedrine in divided doses.

The Apgar scores were 5 and 9 at 1 and 5 minutes respectively. The infant breathed room air by 2 minutes of age. Cord gases were not done.

Discussion: This patient's obstetrical problem was life-threatening and its management unique. Rapid uterine relaxation was essential. The methods used to induce uterine relaxation all have potential problems - eg. delay in onset of action, increased bleeding, risks of emergency induction and subsequent deep general anesthesia.

It is our impression that intravenous nitroglycerin does relax the uterus quickly, effectively and safely and this may obviate the need for an inverted T-incision in the uterus. Our usual dose is a 250 ugm bolus, repeated 2 or 3 times if necessary. We report the first case of its use during cesarean delivery. Further investigation is needed to establish the effectiveness, dosage and side effects of bolus nitroglycerin administration for reduction of uterine tone and also to assess the effects on the newborn.

TITLE: THE CONTAMINATION OF SINGLE DOSE VIALS OF BUPIVACAINE WHEN USED REPEATEDLY WITH THE SAME PATIENT

AUTHORS: Robert M. Ross*, M.D., Robert Mako, D.O., Charles Strogen, M.D., Harold Cordner, M.D., Michele Burday, Ph.D. and Thomas Baker, M.S.

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Local anesthetics used for epidural analgesia are supplied in preservative-free, single dose vials. Continuous lumbar epidural anesthesia is the most popular anesthetic technique for the laboring parturient and bupivacaine is the local anesthetic most commonly administered. Bupivacaine is supplied in preservative-free single dose 30 cc vials. The standard practice of many anesthesiologists is to draw the entire 30 cc of bupivacaine into one syringe and to use that syringe exclusively with one patient. Throughout the first and second stages of labor, additional anesthetic often needs to be administered every 90-120 minutes to maintain adequate analgesia. With each administration, the cap is removed from the epidural catheter and the syringe is attached to deliver the additional bupivacaine. Although every effort is made to maintain aseptic conditions during the procedure, it is possible that the syringe containing the preservative-free bupivacaine could harbor contaminant growth. This study determined that the contents of the syringe can harbor and support bacterial growth when it is used multiple times over several hours. The subjects of the study are laboring parturients who elected to have epidural anesthesia. The contents of two 30 cc vials of bupivacaine (0.25%) were drawn up into two 25 cc syringes (Burron), one vial for each syringe. One syringe served as a control and the second was used to administer the initial and repeated doses of bupivacaine to the same patient. After each administration of bupivacaine, a sample from the patient syringe and the control was taken to be cultured. All syringes were stored at room temperature in a tamper proof area. Samples were incubated at 37°C for a minimum of 8 days. Preliminary data have shown that of the samples taken from 12 patients, those of 6 patients had bacterial growth. One of the controls also had bacterial growth. No patient demonstrated any clinical signs or symptoms consistent with infection. Most of the bacteria were those found on the skin. One sample, however, showed a high bacterial count consistent with nasal flora. James et al., (1) determined the incidence of contamination was 5% for the same 10 cc plastic syringes that were reused on the same patients for local anesthesia administration. Those 10 cc syringes, however, were cultured after delivery, not after each epidural injection. Bloggs et al., (2) demonstrated that at least 50% of the plastic and 100% of glass syringes can be contaminated when used more than once. The preliminary data of this study is in accordance with the findings of these earlier investigations. The present study continues to increase the sample size to establish a more accurate evaluation of the incidence of contamination by bacteria of repeatedly used single dose vials of bupivacaine.

Title: EPIDURAL ANESTHESIA IN CHORIOAMNIONITIS: CONTRAINDICATED OR NOT?

Authors: Lorraine C. Ryan, M.D.*, Charles H. Moore, MS, CRNA, David E. Soper, M.D., Norman H. Blass, M.D.

Affiliation: Departments of Anesthesiology and Obstetrics/Gynecology Medical College of Virginia, Richmond, Virginia

Introduction: Chorioamnionitis, a manifestation of intrauterine infection, is a major maternal complication after rupture of membranes and an important cause of fetal and neonatal death. It occurs in 0.5 to 1 per cent of all pregnancies. (1) It is characterized by maternal and fetal tachycardia, maternal fever, uterine tenderness, foul vaginal discharge and elevated white blood cell count. Many patients are denied epidural anesthesia because of fears of seeding the epidural or subarachnoid space and causing epidural or spinal abscesses. At this time, we are not aware of any reports of major complications including epidural abscess, hematoma, or meningitis in patients diagnosed with chorioamnionitis who have received epidural anesthesia. This study was set up to evaluate retrospectively the outcomes of patients with chorioamnionitis who received epidural anesthesia.

Methods: The study period extended from February 1988 to December 1989. A total of 240 patients with chorioamnionitis received epidural (LEA) anesthesia for vaginal or cesarean delivery (C/S). All patients were diagnosed with chorioamnionitis by criteria including two temperatures >100 degrees one hour apart or one temperature >101 degrees, rupture of membranes, increased heart rate, and elevated white cell count. Many patients had blood cultures and amniotic fluid cultures and specific figures will be presented. All patients received antibiotics (either ampicillin and gentamycin or IAI study drugs) after chorioamnionitis was diagnosed. Epidural catheters were placed in the lumbar region with usual sterile technique, and adequate analgesia obtained. Some patients developed chorioamnionitis prior to epidural placement while some developed chorioamnionitis after epidural placement. Post-partum evaluation included presence of backache, back tenderness, sensory or motor deficits, meningitis, epidural hematoma, and epidural abscess.

Results: Preliminary review of the data shows no untoward outcomes from epidurals used in patients with chorioamnionitis, but further specific analysis will be presented at the meeting.

References:
Title: PRESSURE CHANGES IN MACINTOSH BALLOONS

Author: Shah JL.

Affiliation: Department of Anaesthetics, Dudley Road Hospital, Birmingham B18 7QH. U.K.

INTRODUCTION: It is generally believed that there is no resistance to injection in the epidural space. Therefore, an inflated Macintosh Balloon connected to an advancing epidural needle should deflate when the needle point enters the epidural space. Failure of some balloons to collapse in the epidural space prompted this investigation into pressure changes in Macintosh balloons during epidural puncture.

METHOD: Macintosh balloon indicators were used to locate the lumbar epidural space in 10 anaesthetised patients aged 42 to 86 years. The balloon pressure was continuously recorded by attaching a pressure transducer (Statham Gould P50) between the Tuohy needle and the balloon. After the needle had been placed in the ligamentum flavum, the balloon was inflated with 2 ml air. Entry of the needle point into the epidural space was detected by deflation of the balloon or the "feel" of the needle.

RESULTS: With the Tuohy needle in the ligamentum flavum, the balloons inflated with 2 ml air exerted a mean pressure of 33.8 mm Hg (range 15.5 - 58 mm Hg). When the needle entered the epidural space, the balloon pressure suddenly decreased to a mean of 13.1 mm Hg (range 10.5 - 22.5 mm Hg). Whilst the balloon was connected to the epidural space, the pressure in it varied with positive pressure ventilation, increasing with inspiration and decreasing with expiration. Smaller waves, in phase with arterial pulsations, were superimposed on the respiratory waves. In all patients, compression of the jugular veins produced an increase in the balloon pressure. Balloons which failed to deflate in the epidural space exerted a pressure of more than 15 mm Hg. These balloons increased in size when the jugular veins were compressed. The final balloon pressure with the needle in the epidural space was mean 13.1 mm Hg (range 10.5 - 22.5).

CONCLUSIONS: To gain entry into the potential epidural space, the dura has to be pushed away and indented. The cerebrospinal fluid (CSF) resists this inward indentation of the dura. This resistance prevented the soft balloons from deflating in the epidural space. The final balloon pressure of 10.5 - 22.5 mm Hg is approximately the same as the CSF pressure in the lateral posture. These results indicate that there is resistance to injection in the epidural space. From this one may infer that the epidural pressure is positive.

References:
Title: Intrathecal Sufentanil/Morphine versus Fentanyl/Morphine for Labor Analgesia
Authors: Sharkey SJ*, Arkoosh VA, Norris MC, Leighton BL
Affiliation: Department of Anesthesiology, Jefferson Medical College, Thomas Jefferson University, Philadelphia, PA, 19107

Objective: The combination of intrathecal fentanyl and morphine provides rapid, profound prolonged labor analgesia (1). The purpose of this study is to compare the duration of pain relief, and the incidence of side effects between two intrathecal drug combinations administered for labor analgesia: sufentanil 10 ug combined with morphine 0.25 mg versus fentanyl 25 ug combined with morphine 0.25 mg.

Methods: Twenty healthy term primagravid patients with cervical dilatation ≤ 5 cm consented to participate in this IRB approved study. We inserted an 18 gauge Hustead needle at the L2-3 or L3-4 interspace with the loss of resistance technique. We then passed a 24 gauge x 120 mm Sprotte spinal needle through the epidural needle and injected, as determined by a table of random numbers, either sufentanil 10 ug and morphine 0.25 mg (S/M) or fentanyl 25 ug and morphine 0.25 mg (F/M). After removing the spinal needle, we threaded an epidural catheter 3 cm into the lumbar epidural space. We used the epidural catheter for subsequent analgesia at the patient's request.

At baseline and every five minutes for thirty minutes after the initial narcotic injection, we recorded blood pressure and patients rated their pain, nausea, and pruritus on 10 cm horizontal visual analog scales (VAS). They continued to rate these variables every thirty minutes until they requested additional pain relief. When a patient requested additional analgesia, we recorded the time of the request and injected the epidural catheter with bupivacaine. We defined the duration of analgesia as the time from narcotic injection until patient request for additional pain relief.

We used unpaired t-tests to evaluate demographic data and duration of pain relief, (mean±standard deviation). We analyzed pain, nausea and pruritus data using one-way analysis of variance and the Mann-Whitney U test. We considered p<0.05 as statistically significant.

Results: The two patient groups did not differ in age, height, weight, baseline pain, nausea and pruritus scores, time to delivery, method of delivery, Apgar scores, or incidence of postdural puncture headache(0%). No significant hemodynamic changes occurred. The onset of analgesia was rapid in both groups. The mean duration of analgesia was 161.5 ± 85 min in the S/M group and 129 ± 66 min in the F/M group. The S/M group tended toward more profound analgesia than the F/M group (Figure I). The S/M group showed significantly more pruritus than the F/M group (p<0.0052, Figure II). Nausea scores did not differ during the study period.

Conclusions: Both S/M and F/M provide adequate labor analgesia. Although not significantly different, the S/M combination tends to provide more profound analgesia of longer duration.

Title: In-hospital Incidence of Postlumbarch Puncture Headaches (PLPH) in Cesarean Section Patients Associated with the ATRAUCAN™ 23-gauge Whitacre-type needle Y. the 24-gauge Sprotte needle as opposed to a 25-gauge Quincke needle.

Author: M.N. Skaredoff MD
Affiliation: Department of Anesthesiology, Loyola University Medical Center, Maywood, IL 60153

The incidence of PLPH in parturients associated with a 24 gauge Sprotte (pencil point--modified Whitacre) needle is very low. Recently, a 23-gauge Whitacre-type needle is about to go on the market (ATRAUCAN™, Burron). The needle appears to be slightly stiffer than the 24 gauge sprotte needles and seems to have excellent flow characteristics. 26 consecutive patients, ASA I or 2 undergoing cesarean section were prospectively studied. Institutional Review Board approval was obtained. The patients were informed of the complications including PLPH. Patients were prehydrated with 1-2 liters of Plasmalyte™. Spinal anesthesia was induced using the midline approach in the right lateral position, utilizing hyperbaric Bupivacaine.

The patients were ambulated 12-24 hours after operation, after which they were visited by one of the investigators 24, 48 and 72 hours after operations. Patients were asked how they felt and if no complaints were reported, they were specifically asked about headache. If the patient reported a headache, she was asked about its relation to posture and asked to grade its severity on a scale of 0-10. Headaches were also objectively assessed as MILD (not interfering with activity, facial makeup applied, able to are for child) MODERATE (able to care for child, ambulating for short periods, little interest in appearance; or SEVERE (unable to care for child, up only to bathroom, tinnitus or diplopia.) A headache was considered to be a PLPH if it was aggravated by sitting or standing and ameliorated or relieved by lying down.

The planned treatment for PLPH was 1 (MILD/MODERATE) encourage PO fluids and caffeine, acetaminophen, and abdominal binder. 2 (SEVERE) 500 mg IV caffeine to be repeated if no improvement in 4 hours, and 3 (SEVERE/NO IMPROVEMENT AFTER 72 HRS) Epidural blood patch. If no headache was reported after 72 hours, the patient was told to contact us in hospital or after discharge should she develop any of the symptoms she was asked about. Results from this needle were combined with data regarding Sprotte and Quincke needles from an earlier study(1) and a chart review.

A total of 4 patients had complaints consistent with PLPH (1/250--Sprotte needle (0.04%); 3/35--Quincke needle (8.5%), ATRAUCAN™; 1/25 (4%).

<table>
<thead>
<tr>
<th>Pt</th>
<th>Age</th>
<th>ASA</th>
<th>PLPH</th>
<th>Worst Score</th>
<th>Caff</th>
<th>EBP</th>
<th>Needle Type</th>
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<tbody>
<tr>
<td>1</td>
<td>33</td>
<td>1</td>
<td>24</td>
<td>2</td>
<td>8/10</td>
<td>mild</td>
<td>no</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>1</td>
<td>48</td>
<td>0.5</td>
<td>5/10</td>
<td>mild</td>
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</tr>
<tr>
<td>3</td>
<td>25</td>
<td>1</td>
<td>24</td>
<td>1</td>
<td>8/10</td>
<td>mild</td>
<td>no</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>1</td>
<td>24</td>
<td>3</td>
<td>10/10</td>
<td>severe</td>
<td>yes</td>
</tr>
</tbody>
</table>

*Onset (hours) +Duration (days)

A Chi-Square Test showed statistically a significant difference (p < 0.04) among the three types of needles. We conclude that 1) the ATRAUCAN™ needle is not significantly better to Quincke-type needles and 2) the 24 gauge Sprotte needle still affords the parturient the best odds of not having a dural puncture headache.

1) Skaredoff MN. Same H: SOAP Abstracts, 1991: H-20
Title: DOES INTRATHECAL CLONIDINE RELEASE ACETYLCHOLINE?

Authors: C Tong, JC Eisenach, P Shea, B Bucklin

Affiliation: Section of Obstetric Anesthesia, Wake Forest University Medical Center, Winston-Salem, North Carolina 27103

Introduction. Intrathecally administered α₂-adrenergic agonists produce profound analgesia free of respiratory depression, but may also decrease blood pressure and heart rate. One approach to minimize the hemodynamic side effects of intrathecal α₂-adrenergic agonists is to exploit interactions between α₂-adrenergic and other spinal systems in order to enhance analgesia and counteract hemodynamic depression. Preliminary studies suggest that α₂-adrenergic agonists produce analgesia via a cholinergic mechanism. This study examined the effect of intrathecal injection of clonidine on release of acetylcholine (ACh) in cerebrospinal fluid (CSF).

Methods. The study was approved by the Animal Care and Use Committee. Intrathecal catheters were inserted in ewes via a mid-lumbar laminectomy, with catheter tip advanced to mid-thoracic levels. At least 3 days after surgery, the ewes received intrathecal injections, in random order, of physostigmine, 2 mg (N=2), or physostigmine followed in 10 min by clonidine (300 μg; N=3). CSF samples were collected before the injection, then every 10 min for 2 hrs for the measurement of ACh by HPLC. Data are expressed as mean ± SEM. These initial data were not tested for statistical significance.

Results. ACh was not detectable in any sample prior to physostigmine injection. Numerically more ACh was present in CSF following clonidine plus physostigmine than physostigmine alone, as measured by peak concentrations (Figure 1) and area under curve analysis (2510 ± 500 vs 1510 ± 700 pmol·ml⁻¹·min⁻¹). Statistical significance will be tested with completion of experiments.

Discussion. These data support previous studies demonstrating cholinesterase activity in CSF, such that inclusion of physostigmine is necessary to observe ACh. Whether intrathecal clonidine injection increases ACh in CSF, in accordance with functional studies suggesting a spinal α₂-adrenergic - cholinergic link in analgesia, will be determined with the completion of more experiments.

TITLE: THE EFFECT OF EPIDURAL BUTORPHANOL ON SHIVERING IN PARTURIENTS

AUTHORS: R.P. Urella, M.D.,*, M.M. Juneja, M.D., W. E. Ackerman, M.D., V. Cases-Cristobal, M.D., and B.M. Rigor, M.D.

AFFILIATION: Department of Anesthesiology, University of Louisville, and Norton Hospital, Louisville, Kentucky.

INTRODUCTION: Following the administration of epidural anesthesia in parturients, the incidence of shivering is 45-65%.

The mechanism for shivering is unknown. The purpose of this study was to look at the effect of epidural butorphanol on the incidence of shivering in parturients following epidural anesthesia.

METHODS: Institutional Review Board Approval and patient informed consent were obtained from twenty ASA I or II patients who requested epidural anesthesia for labor were included in this study. All patients received 10-12 ml/kg of lactated Ringer's solution. Preanesthetic oral temperature and room temperature were noted. A 17-gauge Husted epidural needle was placed at L2-3 or L4-5 interspace with a loss of resistance technique. Following epidural dosing with 0.25% bupivacaine, each patient was monitored for shivering by an independent observer. Group I received butorphanol 1 mg epidurally, while Group II received normal saline (1 ml) in a randomized, double blind fashion. Statistical analysis consisted of the Student's t-test and \( X^2 \) test. A \( p < 0.05 \) was considered significant.

RESULTS: There was no difference in demographic data between the two groups. Group I had a statistically significant decrease in the incidence of shivering when compared to the control group (Table I).

DISCUSSION: It has been reported that shivering is the symptom mentioned by parturients as the most disconcerting part of the birth experience.

Epidural fentanyl and sufenta have been shown to reduce shivering in parturients following epidural dosing. This study demonstrated the efficacy of epidural butorphanol in attenuating shivering. This is a preliminary study and is ongoing. The mechanism by which epidural opioids alleviate shivering is under further investigation.

REFERENCES:

Table I. Study Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Group I (N=10)</th>
<th>Group II (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient temperature (°C)</td>
<td>36.1±0.9</td>
<td>35.9±0.7</td>
</tr>
<tr>
<td>Room temperature (°C)</td>
<td>22.1±0.3</td>
<td>21.9±0.4</td>
</tr>
<tr>
<td>Solution temperature (°C)</td>
<td>22.1±0.3</td>
<td>21.9±0.4</td>
</tr>
<tr>
<td>Cessation shivering (N/%)</td>
<td>10/100%*</td>
<td>1/10%</td>
</tr>
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</table>

*p < 0.05
EPIDURAL FENTANYL DOES NOT WORSEN POST-CESAREAN SECTION ANALGESIA WHEN ADMINISTERED BEFORE EPIDURAL MORPHINE

Authors: Vincent RD, Chestnut DH, Choi WW, Coffin SA, Ostman LP, Bates J, Laszewski L
Institution: Departments of Anesthesia and Obstetrics and Gynecology, University of Iowa College of Medicine, Iowa City, IA. 52242

Introduction: Epidural fentanyl may enhance the quality of epidural anesthesia during cesarean section. However, in a retrospective study Cohen et al. noted that analgesia from epidural morphine was inferior among parturients who had first received epidural fentanyl. The purpose of this study was to determine whether epidural fentanyl given before epidural morphine improves the quality of intraoperative analgesia without worsening postoperative analgesia provided by epidural morphine.

Methods: The protocol was approved by the institutional review board for human research. Informed consent was obtained from 40 parturients having cesarean delivery with epidural anesthesia. Exclusion criteria included: 1) fetal distress; 2) epidural administration of either 2-chloroprocaine or opioid during labor; and 3) history of substance abuse. Epidural anesthesia was established with 2% lidocaine with epinephrine 5 μg/ml. Following delivery and clamping of the umbilical cord, either fentanyl 100μg/10 ml or normal saline 10 ml was injected through the epidural catheter in a randomized, double-blind manner. After uterine repair all patients received 3.5 mg of morphine epidurally. At delivery and at 10, 20, 30, and 40 min later, patients were asked to describe the intensity of operative pain as "none", "mild", "moderate", or "severe". Patients were also asked to mark 10 cm visual analogue scales for pain, nausea, pruritus, and sedation at 1, 2, 4, and 8 h after epidural morphine. Fentanyl and metoclopramide were administered iv as needed for intraoperative pain relief and nausea, respectively. After surgery morphine iv, metoclopramide iv, and nalbuphine eq were given as needed for pain, nausea, and pruritus, respectively for 24 h. Chi-square analysis with continuity correction or the Mann-Whitney U-test was used to compare nonparametric data between groups. P < 0.05 was considered significant.

Results: There were no significant differences between the two groups in the quality of intraoperative pain relief at any time. After surgery visual analogue pain scores appeared to be slightly lower over all four observations in the epidural fentanyl group than in the epidural saline group (figure). However, these small differences did not achieve statistical significance at any of the four individual times (0.10 < P < 0.20). Visual analogue scale scores for nausea, pruritus, and sedation were not significantly different between the two groups. The % of patients requiring treatment of intraoperative or postoperative pain, nausea, or pruritus were similar in both groups.

Discussion: Administration of epidural fentanyl did not improve the quality of epidural anesthesia during surgery. Further, epidural fentanyl administered before epidural morphine did not markedly improve postoperative analgesia after cesarean section. However, this study suggests that epidural morphine will not be less effective when administered after epidural fentanyl.

References:
Title: CONTINUOUS INTRATHECAL FENTANYL LABOR ANALGESIA

Authors: Zakowski MI*, Goldstein MJ, Ramanathan S, Turndorf H


Introduction: Since intrathecal morphine used for labor analgesia produces several side-effects, we studied the efficacy and side-effects of fentanyl for this purpose.

Methods: After institutional review board approval, 10 patients requesting labor analgesia gave informed consent. Patients received Ringer's lactate 125 ml/hr without a fluid bolus. A #32g Microspinal catheter was inserted at L3-4 level via a #25g spinal needle at 4 cm cervical dilatation and fentanyl 25 μg (0.5 ml) administered. Patients rated pain, itching, and nausea using a 10 cm visual analog scale. End tidal CO₂ (ETCO₂), respiratory rate, heart rate and blood pressure, fetal heart rate (FHR) and Bromage motor scale were recorded at 0, 5, 15, 30, 60, and 90 min following injection. Subsequent 25 μg doses were given upon request. Results were expressed as mean ± 1SE. For statistical analysis, analysis of variance and t test were used.

Results: All patients experienced satisfactory analgesia after each dose (Fig 1). The duration of the third injection was significantly shorter than the first (Fig 2). No patient had nausea. Most patients had moderate itching (VAS < 5). One patient required diphenhydramine 25 mg IV for itching and had urinary retention. There was no significant effect on ETCO2, RR, BP, HR, FHR or motor function.

Conclusion: Continuous intrathecal fentanyl analgesia produces effective labor analgesia with minimal side effects and no hemodynamic changes or motor blockade.

Title: CARDIOVASCULAR AND CENTRAL NERVOUS SYSTEM EFFECTS OF BUPIVACAINE IN MAGNESIUM-DEFICIENT RATS

Authors: Zavisca F*, Heavner J, Boylan M, Badgwell M, & Rosenberg P

Affiliation: Departments of Anesthesiology and Home Economics (Nutrition), Texas Tech University, Lubbock, Texas and Department of Anesthesiology, University of Helsinki, Helsinki, Finland

Introduction. Magnesium (Mg) deficiency, and the local anesthetic bupivacaine can produce seizures1 and cardiac arrhythmias.2 We studied the effect of Mg deficiency on bupivacaine toxicity. The objective of this study was to determine if magnesium deficiency enhances the central nervous system (CNS) and/or cardiotoxicity of bupivacaine.

Methods. After approval from the Animal Care and Use Committee, we studied Sprague Dawley rats (age 7 wks) maintained on a magnesium deficient diet (n=8) and a control diet (n=7) for 4 weeks. Then, rats were anesthetized with halothane, tracheostomized, and ventilated. PCO2 was maintained between 32-36 mmHg. The electrocardiogram (EKG), electroencephalogram (EEG), and arterial blood pressure (BP) were recorded. Rats were paralyzed with pancuronium and stabilized for 30 minutes on 70% nitrous oxide, 30% oxygen, and 0.5% halothane. Bupivacaine was then infused at 2 mg/kg/min.

Results and Discussion. Doses of bupivacaine producing arrhythmias (ARR), seizures (SZ), isoelectric EEG ISOI, and asystole (ASYS) were determined. Results were analyzed by analysis of variance and the Student-Neuman-Keuls test. The magnesium deficient animals had skin lesions, and were more active and gained less weight than controls. Bupivacaine doses producing ARR and ASYS (indices of cardiotoxicity) were lower (p<0.05) in the magnesium deficient group (see fig.); however, doses, doses producing SZ and ISO EEG (indices of central nervous system toxicity) were identical in magnesium deficient and control rats (see Fig). In this model, magnesium deficiency apparently enhances the cardiotoxicity of bupivacaine without affecting its toxicity.

References.
Title: BUPIVACAINE TOXICITY IN SPONTANEOUSLY HYPERTENSIVE RATS

Authors: Zavisca F*, Heavner J, Kytta J, Rosenberg P, Iacono C

Affiliation: Departments of Anesthesiology, Texas Tech University Health Sciences Center, Lubbock, Texas and University of Helsinki, Helsinki, Finland

Introduction. Hypertension is associated with a number of changes that might modify toxic response to bupivacaine. For instance, animals with hypertension have increased susceptibility to seizures and increased propensity for cardiac arrhythmias.1,2

Methods. The toxicity of bupivacaine in spontaneously hypertensive rats (SHR/n=6) and Wistar Kyoto rats (WKY/n=6) was compared. After institutional approval, the animals were anesthetized with halothane. Following tracheal and vessel cannulation, pancuronium 0.1 mg/kg was given IV and mechanical ventilation with 70% N2O, 30% O2 and 0.5% halothane was started. Bupivacaine infusion at 2 mg/kg/min IV produced ventricular dysrhythmias (DYS), seizures (SZ), isoelectric EEG (ISO EEG), and asystole (ASYS). Doses producing these endpoints were compared by analysis of variance.

Results and Discussion. Doses producing DYS and SZ were not significantly different from each other within each group, nor between SHR and WKY (see fig.). The dose producing ISO was greater in the SHR (p<0.05), and greater than the dose producing SZ in both strains (p<0.05). The seizure period was significantly longer in the SHR (8.0 ± 1 min) than in the WKY (4.5 ± 0.6 min) (p<0.05). Doses producing ASYS were slightly though not significantly greater in the SHR (p>0.05), and greater than the dose producing ISO EEG in both strains (p<0.05). Mean blood pressure (MBP) was higher in the SHR at most endpoints (p<0.05). Maintenance of a higher brain perfusion pressure and/or an alteration of brain response to bupivacaine with SHRs may account for the prolonged seizure period in this strain of rats.

References.
**Title:** Efficacy of Intrathecal Meperidine for Labor Analgesia

**Authors:** C. R. Swayze, M.D., F. G. Sholte, M.D., E. B. Walker, R.N. and J. H. Skerman, D.Sc.

**Affiliation:** Departments of Anesthesiology and Obstetrics and Gynecology, School of Medicine in Shreveport, LSUMC, 1501 Kings Highway, Shreveport, LA 71130

**Introduction:** Meperidine is an opioid agonist with known weak local anesthetic properties. The use of epidural narcotics both with and without local anesthetics is now widespread in the management of postoperative pain and for labor and delivery. This study was designed to assess the efficacy of low-dose intrathecal meperidine, administered via continuous spinal catheter, for the relief of labor and delivery pain.

**Methods and Materials:** To determine the efficacy of intrathecally administered meperidine as a labor and delivery analgesic, twenty term parturients with IRB approval were given 10 mg of meperidine via continuous spinal catheter. Visual Analog Pain Scores (VAPS) on a 0-10 point scale and Patient Satisfaction Scores (PSS) on a 0-4 point scale were measured before and after establishment of the block, and one hour after maximum block was achieved. Time to pain relief and return of pain was recorded. Additional doses of 7 mg of meperidine were given intrathecally via the catheter when patients requested additional analgesia.

**Results:** Mean VAPS scores (+ S.D.) were 8.57 (+ 1.43) before block, 0.62 (+ 0.89) after block, and 0.33 (+ 0.57) at one hour (p < 0.0001). Mean PSS scores (+ S.D.) were 0.83 (+ 0.88) before block, 3.90 (+ 0.37) after, and 3.85 (+ 0.31) at one hour (p < 0.0001). At follow-up, fourteen of eighteen patients rated satisfaction as "excellent", with the remaining four rating it as "good". Expulsive efforts were excellent in fourteen, good in three, and fair in one; two patients had cesarean sections. Mean time to onset of pain relief was 3.9 minutes (range 2 - 12 minutes) with analgesia lasting a mean of 83 minutes (range 38 - 180 minutes). Two patients developed slight motor block. Side effects appeared insidiously and are similar to those observed with other neuraxial opioids.

**Discussion:** An additional advantage over other opioids given intrathecally is that the added lipophilicity of meperidine may reduce cephalad spread due to bulk flow of CSF, thereby reducing the chance of respiratory depression. In conclusion, the low-dose intrathecal meperidine technique for obstetric analgesia did prove to be efficacious. It was well accepted by the patients, with 94% requesting it for their next delivery. Although the incidence of side effects is comparable to other intrathecal and epidural narcotic techniques, the patients indicated a high patient satisfaction score.