Concentration of mepivacaine in amniotic fluid was studied in 13 parturients following epidural anesthesia for labor and delivery. An abrupt rise in the level of the local anesthetic was observed in several instances suggesting that fetal micturition was primarily responsible for the presence of the drug in amniotic fluid.

At delivery, the concentration of mepivacaine in this fluid was significantly correlated with level in neonatal urine ($r = 0.860$, $p = 0.01$), and gastric content ($r = 0.890$, $p = 0.05$). It was also highly correlated with concentration in maternal and umbilical artery blood.

Data found at delivery are presented in the following table:

<table>
<thead>
<tr>
<th>Sample Site</th>
<th>Mean Concentration (µg/ml) ± SE</th>
<th>pH (Mean ± SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal vein</td>
<td>3.36 ± 0.30</td>
<td>7.40 ± 0.01</td>
</tr>
<tr>
<td>Umbilical vein</td>
<td>2.29 ± 0.26</td>
<td>7.35 ± 0.02</td>
</tr>
<tr>
<td>Umbilical artery</td>
<td>1.86 ± 0.26</td>
<td>7.25 ± 0.02</td>
</tr>
<tr>
<td>Amniotic fluid</td>
<td>1.80 ± 0.56</td>
<td>7.14 ± 0.02</td>
</tr>
<tr>
<td>Urine</td>
<td>47.48 ± 16.03</td>
<td>5.91 ± 0.12</td>
</tr>
<tr>
<td>Gastric content</td>
<td>53.36 ± 21.25</td>
<td>5.77 ± 0.49</td>
</tr>
</tbody>
</table>

Amniotic fluid may be a significant site of disposition of local anesthetics following epidural anesthesia. The possible circle of distribution will be discussed.
The Use of Mepivacaine and Bupivacaine in a Double Blind Paracervical Study

L. W. Hillman, W. E. Dodson, R. E. Hillman, J. D. Jones, II, W. L. Holcomb. Departments of Pediatrics, Anesthesiology, and Obstetrics and Gynecology, Washington University School of Medicine, St. Louis, Missouri

This study was undertaken to compare in a double blind fashion the use of mepivacaine and bupivacaine for paracervical block (PCB) when used for first stage of analgesia in obstetrics.

At St. Louis Maternity Hospital (Barnes Hospital Complex) PCB is a widely accepted technique. The principal drug used is mepivacaine. The clinical impression is that mepivacaine is a safe drug for use in this technique and the incidence of severe post-PCB fetal bradycardia is rare. Furthermore, it is felt that untoward fetal or maternal results from this technique are not of any considerable consequence in this hospital.

While bupivacaine for PCB is recommended and used by some obstetricians or anesthesiologists and while fetal blood levels of the drug following PCB appear to be in the low range, the pharmaceutical company dispensing it does not as yet recommend bupivacaine for use in the PCB technique. The rash of reports in the literature five or six years ago from uncontrolled studies associating bupivacaine with a high incidence of post-PCB fetal bradycardia and implicating the drug in fetal demise, seem to be the principal deterrents to its use.

More recent investigations and comparisons of bupivacaine with the other anilides, when used for peridural (epidural) techniques in labor and delivery, indicate lower blood levels and shorter half life in the newborn. Reported results also indicate no detectible interference with neuro behavioral responses.

The following data from this study will be presented:

a) Drug levels from serial maternal blood samples and cord blood.

b) Pertinent data from routine FHR tracings and other obstetrical records.

c) Scalp pH samples when significant fetal bradycardia occurs.

d) Apgar scores plus neuro behavioral scores on arrival in the nursery and again at 8 hours.

e) Total drug extraction from 24-hour urine samples (newborn).

f) Drug decay curves from a subset of infants measured by heal stick q 8 hours x 3, then 12 hours x 4.
EFFECTS OF LIDOCAINE ON UTERINE ACTIVITY AND UTERINE BLOOD FLOW IN THE GRAVID EWE

Departments of Anesthesiology, Obstetrics and Gynecology and Pediatrics, College of Physicians and Surgeons, Columbia University, New York, N.Y.

While fetal bradycardia with an associated acidosis is not uncommon following paracervical block, its etiology has yet to be elucidated. Previous investigators have shown fetal bradycardia is associated with high fetal blood levels of local anesthetic. Earlier experiments from our laboratory, indicated the cardiovascular system of the fetal lamb in good condition is tolerant of extremely high doses of both lidocaine and mepivacaine injected directly into the fetal circulation. Transient fetal bradycardia and reduction of umbilical blood flow with an associated fall in fetal pHa was observed after the intravenous administration of lidocaine to two pregnant ewes at a rate of 0.3 mg/kg (mat. wt)/min for the first 15 minutes followed by a rate of 0.1 mg/kg/min. This infusion resulted in a maternal blood level of approximately 4-5 μg/ml, a concentration not uncommon in the human mother following paracervical or epidural analgesia administered during labor. Fetal levels were maintained at approximately 3-4 μg/ml. Lidocaine also reduced the uterine blood flow which may have contributed to the observed fetal cardiac changes.

This experiment in the pregnant ewe was designed to determine whether transient fetal distress following maternal administration of lidocaine was related to a reduction in uterine blood flow with a concomitant increase in placental vascular resistance. Since in vitro studies have shown lidocaine increases myometrial activity, this aspect was investigated.

Using a chronic sheep preparation, with an electromagnetic flow meter implanted on the main uterine artery, lidocaine was infused into a maternal vein. Changes in heart rate, arterial blood pressure, acid-base status and blood lidocaine levels were determined in mother and fetus as were uterine blood flow and intraamniotic pressure.

To date, three animals have been studied, with further studies to be reported.

In the first animal, an infusion at a rate of 0.3 mg/kg/min for 15 minutes followed by 0.1 mg/kg/min for 45 minutes did not change maternal heart rate, blood pressure or fetal pressure. Immediately following initiation of the infusion fetal heart rate decreased significantly in association with a 10% reduction of uterine blood flow and a slightly increased intraamniotic pressure. In two further studies, the rate of infusion was doubled to ascertain the effect on uterine blood flow. There was a 50% decrease in uterine blood flow and a marked increase in uterine activity during the initial infusion, but preinfusion levels returned in 15 minutes. One fetus appeared to convulse with an initial bradycardia followed by tachycardia during the first 15 minutes. Fetal and maternal blood levels of lidocaine have yet to be analyzed. They will be reported.

While further studies are planned, present results suggest that lidocaine transiently increases uterine activity and reduces uterine blood flow. This could be related to fetal bradycardia and fall in fetal pHa. In future experiments oxytocin and ADH levels will be determined to see if they might be related to uterine activity.

Supported in part by Grant 5P01 - GM09069, NIGMS, NIH.
HUMAN UTERINE ARTERY RESPONSE TO LIDOCAINE. Charles P. Gibbs & Stephen C. Noel, Department of Obstetrics and Gynecology and Anesthesiology, University of Florida, Gainesville, FL

Local anesthetics are widely used for obstetrical analgesia. In some instances they have been held responsible for fetal distress. Although these drugs are usually considered vasodilators, their effects on the human uterine artery have not been studied. This work investigated the in vitro responses of the human uterine artery to 8 doses of lidocaine hydrochloride. Arterial segments were taken from 6 cesarean hysterectomy specimens and 3-4 mm tubular rings fashioned from each segment. The isometric contractions produced by these rings were measured in a manner similar to that reported by Faye & Cook (Am J Physiol 222:841, 1972). Each segment was subjected to the following concentrations of lidocaine: 3, 6, 10, 20, 50, 100, 1,000, and 2,000 µg/ml. All 6 segments contracted to the 1,000 and 2,000 µg/ml concentrations. Five of the six contracted to the 100 µg/ml concentration while 4 of the 6 reacted to the 50 µg/ml concentration. One segment reacted to all concentrations. Although fetal or maternal systemic blood levels of a local anesthetic agent would not be expected to reach most of these levels, the uterine artery is exposed to quantities well above these concentrations during the administration of a paracervical block. These in vitro results suggest that uterine blood flow could be decreased and the fetus compromised upon exposure of the uterine arteries to high concentrations of local agents during anesthetic procedures such as the paracervical block. Also, one of the segments did react to concentrations of lidocaine often achieved in the maternal circulation after paracervical, pudendal or epidural block. The data is represented below.

<table>
<thead>
<tr>
<th>Artery No.</th>
<th>Lidocaine µg/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>220</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td>36.67</td>
</tr>
<tr>
<td>S.E.</td>
<td>36.7</td>
</tr>
</tbody>
</table>
THE EFFECT OF MATERNAL AND FETAL pH CHANGES ON PLACENTAL TRANSFER OF LIDOCAINE

F. A. Radosevich, M.D.; R. L. Kennedy, M.D.; T. Turner, B.S.; A. Erenberg, M.D. Departments of Anesthesia, Obstetrics and Gynecology, and Pediatrics, University of Iowa Hospitals and Clinics, Iowa City, Iowa

Maternal respiratory alkalosis and fetal metabolic acidosis, conditions which commonly occur during labor and delivery, may affect fetal uptake of local anesthetic. In the mother respiratory alkalosis increases the concentration of the nonionized, more easily transferable drug form. In the fetus metabolic acidosis reduces the concentration of this form. Both states increase the maternal-to-fetal concentration gradient of non-ionized drug which may result in an increase in total fetal drug level. This study evaluated the effect of these pH changes on placental transfer of lidocaine in the pregnant ewe.

The experimental preparation consisted of pregnant ewes (gestational age 90-110 days) upon whom hysterotomy was performed under halothane anesthesia with insertion of fetal venous and arterial catheters into the hind limb. A maternal catheter was placed into a branch of the left femoral artery and a recovery period of 36-48 hours allowed prior to any experimentation. In addition to an initial control, the following conditions were studied in each preparation: maternal respiratory alkalosis, fetal metabolic acidosis, and a combination of maternal respiratory alkalosis and fetal metabolic acidosis. The control study was always performed first. The other three conditions were randomized to decrease sequential error and were performed at intervals no less than 24 hours apart.

The experimental procedure consisted of injecting 4 mg/kg of lidocaine over one minute through a maternal external jugular catheter. Fetal and maternal blood pressures and heart rate were continuously recorded. Fetal and maternal arterial samples were obtained simultaneously at 0.5, 5, 15, 30, and 60 minutes following injection and analyzed for pH, PCO2, PO2, and lidocaine. This procedure was then repeated under the following conditions:

A. The effect of maternal respiratory alkalosis was studied by hyperventilating the ewe with air through a tracheostomy and maintaining the pH elevated 0.20 above control value for one hour following the injection of lidocaine.

B. Fetal acidosis, defined as a pH 0.15-0.20 below control, was produced by intravenous infusion of 0.25 M lactic acid directly into the fetus and was maintained for the hour following lidocaine injection.

C. The final experiment involved simultaneous production of A and B.

Preliminary results indicate that with the combination of maternal respiratory alkalosis and fetal metabolic acidosis there was a considerable increase in fetal uptake of lidocaine. Lower fetal lidocaine levels were seen with fetal metabolic acidosis and the lowest levels with maternal respiratory alkalosis. Possible explanations and final results will be presented.
Lidocaine is a weak base with a pK of 7.86. Placental transfer of lidocaine depends in part on the amount of unionized base present. Acidemia increases the amount of ionized base which does not traverse the placenta. Thus fetal acidemia should "trap" lidocaine in the fetal circulation. To investigate this premise, we studied lidocaine transfer in both experimental animals and in a clinical setting.

Sixty normal patients undergoing elective cesarean section were given epidural anesthesia with lidocaine 2% with or without epinephrine to produce anesthesia to a T4 dermatome level. At birth, a maternal artery sample and umbilical vein and artery samples from a double-clamped cord segment were analyzed for pH, P02, PCO2, and lidocaine concentration.

The maternal pH ranged from 7.33 to 7.51. Umbilical vein pH ranged from 7.14 to 7.41, and the umbilical artery pH ranged from 7.04 to 7.33. The ratio of umbilical artery lidocaine concentration to maternal artery concentration is shown in the following table:

<table>
<thead>
<tr>
<th>Umbilical Artery pH</th>
<th>Mean UA/MA lidocaine ratio</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.05 - 7.14</td>
<td>0.34</td>
<td>10</td>
</tr>
<tr>
<td>7.15 - 7.24</td>
<td>0.40</td>
<td>31</td>
</tr>
<tr>
<td>7.25 - 7.34</td>
<td>0.35</td>
<td>16</td>
</tr>
</tbody>
</table>

There were no significant differences in the ratio of umbilical artery/maternal artery lidocaine concentration demonstrated in these pH ranges. The ratio of umbilical vein/maternal artery lidocaine concentration also did not change significantly with pH. Comparison of lidocaine concentration with base excess or PCO2 changes in the fetus was not significant.

Thus, in the clinical setting, the presence of acidosis in the fetus does not appear to increase lidocaine levels in fetal blood.

Greater degrees of fetal acidosis were studied in experimental animals. Pregnant ewes near term were anesthetized with halothane:O2 and catheters were placed in the fetal femoral artery and vein, the maternal right and left femoral artery and vein, and a flow probe was placed on a major branch of the uterine artery. A maternal external jugular vein was cannulated for infusion of intravenous fluids and for injection of cardiogreen for measuring cardiac output. Experiments were performed 24 to 48 hours later.

Following a 30 to 45 minute control period during which maternal and fetal cardiovascular and acid-base status were stable, we infused lidocaine into the maternal vein at a rate of 100 mcg/kg/min to maintain a stable lidocaine level of 2 to 3 mcg/ml in the maternal blood. Lactic acid was then infused into the fetal femoral vein until the fetal arterial pH was 6.9-7.1. Lidocaine levels and pH were measured in both mother and fetus at 15-minute intervals for 2 hours. The ratio of fetal artery to maternal artery (FA/MA) lidocaine concentration was plotted against pH change in the fetus. Data regarding the change in fetal blood concentration relative to maternal concentration during fetal acidemia will be presented.
The use of epidural blood placement as a treatment for post-lumbar-puncture headache is certainly familiar to the majority of members of this society. Many of you have been instrumental in collecting data attesting to the efficacy and safety of this procedure. Many anesthesiologists, however, possibly because of unfamiliarity with a relatively new technique, are reluctant to utilize it. Reasons cited for this reluctance include concern over possible as yet unknown complications, and belief that other methods of treatment, such as epidural saline placement, may work equally as well.

Realizing that personal preferences for and against epidural blood patch tend to run fairly strong, it is not unreasonable to assume that patient's interpretations, and therefore investigator's results, may be colored by these personal prejudices. Accordingly we attempted to design a prospective study wherein patients with post-lumbar-puncture headaches sufficient to warrant epidural fluid administration would be randomly selected to receive either blood or saline.

Patients were selected from the obstetric service only, and included those who had had spinal anesthesia and those who had inadvertent dural punctures during attempted epidural anesthesia administration. Criteria for treatment included severity of headache, visual disturbances, nausea, inability to care for newborns effectively, and impediment to discharge from the hospital. Saline administration was according to the recommendations of Usubiaga, with 30 cc adopted as a standard dose. Blood administration was according to the technique of DiGiovanni and Dunbar, utilizing 10 cc of autologous blood.

Efficacy was judged both according to the degree of relief obtained within the first hour after treatment, and according to the permanence of relief, evaluated 24 hours after treatment.

If a headache recurred after successful initial treatment, further management was not bound to protocol, and appropriate clinical judgement was exercised.
Prolonged Pain and Weakness Following Lumbar Epidural Blood Patch

*Robert W. Paige, Maj, USAF, MC  **George C. Bell, M.D., USAFR

Since the descriptions by Gormley in 1960 and DiGiovanni in 1970, the epidural blood patch has become a frequently used method of treating post-lumbar-puncture headaches. Several reports compiling large series of blood patches have been reported, but only two cases of neurologic complications have been reported. The following case reports adds a third to the literature.

The patient received continuous epidural analgesia for labor and vaginal delivery. The dura was inadvertently punctured with the epidural needle, following which the 19G epidural catheter was inserted uneventfully into the epidural space and analgesia provided without complications. Following the vaginal delivery, while analgesia to approximately the tenth thoracic dermatome was present, 10 mls of autologous blood was injected into the epidural space through the epidural catheter. Once the analgesia had disappeared, the patient noted pain and weakness in the left lower extremity which responded poorly to physical therapy and analgesics. This problem persisted for several days post-partum.

Follow-up and discussion will be presented.
REGIONALIZATION, AN EFFECTIVE METHOD OF REDUCING NEONATAL MORTALITY,
H. H. Shuman, M. D., Medical Center of Western Massachusetts, Springfield,
Massachusetts.

During the five year period 1971-1975, the neonatal mortality rate for
Health Region I of the Commonwealth of Massachusetts perceptibly decreased. The greatest impact has been in the weight groups of 1001-2000 grams.

The singular change made in the delivery of newborn care to this region has been the establishment of a Regional Neonatal Transfer Center - providing an opportunity for optimal care for all newborns at risk born anywhere in the Region.

At the Center itself the reduction in neonatal mortality rates has been more than 50% of its level prior to establishment of the program. The Wesson Women's Hospital in Springfield where the Transfer Nursery is located delivers 4,500 of the 10,000 infants born each year in the Region. The Center serves, through a transportation, 10 Community Hospitals in an area of 2,500 square miles, is responsible for an educational program in the field of Perinatal Medicine to all personnel in the Region and it also provides a system of documenting statistics for the Region.

This paper describes the necessary ingredients for the establishment of a Regional Program of care to the high-risk newborns for a large Health Region and its beneficial effect to the entire region. Data will be presented documenting these results.
Lack of Relation Between Arterial Blood Pressure and Blood Volume in the Preterm Infant. Peter A. Barr, Penrbyn E. Bailey, James E. Sumners, George Cassady.
Department of Pediatrics, Division of Perinatal Medicine, University of Alabama, Birmingham, Alabama.

Aortic blood pressure (BP) and blood volume (BV) were measured in 42 preterm infants. Fourteen infants were hypotensive (mean BP < 30 mmHg); 28 were normotensive. The hypotensive babies were significantly lighter (1370 vs 1870 g), had lower Apgar scores (8/12 vs 7/25; 6) and were younger at the time of study (13/14 vs 17/28; < 12 hrs). There were no significant differences in gestation (31 vs 32 wk), frequency of hyaline membrane disease (HMD, 6/14 vs 19/28) or arterial pH and blood gases at the time of study.

The BV, plasma volume (PV = 10 minute T1824 dilution space), and hematocrit (HCT) in the hypotensive babies (88.9 ± 15.2 ml/kg; 48.7 ± 7.9 ml/kg; 45.5 ± 6.5% respectively) were not significantly different from those in the normotensive babies (90.7 ± 20.8 ml/kg; 48.9 ± 7.9 ml/kg; 47.5 ± 8.7%). There was no significant correlation of mean BP with BV, PV or HCT. There was a significant correlation of mean BP with both birth weight and gestation.

Eight hypotensive infants were then given 10% salt poor albumin, 1.0 gm/kg, over 10 minutes. Mean BP and arterial pH and blood gases were measured 30, 45 and 60 minutes after volume expansion. There was a small but significant increase in mean BP from 26.8 ± 2.0 mmHg before expansion to 29.1 ± 1.1 mmHg at 60 minutes, but 5 of 8 were still hypotensive. There was no significant change in arterial pH and PCO2 with volume expansion. In 7 infants with HMD there was a trend toward a decrease in the arterial/alveolar PO2 ratio with volume expansion implying increased venous admixture.
MECONIUM ASPIRATION SYNDROME - A RETROSPECTIVE STUDY

Shyan C. Sun, M.D., D.C.H. Suwanee Verasestakul, M.D.
Regional Neonatal Intensive Care Unit
Children's Hospital of Newark, N.J.
New Jersey College of Medicine and Dentistry

A retrospective study of infants referred to the Neonatal Intensive Care Unit of Children's Hospital of Newark was made between 1972 and 1975. Of 1000 admissions, 103 infants were meconium stained and 59 of these had meconium aspiration syndrome. Sixteen of the infants had deep tracheal and bronchial suctioning upon delivery whereas 43 babies had not. Complications occurred in both groups; however, morbidity and mortality were significantly reduced in the suctioned group. Pneumomediastinum and/or pneumothorax occurred in 37% of non-suctioned babies, with mortality rate of 25%. This complication appeared in 19% of suctioned babies but the mortality was 0%. Seizures occurred in 20% of non-suctioned babies, and of these 63% expired. No seizures were seen in the suctioned group. Recommendation was made in management of these neonates.

TOTAL ADMISSIONS: 999; Meconium-stained infants: 103; Meconium Aspiration Syndrome: 59 cases.

<table>
<thead>
<tr>
<th>Cases</th>
<th>Morbidity%</th>
<th>Mortality%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Born In</td>
<td>16</td>
<td>43</td>
</tr>
<tr>
<td>No lung complications</td>
<td>13</td>
<td>19</td>
</tr>
<tr>
<td>Complications</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>Pn. Mediastinum</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Pn. Thorax</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Both</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Seizures + Pn. Thorax</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Seizures alone</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Other complications (diaphragmatic hernia)</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Deaths: Total</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

On Chi² tests: \( p < .05 \) for deaths \( p = .05 \) for lung complications \( p = .05 \) for seizures \( p < .05 \) for complications

These findings support the recommendation that meconium-stained infants be vigorously suctioned as soon as possible. We strongly advocate:

1. Thorough suctioning of the oropharynx by the obstetrician or an assistant upon delivery of the head, before the shoulder appears.
2. Deep tracheal suctioning by an attendant pediatrician or anaesthetist immediately after delivery.
3. Transfer as soon as possible to an intensive care facility.
4. Intensive regimen of bronchial lavage during the first two to three days of life, along with chest vibration, high humidity, intermittent ultrasonic mist, head-down position, thermoneutral environment and antibiotics when indicated.

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PULMONARY VASCULAR CHANGES FOLLOWING INDOMETHACIN IN NORMOXIC AND HYPOXIC PREMATURE NEWBORN GOATS. T.L. Tyler, C.W. Loeffler, and S. Cassin. Division of Physiology, College of Medicine, University of Florida, Gainesville, Florida 32610.

Prostaglandin synthetase inhibitors may affect pulmonary circulation of perinates when administered to women to prolong gestation or when given to newborns to control ductal shunting. Since de novo synthesis of prostaglandins may be important in local regulation of pulmonary blood flow, we investigated effects of indomethacin, a prostaglandin synthesis inhibitor, on pulmonary vascular resistance of premature newborn goats. Left pulmonary arterial pressure (PAP) at constant flow (Q), left atrial pressure (LAP), and systemic arterial pressure were monitored in mechanically ventilated newborn goats (133-135 days gestation, wt = 2.7 kg, n = 6) which were delivered prematurely by cesarean section. Pulmonary vascular resistance ([PAP-LAP] body wt/Q) of animals breathing 25% oxygen or 5% oxygen (one minute) in nitrogen were measured before and thirty minutes after administration of indomethacin (1.9 mg/kg). Prior to indomethacin pulmonary vascular resistance during normoxia was 1.6 ± 0.15 [S.E.] mmHg·Kg·min⁻¹ and increased 20% during hypoxia. Pulmonary vascular resistance during normoxia was 82% greater following administration of indomethacin than prior to indomethacin administration. Hypoxia following indomethacin increased pulmonary vascular resistance an additional 55%. The increased pulmonary vascular resistance and augmented pressor response to hypoxia following indomethacin suggest that: (1) prostaglandin synthetase inhibition effectively removes a dilator influence from the pulmonary circulation, and (2) prostaglandins or other products dependent on synthetase activity do not mediate the pulmonary vasoconstrictor response to hypoxia. The increased pulmonary vascular resistance that follows indomethacin administration could result in reduced pulmonary blood flow in immature newborns with parallel foramenal or ductal circulations. This reduction in pulmonary blood flow would be augmented in the hypoxemic newborn.

(Supported in part by NIH-2R01-HL10834-07, NIH-5T01-HL05979-03, and Florida Heart 74-AG-2 and 75-AG-231.)
A study by Datta et al (1) on lidocaine levels in neonatal gastric juice following maternal extradural analgesia revealed larger amounts of drugs in infants delivered vaginally as compared with those delivered abdominally. This finding was attributed to a concomitantly observed lower gastric pH in the former group. We became interested in the factors determining gastric pH in the neonate and, therefore, proceeded to survey gastric pH in all infants born during day shift.

Gastric juice was suctioned into a clean DeLee trap 3-4 minutes after birth, i.e., after completion of the initial care of the neonate but before assignment of the 5-minute Apgar score. The pH was measured twice, first by litmus paper and then with a Corning electrode. Whenever possible, amniotic fluid was also obtained for pH measurements, and umbilical vein and artery bloods were sampled from a double-clamped piece of cord for determination of acid-base data.

RESULTS
Gastric juice pH has been measured in 91 neonates. Of these, 71 were born vaginally and 20 by cesarean section. Gastric juice pH ranged from 7.8 to 2.5. The pH was significantly (p<0.02) higher following cesarean section delivery (Table) and was highest (above 7) in all premature babies regardless of the mode of delivery. In contrast, all amniotic fluids had a pH between 7.0 and 7.5, and in 12 cases in whom amniotic fluid was sampled at the time of rupture of membranes and again at delivery, there was no change in pH. No correlation was discernible between cord blood pH or base deficit or Apgar scores and the pH of gastric juice.

It appears that labor and vaginal delivery predispose to the extrauterine development of acid gastric juice and that this preparation is less operational in abdominal deliveries. Furthermore, premature infants seem unable to react to this preparation. Most importantly, the gastric pH of newborn babies may be below 3.0 facilitating the development of chemical pneumonitis, should aspiration of stomach contents occur. For this reason, gastric aspiration is recommended in all neonates with poor muscle tone and poor reflex activity.


<table>
<thead>
<tr>
<th>Gastric pH</th>
<th>&lt;6</th>
<th>&gt;6</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Infants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vaginal Delivery</td>
<td>23</td>
<td>48</td>
</tr>
<tr>
<td>Cesarean Section</td>
<td>1</td>
<td>19</td>
</tr>
</tbody>
</table>
REDISTRIBUTION OF BLOOD FLOW IN THE NEWBORN DURING ACIDOSIS.
Richard L. Bucciarelli and Donald V. Eitzman, University of
Florida College of Medicine, Department of Pediatrics, Division
of Neonatology, Gainesville, Fla.

Distribution of blood flow was studied using radioactive spheres
in 21 newborn goats (post C-section) ranging from 128-148 days gestation
and in 18 goats aged 1-37 days. Injections were made 10 minutes after
production of the experimental condition. Acidosis was produced with
decreased ventilation, lactic acid infusion, post hypoxia or stress.
Pressure was measured directly in left atrium, pulmonary artery, and
femoral artery. Oxygen consumption was measured with a closed system
and oxygen content calculated from the pulmonary artery and left atrial
samples. At the end of the experiment, individual organs and the
entire carcass were ashed and counted. Resistance was calculated and
total flow was checked by the Fick Principle. In general, there was
an increase in flow to the brain with all types of acidosis. This
increase was most marked with respiratory acidosis and was most consist-
ent with infusion of lactic acid. There was a smaller and less consistent
increase in coronary flow with all types of acidosis. Flow to kidney,
gut, and carcass was variable with mean change in flow being a small
decrease.

Summary of change in flow during acidosis in all age groups

<table>
<thead>
<tr>
<th></th>
<th>Brain</th>
<th>Body</th>
<th>Heart</th>
<th>Kidney</th>
<th>Gut</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Increasing Flow</td>
<td>35</td>
<td>15</td>
<td>23</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>No. Decreased Flow</td>
<td>4</td>
<td>24</td>
<td>18</td>
<td>33</td>
<td>26</td>
</tr>
<tr>
<td>Mean % Change</td>
<td>+83.2</td>
<td>-5.3</td>
<td>+34</td>
<td>-20.5</td>
<td>-12.4</td>
</tr>
</tbody>
</table>

(Supported by NIH Training Grant HD-00054 and Research Grant HL-14829.)

The prevention of inadvertent hypothermia is a challenge to all those responsible for the care of small or sick infants. Such infants often must undergo diagnostic or therapeutic procedures in environments where exogenous methods of heating are inadequate or unavailable and where swaddling wraps of foil or "air pocket" plastic interfere with monitoring, manipulation and observation.

A single-layer transparent polyethylene thermal gown was designed and tested in a variety of situations where cold stress can occur: i.e., in the delivery room, during inter- and intra-hospital transport, and through lengthy radiologic and operative procedures. The material is flame retardant and can be gas-sterilized. It permits auscultation of breath and heart sounds and causes no interference with X-ray studies. Close fit is provided by adhesive strips which can be resealed after insertion of catheters or administration of medication.

In the delivery room study, 30 full-term, healthy neonates were randomly assigned at the time of birth to 3 groups. Rectal and skin temperatures were recorded at 5 minute intervals. Infants in group 1 were placed under radiant heaters with servocontrol set for 99°F skin temp. Those assigned to group 2 were dressed in the polyethylene gowns and placed in open bassinettes. Infants in group 3 were dressed in the polyethylene gowns and placed under servocontrolled warmers. Mean room temp. was 68°F. Mean rectal temps. were as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>5'</th>
<th>10'</th>
<th>15'</th>
<th>20'</th>
<th>25'</th>
<th>30'</th>
<th>Skin Temps.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>10</td>
<td>98.6</td>
<td>98.5</td>
<td>93.4</td>
<td>98.5</td>
<td>98.4</td>
<td>93.3</td>
<td>96.0-100.0</td>
</tr>
<tr>
<td>Group 2</td>
<td>10</td>
<td>97.8</td>
<td>97.6</td>
<td>97.8</td>
<td>97.7</td>
<td>97.8</td>
<td>97.6</td>
<td>95.4- 95.7</td>
</tr>
<tr>
<td>Group 3</td>
<td>10</td>
<td>98.4</td>
<td>98.3</td>
<td>98.6</td>
<td>98.5</td>
<td>98.4</td>
<td>93.7</td>
<td>96.0-100.0</td>
</tr>
</tbody>
</table>

Infants with gown alone (grp 2) demonstrated thermal stability comparable to those under servocontrolled heaters. Servocontrolled heating of gowned infants (grp 3) for 30 min. did not cause hyperthermia.

Five infants ranging in weight from 1.4 to 3.4 Kg were gowned and monitored during diagnostic x-ray procedures lasting from 50 to 80 min. No exogenous heat source was available. The smallest infant showed a temp. drop from 38.9 to 97.7°F; the other 4 patients were stable to within 0.2°F.

A third study group consisted of 8 infants undergoing major operative procedures under general anesthesia. They ranged in weight from 2 to 5 Kg and in age from 4 days to 4 months. These patients were gowned before transport to the operating room. Operative fields were cut in the gowns prior to induction and prepping. The gowns were not removed until the infants reached the recovery room. The mean change in temp. during intra-hospital transport was 0.2°F. Induction of anesthesia caused no significant heat loss. Mean drop in core temp. during procedures lasting over 2 hrs. was only 0.8°F.

The gowns were also used for inter-hospital transport of a group of 10 sick infants ranging in weight from 1.4 to 2.5 Kg. The study period included transfer of infants from referral hospital to transport vehicle and to receiving nursery. Normal core temps. were maintained to within 1°F over intervals ranging from 30 to 60 min. Hyperthermia did not occur even when gowned infants were placed in closed incubators for up to 30 min. The various members of the transport team found that the gowned infants were easy to observe and handle despite varying degrees of medical and environmental instability.
Deficiency of Pulmonary Alpha-1-Antitrypsin in Fetal Bronchopulmonary Dysplasia

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Department of Neonatology
Georgetown University Hospital

Alpha-1-Antitrypsin (A-1-AT), an anti-proteolytic glycoprotein, has been shown to have a significant role in the pathology of pulmonary injury of diverse etiologies. This central role seems to be by virtue of A-1-AT ability to block or moderate the effects of elastase, collagenase and other enzymes involved in the pulmonary inflammatory process. This preliminary report describes A-1-AT activity in the lungs of infants dying of bronchopulmonary dysplasia (BPD), a significant cause of mortality and morbidity in the neonatal period.

Freshly frozen post-mortem lung tissue from five infants who died of BPD was stained using the fluorescent antibody technique of Ficler, Handl and Evans.1 The diagnosis of BPD was suspected on clinical and radiologic grounds. It was confirmed by post-mortem pathologic criteria.

All BPD infants demonstrated a complete absence of A-1-AT in their pulmonary parenchyma. This is in distinct contrast to the prominent pulmonary A-1-AT seen in newborns who died of the idiopathic respiratory distress syndrome.

We postulate that the chronic pulmonary inflammatory state of BPD develops associated with a relative deficiency of A-1-AT. This deficiency permits the proteolytic enzymes of pulmonary injury to act uncontrolled allowing progression of the lung pathology to the irreversible point seen in end-stage BPD.

Additional observations on the presence of A-1-AT in neonatal tracheal aspirate and serum specimens, correlated with pulmonary pathologic material, will be discussed in relation to the ante-mortem diagnosis of BPD.

Serum A-1 AT levels in infants are usually low.

Neurobehavioral Performance of Newborns Whose Mothers Had Oxytocin Challenge Testing: A Prospective Study

John Y. Scanlon, M.D.,* Kotaro Suzuki, M.D., Elizabeth Shin, M.S.

From the Departments of Pediatrics and Obstetrics, Harvard Medical School and the Beth Israel Hospital, Boston, Massachusetts

The Oxytocin Challenge Test (OCT) has become widely accepted as a hall-mark for invasive fetal anesthesia, although controversy exists about its predictive value. Intrauterine asphyxia can impair neonatal neurobehavioral performance without lowering Apgar scores. This preliminary study reports on the relationship between OCT and newborn outcome, specifically neonatal behavioral performance.

Forty-six infants, delivered from oxytocin challenge tested mothers, were neurobehaviorally tested at birth, and on days 2 and 4, by an examiner unaware of the OCT result. OCT was done for post-maturity, diabetes, hypertension, small fetal size for dates or other "high risk" indications.

Using the criteria established by Mak, there were 12 positive or equivocal tests and 36 negative OCT's. There were no significant differences between negative and positive test group newborns for gestational age, maternal age, parity, one or five minute Apgar scores, birth weight, and incidence of fetal malnutrition. Furthermore, there were no significant differences in the indications for OCT, abnormalities of labor or delivery, intrapartum fetal heart rate patterns and method of delivery between groups.

On day four, statistically significant differences (p < .01) in behavior were found in the positive OCT newborns which included diminished orientation to visual stimuli, decreased alertness, decreased motor maturity and decreased evoked muscle tone. In addition, there was a significantly increased incidence of tremulousness in the "positive" group.

Positive OCT newborns also had significantly decreased passive motor tone in the first 12 hours of life which persisted for 4 days.

These preliminary observations suggest that a "positive" OCT is associated with impairment of neonatal neurobehavioral performance in infants from "high risk" pregnancies.

These data are consistent with an hypothesis that diminished placental respiratory capacity is associated with impaired neonatal central nervous system function.

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Double Blind Comparison of Neonatal Neurobehavioral Tests Following Cesarean Delivery under Ketamine, Thiopental and Spinal Anesthesia.

- Robert Hodgkinson, S.S. Kim, Manojkumar Bhatt

The Scalon group of neurobehavioral tests (Anesthesiology: 40, 121-128, 1974) were performed on babies before feeds at 4 - 12 hours after delivery by cesarean section and 24 hours later. Ketamine (1 mg/kg) was administered to 36 mothers, (thiopental < 4 mg/kg) to 44 and spinal anesthesia (tetracaine 7 - 9 mg) to 36. Atropine 0.4 mg intravenously was given as the sole pre-medication before ketamine and thiopental and this was followed with 6 liters of nitrous oxide and 6 liters of oxygen until the baby was delivered. The uterus was displaced to the left in all cases. Patients receiving spinal anesthesia were given one liter of lactated Ringers solution before operation. The examiner was unaware of the method of delivery, anesthesia or perinatal risk factors. All babies delivered during the period of the study were examined. All babies weighing < 2500 G, with an Apgar 7 - 9, with medical complications, whose mothers received 50 mg of meperidine or more within 4 hours of delivery and any baby with any special risk factors were excluded by a second investigator without access to the test scores. 50% of the ketamine and thiopental groups and 56% of the spinal group were in labor at the time of cesarean section but this did not exceed 12 hours in any case.

The highest scores on neonatal neurobehavioral testing on both the first and second day after birth for overall assessment, tone, placing, rooting, alertness and decremental scores to pinprick, were obtained following spinal anesthesia and the lowest following thiopental (p < .05). Intermediate scores were obtained following ketamine. In no test did the thiopental group outperform the spinal or ketamine group. The difference in the overall scores based on the evaluator's assessment of the neonates' performance on all the neurobehavioral tests between those in labor and those not in labor was insignificant (p < .6) as was the difference between those receiving meperidine 50 mg or less within 4 hours of delivery and those receiving no narcotics (p < .4).
Acid-base and blood gas states were studied in 19 diabetic parturients following either general or spinal anesthesia for Caesarean delivery. Thirty uncomplicated pregnancies were similarly studied and served as a control group. Data for the patients are presented in the following table.

<table>
<thead>
<tr>
<th></th>
<th>Uncomplicated</th>
<th>Diabetic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General</td>
<td>Spinal</td>
</tr>
<tr>
<td>MV pH</td>
<td>7.40 ± 0.01</td>
<td>7.39 ± 0.01</td>
</tr>
<tr>
<td>UV pH</td>
<td>7.36 ± 0.01</td>
<td>7.34 ± 0.01</td>
</tr>
<tr>
<td>PO2</td>
<td>38.1 ± 1.78</td>
<td>34.2 ± 2.7</td>
</tr>
<tr>
<td>PCO2</td>
<td>41.0 ± 0.21</td>
<td>46.6 ± 2.13</td>
</tr>
<tr>
<td>UA pH</td>
<td>7.29 ± 0.01</td>
<td>7.27 ± 0.01</td>
</tr>
<tr>
<td>PO2</td>
<td>21.7 ± 1.42</td>
<td>17.3 ± 1.29</td>
</tr>
<tr>
<td>PCO2</td>
<td>56.43 ± 2.17</td>
<td>63.1 ± 1.66</td>
</tr>
<tr>
<td>BE</td>
<td>-2.5 ± 0.62</td>
<td>-2.4 ± 0.83</td>
</tr>
<tr>
<td>I-D Interval</td>
<td>7 min ± 0.73</td>
<td>17 min ± 1.39</td>
</tr>
<tr>
<td>Apgar 1 min</td>
<td>8** (3-9)</td>
<td>9 (6-9)</td>
</tr>
<tr>
<td>Apgar 5 min</td>
<td>9 (9-10)</td>
<td>9 (8-10)</td>
</tr>
</tbody>
</table>

*Mean ± SE  **Median (range)

This study reaffirms previous reports1,2 which indicate that a "normal" acid-base exists in infants of diabetic mothers following general anesthesia for Caesarean section. Our data suggest, however, that in contrast to general anesthesia, spinal anesthesia is associated with a significantly lower pH and greater base deficit in these infants. In the healthy patients, the comparison did not reveal any significant differences. Possible explanation for these findings will be discussed.

References

A CLINICAL EVALUATION OF THE ROLL-OVER TEST

Alfonso E. Barnes, M.D., R. Daniel Braun, M.D., FACOG, University of Tennessee Clinical Education Center-Chattanooga

This paper is an evaluation of the roll-over test of Gant, which was supposed to differentiate early in pregnancy which patients would later develop hypertension. One hundred six normal gravidas were enrolled in this study and submitted to the roll-over test. Thirty-five of these had positive roll-over tests and 71 had negative tests. Of the 35 positives, twenty did not develop hypertension. Of the 71 negatives, 11 did develop hypertension. This meant that 57 per cent of the patients with hypertension were identified in a group that consisted of 1/3 of the entire population. It is our conclusion from this study that the roll-over test is not clinically applicable.
Evidence suggests that infection risk and mortality increase with more time between ROM and delivery. The effect of ROM on the incidence of IRDS is unclear. We compared records on 694 infants with ROM < 12 hrs. and 152 infants with ROM > 24 hrs. before delivery. The incidence of IRDS was significantly lower at 28-33 wks. gestation when ROM was > 24 hrs.

<table>
<thead>
<tr>
<th>Wk. Gestation</th>
<th>ROM &lt; 12 hrs.</th>
<th>ROM &gt; 24 hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-29</td>
<td>19/24 (79%)</td>
<td>3/8 (37½%)</td>
</tr>
<tr>
<td>30-33</td>
<td>85/133 (64%)</td>
<td>15/41 (37%)</td>
</tr>
<tr>
<td>34-37</td>
<td>106/327 (32%)</td>
<td>15/70 (21%)</td>
</tr>
</tbody>
</table>

Furthermore, the incidence of IRDS with respiratory failure (RF) was lower in infants with ROM > 24 hrs.:

<table>
<thead>
<tr>
<th>Wk. Gestation</th>
<th>ROM &lt; 12 hrs.</th>
<th>ROM &gt; 24 hrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>28-29</td>
<td>13/24 (55%)</td>
<td>3/8 (37½%)</td>
</tr>
<tr>
<td>30-33</td>
<td>48/133 (40%)</td>
<td>7/41 (17%)**</td>
</tr>
<tr>
<td>34-37</td>
<td>49/327 (15%)</td>
<td>5/70 (7%)</td>
</tr>
</tbody>
</table>

There was no significant difference in the incidence of sepsis or mortality between ROM groups. We conclude that > 24 hrs. between ROM and delivery will significantly reduce the incidence of IRDS in 28-33 wk. infants, and IRDS with RF at 30-33 wks. This benefit is not accompanied by a higher incidence of sepsis or mortality.
Evaluation of myocardial function measuring the systolic time intervals in patients submitted to cesarean section. Comparison between normal patients and with toxemia of pregnancy.

Fernando Rodriguez, M.D.
Carlos Fernandez-del Castillo, M.D.

Measuring the systolic time intervals by non-invasive techniques utilizing a 3 channel device for simultaneous recording at 100ms/second the EKG, Phonocardiogram and carotid pulse, make possible the evaluation of myocardial function as has been well established by Weissler, Garrow, etc. Measuring pre-ejection period (PEP), left ventricular ejection time (LVET), the rate PEP/LVET, it is possible to derive the ejection fraction (EF) that correlates with cardiac performance and cardiac output. Fig. 1. Prolongation from the expected normal of the PEP (<100ms) and shortening of LVET (>300ms), widening the PEP/LVET (<0.33) and a decrease in the EF (>0.70) indicates poor myocardial function and contractility. On the contrary, reduction of PEP, prolongation of LVET, reduction of PEP/LVET and increasing EF, can be interpreted as an improvement of the function. This study includes 29 normal patients at term and 38 patients with different degree of toxemia, scheduled for cesarean section. Measures were made before in supine and lateral position and the anesthesia techniques used was continuous lumbar peridural block with the technique recommended by Bonica, Bromage and others. All patients were treated with fluids and uterine displacement during the performance of the anesthesia.

Results: In supine position lying flat have a poor myocardial function expressed by prolongation of PEP, reduction of LVET, widening the PEP/LVET and reduction EF, more marked in toxemias. In lateral position myo CARDIAL function return to normal in the control group but in toxemia remain at lower levels. (Table 1-2). All are mean values. During the procedure with adequate fluids and uterine displacement and after the extraction of fetus, the cardiac function in the control group remain in upper limits and normal in the toxemias. We believe it has been demonstrated by many authors (Bonica, Bieniarz, Mark etc.) that the supine position in the third trimester of pregnancy can be deleterious becoming worst in patients with toxemia, due to aorticophleb compression and the profound hypovolemia pre-existing in toxemia as has been demonstrated by Page, Cloerens, Sporoff et al. and the metabolic rearrangements that we have found in these patients who showed subendocardial ischemic lesions. The lumbar peridural block improve the myocardial function in all patients probably due to a decrease of peripheral resistance, administration of fluids and the inotropic effect of epinephrine added to the local anesthetic as has been demonstrated by Bonica.

Professor of Anesthesia. ++ Director and Professor of Gynecology and Obstetrics. Hospital Infantil Mexico City. Jan. 10th, 76
This paper should be read by Dr. F. Rodriguez.
General anesthesia was administered to 80 pregnant women at term who underwent elective cesarean section; they had no special pathology and were operated on because previous cesarean sections.

The patients inhaled fifty percent oxygen-nitrous oxide (4 L) for 3 to 5 minutes and enflurane 0.2 to 0.8%; after the injection of pancuronium bromide hypnosis was induced with one of the following intravenous agents (n=10 in each group): thiopental (T), propanidid (P), alphaxalone (A), etomidate (E), ketamine (K), lorazepam (L), hydroxybutyrate (H), or diazepam (D), in doses just enough to produce disappearance of the eye-lid reflex. The tracheal intubation was accomplished and a surgical level of anesthesia was maintained with fifty percent oxygen-nitrous oxide (1 L each) in closed circuit and enflurane (0.4 to 1%). The ventilation was controlled mechanically (Bennett). At the end of the procedure, muscular relaxation was antagonized with atropine-neostigmine i.v. The administration of nitrous oxide and enflurane was discontinued at the opening of the peritoneum and continued after the extraction. A drip of 5% D/W with 20 U of oxytocin was used to control the uterine tone.

Maternal arterial and venous blood samples were drawn as well as from a double clamped segment of umbilical cord for PO$_2$, PCO$_2$, pH and buffer base. The ECG was recorded throughout the anesthesia and the Apgar was scored at one and five minutes.

The patients who received thiopental, hydroxybutyrate, ketamine and lorazepam had "depressed" babies (Apgar 6) one minute after extraction, whereas all were "vigorous" (Apgar 7 or more) five minutes after.

The mean values for PO$_2$ varied between 20 and 30 torr in the umbilical vein and between 10 and 20 in the artery (Table I), for PCO$_2$ between 20 to 40 torr (Table II); the pH ranged from 7.20 to 7.35 (Table III) and the H$_2$CO$_3$ between 0.74 to 1.22 mEq/L (Table IV).

Based mainly on the pH and H$_2$CO$_3$ results, the "safest" (from the newborn point of view) among the intravenous induction agents studied were: ketamine (K), diazepam (D), thiopental (T) and propanidid (P). Alphaxalone, etomidate, lorazepam and hydroxybutyrate were within the pre-pathological range (Tables III and V).
URINARY TRACT INFECTIONS AFTER VAGINAL DELIVERY IN PARTURIENTS RECEIVING REGIONAL ANESTHESIA

Joan R. Golub, M.D., Jerome M. Federschneider, M.D., and Gerard W. Ostheimer, M.D.
Departments of Obstetrics and Anesthesia, Boston Hospital for Women, and Harvard Medical School, Boston, Massachusetts

We recently found that the high incidence of urinary retention requiring bladder catheterization in parturients receiving regional anesthesia for labor and delivery in our institution was directly related to a nursing policy of not discharging postpartum patients who have a full, distended and palpable bladder from the recovery room until they have voided voluntarily or been catheterized. This standard nursing procedure avoids patient discomfort and facilitates early postpartum care. We are unaware of any increase in urinary tract infections in these patients.

The present study was undertaken to define the incidence of urinary tract infection after vaginal delivery in parturients receiving regional anesthesia.

In our preliminary study, 50 parturients were evaluated after receiving epidural, spinal, local infiltration or no anesthesia by performing a urine culture and sensitivity on a clean voided specimen before discharge from the hospital.

Twenty-four parturients required straight catheterization one or more times during labor, delivery or recovery.

The following table summarizes our preliminary findings:

<table>
<thead>
<tr>
<th>Anesthesia</th>
<th>Catheterization</th>
<th>Urinary Tract Infection</th>
<th>Parturients Catheterized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epidural</td>
<td>18</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Spinal</td>
<td>17</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Local or None</td>
<td>15</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>24</td>
<td>6</td>
</tr>
</tbody>
</table>

The results of this preliminary study show a higher incidence of catheterization in patients receiving regional anesthesia than those who had local or no anesthesia. Patients requiring regional anesthesia appear to have a greater chance of urinary tract infections (5/6 had regional anesthesia - 4 epidural and 1 spinal) in this preliminary evaluation.
MATERNAL AND FETAL EFFECTS OF LUMBAR EPIDURAL ANALGESIA FOR LABOR AND DELIVERY IN PATIENTS WITH GESTATIONAL HYPERTENSION

Francis M. James, III, M.D., Paul Davies, Ph.D., Birmingham Maternity Hospital, Bowman Gray School of Medicine, University of Birmingham, Birmingham, England

The effects of continuous lumbar epidural analgesia for labor and delivery were studied in twenty women with gestational hypertension. Maternal hemodynamics, renal function, acid-base and blood gas findings were examined together with newborn Apgar Scores and umbilical vessel blood gas and acid-base values. Minimal change occurred in maternal renal function and hemodynamics. Maternal and newborn acid-base and blood gas findings were comparable to those of normotensive control subjects also receiving epidural analgesia. Apgar Scores in both groups of subjects were good. Continuous epidural analgesia is recommended as a useful form of therapy in the management of labor and delivery in women with gestational hypertension.
Maternal hypotension during spinal anesthesia for cesarean section is a pervasive problem. Shnider reported an incidence as high as 82%. We evaluated several methods of preventing spinal hypotension in 247 patients for cesarean section. One hundred fifty six patients were sectioned electively and were not in labor, 91 were in early labor. The methods used to prevent hypotension were the prespinal infusion (GROUP 2) of 1000 ml 5% dextrose in lactated Ringer's (D$_5$L/R), plus the use of the LUD device ("Sluder") of Kennedy (GROUP 3).

Elective Section

GROUP 1E. (27 patients). No prophylaxis was used. If hypotension occurred (defined as a fall below 100 torr systolic), the table was tilted to the left & 1000 ml D$_5$L/R rapidly infused. The table was leveled at the beginning of surgery. Twenty-five of these 27 patients (92%) became hypotensive. Thirteen of these 25 received ephedrine intravenously; the other 12 responded to the table tilt and fluid infusion. The mean dose of ephedrine was 21.8 mg. The neonatal depression rate (1 minute Apgar score 1-6) was 0%.

GROUP 2E. (76 patients). These patients were loaded with 1000 ml D$_5$L/R before the spinal was given. Forty-three became hypotensive (57%) and were tilted to the left. The table was leveled at the beginning of surgery. Thirty-two of the 43 required ephedrine. The mean dose of ephedrine was 20.1 mg. The neonatal depression rate was 1.9%.

GROUP 3E. (53 patients). These patients were loaded with 1000 ml D$_5$L/R before the spinal, and the uterus displaced with the "Sluder" after the spinal. There was no table tilting. Twenty-eight became hypotensive (52.8%). Twenty-three were given ephedrine (mean dose 25.6 mg). The neonatal depression rate was 0%.

In Labor Patients

GROUP 1L. (18 patients). There was no prophylaxis used, but only 50% became hypotensive. This group was treated the same as Group 1E; 4 of 9 received ephedrine (mean dose 27 mg). The neonatal depression rate was 11.1%.

GROUP 2L. (39 patients). Fluid loading before spinal, table tilt if hypotensive. Seventeen of 39 became hypotensive (46%). Thirteen of the 17 were given ephedrine (mean dose 27 mg). None of the infants were depressed.

GROUP 3L. (34 patients). Fluid loading before the spinal, "Sluder" after the spinal. Only 5 of the 34 (14.7%) became hypotensive (all received ephedrine - mean dose 22.5 mg). The neonatal depression rate was 0%.

Our incidence of hypotension, without prophylaxis, was a shocking 92% (GROUP 1E). If the patient was in labor however, the incidence was only 50%. By fluid loading plus LUD, the incidence was greatly reduced in both groups (92 to 52.8% in the elective group; 50 to 14.7% in the early labor group). The presence of uterine contractions may decrease the incidence of hypotension because of the squeezing of 300 ml of blood into the circulation with each contraction.

This study utilized fluid loading, plus left uterine displacement by the "Sluder" of Kennedy. Other devices, such as that of Colon-Morales, or right hip displacement with folded towels, blankets, wedges, or lateral tilt, may or may not be superior.

In summary, the infusion of 1000 ml D$_5$L/R plus uterine displacement markedly reduced the incidence of maternal hypotension and is to be recommended.
The ideal agent for conscious analgesia during vaginal delivery is elusive. Hicks, Shnider and Cohen recently reported the use of isoflurane for this purpose. 1

Enflurane is a halogenated ether closely related to isoflurane. Moreover, enflurane is commercially available. Accordingly, we studied this agent as an inhaled analgesic.

One hundred gravidas aged 16 to 42 years (mean 35) received enflurane in oxygen (1% to 1.5%) for vaginal delivery. Eight patients were primigravida and 64 were premedicated, usually with meperidine and a tranquilizer.

Eighty-eight deliveries were normal and spontaneous, usually with episiotomy. Sixty-eight patients received local infiltration or pudendal block.

Eighty-eight patients inhaled concentrations in the range of 0.50% to 0.75% for 3 to 50 minutes (mean 17). Analgesia was ranked on a scale of 0 to 3, from "no relief" to "no pain." Seventy-five patients scored themselves 2 or 3. Physicians scored 77 patients 2 or 3 and observed partial or complete amnesia in 50 patients. Seventy patients were considered cooperative.

Apgar scores were recorded for all newborns at 1, 2 and 5 minutes of age: 10, 3 and 0, respectively, scored less than 7.

Since these figures are comparable to those reported for isoflurane and nitrous oxide, enflurane appears to be a useful agent for inhalational analgesia for vaginal delivery. 1, 2

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REFERENCES


DIFFICULTIES ENCOUNTERED DURING RAPID ENDOTRACHEAL INTUBATION

James P. Anqiulo, M.D. and Charles P. Gibbs, M.D.

University of Arizona, College of Medicine, Department of Anesthesiology

The use of a rapid induction to anesthetize the patient with a full stomach is not without hazard. One of several complications may occur as a result of this technique including drug overdosage, gastric regurgitation, pulmonary aspiration, circulatory collapse, and inability to intubate the trachea.

The anesthesia records of 556 surgical and obstetric patients subjected to rapid induction were randomly selected for study. The records were examined with regard to comments concerning the difficulty of intubation. (see Table I) On 27 records (4.86%) there was a notation explaining some delay or difficulty with the intubation for any of a variety of causes including anatomic variations, endotracheal tubes which would not fit, and abnormal responses to muscle relaxants. There was no significant difference between the non-obstetric and obstetric patients. As a result of the difficult intubation, one of the 27 patients suffered a cerebral death.

A number of these problems might have been avoided with more careful examination of the patient and the equipment prior to induction. However, even with the most diligent forethought, there will be some patients who will present unanticipated problems at the moment of endotracheal intubation.

Table I

Notations on Records of 556 Rapid Inductions

<table>
<thead>
<tr>
<th></th>
<th>Non-Obstetric</th>
<th>Percent</th>
<th>Obstetric</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Notation</td>
<td>34</td>
<td>16.7</td>
<td>55</td>
<td>15.6</td>
</tr>
<tr>
<td>Atraumatic and easy</td>
<td>34</td>
<td>16.7</td>
<td>70</td>
<td>19.9</td>
</tr>
<tr>
<td>Atraumatic or intubated on one attempt</td>
<td>125</td>
<td>61.3</td>
<td>211</td>
<td>59.9</td>
</tr>
<tr>
<td>Delayed or difficult</td>
<td>11</td>
<td>5.4</td>
<td>16</td>
<td>4.6</td>
</tr>
</tbody>
</table>

TOTAL 204 352
Prenatal Anesthesia Visits: Upgrading Obstetrical Anesthesia Care

Jay S. DeVore, M.D., Alexander Bart, M.D., and Evclince Ricciarelli, M.D.

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The obstetric patient has always been a stepchild in the anesthesia world. Many excuses have been used to justify their second class treatment. Among these are lack of personnel to cover obstetrics and lack of patients to justify the coverage. However one of the most common arguments for rather cavalier treatment of the obstetric patient is that they are all emergency patients who have never been seen before and therefore it is justified to give them whatever care is available. This program was set up to upgrade the standard of care for the obstetric patient. At Prentice Women's Hospital of Northwestern Memorial Hospital in Chicago a program has been set up whereby all obstetric patients are given the opportunity and indeed are encouraged to make an elective appointment to be seen by an attending anesthesiologist prior to their admission for vaginal or abdominal delivery. Information on anesthesia is distributed to the offices of all practicing obstetricians at the hospital and appointment times are made available to all obstetric patients. Currently only those patients who express a desire to be seen make appointments. This study was devised to determine if it will be justified to make a preanesthetic visit mandatory in order to receive elective anesthesia care on the labor floor.

In the initial phase of this program a questionnaire has been devised which will be distributed randomly to post-partum patients in the hospital. This questionnaire is an attempt to determine if either subjectively or objectively patients who were seen electively do better than those who were not. The questionnaire is administered by an observer who does not know whether or not the patients had been seen prenatally. Data is being analyzed to determine if this project does indeed provide better patient care.

Though statistical analysis is not yet available the general impression is this service does indeed provide better care for the obstetrical patient. Further studies will be necessary to determine whether or not this is borne out by the facts and indeed whether the cost in time and personnel is indeed justified.
Previous studies have shown the incidence of respiratory complications following Caesarean section to be 8 to 10%. There appeared to be no relationship between the choice of anesthesia and the incidence of respiratory complications. The following study was undertaken to evaluate the predictive value of a screening pulmonary function study in identifying who would get respiratory complications.

Three hundred consecutive patients who underwent elective Caesarean section were evaluated preoperatively using a brief history of respiratory illnesses including smoking habits and a measurement of forced vital capacity (FVC) and forced expiratory volume at one second (FEV₁). The history was taken by technicians using a standard form and covered the following areas.

1. History of respiratory illnesses
2. Detailed smoking history
3. Description of cough and sputum, if present
4. History of an acute URI or sinusitis
5. History of heart disease
6. An indication of exercise tolerance
7. Allergic history
8. Medications
9. Employment and toxic exposure history

The pulmonary function studies were measured using a simple water displacement spirometer and were measured to the nearest 0.1 of a liter.

The diagnosis of a respiratory complication was made if one or more of the following criteria were met:

1. Positive chest film, usually ordered because of fever.
2. Rales or rhonchi on physical examination and a temperature of over 100°F.
3. Temperature over 100°F and a positive sputum culture in the absence of other explanation for the fever.
4. Temperature over 100°F and mucopurulent sputum requiring respiratory therapy.

Results

Thirty of the 300 patients developed postoperative respiratory complications for an overall incidence of 10%. Of those with an abnormal respiratory history (n=41), 12% developed respiratory complications. Of those with abnormal pulmonary functions (n=46), 9% developed respiratory complications. Smokers ran no additional risk of respiratory complications. Eighty-five of the 300 were smokers and their incidence of respiratory complications was 11%. Thus, neither the respiratory history, the smoking history, nor the pulmonary function studies were of value in predicting who would develop post Caesarean section respiratory complications.
FETAL FIBEROPTIC PLETHYSMOGRAPHY

The long range goal of this study is better quantification of fetal circulatory dynamics in the parturient. The present purpose is the development of a fiberoptic method for applying reflectance photometry (plethysmography) to the fetal scalp during labor.

The method is "direct" but "noninvasive." It requires that a smooth, blunt probe be applied to the fetal scalp. This may even be done before amniorrhexis. The probe emits "cold" white light from one fiberoptic bundle. The reflected light passes along a parallel bundle to a sensor. Thus, optical isolation is assured. The voltage output (analogue of the modulated carrier) of a photometer is recorded on a strip chart for subsequent graphic analysis. Interesting variables include pulse rate and characteristics of the pulse wave.*

The pulse morphology may be interpreted to suggest clinically important changes in cardiac output, ejection time, and myocardial contractility (dV/dt maximum). Some measurements are semi-quantitative. Others are only qualitative. Nevertheless, the fetal circulation can be evaluated in greater detail than is possible using routine biophysical techniques.


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During the neonatal period, human infants asphyxiated at birth display abnormal plasma electrolyte composition, low glomerular filtration, poor urea clearance, low urine output and high urinary ratio of nitrogen to potassium. Studies have been undertaken in our laboratories to investigate the causes underlying these abnormalities in renal function. One aspect of this investigation involves the renal response of the fetal lamb to repeated complete occlusion of the umbilical cord. Six fetal lambs chronically catheterized and intact in utero were studied. In each experiment there were 5 episodes of cord occlusion of 2 minute duration followed by 13 minute recovery. Fetal arterial pH fell from a mean of 7.37 to 7.31 following the first episode; during the 5th episode pH fell from 7.31 to 7.24 and rose to 7.34 during the next hour of recovery. These biochemical changes were accompanied by a fall in fetal heart rate of 30-40% and by a rise in blood pressure of 25-30% during the occlusion. These intermittent periods of occlusion of the umbilical cord produced a rise in fetal urine osmolality from a mean control value of 186 to 243 mOsm/kg following the first episode of occlusion to a maximum of 344 mOsm/kg at the end of the 5th episode. Urinary output remained essentially unchanged; while free water clearance decreased from a control of 0.12 to -0.05 ml/min at the end of the 5th episode; this was accompanied by a 50-100 fold increase (from 2.5 to 230 pg/ml) in fetal plasma vasopressin concentration. During the same period, urine sodium concentration rose from 46 to 98 mEq/L, chloride from 22 to 65 mEq/L and potassium from 5.0 to 12.8 mEq/L. Urinary electrolyte concentrations remained elevated for at least two hours after the termination of the occlusions. These studies indicate that complete interruption of the umbilical circulation even though of short duration can lead to a loss of electrolytes in the urine. These losses are even greater than have been reported previously with partial cord occlusion, of longer duration and appear to be related to a sudden rise in plasma levels of vasopressin following each episode of cord occlusion.

Supported by: United States Public Health Grant GM 09069 and the National Foundation Grant T-339
TEMPERATURE GRADIENT BETWEEN FETUS AND MOTHER AS AN INDEX FOR ASSESSING INTRAUTERINE FETAL CONDITION
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The fetal temperature in utero is slightly higher than that of the mother and the gradient between fetus and mother ($\Delta T_{FM}$) appears to be maintained through heat exchange across the placenta, rather than a heat transfer from fetal skin to amniotic fluid to uterine wall. Previous observation has shown that the $\Delta T_{FM}$ is altered during fetal deterioration, induced by maternal hyperthermia in the baboon. The present experiment was designed to examine whether the measurement of $\Delta T_{FM}$ is a predictive index in assessing the intrauterine condition of the fetus, in addition to monitoring of the heart rate. Twenty-nine pregnant baboons near term were observed. Catheters were placed in the maternal and fetal artery and vein, and the amniotic cavity. Thermocouples or thermistor probes were implanted in the fetal esophagus, scalp, and the shoulder muscle, and the maternal rectum and abdominal cavity. Arterial blood pressure and heart rate, temperature in both mother and fetus, as well as the intra-amniotic pressure, were measured and recorded continuously. Blood pH and gases were determined serially. The maternal temperature was kept between 37.5 and 38.5°C throughout the experiment. During steady state the mean $\Delta T_{FM}$ was $0.49 \pm 0.074$ (S.E.)°C. Acute fetal deterioration was produced over 5 to 30 minutes either by a marked increase in uterine activity, or by reduction of blood supply to the fetus, by occlusion of the umbilical cord or compression of maternal vena cava or abdominal aorta. In 1/2 of these deteriorated fetuses there was a marked increase in $\Delta T_{FM}$, to an average of $0.66°$C. However, the remaining fetuses in which the duration of stress was shorter than 10 minutes, did not change $\Delta T_{FM}$. Gradual deterioration of the fetus during strong labor over a period of 1 to 5 hours was accompanied by a gradual decrease in $\Delta T_{FM}$, to about $0.09°$C. Prior to fetal death there was a further fall in $\Delta T_{FM}$, fetal temperature equalling maternal core temperature. After the cessation of vital signs in the fetus a reversed relation was obtained.

These observations in baboons indicate that $\Delta T_{FM}$ is a useful index for evaluating fetal condition during steady state, gradual fetal deterioration, or death. However, it is not a reliable index in case of acute distress; at least 10 minutes elapsed in a state of thermal equilibrium before a difference in temperature was reached between fetal and maternal tissues.

Supported in part by Grant 5P01 - GM09059, NIGMS, NIH.
Sodium Nitroprusside is widely used for the treatment of severe arterial hypertension, and has been used in cases of severe pre-eclampsia. Recently, however, attention has been directed to the fact that the immediate products of nitroprusside biotransformation are Hydrocyanic acid and Thiocyanate. Several fatal episodes of cyanide intoxication have been attributed to nitroprusside infusion.

The potential for placental transfer and fetal toxicity of Sodium Nitroprusside is unknown. Therefore, we have designed a nitroprusside assay to determine placental permeability in the sheep of this drug, and have measured blood cyanide levels in both mother and fetus simultaneously. We have also investigated the hemodynamic effects of nitroprusside infusion in the normotensive pregnant ewe.

Preliminary data suggests that the nitroprusside infusion decreases maternal and fetal blood pressures, while uterine and umbilical blood flows increase slightly or remain the same. Nitroprusside is detectable in significant amounts in fetal blood, and significant levels of cyanide ion are found in both mother and fetus. Fetal levels of cyanide usually far exceed maternal levels, reflecting either an increased rate of production of cyanide from nitroprusside in the fetus or a lesser ability to detoxify and excrete the cyanide produced. Several fatalities in fetuses have occurred in this study, and lethal levels of cyanide were present in these animals. Studies are presently in progress to further elucidate this phenomenon.
The experiment was conducted in three chronically catheterized pregnant sheep, with intact fetus in utero, an electromagnetic flow transducer was placed on a main maternal uterine artery. Maternal heart rate (MHR) blood pressure (MBP) and respiratory rate (MRR) fetal blood pressure FBP and heart rate (FHR) maternal uterine blood flow (UBF) and amniotic pressure (AP) maternal and fetal acid-base balance were continuously measured and recorded during the time of each experiment.

Regular uterine contractions, comparable to early labor, were successfully induced with continuous infusion of oxytocin, 40 to 80 mU/min reducing UBF by 20%. FBP was infused intravenously to the mother at a rate of .2, .4 and .8 µg/kg/min. It suppressed uterine activity 50, 75 and 100 percent respectively within a few minutes after the onset of the infusion. No changes were noticed in the fetal cardiovascular or acid-base conditions. Maternal heart rate increased by 25%, maternal systolic pressure rose from 140 to 150 mmHg diaostolic pressure decreased from 90 to 84 mmHg. Uterine blood flow returned to pre-oxytocin levels. Maternal heart rate was unchanged.

Bolus injections of 250 µg terbutaline immediately suppressed uterine activity. Maternal tachycardia occurred with a 50% increase in uterine blood flow. Fetal heart rate increased from 160 to 190 beats/minute. All changes were only transient.

Thus terbutaline appears to be an effective tocolytic agent on oxytocin-induced labor compared to the partial efficacy of other drugs such as orciprenaline, tosidoxide salbutamol or ethanol. Terbutaline appears to have less effect on the cardiovascular system of both mother and fetus. Clinically recommended dose of 0.4 µg/kg/min seems to be effective on the pregnant uterus in sheep. However, further experiments are needed to draw the conclusion.

Supported in part by Grant 5P01 - GM09069, NIGMS, NIH
THE EFFECTS OF DOPAMINE ON UTERINE BLOOD FLOW AND FETAL ACID-BASE STATUS IN THE PREGNANT EWE


Dopamine increases arterial blood pressure, cardiac output, and renal and splanchnic blood flow in non-pregnant normotensive and hypotensive animals. We asked if a similar increase might occur in the uterine blood flow of pregnant animals.

Pregnant ewes were anesthetized with halothane:0₂ for the placement of electromagnetic flow probes on the right renal artery and the uterine artery supplying the pregnant horn. Vinyl catheters were inserted into the maternal right atrium, right and left femoral arteries and veins, amniotic fluid, and the fetal right and left femoral arteries. The ewe then was allowed approximately 36 hours to recover before proceeding with the study. After a control period during which time maternal and fetal cardiovascular and acid-base variables were stable, dopamine was infused at randomized rates of either 5, 10, 20, 30, or 40 μg/kg/min for 30 minutes each. Following each infusion, the animal was allowed to return to control conditions (30 minutes) prior to beginning another infusion.

There was no significant change in renal blood flow at any level of dopamine administration. No cardiovascular changes occurred with the 5 or 10 μg/kg/min infusion. An infusion of 20 μg/kg/min was necessary to produce a significant rise in maternal arterial pressure, cardiac output, and stroke volume. At this dose, uterine blood flow was decreased 30 per cent (p < .025). Maternal arterial pressure was increased at all higher dopamine infusion rates. Uterine blood flow and uterine vascular conductance fell as the blood pressure increased. Total peripheral resistance decreased at 20 μg/kg/min, then increased at 40 μg/kg/min. There were small but statistically significant increases in maternal Pco₂ (approximately 5 torr) during infusion of 20 and 30 μg/kg/min. There were no significant changes in fetal oxygenation or acid-base status.

Presuming the applicability of these data to man, they suggest that dopamine at doses which alter cardiovascular dynamics results in a decrease in uterine blood flow.
INTRAVENTOUS FLOW AFTER

OXYTOCIN AUGMENTATION OF LABOR

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Department of Anesthesiology
UCLA School of Medicine

Delayed induction of general anesthesia has been attributed to venospasm after an oxytocin drip. The present study investigates the effect of oxytocin on intravenous flow rate. The resistance to intravenous flow may be determined by measuring the pressure in the intravenous cannula during a known flow rate.

Pregnant patients in labor were given a rapid intravenous infusion of saline (35 ml/min) via a Harvard pump and the pressure in the intravenous cannula was measured by a transducer.

Pressure measurements were made through the same intravenous cannula before and after oxytocin augmentation of labor.
In a series of 118 monitored labors 86 fetuses were found to demonstrate abnormal heart rate patterns of variable deceleration (VD) and late deceleration (LD). Using the Kubi scale these were further subdivided into: A) VD - mild 21, moderate 15, severe 15 and B) LD - mild 6, moderate 15, severe 16. These groups were compared to a control population of 30 patients who had no abnormal FHR patterns. Fetal and neonatal heart rate recordings were accomplished by cardiotachometer. At birth the umbilical cord was doubly clamped and blood gas analyses were done immediately. Neonatal blood gases, pH, and base deficit were determined on umbilical arterial blood via an indwelling catheter reaching the level of the diaphragm in the mother. pH, PO2 and PCO2 and base deficit were performed 4, 8, 16, 32 and 64 minutes following birth, while heart rate was recorded continuously.

The results are: HR in all degrees of VD is elevated from 4 to 16 minutes. LD is related to an immediate bradycardia at 2 minutes. LD-moderate shows a significant tachycardia between 4 and 16 minutes. Umbilical cord pH is significantly lower in VD (Fig. 1) and LD of moderate and severe forms. Neonatal pH falls to its lowest point at 4 minutes in all groups with a sharp rise between 4 and 6 minutes and gradual rise thereafter. Only neonates with VD - severe and LD - severe show a significant acidosis throughout the first hour of life. Oxygen tension changes fastest of all blood parameters measured. There are no significant differences in umbilical cord or neonatal PO2 values in all degrees of VD or LD. Carbon dioxide tensions fall gradually from umbilical cord levels until 8 minutes of age and plateau thereafter. Umbilical cord PCO2 is significantly higher with VD - severe. However, no significant differences were noted during the neonatal study period.

CONCLUSIONS: 1) Neonatal pH of the severe degrees of VD and LD are more acidic during the first hour of life. 2) HR with all degrees of VD and LD - moderate shows a rebound tachycardia. 3) Umbilical arterial cord specimens demonstrate a lower pH with moderate and severe degrees of VD and LD. 4) Neonatal PO2 and PCO2 show no appreciable differences with either VD or LD. 5) Neonates who demonstrated fetal distress during labor, as judged by the presence of abnormal FHR patterns, show a remarkable recovery in the first few minutes of life.

### NEONATAL pH WITH VARIABLE DECELERATION (VD)

<table>
<thead>
<tr>
<th>pH</th>
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<tr>
<td>7.10</td>
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</tr>
<tr>
<td>7.15</td>
<td>4</td>
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<tr>
<td>7.20</td>
<td>8</td>
</tr>
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<td>7.30</td>
<td>32</td>
</tr>
<tr>
<td>7.35</td>
<td>64</td>
</tr>
</tbody>
</table>

**FIG. 1:** pH of umbilical artery (UA) at birth and during 64 minutes following delivery of fetuses demonstrating variable decelerations during labor.
EFFICACY OF TRANSCUTANEOUS ELECTRICAL STIMULATION FOR

RELIEF OF LABOR PAIN

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Department of Anesthesiology
UCLA School of Medicine

Transcutaneous electrical stimulation is the stimulation of skin with electrical pulsations. It has been found to be a safe, noninvasive method for relief of acute and chronic pain. The present study evaluates the effectiveness of transcutaneous stimulation for the relief of labor pain.

The electrical stimulator used was powered by a nine-volt battery and was electrically isolated. It produced an alternating current with an attenuated square waveform. The amperage ranged from 1-5 milliamps, the frequency from 10-100 Hertz, and the duration from 0.1-1.5 milliseconds. The skin electrodes were sponge rubber and were fitted inside adhesive EKG electrode pads.

Subjects were pregnant women undergoing second trimester prostaglandin stimulated abortions. These patients experience labor pain for several hours and after delivery of the fetus receive uterine curettage. The patients received either continuous epidural anesthesia or transcutaneous electrical stimulation over selected acupuncture points. The subjects and the investigator judged the effectiveness of the anesthesia.
DIRECTIONAL CHARACTERISTICS OF THE
WHITACRE SPINAL NEEDLE

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Department of Anesthesiology
UCLA School of Medicine

The level of a spinal anesthetic may be influenced by patient position, level and rate of injection, and specific gravity, dose, and volume of drug injected. A spinal needle which directs the flow of drug caudad or cephalad may also influence the level of anesthesia.

The present study examines the directional characteristics of the 22 gauge pencil-point lateral orifice spinal needle, also known as the Whitacre spinal needle.

Dye was injected under controlled conditions through a Whitacre spinal needle into a glass model of a spinal canal. The orifice was aimed in different directions and the distance the dye traveled was measured.

Patients undergoing elective Cesarean section were administered spinal anesthesia using the Whitacre needle with the orifice aimed in different directions and the sensory levels measured.
Theophylline is being used successfully for the treatment of apnea in low birth weight infants. Practically no information is available regarding the pharmacokinetics of theophylline in low birth weight infants. We recently developed a rapid and specific high pressure chromatographic assay which allows analysis of theophylline in 0.1 ml. of serum or less. This microassay has permitted the examination of theophylline disposition during the course of treatment of apnea of several infants. The purpose of this report is to relate our initial experience in monitoring theophylline therapy in infants. These pharmacokinetic data may assist in formulating and modifying therapeutic regimens for use of theophylline during early postnatal development. Theophylline treatment was initiated with a dosage regimen of 2 mg/kg every 6 hours administered in aqueous solutions via a nasogastric tube. Following cessation of therapy, additional blood samples were collected at 2, 4, 6, 8, 11, 14, & 24 hours for assay of theophylline. Upon cessation of theophylline therapy, the decline in serum concentrations yielded a half-life of about 20 hours. This value is considerably longer than the half-life of the drug in adolescent patients who exhibit a $t_{1/2}$ averaging only 3.7 hours. Other parameters which could be calculated at the end of therapy were the body clearance and apparent volume of distribution. The $Cl_B$ values ranged from 36 to 52 ml/hr/kg, appreciably less than average of 87 ml/hr/kg reported in older children. The $V_D$ was relatively large in the large infants, 0.60 to 0.74 l/kg. Adolescent patients and adults have a $V_D$ averaging 0.42/kg. The larger fraction of body water in the infants undoubtedly accounts for this difference in volume. These computations assume that theophylline is fully absorbed in the neonate. Incomplete absorption would lead to relatively smaller $Cl_B$ and $V_D$ values if appropriately corrected for. Absorption of theophylline appears to proceed slowly in the neonate. On several occasions samples were collected before and at two hours after the oral dose of the drug. In all instances, the difference in serum concentration was less than 2 mg/liter, reflecting both the slow absorption and slow elimination of the drug. Thus it seems appropriate to monitor serum theophylline concentrations at any time during a dosing interval because of the slow change in serum levels which have been observed. The body clearance observed at the end of theophylline therapy overestimated the lower functional body clearance observed during the first week of life. The maturation of liver function, the major route of elimination of theophylline, probably accounts for this phenomenon in these infants. A general pharmacokinetic principle is that at least four half-lives are required before a steady-state will be attained during continuous multiple dosing. Thus, these patients will not be in true steady-state until 3 to 6 days after initiation of therapy. To overcome this lag phase and to rapidly generate an average serum concentration of about 8 mg/liter, an oral loading dose of 5 mg/kg could be administered (8 mg/l. = 5 mg/kg x $V_D$). This can be followed by a maintenance dose of 1.5 to 2 mg/kg every 8 hours. Secondly, early serum concentration data are highly variable for these infants which necessitates careful observation and analytical monitoring to assure a safe and effective dose. Thirdly, when the dosage must be diminished, one to three doses of theophylline should be omitted in order to allow an adequate fall in serum concentrations to the desired lower level before the new regimen is instituted. Finally, it appears that early maturation of the liver leads to an increased body clearance and relatively lower serum concentrations of theophylline. Thus it might be necessary to gradually increase the dose of theophylline with time in order to maintain serum concentrations in the therapeutic range. Our comments are based on limited pharmacokinetic observations which will be eventually supplemented from a larger database.
ASPHYXIA AS A CAUSE OF HYALINE MEMBRANE DISEASE. Gonzalo Mantilla, Barry V. Kirkpatrick, William H. Donnelly, Hugh W. Calderwood, Jack R. Hessler, and Donald V. Eitzman, Univ. of Fla. College of Medicine, Departments of Pediatrics, Comparative Medicine, Pathology, and Anesthesiology, Gainesville, Florida.

To evaluate asphyxia as a significant determinant in hyaline membrane disease, premature monkeys were delivered by C-section at a gestational age of 139-150 days, which is before the surge of surfactant as measured by the L/S ratio. An experimental group was asphyxiated for five minutes at the time the infant was delivered. The control group was matched for age and both groups were managed the same way with oxygen as needed and ventilation. There was a significantly greater incidence of hyaline membrane disease on the basis of histopathology in the asphyxiated group. The other data analyzed includes right-to-left shunts and at the termination of the experiment (3 hours), when the animals were killed, the lungs were excised. Several lung stability indices and the area of hysteresis were plotted during the generation of pressure volume curves, as described by Avery et al.

<table>
<thead>
<tr>
<th></th>
<th>HISTOPATH.</th>
<th>R-L SHUNTS&gt;50%</th>
<th>LUNG STABILITY</th>
<th>HYSTERESIS</th>
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<tr>
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<td>9</td>
<td>8/9</td>
<td>8/9</td>
<td>L₁, L₃</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.50±.29</td>
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<tr>
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<td></td>
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<td>29.8±20</td>
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<td>Control</td>
<td>8</td>
<td>2/8</td>
<td>3/8</td>
<td>.89±.37</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td>36.7±57.2</td>
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<td>27±41.9</td>
</tr>
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<td></td>
<td></td>
<td></td>
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<td>11.4±11.4</td>
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</tbody>
</table>

Asphyxia is a significant determinant of hyaline membrane disease in the premature primate and modifies the animal’s ability to stabilize its lung. Management of the perinatal period in the high-risk premature infant is critical to the development of pulmonary disease and to the survival of this group of babies.
A PROSPECTIVE CONTROLLED TRIAL OF ORAL KANAMYCIN PROPHYLAXIS FOR NEONATAL NECROTIZING ENTEROCOLITIS. Edmund A. Egan, Gonzalo Mantilla, Robert M. Nelson, and Donald V. Eitzman, University of Florida College of Medicine, Department of Pediatrics, Gainesville.

In July, 1974, a prospective controlled study was initiated to determine if a regime of oral kanamycin, 15 mg/kg/day in a t.i.d. dosage prevented neonatal necrotizing enterocolitis. The study was limited to infants under 1500 grams birthweight who survived to feedings. Placement in treatment or control group depended only on whether the last digit of the hospital number was even or odd. Blood levels of kanamycin were determined in the first 12 treatment infants and were less than 0.5 mg/ml, the level of detectability of the test. Diagnosis of necrotizing enterocolitis required radiologic confirmation of pneumatosis or pneumoperitoneum. In the 13 months of the study, there were 5 cases in 40 control infants and zero cases in 35 treatment infants (p=0.038, Fisher's Exact Test). Further analysis of 18 separate factors, possibly associated with enterocolitis, showed no difference between treatment and control groups. The infection rate was the same in both groups, although kanamycin resistance reappeared in coliform organism isolated from nursery patients during the study. The study demonstrated effectiveness of prophylactic oral kanamycin in preventing necrotizing enterocolitis in small premature infants.

Continuous positive airway pressure (CPAP) is a proven form of therapy in neonates with pulmonary disease. Complications most frequently described have been some type of airleak or a metabolic acidosis ascribed to decrease in cardiac output. Only in meconium aspiration has there been mentioned an increase in right-to-left shunts (Qs/Qt) with the use of CPAP. In the past 18 months at Shands Teaching Hospital, 5 neonates have shown an increased Qs/Qt while on CPAP. The patients had a gestational age between 28 and 40 weeks and weighed between 960-3300 grams. All infants had clinical respiratory distress, hypoxemia and 4/5 had respiratory failure. Nasal CPAP was instituted in 2 and positive pressure ventilation with CPAP for the other 3. As CPAP was raised because of increasing hypoxemia, Qs/Qt increased from a mean of .60 to a mean of .73. CPAP was then lowered, by an average of 50%, and Qs/Qt fell in each. After lowering CPAP the mean Qs/Qt was .37. In no case did an airleak occur. Levels of CPAP producing the increased shunting were low, 4-10 cmH2O. Two possible mechanisms for this paradoxical effect of CPAP are discussed. (1) CPAP may have primarily hyperinflated already open alveoli. Hyperinflation of airspaces will increase the pulmonary vascular resistance in these areas, and this could increase the fraction of pulmonary blood flow perfusing unventilated airspaces. (2) CPAP can increase total pulmonary vascular resistance above systemic resistance and produce extrapulmonary shunting thru the ductus arteriosus or the foramen ovale, as we have demonstrated in immature goats. The danger of increased Qs/Qt as a result of CPAP should be considered in any neonate in whom the PaO2 falls in response to increasing CPAP.
Neonatal Blood Pressures as Influenced by Obstetric and Anesthetic Conditions

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Indiana University School of Medicine

Marx et al have reported that newborn blood pressure is influenced by the maternal anesthetic. The present study sought to determine the range of blood pressure measurements in the newborns. Conceivably factors other than the anesthetic drugs could influence these measurements. Therefore, we measured blood pressure within 10 minutes after delivery in 68 newborn infants using an Infra-sonde System Model 3000.

Blood Pressures were placed in three groups. Type of delivery, anesthetic, and complications were recorded. Results are summarized in the following table:

<table>
<thead>
<tr>
<th>Group</th>
<th>Average Systolic (mmHg)</th>
<th>Range</th>
<th>Type of Anesthetic</th>
<th>Obstetric Procedure</th>
</tr>
</thead>
<tbody>
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<td>I</td>
<td>68</td>
<td>66-86</td>
<td>1 Epidural</td>
<td>Mid forceps rotation</td>
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<td></td>
<td></td>
<td></td>
<td>2 Pudental</td>
<td>1 Meconium aspiration</td>
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<td></td>
<td>3 Pudental</td>
<td>1 Base deficit infant - 6</td>
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<td>6 Saddle block</td>
<td>1 Pre-eclamptic</td>
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<td></td>
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<td></td>
<td>1 General anesthetic</td>
<td>3 Deceleration with protracted Valsalva</td>
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<tr>
<td>II</td>
<td>56</td>
<td>50-62</td>
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<td>NVD</td>
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<td></td>
<td></td>
<td>9 Epidural</td>
<td>1 Variable deceleration ph UA 7.11</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>4 Pudental</td>
<td>NVD</td>
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<td></td>
<td>5 Pudental</td>
<td>NVD</td>
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<td></td>
<td>5 Spinal</td>
<td>Cesarean Section</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>5 General</td>
<td>Cesarean Section</td>
</tr>
<tr>
<td>III</td>
<td>44</td>
<td>40-48</td>
<td>1 Epidural</td>
<td>Forceps rotation</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>4 Saddle</td>
<td>1 SGA infant</td>
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<td></td>
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<td></td>
<td>5 Spinal</td>
<td>1 Mother on Valium</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4 General</td>
<td>Cesarean Section</td>
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<td>Cesarean Section</td>
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<td></td>
<td></td>
<td></td>
<td>1 2.6 Kg infant</td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>1 Torn uterine artery</td>
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<td></td>
<td>1 35-36 week infant</td>
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<td></td>
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<td>developed RDS</td>
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General anesthesia was used only for cesarean section. This was performed in the following manner. Following pre-oxygenation with 100% oxygen thiomyal (3-4 mgm/Kg.) and succinylcholine were administered. Endotracheal intubation utilizing cricoid pressure insured the airway. N2O, 3L/min O2 3L/min was uniformly adequate until delivery of the infant. Appropriate additions of anesthetic agents were administered after that event.

The tendency to lower blood pressure in infants born by cesarean section is reemphasized in this study. The influence of obstetric procedures is suggested. The contrast between general anesthesia including barbiturate and regional anesthesia was not evident.
A PROPOSED METHOD OF OBJECTIVE MEASURE OF PAIN IN LABOR

Robert B. Roberts, M.D.; Norman Sonnenklar, M.D.
Mount Sinai School of Medicine

Assessment of pain relief in labor has been entirely subjective, usually based on a scale of 1 to 5, complete, very good, fair, poor, and nil. Observer as well as subjective assessments are utilized and are fallible.

The placement of an intrauterine balloon catheter to record uterine contractions has enabled us to measure objectively changes in the patient's appreciation of pain. Duration of pain and intrauterine pressure relationships during the contractions were compared without asking any questions other than "Do you have pain?". A simple switch allowed the patient or observer to mark on the monitoring trace the start and the end of pain. Intensity or response to that pain were not considered, as these are subjective. Assuming that in an individual patient the longer the duration of pain, the more the pain and, secondly, that the lower the uterine pressure at which pain is first appreciated represents a greater response than if the pain were not appreciated until a higher uterine pressure, then we can express this:

\[
\text{Intensity of Pain} \times \frac{\text{I.U.P. at Height of Contraction (mm Hg.)}}{\text{Duration of Pain (secs)}} \times \frac{\text{I.U.P. at Onset of Pain Appreciation (mm Hg.)}}{\text{Duration of Contraction (secs)}}
\]

Results are expressed graphically; examples are given to show the response and the time relationships with both parenteral medication and regional anesthesia. The delay until onset of pain relief is sharply delineated as well as the exact time and duration of maximum effect. This presentation is to test methodology and analyze information.
Modification of Neutrophil Chemotaxis by Amniotic Fluid
Abdul J. Khan, Leonard Glass, Chia Chang, Parvin Khan,
Ethan Levy and Hugh E. Evans, Department of Pediatrics,
Jewish Hospital and Medical Center of Brooklyn, New York

The immunologic properties of amniotic fluid (AF) are not well understood. We assessed the effect of 8 term AF specimens on chemotactic migration of neutrophils (PMNs) obtained from 8 non-pregnant adults.

Standard chemotactic indices (CI) were determined utilizing a modified Boyden's technique in which PMNs were placed on a 3 μm micropore filter in the upper chamber, containing Hank's solution (H) and chemotactic mixture, containing endotoxin (E) normal AB serum (S) and H in the lower chamber. CIs obtained with H alone in both chambers represented random migration (RM).

The effect of AF on CI was evaluated by 1) adding AF to the upper chamber 2) adding AF instead of E to the chemotactic mixture 3) placing only H and AF in the lower chamber. The results represent mean and (standard deviation).

<table>
<thead>
<tr>
<th>Upper</th>
<th>H</th>
<th>H+AF</th>
<th>H</th>
<th>H</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower</td>
<td>S+E+H</td>
<td>S+E+H</td>
<td>S+AF+H</td>
<td>H+AF</td>
<td>H</td>
</tr>
<tr>
<td>CIs</td>
<td>340 (115)</td>
<td>219 (102)</td>
<td>172 (50)</td>
<td>81 (39)</td>
<td>60 (27)</td>
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</table>

AFs significantly retarded the CIs when added to the upper chamber (p=0.03) when added to S, they generated chemotactic activity which was significantly less (p<0.01) than that generated by E but higher (p<0.01) than AF and H or H alone in the lower chamber. The activity of AF + H was similar to RM.

The findings suggest that AF inhibits chemotactic migration of PMNs, and also generates chemotactic factors from the serum. It may be speculated that AF in association with serum chemoattracts PMNs at the onset of amniotic infection syndrome, and later on keeps them at the site by inhibition of chemotaxis.
Several studies have demonstrated both immediate and long term delivery medication effects on infants' ability to process auditory stimuli (Brackbill et al., 1974; Conway & Brackbill, 1970; Kron et al., 1966; Vander Maelen et al., 1975; Bakeman & Brown, 1975; Sostek & Brackbill, 1975). The present study investigated whether the visual modality is similarly affected by obstetrical medication. Subjects were 110 4- and 5-month old normal infants who were born following full term, low risk pregnancies. They were grouped according to the delivery medication their mothers had received: general, regional, or no anesthesia; analgesia; oxytocin. The groups ranged from full premedication plus general anesthesia to no premedication or delivery medication (natural childbirth). Subjects were exposed to the same visual stimulus (a schematic face) on 6 successive trials. Dependent measures were decrement in looking over trials and amount of looking for all trials combined. All groups habituated, i.e. showed decrement in visual attention over trials. Individual analyses suggest that delayed decrement was associated with premedication rather than medication. On the other hand, between-group comparisons for amount of visual attention suggest that this behavior may be depressed by general anesthesia. These results are clearly less strong than are those linking obstetrical medication to changes in auditory processing. Their interpretation focusses on this inter-sensory comparison in conjunction with the differential rates pre- and post-natally at which visual and auditory systems mature both structurally and functionally.
The incidence of gestational diabetes has been quoted between 1 and 2 percent. The criteria used to establish this incidence are in error, leading to identification of fewer patients. Using the criteria established by O'Sullivan et al, we were able to pick up an incidence of gestational diabetes of 5.2 percent, but this may still be in error, because of some patients who had abnormal insulin curves, but did not have abnormal glucose tolerance tests. Our study seems to suggest that insulin measurement may be a better method of detecting gestational diabetes than the glucose tolerance test, and that the incidence of gestational diabetes may be even higher than 5 percent.
EFFECT OF MORPHINE-DIAZEPAM ON AWARENESS AND DREAMS OF PATIENTS UNDER NITROUS OXIDE ANESTHESIA FOR CESAREAN SECTION.

Ezzat Abouleish, M.D., Magee-Womens Hospital, Pittsburgh- Pennsylvania and Floyd H. Taylor, Sc.D. University of Pittsburgh, Pittsburgh, Pennsylvania

In 68 cesarean sections (C.S.), under general anesthesia using thiamyal plus N₂O-0₂ (4:2) and muscle relaxant, 0.2 mg/kg morphine and 0.1 mg/kg diazepam to a maximum of 15 mg and 7.5 mg respectively, were injected intravenously into the mother after delivery of the fetus. Twenty-four to thirty-six hours postoperatively, one patient had recall, one had unpleasant dreams and two had pleasant dreams. The incidence of recall and unpleasant dreams was 3.8% in elective, and 0% in emergency C.S. Morphine-diazepam combination caused anterograde and retrograde amnesia. During surgery, movement of patient, size of pupils or changes in blood pressure were not indicative of awareness or dreams. During anesthesia, 33% O₂ produced adequate oxygenation of mother and fetus. Maternal arterial and fetal umbilical venous blood PCO₂ as well as base excess showed strong correlation when the fetus was normal. Such correlation was absent with compromised or distressed fetus. Base excess and one-minute Apgar score were the only parameters showing significant difference between normal and compromised fetus.
LUMBAR EPIDURAL ANALGESIA FOR LABOR AND DELIVERY OF TWINS

Francis M. James, III, M.D., J. Selwyn Crawford, M.D., Ch.B., F.F.A.R.C.S., D.A., M.D. (III.) and Paul Davies, Ph.D.
Birmingham Maternity Hospital, Bowman Gray School of Medicine, and the University of Birmingham, Birmingham, England

The delivery of a multiple pregnancy is an obstetric problem requiring the aid of expert anesthetic care. In the past, controversy has existed concerning the use of major conduction analgesia for labor and delivery of twin pregnancies. This study was conducted to increase knowledge of the effects of lumbar epidural analgesia on mother and infants rather than to settle the differences of opinion concerning the best type of anesthesia for labor and delivery in twin pregnancies.

Fourteen women with twins received lumbar epidural analgesia for labor and delivery. Maternal radial artery samples were taken prior to the start of or as early in labor as possible and again at the time of delivery. Infant observations included Apgar scores and umbilical vessel blood gas and acid-base determinations. These resultant values were compared to those of women receiving epidural analgesia for labor and delivery of a single infant.

The results of lumbar epidural analgesia for labor and delivery of twins at the Birmingham Maternity Hospital have been good. Our small series reporting umbilical vessel acid-base and blood gas values confirms the well-known problem of second twin compromise, but this was minimal and was more pronounced in second twins with non vertex presentations as would be expected. Apgar Scores and blood gas findings for first twins were virtually the same as for singleton control infants. We feel that there is much to recommend lumbar epidural analgesia for labor and delivery of twins, and that it is a safe form of analgesia in this situation.
A COMPARISON OF GENERAL ANESTHESIA AND LUMBAR EPIDURAL ANALGESIA FOR ELECTIVE CESAREAN SECTION

Birmingham Maternity Hospital, Bowman Gray School of Medicine, and the University of Birmingham, Birmingham, England
Francis M. James, III, M.D., J. Selwyn Crawford, M.B., Ch.B., F.F.A.R.C.S., D.A., M.D. (III.), Paul Davies, Ph.D.

Controversy exists concerning the choice of anesthetic technique for elective cesarean section. Several maternal and newborn parameters were compared during general anesthesia and epidural analgesia. The technique of general anesthesia employed minimized the depressant effects of intravenous and inhalation anesthetics with the added advantage of providing a 66 percent inspired oxygen concentration.

Vigorous well oxygenated infants with good umbilical cord acid-base values were delivered during both general anesthesia and epidural analgesia. Umbilical artery pH values were better with general anesthesia, but one minute Apgar Scores were higher and time to sustained respiration was shorter with epidural analgesia.

From the infant's standpoint neither technique can be vigorously recommended over the other. Maternal preferences will vary and should be honored provided the anesthetist is skilled in both techniques.
Respiratory Distress (RD) may occur in infants delivered by elective cesarean section (ECS) as a result of either lung immaturity or CS or both. It may be argued that amniocentesis for assessment of fetal lung maturity should precede ECS, but data for such recommendation is lacking. In 121 ECS transuterine needle aspiration for amniotic fluid (AF) was attempted (successfully in 75) prior to hysterotomy. In 19 unsuccessful cases, gastric aspirates (GA) were obtained from infants within 30 minutes of birth. The AF and GA were analysed by the foam stability test (FST) as an indicator of lung maturity. The timing and indications of ECS were independently determined by attending obstetricians who were unaware of the aims of the study. Objective scoring for transient respiratory distress syndrome (RDS) were done by nursery staff unaware of FST results. The mean birth weight was 3280 gms; mean gestation 38.6 wks. Of the 73 infants with a positive FST, 2 had TRD. In 13 infants with an intermediate FST, 1 had TRD and 1 RDS. In 8 infants with a negative FST, 4 developed TRD and 2 had RDS. The incidence of respiratory difficulty due to inadequate lung maturity is 9% (8/94) which could be reduced to 3% (2/73) if there were appropriate delay for ECS when intermediate or negative FST was observed. The data suggest that assessment of fetal lung maturity seems indicated to minimize respiratory difficulty in infants delivered by ECS.

<table>
<thead>
<tr>
<th>GROUP</th>
<th>POS</th>
<th>INT</th>
<th>NEG</th>
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<tbody>
<tr>
<td>TRD or RDS</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>NORMAL</td>
<td>71</td>
<td>11</td>
<td>2</td>
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BLOODGAS EFFECTS OF MEPERIDINE ANDNALOXONE
ON THE FETUS AND NEWBORN

E. Lanz and P. Knapstein
University of Alabama, Birmingham and University of Mainz, Germany

Purpose of this study was to examine 1) the bloodgas effects of Meperidine on mother and fetus during labor and delivery, 2) the antagonizing effects of different dosages of Naloxone in the newborn, 3) the non-existing respiratory depression of Naloxone in the newborn, described in the literature.

Methods: To 50 parturients during labor Meperidine was given IM 1.5 mg/kg initially, thereafter 0.75 mg/kg every 2 hours. The initial dose was combined with Dehydrobenzperidol (DHB) 0.1 mg/kg. For the vaginal delivery 300-500 mg was injected IV.

Maternal blood gases were taken at cervical dilation 5 and 10 cm and at delivery. Blood gas analyses from the fetal scalp were performed at a cervical dilatation of 5 and 10 cm and from the umbilical artery at delivery.

In a blind study Naloxone 0.03, 0.02, 0.01 mg/kg or a placebo were injected into the umbilical vein. The 4 groups of dosage were determined in a randomized manner. Blood gas analyses by heelstick in the newborns were done at 15, 30, 60, 120 and 240 minutes postpartum.

Results: The mean Meperidine dosage was 130-160 mg. The median of the interval between 1. injection to delivery was 2 1/2-4 hours, of the interval between last injection to delivery 1 3/4-2 hours. The mean DHB medication varied between 6.4 and 7.7 mg.

The maternal pH dropped slightly during labor and delivery (7.41 to 7.35); pCO2 (27-25 Torr) and pO2 (100-90 Torr) stayed in the same range. The 50 newborns showed Apgar scores 9 and 10 with one exception. The pH values of the newborns, whose mothers had received different dosages of Naloxone or the placebo, did not differ significantly from each other. At delivery, 15 and 30 minutes later, the acidosis was most marked (mean pH 7.25). The pCO2 values, varying within a wide range, were not differing from each other. They were highest at delivery (40 Torr) and fell continuously thereafter. The pO2 values didn't differ either. They were lowest at delivery (25 Torr) and increased markedly after 15 minutes (47 Torr).

Conclusions: It could be shown by bloodgas analyses that Meperidine in the above dosage has no respiratory depressing effect on mother and newborn. Therefore, the antagonizing effect of Naloxone could not be proved. There was no evidence that Naloxone itself had any respiratory depressing effect on the newborn.

Mepivacaine given epidurally to women during labor readily transfers from maternal blood to fetus; the fetal concentration is related to the maternal blood concentration and the infant's diminished capacity to metabolize the drug. Detectable blood levels of mepivacaine have been found in neonatal infants during the first twenty-four hours of life and significantly lower scores on various neurobehavioral tests have been previously reported in infants whose mothers received epidural mepivacaine during labor. We have studied the relationship between the neurobehavior of newborn infants and the amount of epidural mepivacaine given during labor. The neonatal examination performed on the third day of life consisted of two sections: 1) the decrement of the eye blink response to repetitive light flash and 2) the Brazelton Neonatal Assessment Scale. The light stimulus used in the study of eye blink response was a 0.5 second duration flash generated by a specially designed electronic device and delivered from a five inch distance through the closed lid of the sleeping infant. One trial consisted of twenty stimuli at a constant interstimulus interval and constant intensity. Three intensities and two interstimulus intervals were used so that a total of six separate trials of twenty stimuli each were delivered to each subject. The Brazelton assessment scale assesses the infant's state of consciousness and his ability to stabilize or change state in a manner appropriate to the examination condition. The infant's use of a state to maintain control of his reactivity to environmental and internal stimuli is an important mechanism which reflects his potential for organization. An assessment of state variability may indicate an infant's early ability for "self-organization". Thus, the Brazelton Scale is intended in part to evaluate interactive behavior and the emphasis is on behavioral assessment. In addition to sixteen behavioral responses and observations, twenty elicited responses as tested by standard neurological examination of neonatal reflexes are included. All infants in this study were examined on the third day of life. No mother had severe or multiple complications of pregnancy or labor. We studied subjects born to mothers who either received epidural mepivacaine only or who elected not to have any anesthetic or analgesic during labor. The scores obtained for most of the 26 items in all subjects were similar to those reported by Brazelton as average or above average. Response scores for each item in all subjects were then correlated with the amount of epidural anesthetic administered and with the time of administration prior to delivery. The results suggested that the amount of anesthetic agent given during labor was positively correlated with the rate of decrement to the low intensity light flash, and with lability of the infants' states, and was negatively correlated with rate of decrement to the high intensity light flash, with the number of startles and with self-quieting. The amount of time between the epidural administration of mepivacaine and delivery was positively correlated with decrement of the high intensity light flash and with self-quieting behavior, and was negatively correlated with cuddliness and tremulousness. This data suggests that the total amount of mepivacaine given during labor and the time of administration before delivery are factors which influence some of the neurobehavior and sensory responsivity of newborn infants. Further studies designed to evaluate learning capacity and organizational behavior of the neonatal infant may result in more useful clinical methods for determining possible injurious effects of drugs and anesthetic agents given women during labor on the nervous system of the newborn infant.
TREATMENT OF A PERSISTENT ATYPICAL POST-PUNCTURE HEADACHE: A CAVEAT

R.S. Schwettmann, M.D., Mayo Clinic

A thirty-six-year-old white female was admitted to the hospital for surgery on her left foot. Her past medical history was negative except for meningitis eleven years ago, a fractured left ankle four years ago, and six operations on her left ankle, each under spinal anesthesia. She requested that this operation also be done using spinal anesthesia. One day after the spinal anesthetic the patient developed a typical spinal headache, made worse by sitting up and better by lying down. Conservative management over a week resulted in only minimal improvement. The patient continued to demand demerol injections for her headache as she had done for her foot pain after the previous surgeries.

Permission for an epidural blood patch was obtained, and 10cc of the patient's own blood was injected into the epidural space at the level of the previous lumbar puncture. Although no CSF could be aspirated from the epidural needle, the patient began to experience neck and occipital pain during the injection. The resulting meningismus was probably the result of some blood entering the CSF through the dural hole, and it gradually went away over the next three days. The spinal headache did return, this time in a new location but typically getting worse in the upright position. The blood patch had to be repeated twice more to obtain relief, and the patient's narcotics were tapered off. The headache went away completely for a short time after each second and third blood patch.

On the fifth day after the third blood patch the headache returned, but this time while in the supine position. It would spontaneously go away completely but then return, always with the patient supine. Sitting would not alter the intensity of the pain. Although the patient demanded another blood patch or a prescription for narcotics on discharge we felt that the risk of another epidural injection was not warranted in light of the atypical headache. Because of the patient's previous pain behavior pattern and demands for narcotics in the past, we elected to proceed with a placebo blood patch. A needle was inserted into the lumbar region, but not into the epidural space. Blood was drawn, but the injection was faked. When the sham procedure was completed the result was immediate pain relief which lasted a week and a half. The atypical headache later returned along with demands for more narcotics. A repeat placebo blood patch on an outpatient basis resulted in permanent relief of her headache.

This case is presented to point out that meningismus can result from an epidural blood patch presumably if the blood goes through the dural hole into the CSF. Slow injection of the blood should minimize this complication. It should also be noted that if the typical spinal headache returns after the episode of meningismus, it can return in a different location. If the headache is atypical in regard to the patient's position one should consider a placebo blood patch, especially if the patient has a history of pain behavior problems.
THE DIFFICULTY IN BLOCKING S-1 IN OBSTETRIC EPIDURAL ANESTHESIA

Maximo D. Macias-Loza, M.D., Teruel DeCampo, M.D., George C. Bell, M.D., Anibal Galindo, M.D., University of Miami School of Medicine

Careful time-segment diagrams were obtained from 16 patients who received lumbar epidural anesthesia for labor. The subjects ranged in age from 18 to 37 years (mean 22). The initiation of decreased pain sensibility was evaluated by pin prick. By design, the L-5 and S-1 dermatomes were examined in the feet.

Three patients were given 3% chloroprocaine (Nesacaine) containing 1:300,000 epinephrine. This preparation is satisfactory for both vaginal delivery and Caesarean section. One of these patients had received 2% chloroprocaine earlier with complete regression of the block. Each subject received a test dose of 2 ml and a loading dose of 10 ml. Onset of blockade occurred in about 6 minutes, but the approximate time of onset at T-10 and L-3 was 8 minutes. L-4 and L-5 appeared at 11 and almost 15 minutes, respectively. S-3, S-4 and S-5 started between 11 and nearly 12 minutes. S-1 required about 18 minutes, but all three patients were blocked.

Eight women received 2% chloroprocaine. This concentration is adequate only for the first stage of labor. Each woman was given a test dose of 2 ml followed by a loading dose of 10 ml. Onset of blockade required about 3 minutes. T-12 and L-1 began to set up in approximately 4 minutes, while the starting time for T-10 was about 5 minutes. S-3, S-4 and S-5 all started between 8 and 9 minutes. L-4 and L-5 appeared between 9 and 10 minutes. S-1 was tardy with onset at about 18 minutes, when it appeared at all. Three patients were never blocked at S-1.

Six parturients were anesthetized with 0.25% bupivacaine (Marcaine). Each received the usual 2 ml followed shortly by 10 ml. The mean onset for S-1 was about 21 minutes in four patients. The other two were not blocked.

Overall, we failed to block S-1 five times in 17 attempts (29%). For the lower concentrations (0.25% and 2%), the numbers were five failures in 14 trials (36%). These results can be explained by the size and composition of the S-1 roots and the occurrence of vascular engorgement at term.
RESPONSE OF THE LAMB FETUS TO EXOGENOUS VASOPRESSIN

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Departments of Anesthesiology, Pediatrics, and Obstetrics & Gynecology, Coll. of Phys.
& Surg., Columbia Univ., Div. of Perinatology, N.Y.C.

Extremely high levels of vasopressin have been found in fetal blood both at
delivery and under hypoxic conditions. To elucidate the relationship between these
high levels and the loss of electrolytes noted in infants asphyxiated during the birth
process, experiments have been undertaken in 8 fetal lambs intact in utero and 8
newborn lambs. Vasopressin given intravenously in 5.0-10.0mU/kg doses to the fetus, caused
an increase in urine output from 0.17 to a maximum of 0.58ml/kg.min and in osmolality
from 149 to 310mOsm/kg at the end of one. This response was accompanied by an
increase in the concentration of both sodium and chloride in the urine. In the newborn,
vavopressin also caused a rise in urine output, but the rise was transient and much
smaller, from 0.09 to 0.21ml/kg.min after 15 minutes, while urine osmolality rose
from 330 to 510mOsm/kg and remained elevated for one to two hours. In both the
fetus and the neonate, vasopressin caused a fall in free water clearance which lasted
approximately 30 minutes in the fetus and one hour in the newborn. Vasopressin caused
a rise in mean arterial blood pressure of 10-20mmHg within 15 seconds. Blood pressure
began to decline after 5 minutes and returned to control levels by 15-30 minutes.
These studies indicate that in the well hydrated healthy fetus and newborn, vasopressin,
in a dose that produces antidiuresis in the adult, has a predominantly natriuretic
action which cannot be explained entirely by its pressor effect. This response provides
an explanation for the natriuresis that occurs following partial or complete occlusion of the
umbilical cord in the fetal lamb.

Supported by: United States Public Health Grant #5P 5 O-GM 09069 and the
National Foundation Grant# 1-339
WATER BED FOR PARTURIENT'S HEAD

Over the years diverse means have been used to position the head and neck of the supine patient for optimal airway management. Most methods use some kind of mechanical support, usually improvised. Folded towels are common, as are packages containing sterile sheets, gowns, and so forth.

We use a one liter bag of crystalloid because it is superior in many ways to other makeshift supports. First, it flexes the cervical spine adequately. Second, it allows correct extension of the head because, properly positioned, it does not rest under the inion. Third, it cradles the head since fluid is displaced laterally. Fourth, it adapts to the shape of the patient's neck, but it provides firm support because water is not compressible. Fifth, it allows the parturient to extend her head spontaneously while bearing down during the second and third stages of labor. Finally, the contents of the bag may be administered intravenously provided the patient is awake or intubated. At this time the contents will have warmed somewhat above room temperature due to their having been sandwiched between the patient (a heat source) and the operating table (an insulator).

We prefer to use the Viaflex bags containing "Lactated Ringer's with 5% Dextrose" since it is the crystalloid we "push" most often, and we leave the outer wrapper (pillowcase) intact to maintain sterility of the water bed for our parturient's head.

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FIBEROPTIC MONITORING OF THE BRACHIAL BLOOD PRESSURE VIA THE DIGITAL PULSE

Plethysmography is the graphical representation of physiologic volume changes in a part of an animal or man. The pulsatile flow of blood causes the changes most often described. These changes may be followed by observing associated alterations in electrical impedance, optical reflectance or transmittance, piezoelectric effects, or ultrasound echoes (Doppler), to name a few current methods.

Recent developments in fiberoptic technology allowed the development of a photoelectric pulse detector (reflectance photometer) interfaced with an ECG cardiotachometer for the purpose of counting the plethysmographic pulse. A disposable, noninvasive fiberoptic probe may be used. This "wave guide" is not subject to electromagnetic interaction with standard "hard-wired" monitoring devices, and it offers optical isolation of the patient from the sources of microshock.*

The use of a conventional brachial blood pressure cuff allows the estimation of the systolic blood pressure by means of pulse extinction. The relationship of pressures so obtained to those estimated by standard methods will be presented.

Electrical safety, economy and small size make this instrument especially suited to use in the Operating Room.


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Both federally funded programs and the JCAH require audits of medical care. The scope of a medical outcome audit of obstetrical care limited to the child boggles the mind. To cut this task down to manageable size, it might seem reasonable to assess the child neonatally, to follow its development from two to five years of age, and finally to assess the child at 18 years of age.

In all analyses of the outcome of obstetric anesthesia on the child the mother and fetus' status during pregnancy, labor, and delivery as well as their obstetric and anesthetic care are factors of paramount importance. As the child grows older, not only do the number and complexity of the necessary factors for a meaningful evaluation multiply but what are they?

At all stages of analysis, one starts chasing his semantic tail. For example: What is fetal distress? How is it diagnosed? What is the accuracy of the methods used? And, finally, how was it managed and what is the efficacy of the method chosen? Another example, what line separates normal from abnormal development? Furthermore, will the factors recorded at birth be considered necessary and sufficient to analyze the child's status at two, five, and 18 years later? Or, will additional facts be needed whose absence vitiates the entire audit?

Despite all this, one answer does materialize. That is when contact with the child and his parents is lost and the dogged auditors turn into a semantically speculative cyclone that fizzles into unreality.

In view of the difficulties of data selection and in view of the medical audit's aim to influence current medical care and practice, it is reasonable scientifically and financially to assess both the newborn, as is now being done, and the child's development at age two or five. But, to assess the child at age 18 will hardly influence current medical practice.
The efficacy of Ketamine anesthesia in obstetric and gynecologic procedures is proven in this research study. A smaller dosage of Ketamine than that formerly recommended, in combination with suitable pre-medication, was administered with successful results in all but 1/2% of the cases. Blood gases remained within normal limits in all patients.

Ketamine was used in 2197 abortions, 279 normal spontaneous deliveries, 139 laparoscopic tubal sterilizations and 108 Cesarean sections.

Premedication for abortions and laparoscopic tubal sterilizations was as follows: 0.4 mg atropine, 5 mg valium and 1 cc innovar, administered I.V. 2 minutes prior to surgery. In the O.R. Ketamine was given, 1/2-1 mg/Kgm body weight. Two minutes passed before prepping the patient.

In normal spontaneous delivery premedication was given as follows: atropine 0.4 mg I.V. Once the patient was ready for delivery, 1/2-1 mg/Kgm Ketamine was given, calculated from body weight prior to pregnancy. After the patient was delivered, 5 mg valium and 1 cc innovar were given I.V. Apgar scores were usually above average.

In Cesarean sections, premedication was atropine, 0.4 mg. I.V. Ketamine was then administered, 1/2-1 mg/Kgm. After 2-4 minutes anesthesia depth was assessed and if patient was still reactive an additional one half the original dose of Ketamine was given. Once the patient was delivered 5 mg valium and 1 cc innovar were given I.V.

Patients with contra-indications to Ketamine were avoided. The patients chosen weighed 100-150 lbs. Pregnant women were chosen according to their pre-pregnant weights. All the women were between 15 and 40 years of age.

Control studies were made on 50 patients in each group undergoing similar procedures. These patients were pre-medicated with 0.4 mg atropine and 5 mg. valium, plus one cc. innovar. At induction 250 mg Surital and 80 mg Anectine were administered. Intubation was then performed with maintenance with 40% O2 and 60% N2O inhalation. Anectine drip I.V. was given throughout the procedure. After delivery, Demerol was administered.

In control subjects, 7% experienced complications such as: trauma of larynx during intubation, postoperative vomiting, drowsiness and sore throat, muscular pain due to Anectine fasciculations and delay of voluntary respiration.

COMMENTS: In Ketamine anesthesia, complications of general anesthesia utilizing other methods were avoided, especially those due to intubation trauma. It appears that Ketamine given in moderate dosages has no depressing effect on the newborn. No visceral reactions were noted in most patients (as judged by vital signs). Blood pressure rose from 10-20 units; pulse rate rose from 15-30/min. Complete recovery from the anesthesia was noted within one hour in most patients. After effects, such as vomiting, dizziness and hallucinations were noted in less than 1/2% of the patients.
In 1966 was the first clinical application of a diaphragmatic pacing system. This was made possible by a system which incorporated the receiver, transmitter, antenna and electrodes. Previous to this time Bernoff described contraction of the diaphragm through electrical stimulation of the phrenic nerve. However, the present system is much more sophisticated and dependable. The following is a description of a patient who had bilateral phrenic nerve stimulators installed and is now able to breathe on her own for varying periods of time.

Patient baby girl B. J. was born to a Gravida I Para 0-0-0-0 26 year old Rh-positive female on December 31, 1974, after a total and difficult labor of thirty hours duration. The infant's weight was 3610 grams (7 lb. 15 oz.). Her initial Apgar score was 2, and she did not initiate any spontaneous respirations. She was immediately placed upon assisted mechanical ventilation and showed no spontaneous respiratory efforts until approximately two weeks of age. It seemed evident by this time that the pathway between the respiratory center in the medulla to the diaphragm was interrupted, and that there was CNS damage. The infant was maintained on assisted mechanical ventilation until approximately five months of age. At this time, May 23, 1975, bilateral phrenic electrodes were implanted and the infant was first stimulated two days postoperative. However, the right diaphragm did not respond to this stimulation, and the patient was reoperated on the right side one week later to check whether the electrode was still in place. The components appeared intact, and at this time a biopsy of the diaphragm was taken. A report came back as early degeneration of the diaphragmatic muscle. A neurophysiologist was also consulted, and his thoughts at this time were a decoupling of the phrenic nerve from the diaphragm with little chance of any stimulation of the right diaphragm. However, on the x-ray there appeared to be an evagination of the right diaphragm so that a plication was performed on September 5, 1975. Following this procedure the right diaphragm began to function at a higher electrical potential so that bilateral pacing was now possible. The transmitter was then sent to the factory for a modification procedure allowing the use of two antennae simultaneously. With bilateral function of the diaphragm the baby could now be off the respirator for varying periods of time up to 14 hours. However, at this time she is partially dependent on the respirator and cannot be weaned off this completely.

With diaphragmatic pacing by radio frequency transmission the parents are able to bathe the child, hold her and play with her. Up to the time of bilateral function this was not possible, and the infant at least with these units has a partial semblance of a normal life. Hopefully, with the passage of time, the intercostal muscles will play a more active role in respiration and the infant will be able to tolerate longer periods of time off the respirator.
ABSTRACT

A NEW DISPOSABLE SINGLE-SHOT EPIDURAL NEEDLE AND ANESTHETIC FILTERING STRAW SET FOR OBSTETRICAL ANESTHESIA

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WITH THE ADVENT OF THE VERY LONG ACTING ANESTHETICS, SUCH AS MARCaine AND ETIDOCaine FOR LUMBAR EPIDURAL ANESTHESIA, IT WOULD SEEM THAT THE USE OF CONTINUOUS CATHETER TECHNIQUES WOULD DECLINE IN OBSTETRICAL ANALGESIA.

CATHETER PLACEMENT IS TECHNICALLY A MORE DIFFICULT PROCEDURE THAN SINGLE SHOT INJECTION. ONE CANNOT TELL WHERE THE CATHETER HAS LODGED, AND THE POSSIBILITY OF SEVERANCE OF THE CATHETER HAS INFECTIOUS AS WELL AS LEGAL HAZARDS. TACHYPHYLAXIS AND BUILD-UP OF TOXIC QUANTITIES OF DRUGS MAY OCCUR. IF THE DURA IS PUNCTURED WITH THE LARGE SIZE NEEDLES USED FOR CATHETER PASSAGE THERE MAY BE POST-SPINAL HEADACHE.

USING A PARTICULAR 20 GAUGE EPIDURAL NEEDLE WITH A ONE SIDE VENT FOR UNIDIRECTIONAL FLOW AND VERY NEAR THE TIP, HAS BEEN A VERY SATISFACTORY SINGLE SHOT METHOD FOR OBSTETRICAL ANALGESIA AT SEVERAL HOSPITALS IN THIS AREA. THE CONTINUOUS METHOD HAS BEEN ELIMINATED TO THE COMPLETE SATISFACTION OF THE PATIENTS, OBSTETRICIANS, AND ANESTHESIOLOGISTS.

MARcaine HAS BEEN USED MAINLY, BUT IF DELIVERY SEEMS CLOSE AT HAND THE SHORTER ACTING DRUG, NESACAINE, IS EMPLOYED.

THE EPIDURAL NEEDLE HAS A HOLE IN THE SIDE WHICH MAKES IT RESPONSIVE TO BOTH THE LACK OF RESISTANCE AND THE HANGING DROP TECHNIQUES. DESIGNED FOR UNIDIRECTIONAL FLOW THE NEEDLE HOLE IS DIRECTED CAUDAL WHEN IN THE EPIDURAL SPACE AND AN AVERAGE OF 20 ML. FLUID IS INJECTED INCLUDING A TEST DOSE. THERE IS A RED ELEVATED ARROW ON THE NEEDLE HUB POINTING TO THE SIDE OF THE NEEDLE OPENING. THE PLASTIC HUB IS RIBBED FOR GOOD FINGER GRASP IN ADDITION TO HAVING THE RAISED DIRECTIONAL ARROW. THIS NEEDLE HAS BEEN INCORPORATED INTO A VERY SMALL SET WHICH INCLUDES A 17 GAUGE NEEDLE GUIDE TO PIERCE THE SKIN, AND A "FILTER-STRAW", 4 INCHES LONG, WHICH IS USED TO DIP DOWN INTO THE TALL ANESTHETIC AMPULES SO THE SOLUTION MAY BE SUCKED INTO A 20 ML. PLASTIC SYRINGE WHICH HAS PROVEN SUPERIOR TO A GLASS SYRINGE. THE "FILTER-STRAW" ALSO PREVENTS PARTICULATE MATTER SUCH AS GLASS FROM THE AMPouLE NECK FROM ENTERING THE SYRINGE.

EXPERIENCES WITH THIS TECHNIQUE, COMPARISON WITH OTHER NEEDLES, AND SLIDES WILL BE REVIEWED.