Objective: Upon completion of this presentation, participants will be able to identify novel concepts, themes, and areas of research relevant to the understanding and management of major pregnancy-related disorders, labor and delivery, obstetric anesthesia, and perinatal complications.

Summary: This presentation will outline the methods used to identify 150 of the most important articles for obstetric anesthesiologists published in 2009. Discussion of selected articles will illustrate salient themes, and suggest future directions for the science and practice of obstetric anesthesia.

Methods: Article ascertainment relied primarily on a monthly review of the tables of contents of major journals published in the English language from January – December 2009 covering anesthesiology, obstetrics, pediatrics, and general medicine. Ascertainment was augmented through a variety of electronic and print media including: MDLinx, Faculty of 1000 Medicine, Doctor’s Guide, ISI Web of Knowledge, LexisNexis, PubMed and Google searches of keywords, Obstetric Anesthesia Digest, Obstetric and Gynecological Survey, and the Journal of Women’s Health: Hot Papers in the Literature.

In total, 1,323 potentially relevant items were retrieved, including articles, reports, news releases, and other media. Of these, 894 were excluded based on initial review. The remaining items were evaluated for the following criteria:

1. Relevance to the practice of obstetric anesthesia
2. Importance of the hypothesis or study purpose, considering whether the study addressed a fundamental question, or a particularly severe or frequent problem
3. Clinical implications for anesthetic management of pregnant or recently delivered women
4. Clinical implications for obstetric or medical management of pregnant or recently delivered women, or clinical implications for perinatal care
5. Research implications, including novel methods, design, questions, or areas of concern that should compel further research by members of the Society of Obstetric Anesthesia and Perinatology (SOAP)
6. Novelty
7. Validity, considering the degree to which study methods were meticulously planned, executed, and analyzed in order to minimize bias to the maximal degree for a given research question and design. Sources of residual bias were identified and implications were addressed
8. Definitiveness, considering not only the level of evidence, but also the magnitude of the established effect size, the precision of the estimate, and the relationship with previously published results
9. Educational value or clinical pearls
10. Overall assessment, including my general impression of the article, the degree to which I was compelled to read in detail, the strength of the graphics, a connection to emerging topical themes, and timeliness in the current sociopolitical environment

Additional metrics included the journal impact factor, the Faculty of 1000 Medicine score, and any relevant quality scores, including the Chalmers score for the quality of randomized controlled trials (RCTs).

Articles were sorted by topic area. At the end of the year, topic areas were reviewed to identify not only the strongest individual articles, but also the most important themes that emerged in 2009. In order to more fully illustrate themes and to direct readers to accompanying editorials, supplementary references have been inserted.

Study design is reported below each citation. Randomized controlled trials were evaluated using the Chalmers quality assessment tool. Quality scores over 75% are reported as “high quality,” scores between 50% and 75% as “moderate quality,” and scores less than 50% as “limited quality.” Refer to Anesthesia & Analgesia (2009; 108:1916-1921) for a description of this scoring method.

List of Journals

Anesthesia Journals
Acta Anaesthesiologica Scandinavica
Anaesthesia
Anaesthesia and Intensive Care
Anesthesia & Analgesia
Anesthesiology
Anesthesiology Clinics of North America
British Journal of Anaesthesia
Canadian Journal of Anaesthesia
Current Opinion in Anaesthesiology
European Journal of Anaesthesiology
European Journal of Pain
International Anesthesiology Clinics
International Journal of Obstetric Anesthesia
Journal of Clinical Anesthesia
Journal of Pain
Obstetric Anesthesia Digest
Pain
Regional Anesthesia and Pain Medicine
General Medical Journals
American Journal of Epidemiology
Annals of Internal Medicine
British Medical Journal
British Journal of Haematology
Chest
Circulation
Critical Care Medicine
European Heart Journal
Health Affairs
Health Services Research
Heart
Journal of the American Medical Association
Journal of American College of Cardiology
Journal of Clinical Epidemiology
Journal of Patient Safety
Lancet
Morbidity and Mortality Weekly Report
Nature
New England Journal of Medicine
Quality and Safety in Health Care
Resuscitation
Science

Obstetric and Gynecology Journals
Acta Obstetrica et Gynecologica Scandinavica
American Journal of Maternal/Child Nursing
American Journal of Obstetrics & Gynecology
The Australian and New Zealand Journal of Obstetrics & Gynecology
Birth: Issues in Perinatal Care
British Journal of Obstetrics and Gynaecology
Clinical Obstetrics and Gynecology
Obstetrics, Gynaecology & Reproductive Medicine
Current Opinion in Obstetrics and Gynecology
European Journal of Obstetrics & Gynecology and Reproductive Biology
Fertility and Sterility
Gynecologic and Obstetric Investigation
International Journal of Gynecology & Obstetrics
Journal of Perinatology
Journal of Maternal-Fetal & Neonatal Medicine
Journal of Midwifery & Women’s Health
Journal of Women’s Health
Midwifery
Obstetrical & Gynecological Survey
Obstetrics & Gynecology
Obstetrics & Gynecology Clinics of North America
Obstetric Medicine: The Medicine of Pregnancy

Pediatrics Journals
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Non-pharmacologic Analgesia

Acupuncture

   
   **Study Design:** High quality RCT (n=159 comprising 3 groups of n=58 [acupuncture] vs. n=54 [sham acupuncture] vs. n=47 [control])
   
   **Conclusion:** One week of continuous auricular acupuncture decreases the pain and disability experienced by women with pregnancy-related low back and posterior pelvic pain.

Physiology and Psychology of Non-pharmacologic Analgesia

   
   **Study Design:** Randomized controlled healthy volunteer experiment (n= 40 men comprising 2 groups of n=19 [naloxone] vs. n=21 [saline])
   
   **Conclusion:** By combining a robust procedure to generate placebo analgesia, a randomized naloxone infusion, and functional MRI, this study provides functional evidence of the endogenous opioid-mediated interactions between the hypothalamus, the periaqueductal gray, and the rostral ventromedial medulla, in effecting placebo analgesia.

   See also:
   
   
   **Study Design:** Healthy volunteer cross-over experiment (n=13 men)
   
   **Conclusion:** Further work by the same group illustrates the contribution of the dorsal horn of the spinal cord to placebo analgesia.

   
   **Study Design:** Randomized controlled healthy volunteer experiment (n=104 men and women comprising 2 groups of n=51 [threat condition] vs. n=53 [non-threat condition])
   
   **Conclusion:** In this experimental task (arm immersion in 5°C water), both description of the task in threatening terms (‘risk of frostbite’), and training attention towards pain-related stimuli, independently lowered the threshold for pain and initial pain ratings, but did not change tolerance (time to arm withdrawal) or pain ratings at tolerance.

   
   **Study Design:** Randomized controlled healthy volunteer experiment (n=48, comprising 3 groups of women, n=16 [social observation] vs. n=16 [conditioning] vs. n=16 [verbal suggestion])
   
   **Conclusion:** The participants who observed a beneficial effect of the intervention in an actor (simulating benefit) experienced a marked placebo effect, which correlated with scores for empathy. The group who received verbal instruction to expect a benefit experienced significantly smaller placebo effects.

   Two accompanying editorials:
   
   Pourro CA: Open your mind to placebo conditioning. Pain 2009; 145: 2-3
   
   Robinson ME, Price DD: Placebo analgesia: widening the scope of measured influences. Pain 2009; 144: 5-6

   
   **Study Design:** Healthy volunteer cross-over experiment (n=67, including 38 men and 29 women)
   
   **Conclusion:** In this experimental model, swearing increased pain tolerance, increased heart rate, and decreased perceived pain compared with not swearing. The effect was more dramatic in women than men.

Intravenous Analgesia

Remifentanil

6. Angst MS, Chu LF, Tingle MS, Shafer SL, Clark JD, Drover DR: No evidence for the development of acute tolerance to analgesic, respiratory depressant and sedative opioid effects in humans. Pain 2009; 142: 17-26
   
   **Study Design:** Randomized controlled healthy volunteer cross-over experiment including men and women (n=36 comprising 12 groups of n=4 [allocation illustrated in Fig 1])
   
   **Conclusion:** Short-term administration of clinically useful doses of remifentanil is not associated with the development of significant tolerance to analgesic, respiratory depressant, or sedative opioid effects.

   Accompanying editorial:
   
   Simonnet G: Acute tolerance to opioids: methodological, theoretical and clinical implications. Pain 2009; 142: 3-4
Neuraxial Block Placement, Equipment, and Technique

Physical Examination


Study Design: Prospective cohort (n=427 women with BMI 20-62 [mean BMI=33] kg/m²)

Conclusion: Two factors predicted neuraxial technique difficulty: 1) the practitioner’s ability to palpate the patient’s bony landmarks, and 2) the patient’s ability to flex her back. Body mass index was not an independent predictor. Obesity did, however, strongly predict both the ability to palpate landmarks and flex the back.

Ultrasonography


Study Design: Exploratory cohort to evaluate a diagnostic test with a reliable gold standard (actual needle depth) (n=46 women with BMI 30-79 [median 36] kg/m²)

Conclusion: Depth measured by ultrasonography correlated with actual needle depth. Taken together, results from Ellinas (#7 above) and Balki suggest that prepuncture lumbar ultrasonography may be a useful guide to facilitate the placement of epidural needles in obese parturients when black flexion is limited, spinous processes are not palpable, or initial placement attempts fail.

Catheter Design


Study Design: Moderate quality RCT (n=486 comprising 2 groups of n=246 [end-holed] vs. n=240 [three-holed])

Conclusion: There were no differences in the initial analgesia success rate, complications, or labor analgesia between end-hole versus multi-hole flexible epidural catheters.

Catheter Insertion Technique


Study Design: Moderate quality RCT (n=345 comprised of 2 groups of n=173 [air] vs. n=172 [saline])

Conclusion: This study did not identify a difference in either spinal or epidural analgesic efficacy whether air or saline was used for LOR during CSE placement. The aspiration for fluid after observing initial passive fluid return from the hub of the spinal needle may be unnecessary—neither spinal nor epidural analgesic success rates differed whether spinal fluid could be aspirated or not. However, in CSE procedures where fluid did not return spontaneously from the hub of the spinal needle, the corresponding epidural catheter was less likely to provide effective analgesia for the duration of labor.


Study Design: Meta-analysis of 5 RCTs of primarily limited to moderate quality

Conclusion: The risk differences for adverse outcome between loss of resistance to air versus saline were not statistically different for obstetric patients. However, given the rarity of significant outcomes, the available studies do not have sufficient power to demonstrate any differences.


Study Design: Meta-analysis of 30 RCTs of primarily limited to moderate quality

Conclusion: The risk of intravascular placement of a lumbar epidural catheter during pregnancy may be reduced with the lateral patient position, fluid predistension, a single orifice catheter, a wire-embedded polyurethane epidural catheter, and limiting the depth of catheter insertion to 6 cm or less. Limited trial quality weakens the strength of these recommendations.

Epidural Catheter Testing


Study Design: Exploratory cohort study to evaluate a diagnostic test with a weak reference standard (tachycardia in response to epinephrine) (n=419 of which 24 are cases)

Conclusion: For obstetric patients in the sitting position, the meniscus test does not improve diagnostic accuracy of aspiration for detecting intravascular multiorifice epidural catheter placement.
Neuraxial Labor Analgesia

Combined Spinal Epidural versus Epidural Analgesia


Study Design: High quality RCT (n=77 comprising 2 groups of n=41 [CSE] vs. n=36 [epidural])

Conclusion: In the first 15 minutes after block placement, CSE analgesia was associated with a significantly greater incidence of transient FHR abnormalities and uterine hypertonus compared with standard epidural analgesia. Speed of analgesic onset correlated with uterine hypertonus and FHR changes.


Study Design: Moderate quality RCT (n= 84 comprising 2 groups of n= 43 [CSE] vs. n=41 [epidural])

Conclusion: This study did not demonstrate a difference in requirement for top-up doses between CSE and standard epidural analgesia in parous patients, but may have been underpowered to detect a difference. CSE provided better analgesia in the first 30 min compared with standard epidural analgesia.

Pharmacologic Adjuvants


Study Design: Pilot safety assessment (n=12). High quality RCT (n=40) comprising 2 groups of n=20 [bupivacaine] vs. n=20 [bupivacaine+neostigmine]

Conclusion: Epidural neostigmine 4 mcg/mL reduced the hourly bupivacaine requirement by 19%-25% in women receiving labor PCEA. The authors noted an increased rate of mild sedation. Note: Larger studies are needed to evaluate for other side effects.


Study Design: Moderate quality RCT (n=70 comprising 2 groups of n=35 [epidural neostigmine/clonidine] vs. n=35 [epidural saline])

Conclusion: A bolus dose of epidural neostigmine 500 mcg and clonidine 75 mcg, following the intrathecal injection of ropivacaine and sufentanil, prolonged analgesia and reduced subsequent hourly ropivacaine consumption. Note: The study was not powered to detect differences in side effects (hypotension or nausea).

Accompanying editorial:


See also: #39 Horlocker Anesthesiology 2009;110:218-30

Patient-controlled Epidural Anesthesia


Study Design: Moderate quality RCT (n=60 comprising 2 groups of n=30 [CIPCEA = PCEA with computer adjusted basal infusion] vs. n=30 [PCEA with constant basal infusion at 5 mL/hr])

Conclusion: CIPCEA improved maternal satisfaction in conjunction with an increased infusion rate during the second stage of labor. Note: Larger studies are needed to confirm an absence of effect on the duration of the second stage and other side effects.

**Study Design:** Secondary analysis of data from the Comparative Obstetric Mobile Epidural Trial (COMET) RCT (n=353 [Control] vs. n=351 [CSE] vs. n=350 [LDI])

**Conclusion:** This observational analysis did not demonstrate an association between the level of ambulation a woman actually achieved after epidural placement and mode of delivery.


**Study Design:** Secondary analysis of data from the COMET RCT (n=353 [Control] vs. n=351 [CSE] vs. n=350 [LDI])

**Conclusion:** Relative to conventional high-dose block, mobile epidural techniques encourage the retention of normal bladder function. Routine bladder catheterization may not be necessary.

### Neuraxial Analgesia and the Progress of Labor


**Study Design:** High quality RCT (n=12,793 comprising n=6,394 [latent phase epidural analgesia] vs. 6,399 [active phase epidural analgesia])

**Conclusion:** Standard epidural analgesia in the latent phase of labor (cervical dilation 1-3 cm) does not prolong the duration of labor and does not increase the rate of cesarean delivery in nulliparous women compared with a strategy of systemic opiates (meperidine 25 mg IM boluses) used to delay neuraxial analgesia until cervical dilation of at least 4 cm. Mean duration was 11.3 vs. 11.8 hours, P=0.9. Cesarean delivery rates were 23.2% vs. 22.8%, P=0.51. The group with early neuraxial analgesia reported increased satisfaction scores (median 84 vs. 62, P<0.01), but decreased rates of breastfeeding at 6 weeks (70.1% vs. 77.8%, P<0.0001).

**Accompanying editorial:**

Flood PMD: Primary versus secondary outcomes in gargantuan studies. Anesthesiology 2009; 111: 704-705

This editorial suggests that the effect of breastfeeding success rates may be a consequence of multiple comparisons and excessive statistical power, and recommends that breastfeeding success should be followed-up as a primary endpoint in a future trial.


**Study Design:** High quality RCT (n=806 comprising 2 groups of n=406 [early intervention] vs. n=400 [late intervention])

**Conclusion:** In this population of nulliparas admitted for induction of labor, early labor intrathecal fentanyl followed by epidural analgesia did not increase the cesarean delivery rate compared with a strategy of systemic opiates (hydromorphone 1 mg IM and 1 mg IV) used to delay the initiation of standard epidural analgesia until cervical dilation of at least 4 cm (32.7% vs. 31.5%, P=0.65). The original design was powered for 1600 participants.


**Study Design:** Case control (n=555 comprising 3 groups of n=185 [pain score 0-3] vs. n=185 [pain score 4-6] vs. n=185 [pain score 7-10])

**Conclusion:** This case control analysis did not demonstrate an association between the degree of labor pain at initiation of epidural analgesia and mode of delivery or duration of labor.

### Neuraxial Anesthesia for Cesarean Delivery

#### Spinal Hypotension


**Study Design:** Moderate quality RCT (n=104 comprising 2 groups of n=52 [phenylephrine infusion starting at 100 mcg/min] vs. n=52 [ephedrine infusion starting at 8 mg/min] with both infusions titrated to maintain baseline maternal SBP)

**Conclusion:** Ephedrine crosses the placenta to a greater extent and undergoes less early metabolism and/or redistribution in the fetus compared with phenylephrine. The associated increased fetal concentrations of lactate (UA lactate 4.2 vs. 2.2 mmol/L, P<0.001), glucose, and catecholamines support the hypothesis that depression of fetal pH and base excess with ephedrine is related to metabolic effects secondary to stimulation of fetal beta-adrenergic receptors. The overall effect of the vasopressors on fetal oxygen supply and demand balance appears to favor phenylephrine.

**Accompanying editorial:**


This editorial recommends that titrated phenylephrine infusions (25-100 mcg/min) have become the standard of care for spinal hypotension prophylaxis and treatment.


**Study Design:** High quality RCT (n=38 comprising 2 groups of n=20 [phenylephrine 80 mcg] vs. n=18 [ephedrine 10 mg])

**Conclusion:** First, when administered as a bolus to treat maternal hypotension following spinal anesthesia for elective cesarean delivery, phenylephrine reduced maternal CO back towards baseline values, when compared with ephedrine, which increased CO further. Second,
changes in CO correlated with heart rate changes after vasopressor administration, suggesting that heart rate may be a useful surrogate indicator of CO. Third, in an adjunctive pilot RCT (n=20 comprising 2 groups of n=10 [oxytocin 2.5 IU] vs. 10 [oxytocin 2.5 IU + phenylephrine 80 mcg], a coadministered phenylephrine bolus attenuated hemodynamic responses to an oxytocin bolus.


**Study Design:** High quality RCT (n=40 comprising 2 groups of n=20 [preload] vs. n=20 [coload])

**Conclusion:** Intravascular volume expansion with 15 mL/kg HES 130/0.4 given as a preload, but not coload, significantly increased maternal CO for the first 5 min after spinal anesthesia for cesarean delivery. Maternal and neonatal outcomes were not different.


**Study Design:** High quality RCT (n=60 comprising 3 groups of n=20 [1.5L crystalloid] vs. n=20 [0.5L HES] vs. n=20 [1.0L HES])

**Conclusion:** CO and corrected flow time (FFc) increase after fluid preload, particularly with HES 1.0 L. There were no differences among groups in the incidence of hypotension or mean ephedrine dose—in all three groups, regardless of CO, a significant proportion of patients experienced hypotension that required treatment with ephedrine.


**Study Design:** High quality RCT (n=178 comprising 2 groups of n=90 [preload] vs. n=88 [coload])

**Conclusion:** There was no difference in the incidence of hypotension in women who received colloid preload compared with coload. A 500 mL colloid bolus is inefficient as a single intervention to prevent hypotension, regardless of the timing of administration.


**Study Design:** Moderate quality RCT (n=46 comprising 2 groups of n=23 [pre-load] vs. n=23 [co-load])

**Conclusion:** There was no difference in the incidence of hypotension or requirement for vasopressor rescue in women who received colloid preload compared with coload.


**Study Design:** High quality RCT (n=60 patients comprising 3 groups of n=20 [7mg intrathecal bupivacaine] vs. n=20 [8mg] vs. n=20 [9mg])

**Conclusion:** The lowest dose of hyperbaric bupivacaine (7 mg) provided equally rapid onset and effective anesthesia for cesarean delivery while reducing the incidence of hypotension compared with 8 and 9 mg doses. However, because of its shorter duration of anesthesia, low dose spinal anesthesia may be feasible only when the block can be reinforced using a functional epidural catheter.

Accompanying editorial:

This editorial questions the existence of one optimal intrathecal local anesthetic dose for cesarean delivery, given a long list of patient, anesthetic, and surgical covariates.

**Maternal Oxygen Supplementation**


**Study Design:** Moderate quality RCT (n=125 comprising 2 groups of n=64 [air] vs. n=61 [oxygen])

**Conclusion:** Breathing 60% oxygen during emergency cesarean delivery under neuraxial anesthesia increased fetal oxygenation with no associated increase in lipid-peroxidation in the mother or fetus.

Accompanying editorial:

This editorial recommends supplementary oxygen for women undergoing unplanned cesarean delivery, but room air for elective cesarean delivery.

**Combined Spinal Epidural versus Single Shot Spinal**


**Study Design:** Moderate quality RCT (n=28 comprised of 2 groups of n=13 [single shot spinal] vs. n=15 [CSE])

**Conclusion:** The SSS and CSE techniques (1 mL LOR to air, without epidural catheter insertion) inserted with the patient in the lateral decubitus position resulted in similar extent of sensory blockade and CSF pressure.
Pharmacologic Adjuvants


Study Design: Moderate quality RCT (n=90 comprising 3 groups of n=30 [magnesium] vs. n=30 [fentanyl] vs. n=30 [saline placebo])

Conclusion: In patients undergoing cesarean delivery under spinal anesthesia, the addition of intrathecal magnesium sulfate (50 mg) to spinal bupivacaine 10 mg did not shorten the onset time of sensory and motor blockade or prolong the duration of spinal anesthesia, as seen with fentanyl. Note: Data on the safety of intrathecal magnesium are limited. (See page 352, references #11-13, and #30).

Thermoregulation


Study Design: Moderate quality RCT (n=75 comprising 3 groups of n=25 [room temperature] vs. n=25 [cabinet-warmed] vs. n=25 [Hotline®-warmed])

Conclusion: Warming intravenous fluids (either in a cabinet or with a Hotline®) mitigates the decrease in maternal temperature during elective caesarean delivery under combined spinal-epidural anesthesia and improves thermal comfort, but does not affect shivering.


Study Design: Moderate quality RCT (n=30 comprising 2 groups of n=15 [warmed fluid] vs. n=15 [unwarmed fluid])

Conclusion: Administration of pre-warmed intravenous colloid, followed by crystalloids, maintained core temperature better at the time of cesarean delivery and up to 45 minutes after delivery. Infants born to mothers who received pre-warmed fluids had higher Apgar scores at one minute and umbilical arterial pH values (7.33±0.05 vs. 7.29±0.03, P=0.023).

General Anesthesia for Cesarean Delivery

Pharmacologic Adjuvants

36. Lee DH, Kwon IC: Magnesium sulphate has beneficial effects as an adjuvant during general anaesthesia for Caesarean section. Br J Anaesth 2009; 6: 861-6

Study Design: Moderate quality RCT (n=72 comprising 3 groups of n=24 [saline control] vs. n=23 [magnesium sulfate 30mg] vs. n=25 [magnesium sulfate 45mg])

Conclusion: Preoperative IV magnesium sulfate attenuated BIS and arterial pressure increases in the pre-delivery period in patients undergoing cesarean delivery under general anesthesia.


Study Design: Moderate quality RCT (n=42 comprising 2 groups of n=21 [saline control) vs. n=21 [remifentanil])

Conclusion: A single bolus of remifentanil 1 mcg/kg attenuated hemodynamic but not BIS responses to tracheal intubation in preeclamptic patients undergoing cesarean delivery under general anesthesia. Its use was associated with maternal hypotension and neonatal respiratory depression requiring resuscitation.

Post-delivery Analgesia

Analgesia following Vaginal Delivery


Study Design: High quality RCT (n= 61 comprising 2 groups of n=31 [EMLA® cream] vs. n=30 [mepivacaine])

Conclusion: EMLA® cream applied to the perineum 1 hour before the expected time of birth, and reapplied after delivery for 10 minutes prior to perineal suturing, appears to be a superior alternative to local anesthetic infiltration for the relief of pain during repair of first and second degree perineal lacerations.

Analgesia following Cesarean Delivery


Study Design: Guidelines

Conclusion: See pages 224-5 for a summary of the recommended monitoring intervals and durations following various neuraxial opioid dosing.
regimens. "Increased monitoring (e.g., intensity, duration, or additional methods) may be warranted in patients at increased risk of respiratory depression."


**Study Design:** Meta-analysis of 20 RCTs of variable quality; only 4 of 28 outcomes were addressed by more than a single study.

**Conclusion:** Local anesthetic infiltration, peritoneal spraying, and abdominal nerve blocks for caesarean delivery patients reduce postoperative systemic opioid consumption in the 24 hours following delivery. Drug solutions that also contain NSAIDs may confer additional pain relief. These strategies are recommended for patients undergoing general anesthesia. Note: To further define the value for patients receiving neuraxial anesthesia, future studies should test the benefit of these interventions in the presence and absence of neuraxial morphine.


**Study Design:** Moderate quality RCT (n=47 comprising 2 groups of n=24 [saline block] vs. n=23 [ropivacaine block])

**Conclusion:** The ultrasound-guided TAP block reduced morphine requirements after cesarean delivery when used as a component of a multimodal analgesic regimen, including scheduled acetaminophen and NSAIDS, and morphine PCA.


**Study Design:** Moderate quality RCT (n=96 comprising 2 groups of n=49 [saline block] vs. n=47 [ropivacaine block])

**Conclusion:** The TAP block did not improve postoperative visual analogue scale pain or satisfaction scores when used as part of a multimodal regimen that included intrathecal morphine, scheduled acetaminophen and NSAIDS, and morphine 2 mg pm for rescue.


**Study Design:** High quality RCT (n=87 comprising 3 groups of n=29 [morphine followed by 2-chloroprocaine then saline] vs. n=30 [saline followed by 2-chloroprocaine then morphine] vs. n=28 [saline followed by lidocaine then morphine])

**Conclusion:** For postpartum tubal ligation patients, the administration of epidural morphine 30 minutes before epidural anesthesia with 2-chloroprocaine achieved a similar duration of postoperative analgesia as epidural morphine administered after epidural anesthesia with lidocaine. In contrast, epidural 2-chloroprocaine administered before epidural morphine reduced the duration of postoperative analgesia. The discussion considers both pharmacodynamic and biologic explanations for the discrepancy introduced by the relative timing of morphine and 2-chloroprocaine administration.

### Side Effect Management


**Study Design:** High quality RCT (n=208 comprising 2 groups of n=104 [IV pentazocine] vs. n=104 [IV ondansetron])

**Conclusion:** Pentazocine 15 mg (a κ-opioid receptor agonist and μ-opioid receptor partial agonist) is superior to ondansetron 4 mg for the treatment of intrathecal morphine-induced pruritus and has a lower recurrence rate within 4 hours.


**Study Design:** Meta-analysis of 9 RCTs of limited to moderate quality

**Conclusion:** Although prophylactic 5-HT(3) receptor antagonists were not effective in reducing the incidence of pruritus, they significantly reduced the severity and the need for treatment of pruritus, the incidence of postoperative nausea and vomiting, and the need for rescue antiemetic therapy in parturients who received intrathecal morphine for cesarean delivery. They were also effective for the treatment of established pruritus.

### Complications of Anesthesia

#### General Risk Factors


**Study Design:** Cross-sectional study of n=4,438 patients with at least one anesthesia-related complication coded by ICD-9CM in 957,471 deliveries

**Conclusion:** Factors associated with anesthesia-related complications included cesarean delivery, living in rural areas, having preexisting medical conditions, Caucasian race, private insurance, and scheduled admission. Overall, 96 women died, and anesthesia-related complications during labor and delivery were associated with a 22-fold increased risk of maternal mortality. Causal relationships are impossible to infer.

**Study Design:** A pre/post test design in healthy volunteers (n=24 comprising 13 men and 11 nonpregnant women)

**Conclusions:** Approximately 2-4 kg of pressure over the cricoid ring effectively compresses the alimentary tract at the level of the postcricoid hypopharynx, not the esophagus. Anatomic compression is evident even when pressure displaces the crico-hypopharyngeal unit laterally from the vertebral body.

Two accompanying editorials:

Lerman J: **On cricoid pressure:** “may the force be with you.” Anesth Analg 2009; 109: 1363-6

This editorial questions whether anatomic compression measured on MRI guarantees an effective physiologic barrier to regurgitation.


**Study Design:** Secondary analysis of a prospective cohort in which 45 anesthesia providers completed a uniform data sheet on sequential deliveries under their care between 1998 and 2000 (n=139 cases of vomiting or regurgitation reported among n=4,891 cesarean deliveries under general anesthesia)

**Conclusion:** Thirty cases of regurgitation occurred on induction of anesthesia, in 24 of whom cricoid pressure was applied (per the anesthesia provider’s report). Nine of 11 mothers who died after aspiration had cricoid pressure applied on induction. Cricoid pressure was associated with increased rates of regurgitation on induction and overall maternal death. In settings such as Malawi, where anesthetist training is limited, and patient acuity is high (see Fenton BMJ 2003; 327: b587), preoperative gastric emptying may be a more effective measure than cricoid pressure to prevent aspiration of gastric contents.

Accompanying editorial:


See also #97 below [O’Sullivan BMJ 2009]

The Difficult Airway: Risk, Prophylaxis, and Treatment


**Study Design:** Computer simulation

**Conclusion:** A series of hypothetical patients were assumed to breathe 100% oxygen for 10 minutes before a period of apnea. The calculations suggest that a laboring woman with a body mass index of 50 kg/m² would rapidly desaturate after only 98 sec of apnea, compared to 292 sec in a standard pregnant woman in labor. Preeclampsia appears to prolong both pre-oxygenation and tolerance to apnea. Maternal hemorrhage and multiple pregnancy have minor effects.


**Study Design:** Retrospective observational study (n=3,430 obstetric general anesthetics)

**Conclusion:** Of 23 difficult intubations, none had a failed intubation, 1 patient had a prolonged desaturation with no evidence of aspiration, and no major sequelae were noted. The authors attribute the low incidence of airway complications to an above average rate of general anesthesia (8.7% of elective and 30.4% of emergency cesarean deliveries), consultant level supervision during the day; paired staffing with senior and junior trainees out of hours, and specialized anesthetic operating department assistants.


**Study Design:** High quality RCT (n=108 comprised of 2 groups of non-obstetric patients, including men and women with n=55 [rocuronium/ sugammadex] vs. n=53 [succinylcholine])

**Conclusion:** Reversal of profound high-dose rocuronium-induced neuromuscular block (1.2 mg/kg) with 16 mg/kg sugammadex was significantly faster than spontaneous recovery from 1 mg/kg succinylcholine. After sugammadex, the mean time to recovery of T₁ to 10% was just 1.2 minutes.

Lipid Rescue for Local Anesthetic Toxicity


**Study Design:** Animal study (n=30 rats comprised of 6 groups of 5 rats each)

**Conclusion:** While epinephrine improves initial return of spontaneous circulation at 5 minutes, lipid alone results in slower but more sustained recovery. Epinephrine over a threshold dose of 10 mcg/kg impairs lipid resuscitation from bupivacaine overdose, increases lactate, worsens acidosis, and worsens recovery at 15 minutes, possibly due to detrimental metabolic consequences of adrenergic stimulation.
Complications of Neuraxial Anesthesia


Study Design: Review article

Conclusion: This review considers the mechanisms of failed spinal anaesthesia in a sequential way: problems with lumbar puncture; errors in the preparation and injection of solutions; inadequate spreading of drugs through cerebrospinal fluid; failure of drug action on nervous tissue; and difficulties more related to patient management than the actual block. Techniques for minimizing the possibility of failure are discussed, all of them requiring, in essence, close attention to detail.

Accompanying editorial:


Letters to the editor:

Popham PA: Anatomical causes of failed spinal anaesthesia may be commoner than thought. Br J Anaesth 2009; 103: 459


Study Design: Prospective surveillance of major neurologic complications attributed to neuraxial block in the United Kingdom between 9/1/2006 and 8/31/2007 (n=an estimated 320,425 central neuraxial blocks in obstetric patients)

Conclusion: Of 12 cases reported after CNB in obstetric patients, 6 were wrong route errors in which dilute bupivacaine solutions were infused intravenously with no evidence of patient harm. All but 4 patients recovered completely within 6 months. The remaining 4 (1 abscess, 2 nerve injuries, 1 subdural hematoma) all made at least partial recoveries, but in 3 cases follow-up was incomplete. There were no cases of paraplegia or death after obstetric CNB.

Accompanying editorial:


Selected letters to the editor:


Online report:

National audit of major complications of central neuraxial block in the United Kingdom. The Royal College of Anaesthetists 2009; www.rcoa.ac.uk. Accessed 2/19/10


Study design: Healthy volunteer study (n=20 volunteers each serving as his or her own control)

Conclusion: EMLA® cream has a longer bacteriostatic effect after early bactericidal impact compared with skin disinfection with Skinsept Pur®.

Medicolegal Issues in Obstetric Anesthesia


Study Design: Retrospective review of obstetric anesthesia claims in the American Society of Anesthesiologists Closed Claims database (n=616 claims comprising 2 groups of n=426 [from 1990-2003] vs. n=190 [from before 1990])

Conclusion: Among post-1990 claims for maternal death or brain damage, high spinal attributed to unrecognized intrathecal epidural catheters emerged as probably the single most notable anesthesia-related complication in this report. Maternal nerve injury and newborn death/brain damage together accounted for almost 50% of all claims. Possibly preventable anesthetic causes of newborn injury included anesthesia delay and poor communication between the anesthesiologist and obstetrician.

Accompanying editorial:


Study Design: Retrospective review, case series of claims of inadequate anesthesia in the UK (n=159 cases)
Conclusion: Inadequate anesthesia accounts for 19% of anesthesia-related claims in the NHS in England. Of 80 claims in obstetric patients, 50 were for inadequate neuraxial anesthesia, 23 for undesired awareness, and 7 for awake paralysis.

Maternal Coexisting Disease

Cardiac Disease

Study Design: Prospective cohort substudy of 32 consecutive pregnant women with idiopathic DCM (n=32); nonpregnant women with DCM (n=18) matched on age and LV systolic function served as a control cohort
Conclusion: In pregnant women with DCM the risk of adverse cardiac events was 39%, with increased risk among women with moderate to severe LV dysfunction and NYHA functional class of III or IV. In the subset of women with moderate to severe LV dysfunction, 16-month event-free survival was worse in pregnant women compared with non-pregnant controls.

Study Design: Prospective cohort of 51 consecutive pregnant women with congenital AS experiencing 70 pregnancies leading to live-birth; prospective double cohort comparison (sub-sample of n=26 [pregnant] vs. n=26 [never pregnant])
Conclusion: Women with congenital AS who have undergone pregnancy have a higher frequency of late cardiac events (pulmonary edema, cardiac arrhythmia, cardiac death, cardiac interventions >1 year since baseline evaluation) compared with those who have never been pregnant (31% vs. 0%, P=0.02).

Study Design: Retrospective cohort (n=133 [pregnancies in 67 women with unrepaired ASD] vs. n=55 [pregnancies in 31 women with repaired ASD] vs. n=9,667 [population controls])
Conclusion: Women with an unrepaired ASD are at increased risk of delivering infants who experience neonatal events in comparison with women with a repaired ASD. Compared with the general population, women with an unrepaired ASD are at increased risk of preeclampsia, small-for-gestational-age births, and fetal mortality.

Study Design: Retrospective cohort (n= 44, including 39 African Americans)
Conclusion: LV function recovery (35%) and survival rates (84%) of PPCM patients observed in this population recruited at Louisiana State University are worse than prior reports from the United States, and similar to rates reported from Haiti and South Africa.

Study Design: Systematic review of case series and case reports (n=73 cases reported in 48 articles)
Conclusion: Maternal mortality in parturients with PAH remains prohibitively high, at 25%, based on reports published since 1997. General anesthesia was associated with a higher risk of death, but causality cannot be inferred.

Hypertensive Disorders including Preeclampsia

Study Design: High quality RCT (n=756 comprising 2 groups of n=377 [induction] vs. n=379 [expectant monitoring])
Conclusion: Induction of labor was associated with less progression to severe hypertension, and less need for anti-hypertensive medications or anticonvulsants. There were no cases of eclampsia, neonatal death, or maternal death.

Accompanying editorial:
Johnson DD: Induced labour for pre-eclampsia and gestational hypertension. Lancet 2009; 374: 951-2

Letter to the editor:

Study Design: Prospective enrollment with case control analysis (n=12 comprising 2 groups of n=4 [with preeclampsia] vs. n=8 [controls sampled from 124])
Conclusion: Using micro-array analysis and banked chorionic villous samples (CVS), this study identified 36 candidate genes that showed dysregulation in the early placentas of women approximately 6 months before developing preeclampsia. Many were related to inflammation, immunoregulation, and cell motility. These data support the theory that placentaion in preeclampsia is compromised in the first trimester by maternal and fetal immune dysregulation, abnormal decidualization, or both, thereby impairing trophoblast invasion. No evidence was found for alterations in genes regulated by oxidative stress.

Study Design: Prospective enrollment with case control analysis (n=372 comprising 2 groups with n=62 [preeclampsia] vs. n=310 [controls sampled from 598])

Conclusion: A panel of 7 messenger RNA markers measured in maternal plasma (at 15-20 gestational weeks) is able to predict subjects who will experience preeclampsia, with a detection rate of 84% at a 5% false-positive rate with an AUROC of 0.927. A scaled score combining results across markers correlates with the severity of subsequent disease.


Study Design: Case control (n=50 comprising 2 groups of n=17 [pregnant women with gestational hypertension] vs. n=33 [pregnant women without hypertension])

Conclusion: Sleep is highly disturbed in pregnancy. The mean apnea-hypopnea index for normotensive pregnant women was 18.2 events per hour compared with 38.6 for those with new-onset of hypertension during pregnancy. Fifteen potential cases and 13 potential controls were excluded because they were unable to sleep for the study. Gestational hypertension appears to be strongly associated with the presence of obstructive sleep apnea.


Study Design: Stage 1: pilot RCT (n=10 comprising 2 groups of n=5 [exposed to ACET across 5 randomized doses administered blindly in random order] vs. n=5 [control]); Stage 2: Sustained ACET therapy until delivery, interrupted once by saline placebo (n=3)

Conclusion: In preeclamptic patients remote from term (<32 weeks gestational age) antepartum continuous epidural therapy (ACET) reduces uterine artery resistance in a dose-dependent fashion, with the effect localized to the uterine artery which demonstrated higher baseline resistance. The contralateral uterine artery exhibited either increased vascular resistance or no change. Duration of pregnancy was increased in the ACET group, but further studies are needed to confirm a causal relationship.


Study Design: Prospective cohort study conducted between 1990 and 1992 (n= 205 preeclamptic women)

Conclusion: After preeclampsia, it can take up to 2 years for hypertension and proteinuria to resolve. The severity of preeclampsia and the time interval between diagnosis and delivery are associated with postpartum time-to-resolution of hypertension and proteinuria.


Study Design: Retrospective cohort (n=6,384 singletons exposed prenatally to preeclampsia)

Conclusion: Controlling for factors such as gestational age at birth, children exposed to preeclampsia in utero had an increased risk of endocrine, nutritional, and metabolic diseases, and diseases of the blood and blood-forming organs. Exposure to preeclampsia was also associated with an increased risk of being hospitalized in childhood.


Study Design: Retrospective cohort (17,457 men of whom n=891 were exposed to any pregnancy-associated hypertensive disorder)

Conclusion: Controlling for factors such as gestational age at birth, adults exposed to preeclampsia in utero had an increased risk of endocrine, nutritional, and metabolic diseases, and diseases of the blood and blood-forming organs. Exposure to preeclampsia was also associated with an increased risk of being hospitalized in childhood.


Study Design: Retrospective cohort (n=41,206 women who delivered between 1964 and 1976)

Conclusion: The 1,107 women who developed preeclampsia experienced higher rates of subsequent breast cancer and ovarian cancer during the time that this population was followed through 2004.

Diabetes


Study Design: High quality RCT (n=958 comprising 2 groups of n=485 [treatment of dietary intervention, self-monitoring blood glucose, and insulin therapy] vs. n=473 [usual prenatal care])

Conclusion: Although treatment of mild gestational diabetes mellitus did not significantly reduce the frequency of a composite outcome that included stillbirth or perinatal death and several neonatal complications, it did reduce the risks of fetal overgrowth, shoulder dystocia, cesarean delivery, and hypertensive disorders.

Accompanying editorial:


Letters to the editor:


Hematologic Disease


Study Design: High quality RCT (n=110 comprising 2 groups of n=55 [dalteparin] vs. n=55 [no dalteparin])

Conclusion: Dalteparin was effective in decreasing the recurrence of placental-mediated complications (including a composite of severe preeclampsia, IUGR, and/or placental abruption) in women without thrombophilia. These results require confirmation in future randomized trials.


Study Design: High quality RCT (n=88 comprising 2 groups of n=43 [ASA only] vs. n=45 [ASA+LMWH])

Conclusion: ASA+LMWH did not confer incremental benefit compared with ASA alone for women with antiphospholipid antibodies and recurrent pregnancy loss. These findings contribute to a growing body of literature that contests the emerging standard of care comprising LMWH/ASA for women with antiphospholipid antibodies whose only clinical manifestation is recurrent pregnancy loss.

Letter to the editor:


75. Saha P, Stott D, Atalla R: Haemostatic changes in the puerperium ‘6 weeks postpartum’ (HIP Study) - implication for maternal thromboembolism. BJOG 2009; 116: 1602-12

Study Design: Prospective cohort (n=46 deliveries comprising 2 groups of n=24 [cesarean births] vs. n=22 [vaginal births])

Conclusion: Coagulation screens as well as thromboelastometry suggest a persistent hypercoagulation that lasts approximately 3-4 weeks after delivery. Comparing by mode of delivery, there were nonsignificant increases in thrombotic parameters after cesarean delivery.


Study Design: Case report

Conclusion: ADAMTS13 is a protease that cleaves VWF. A deficiency of ADAMTS13 is a genetic cause of thrombotic thrombocytopenic purpura (TTP) that may manifest only during pregnancy. TTP may be lethal if misdiagnosed, may be confused with either HELLP syndrome, DIC or ITP, and is treatable with fresh frozen plasma (which provides ADAMTS13) and plasma exchange. Therapy should help to restore the platelet count and facilitate neuraxial anesthesia.

See also:


Study Design: Case series with familial genotyping

Conclusion: ADAMTS13 activity is important to measure when evaluating thrombocytopenia during childhood and pregnancy.

Infection


Study Design: Population surveillance (n=34 cases reported between April and May 2009, and n=6 deaths reported between April and June, 2009)

Conclusion: Pregnant women might be at increased risk for complications from pandemic H1N1 virus infection, and should receive prompt anti-influenza therapy upon development of symptoms.

Accompanying editorial:

Mangtani P, Mak TK, Pfeifer D: Pandemic H1N1 infection in pregnant women in the USA. Lancet 2009; 374: 429-30

Letter to the editor:

Su LL, Chan J, Chong YS, Choolani M, Biswas A, Yong EL. Pregnancy and H1N1 infection. Lancet 2009; 374: 1417-8

See also:


Study Design: Prospective cohort identified through population surveillance between April and August, 2009 (n=219 comprising three groups of n=94 [pregnant] vs. 8 [≤2 wks postpartum] vs. 137 [non-pregnant women of reproductive age])

Conclusion: 2009 H1N1 influenza can cause severe illness and death in pregnant and postpartum women; regardless of the results of rapid antigen testing, prompt evaluation and antiviral treatment of influenza-like illness should be considered in such women. The high cause-specific maternal mortality ratio (4.3 per 100,000 live births) suggests that 2009 H1N1 influenza will increase the 2009 maternal mortality ratio in the United States.
Study Design: Retrospective secondary analysis of a longitudinal cohort data (n=2,012 maternal/child dyads)
Conclusion: Considering a composite outcome that includes preterm birth, small for gestational age, child obesity, and postpartum maternal weight retention, for normal-weight women, minimum composite risk occurred with a weight gain of approximately 31 pounds, and for overweight women, approximately 16 pounds. These estimates varied modestly with adjustment for maternal characteristics and with different outcome weightings. For obese women, the lowest-risk weight change was weight loss in all models.

Letter to the editor:

Substance Abuse
Study Design: Retrospective trend analysis of surveillance data (n=245,970 pregnant US women admitted for substance treatment between 1994 to 2006)
Conclusion: Methamphetamine has become the primary substance compelling inpatient treatment during pregnancy in the US. Admissions remain most prevalent in the Western States, but substantial increases have been noted in the Midwest and the South.

Obstetric Management
The First Trimester

Study Design: High quality RCT (n=50 comprising 2 groups of n=25 [oral ibuprofen followed by paracervical block with lidocaine] vs. n=25 [oral placebo followed by paracervical block with ketorolac and lidocaine])
Conclusion: Paracervical block with combined ketorolac and lidocaine significantly decreased perceived pain associated with cervical dilation during first-trimester surgical abortion.

Study Design: Retrospective cohort (n=81,703 infants comprising 2 groups of n=3,458 [exposed to metoclopramide] vs. n=78,245 [not exposed])
Conclusion: In this large cohort of infants, exposure to metoclopramide in the first trimester was not associated with significantly increased risks of major congenital malformations, low birth weight, preterm delivery, or perinatal death.

See also:
The US FDA has proposed to eliminate the current pregnancy categories A, B, C, D, and X. Instead, the pregnancy and lactation subsections of labeling would include a risk summary, which summarizes the risks of the medicine to the developing fetus or breastfeeding infant, and a discussion of data supporting that summary.
Cognitive function at 3 years of age after fetal exposure to antiepileptic drugs. N Engl J Med 2009; 360: 1597-605

**Study Design:** Prospective observational multicenter (USA & UK) cohort (n=258 children with fetal exposure to antiepileptic drugs comprised of 4 groups of n=73 [carbamazepine] vs. n=84 [lamotrigine] vs. n=48 [phenytoin] vs. n=53 [valproate])

**Conclusion:** In utero exposure to valproate, as compared with other commonly used antiepileptic drugs, is associated with an increased risk of impaired cognitive function at 3 years of age. This finding supports a recommendation that valproate not be used as a first-choice drug in women of childbearing potential.

**Accompanying editorial:**

**Preterm Labor**

**Study Design:** Moderate quality RCT (n=494 comprising 2 groups of n=247 [progesterone vaginal gel] vs. n=247 [placebo vaginal gel])

**Conclusion:** Progesterone (90 mg vaginal suppository administered daily from 24 weeks’ gestation) does not prevent preterm birth in women with twin pregnancy.

**Accompanying editorial:**

This editorial stresses the importance of planned long-term follow-up for survivors in randomized controlled trials of perinatal interventions, because “…long-term outcomes for the fetus are the primary endpoints of any study designed to prolong pregnancy.”

See also:

The National Children’s Study will examine the effects of environmental influences on the health and development of 100,000 children across the United States, following them from before birth (even before conception in some cases) until age 21 years.

**Treatment of periodontal disease during pregnancy: a randomized controlled trial.** Obstet Gynecol 2009; 114; 1239-48

**Study Design:** High quality RCT (n=1,078 comprised of 2 groups of n=538 [antenatal periodontal treatment] vs. n=540 [no antenatal periodontal treatment])

**Conclusion:** The evidence provided by the present study does not support the hypothesis that treatment of periodontal disease during pregnancy in this population prevents preterm birth, fetal growth restriction, or preeclampsia. Periodontal treatment was not hazardous to the women or their pregnancies.

See also:

**Study Design:** Meta-analysis of 7 RCTs of limited quality

**Conclusion:** Based on this meta-analysis, scaling and root planing decreased preterm birth and low birth weight, but did not reduce spontaneous abortion/stillbirth. Note: Publication bias and heterogeneity limit the strength of these conclusions.

**Letter to the editor:**

**Multicenter randomized trial of cerclage for preterm birth prevention in high-risk women with shortened mid trimester cervical length.** Am J Obstet Gynecol 2009; 201: 375 e1-8

**Study Design:** High quality RCT (n=301 comprised of 2 groups of n=153 [no cerclage] vs. n=148 [cerclage])

**Conclusion:** In women with a prior spontaneous preterm birth less than 34 weeks and cervical length less than 25 mm, cerclage reduced previable birth and perinatal mortality but did not prevent birth less than 35 weeks, unless cervical length was less than 15 mm.


**Study Design:** High quality RCT (n=558 neonates from 437 pregnancies) with known outcome comprising 2 groups of n=276 [rescue course of antenatal corticosteroids] vs. n=282 [placebo control])

**Conclusion:** This study enrolled women with singleton or twins <33 weeks who had completed a single course of antenatal corticosteroids (ACS) before 30 weeks and at least 14 days prior to inclusion, and were judged to have a recurring threat of preterm birth in the coming week. Among this population, a single rescue course of ACS reduced the composite outcome of neonatal morbidity in babies delivering...
before 34 weeks (including respiratory distress syndrome, bronchopulmonary dysplasia, severe intraventricular hemorrhage, periventricular leukomalacia, blood culture-proven sepsis, necrotizing enterocolitis, or perinatal death). ACS rescue did not change short-term neonatal risk or anthropomorphic measurements of the neonate (birth weight, rates of IUGR, or head circumference).

Accompanying editorial:
Bonanno C, Wapner RJ: To rescue or not to rescue: that is the question. Am J Obstet Gynecol 2009; 200: 248 e1-9

90. Shirangi A, Fritchi L, Holman CO: Associations of unscavenged anesthetic gases and long working hours with preterm delivery in female veterinarians. Obstet Gynecol 2009; 113: 1008-17
Study Design: Secondary analysis of a national survey study (n=1,197 [response rate=59%] reporting 744 pregnancies)
Conclusion: Self-reported long working hours and performing surgery in the absence of a scavenger system for anesthetic gases appeared to be independent risk factors for preterm birth in female veterinarians.

Study Design: Meta-analysis and decision analysis of 58 RCTs of primarily limited to moderate quality
Conclusion: Although all current tocolytic agents were superior to no treatment for delaying delivery beyond 48 hours and also to 7 days, prostaglandin inhibitors were superior to the other agents and may be considered the optimal first-line agent before 32 weeks of gestation to delay delivery. Calcium channel blockers demonstrated the highest proportion of patients tolerating treatment and achieving delay in delivery until 37 weeks’ gestation.

Breech Presentation

Study Design: Moderate quality RCT (n=95 comprising 2 groups of n=47 [CSE] vs. 48 [systemic fentanyl]); discussion includes a meta-analysis of 5 trials
Conclusion: There was no difference in the rate of successful ECV or vaginal delivery with CSE compared with intravenous fentanyl analgesia. Pain scores were lower and satisfaction higher with CSE analgesia. Larger trials are needed to assess safety. Meta-analysis suggests that there may be a dose-dependent relationship between neuraxial analgesia/anesthesia and success of ECV—demonstrating a favorable effect when the studies using neuraxial anesthesia are combined, but not when the studies using analgesia are combined.

Trial of Labor after Cesarean (TOLAC) and Vaginal Birth after Cesarean (VBAC)

Study Design: Moderate quality RCT (n=211 comprising 2 groups of n=107 [sweep] vs. n=104 [vaginal exam control])
Conclusion: Serial membrane sweeping at term in women who planned VBAC had no significant effect on the onset of labor, pregnancy duration, induction of labor, or repeat cesarean delivery.

Study Design: Retrospective cohort (n=13,541 comprising 2 groups of n=7,660 [TOLAC] vs. n=5,881 [elective repeat CD])
Conclusion: A prediction model for VBAC provides information regarding the chance of TOL-related morbidity and suggests that maternal morbidity is not greater for those women who undergo TOL compared with those who undergo ERCs if the chance of VBAC is at least 70%.

Study Design: Retrospective cohort (n=672 comprising 2 groups of n=329 [TOLAC] vs. n=343 [elective repeat CD]); cost estimation by intended mode of delivery
Conclusion: Cost estimation suggests that the median total maternal and neonatal cost for patients managed with planned cesarean delivery is 24% higher than for those managed by planned vaginal birth. However, cesarean delivery after a failed trial of labor was estimated to cost 14% more than planned cesarean delivery, so accurate prediction of VBAC success (see #94 above, Grobman) is important.

Induction of Labor

Study Design: Meta-analysis of 11 fair quality RCTs
Conclusion: RCTs suggest that elective induction of labor at 41 weeks’ gestation and beyond is associated with a decreased risk for cesarean delivery and for meconium-stained amniotic fluid.

Accompanying editorial:
Editorial calls for well-designed RCTs of induction versus expectant management at 39 to 41 weeks’ gestation.

**Study Design:** High quality RCT (n=2,426 comprised of 2 groups of n=1,207 [water] vs. n=1,219 [eating])

**Conclusion:** Consumption of a light diet during labor did not influence obstetric or neonatal outcomes in participants, nor did it increase the incidence of vomiting. Women who are allowed to eat in labor had similar lengths of labor and operative delivery rates compared with women who were allowed water only during labor.

**Accompanying commentary:**
Downe S: Eating a light diet during labour does not seem to worsen obstetric outcomes. BMJ 2009; 338: b732

Note: The title of this commentary as well as extensive press coverage for the article framed the study results in a direction that is not clinically relevant. The point of the study is that eating in labor does not improve delivery outcomes. If these results are accurate, then the sole reason to eat in labor is to enhance maternal comfort. The study was not designed to address the question of whether eating in labor changes the risk for aspiration of gastric contents.


**Study Design:** High quality RCT (n=289 comprised of 3 groups of n=97 [NS] vs. n=94 [D5NS] vs. n=98 [D10NS])

**Conclusion:** Administration of a dextrose solution, regardless of concentration, was associated with a shortened labor course in term vaginally delivered nulliparous subjects in active labor.


**Study Design:** Prospective cohort (n=287 women comprised of 4 groups of n=26 [elective cesarean delivery] vs. 113 [received under 1 L of fluids in labor] vs. 87 [received 1-2.5 L fluids] vs. 61 [received >2.5 L fluids])

**Conclusion:** Hyponatremia (Na ≤130 mmol/L) was found in 26% of women who received over 2.5 L of fluid during labor, with a minimum sodium value of 122. Two-thirds of fluids were orally ingested. For women in labor, oral fluids should be recorded, and intravenous administration of hypotonic fluids should be avoided.


**Study Design:** Moderate quality RCT (n=200 comprised of 2 groups of n=93 [chewed gum] vs. n=107 [controls])

**Conclusion:** Gum chewing after cesarean delivery is well tolerated, and associated with more rapid resumption of intestinal motility and shorter hospital stay (40.9±10.6 vs. 50.5±8.9 hours, P<0.001).

**Letter to the editor:**
Byrne H: Gum chewing stimulates early return of bowel motility after caesarean section. BJOG 2010; 117: 117; author reply 117-8


**Study Design:** Retrospective cohort (n=500 patients comprised of 5 groups of n=100 [Asian] vs. n=100 [Black] vs. n=100 [Hispanic] vs. n=100 [White] vs. n=100 [Other])

**Conclusion:** Mathematical models can be used to detect subtle effects of patient covariates on the progress and pain of the first stage of labor. Asian women and heavier women had slower labor and slower onset of labor pain than others. These effects were modest compared with the substantial remaining unexplained subject-to-subject variability in labor progress and labor pain.

**Accompanying editorial:**


**Study Design:** Case control (n=56 comprising 2 groups of n=12 [cesarean deliveries] vs. n=24 [control vaginal deliveries])

**Conclusion:** The center of uterine electrical activity (CUA) was derived from the electrohysterogram during a period of arrest of dilation, or the same dilation in controls. Predominately upward movement of the CUA (longer and/or stronger contraction at the fundus) was more common with normal dilation (P=0.003). Conversely, the CUA was more likely to remain in the lower uterine segment in those who later delivered by cesarean for arrest of dilation.

**Accompanying editorial:**


**Study Design:** Exploratory prospective cohort to evaluate a diagnostic test against a weak reference standard (vaginal examination); (n=311
paired measurements in n=166 women)

**Conclusion:** The LaborPro® ultrasound-based system can determine fetal head station and position during labor, when compared with the current standard vaginal examination.

**Intrapartum Fetal Monitoring**


**Study Design:** Exploratory prospective cohort (n=148) to evaluate a diagnostic test against a reliable reference standard (UA pH ≤ 7.05)

**Conclusion:** Computer analysis of FHR and ST event signals predicted neonatal acidemia with a sensitivity of 1.0 (95% CI 0.56-1.0), PPV of 0.47 (95% CI 0.22-0.72), NPV of 1.0 (95% CI 0.96-1.0), positive LR 17.6 (95% CI 9.0-34.5).

**Article discussion:** Pettker CM, Macones GA. *Predicting neonatal acidemia by computer analysis:* Costa et al. Am J Obstet Gynecol 2009; 201: 543-4


**Study Design:** Retrospective cohort (n=235 comprising 3 groups of n=39 [irreversible group] vs. n=22 [potentially reversible group] vs. n=174 [unknown])

**Conclusion:** Cord arterial pH deteriorates with the bradycardia-to-delivery interval when the underlying cause of fetal distress is irreversible (placental abruption, cord prolapse, uterine rupture, preeclampsia, or failed instrumental delivery), but not so otherwise (iatrogenic uterine hyperstimulation, hypotension after epidural anesthesia, cephalic version without abortion, aortocaval compression, or unknown cause for fetal bradycardia).

**Obstetric Complications**

**Hemorrhage**


**Study Design:** Guidelines

**Conclusion:** These guidelines provide a stepwise algorithm for postpartum hemorrhage, beginning with: 1) uterine massage and oxytocin 2) ergometrine, 3) prostaglandin, and 4) tranexamic acid (if the bleeding is attributed in part to trauma). There is insufficient evidence to recommend recombinant factor VIII. Recommended non-operative and operative maneuvers include: 1) bimanual uterine compression as a temporizing measure in the treatment of PPH due to uterine atony after vaginal delivery, 2) intrauterine balloon tamponade (but not uterine packing), 3) uterine artery embolization, 4) compression sutures, 5) vessel ligation, and 6) subtotal hysterectomy. Isotonic crystalloids should be used in preference to colloids for fluid resuscitation. Health care facilities should adopt a formal protocol for the management of PPH.


**Study Design:** Review article

**Conclusion:** A common theme for pregnancy-associated DIC is the pivotal role played by the placenta. This article reviews how pregnancy-associated DIC can be diagnosed promptly and how treatment should be managed strategically. It also discusses the latest understanding of hemostatic mechanisms within the placenta and how these mechanisms may have relevance to new diagnostic approaches as well as novel therapeutic modalities.


**Study Design:** Retrospective case series (n=74 cases)

**Conclusion:** The periparum transfusion rate was 1.4%. For over one-third of recipients, no documented indication for transfusion could be identified based on chart review.

**Accompanying editorial for Butwick and Parker (#109):**


Given the risks of blood transfusion, the enormous cost of banked blood products, and the relative health of the obstetric population, every effort should be made to restrict transfusion policies, and to avoid the need for blood transfusion.


**Study Design:** Retrospective case series (n=202 cases)

**Conclusion:** The periparum transfusion rate was 3.1%. Almost one-third of recipients had a pre-transfusion hemoglobin >7 g/dL with no documentation of ongoing bleeding or symptoms of anemia.


**Study Design:** Retrospective cohort (n=95 comprising 3 groups of n=42 [cesarean deliveries for true previa] vs. n=24 [laboring women with placental edge to internal os distance of 1-10 mm] vs. n=29 [laboring women with a distance of 11-20 mm])

**Conclusion:** More than two-thirds of women with a placental edge to cervical os distance of >10 mm deliver vaginally without increased risk of hemorrhage.
Accompanying editorial:
The term “low-lying placenta” is out of date, and should be replaced with the distance measured from the placental edge to the cervical os.

Uterine Rupture

Study Design: Population-based surveillance (n=210 cases in 371,021 deliveries)
Conclusion: Although much attention is paid to scar rupture associated with uterotonic agents, 13% of ruptures occurred in unscarred uteri and 72% of ruptures occurred during spontaneous labor.

Study Design: Retrospective case series (n=41 true ruptures [of 69 coded cases] in 226,325 deliveries)
Conclusion: Epidemiological data on uterine rupture based on hospital discharge codes without concurrent chart review may be invalid (28 of 69 cases coded by ICD9-CM were actually cases of uterine dehiscence, not true ruptures). In this US health system with a VBAC rate of 6.2%, only 25% of true uterine ruptures occurred during a trial of labor in a patient with a scarred uterus. Prior uterine surgery, induction with oxytocin or prostaglandins, and nulliparity were other factors noted on chart review.

Neurologic Complications

Study Design: Cross-sectional study of n=33,956 patients with migraine coded by ICD-9CM in n=18,345,538 pregnancy-related hospital discharges
Conclusion: In this large, population-based sample of admissions in pregnant women, active peripartum migraine was strongly associated with both stroke and hypertension. Moderate associations were found between peripartum migraine and other vascular disorders, including myocardial infarction/heart disease, pulmonary embolism/venous thromboembolism, preeclampsia/gestational hypertension, smoking, and diabetes.

Study Design: Prospective cohort of consecutive patients with symptomatic CVST (n=824, including 77 women who were pregnant or postpartum)
Conclusion: Women with symptomatic CVST and a gender-specific risk factor (including pregnancy) have a much better prognosis than other patients with symptomatic CVST.

Study Design: Case report of reversible cerebral vasoconstriction syndrome
Conclusion: Characterized by recurrent thunderclap headaches and dynamic segmental arterial vasocostriction (that may or may not be visualized on serial brain imaging), this syndrome can lead to ischemic strokes, seizures, parenchymal hemorrhage, vasogenic edema, subarachnoid hemorrhage, and death. Treatment is with calcium-channel antagonists, corticosteroids, and blood pressure control.

General Obstetric Complications

Study Design: Trend analysis of a cross-sectional study of n=227,333 patients with at least one severe obstetric morbidity coded by ICD-9CM in n=32,276,863 pregnancy-related hospital discharges
Conclusion: Rates of overall severe obstetric morbidity in the US increased from 1998-1999 to 2004-2005. Controlling for the increasing rate of cesarean delivery, the rates of renal failure, adult respiratory distress syndrome, shock, and ventilation did not change. Increases in pulmonary embolism and blood transfusion correlated with—but could not be completely explained by—increasing cesarean delivery. Complications of anesthesia decreased over time in all models, regardless of mode of delivery.

Study Design: Cross-sectional study of approximately n=52,461 patients with at least one obstetric morbidity coded by ICD-9CM in n=183,431 delivery hospitalizations between 2001-2005
Conclusion: Between 1993-1997 and 2001-2005, the rate of intrapartum morbidity associated with obstetric complications in the US was unchanged (at 28.6%) and the rate of pregnancies complicated by preexisting medical conditions (chronic hypertension, cardiac disease, asthma, diabetes and renal disease) increased from 4.1% to 4.9%. Note: Increasingly comprehensive documentation of comorbidities in order to maintain revenue may explain some of this increase.
The EXPRESS Group: Conde-Agudelo A, Romero R: Early Prematurity


Manuck TA: Outcomes of expectantly managed preterm premature rupture of membranes occurring before 24 weeks of gestation.
Late Prematurity


**Study Design:** Retrospective population-based cohort study of NCHS 2001 US birth cohort linked birth/death files (n=292,627 late-preterm births of n=3,483,496 singleton births)

**Conclusion:** 23% of late preterm births (delivered between 340/7-366/7 weeks) had no recorded indication for delivery noted on birth certificates. Controlling for gestational age at birth, this group (without an indication for late preterm delivery) had higher neonatal and infant mortality rates compared with those born after isolated spontaneous labor.


**Study Design:** Retrospective cohort study of healthy late preterm births vs. healthy term infants (n=159,813 comprised of 2 groups of n=7,152 [healthy late preterm] vs. n=152,661 [term])

**Conclusion:** This study suggests that healthy-appearing late preterm infants (delivered between 340/7-366/7 weeks' gestation) face a greater risk for developmental delay, requirements for supplemental educational services, and adverse early school-age problems through the first 5 years of life when compared with healthy term infants.

Term Birth


**Study Design:** Retrospective cohort study (n=1,262 adverse neonatal events among 13,258 elective cesarean deliveries after 37 weeks gestational age)

**Conclusion:** Elective repeat cesarean delivery before 39th weeks' gestation is common and is associated with preventable increases in neonatal morbidity (including respiratory and other adverse neonatal outcomes) and admissions to the neonatal ICU. Incremental risk was noted even among those infants born between 38th and 39th weeks' gestational age. These findings support the delay of elective cesarean deliveries until 39 weeks' gestation.

**Accompanying editorial:**

Letter to the editor:


**Study Design:** Retrospective population-based cohort study of NCHS 2001 US birth cohort linked birth/death files (n=4,976 neonatal deaths and n=14,776 post-neonatal infant deaths among 12,762,098 births)

**Conclusion:** Neonatal death, low 5-minute Apgar score, and mechanical ventilation show a U-shaped relation across term gestational ages, with minimum risk noted between 39th weeks and 40th weeks. Rates of meconium aspiration syndrome and birth injury rise with increasing gestational age. Post-neonatal death and postneonatal SIDS decrease with increasing gestational age up to 39 weeks.

Neurologic Morbidity and Mortality


**Study Design:** High quality RCT (n=40 comprising 2 groups of n=20 [magnesium sulfate] vs. n=20 [saline placebo])

**Conclusion:** Postnatal magnesium sulfate treatment improves neurologic outcomes at discharge for term neonates with severe perinatal asphyxia when it is given early (within 6 hours). More studies with larger sample sizes, preferably multicenter trials, are needed to confirm the results of this study.


**Study Design:** Population-based longitudinal cohort study (n=11,482 children comprised of 3 groups of n=815 [resuscitated but asymptomatic] vs. n=58 [resuscitated and symptomatic] vs. n=10,609 [not resuscitated and asymptomatic])

**Conclusion:** Infants who were resuscitated at birth had increased risk of a low IQ score at age 8 years, even if they remained healthy during the neonatal period. Resuscitated infants asymptomatic for encephalopathy might result in a larger proportion of adults with low IQs than do those who develop neurological symptoms consistent with encephalopathy.

**Accompanying editorial:**

Letter to the editor:

Study Design: Population-based retrospective cohort study (n=219 intrapartum stillbirths and n=500 neonatal deaths among 1,012,266 births)

Conclusion: Rates of intrapartum stillbirth and neonatal death at term decreased in Scotland between 1988 and 2007. This decrease was only significant for deaths ascribed to intrapartum anoxia (defined broadly including hypoxia, acidosis, and asphyxia), with a total decrease from 5.7 to 3.0 per 10,000 births (adjusted OR 0.46 [95% CI 0.33-0.65]). The authors correlate this decrease in perinatal death with an increasing cesarean delivery rate (from 8.9% to 21.6%), and question the WHO recommendation to limit cesarean deliveries to no more than 15% of all births.

Breastfeeding


Study Design: Retrospective cohort (n=2,540 cases of CAD among 89,326 parous women in the Nurses' Health Study)

Conclusion: Long duration of lactation (life-time total of 2 years or longer) was associated with a reduced risk of coronary heart disease during the 30 years after a woman’s last birth, even when adjusted for age, parity, adiposity, family history, comorbidities, and lifestyle factors.


Study Design: Retrospective cohort (n=139,681 women in the Women’s Health Initiative study)

Conclusion: Among postmenopausal women, increased duration of lactation (life-time total of at least 12 months) was associated with a lower prevalence of hypertension, diabetes, hyperlipidemia, and cardiovascular disease. In fully adjusted models stratified by age, the cardiovascular benefits of lactation appeared to decrease as women age, with the strongest effects among women 50-59 years of age, and no significant effects among women aged 70-79.


See also:

Education

Communication


Study Design: Qualitative analysis of written narratives (n=39)

Conclusion: The ethical, practical, and relational challenges in obtaining informed consent colored trainees’ views of patient care and affected their interactions with patients. Using participant narratives personalizes education and motivates participants. The richness of narratives may help anesthesiologists to appreciate the qualitative aspects of informed consent.

Accompanying editorial:

Selected by the editorial board of Anesthesiology as one of the top 12 articles “...to advance the science and practice of perioperative, critical care, and pain medicine through the promotion of seminal discovery.”


Letter to the editor:
- Edler AA: Paradigm consciousness: a new approach to understanding anesthesia knowledge and education. Anesthesiology 2009; 111: 920


Study Design: Review article

Conclusion: Recent evidence suggests that communication practices should include a consideration of conscious and subconscious processes and responses. This model has potential relevance when learning and teaching how to communicate effectively in the stressful environment of anesthetic clinical practice, and includes reflective listening, observing, acceptance, utilization, and suggestion.
Letters to the editor:

Langford RA: Communication and consent. Anaesthesia 2009; 64: 1259


The Health Care Delivery System

Home Birth

Study Design: Retrospective cohort (n=529,688 comprised of 3 groups of n=321,307 [home birth plan] vs. n=163,261 [hospital birth plan] vs. n=45,120 [unknown plan]) including all women under midwifery care who gave birth in the Netherlands between 2000 and 2006
Conclusion: Planning a home birth was not associated with increased risks of perinatal mortality (intrapartum and up to 7 days after birth) or severe perinatal morbidity among low-risk women (normal singleton vertex gestation, 37-42 weeks' gestation, with no maternal medical or obstetric risk factors), provided the availability of well-trained midwives and a good transportation and referral system.

Letter to the editor:


Study Design: Prospective cohort (n= 12,982 comprising 3 groups of n=2,899 [home birth with midwife] vs. n=4,752 [hospital birth with midwife] compared against a matched control cohort n=5,331 [hospital birth with physician])
Conclusion: Compared with planned hospital births attended by a registered midwife or physician, planned home births attended by a registered midwife were associated with comparable rates of perinatal death (stillbirth after 20 weeks or death in the first 28 days of life) and with reduced rates of obstetric interventions and other adverse perinatal outcomes.

Accompanying editorial:

McLachlan H, Forster D: The safety of home birth: is the evidence good enough? CMAJ 2009; 181: 359-60
This editorial calls for a multicenter RCT with a composite outcome measure of perinatal mortality and major morbidity to compare planned home versus hospital birth.

Organization of Anesthetic Services

Study design: Secondary qualitative analysis of transcripts from 4 focus groups including 18 anesthesia providers
Conclusion: Physicians in community hospitals face significant barriers in the provision of obstetric anesthesia care. These barriers are greatest among family practitioner/general practitioner anesthetists and in rural hospitals where physician shortages and lack of supports threaten provision of services. Future study of local context-specific and systems-level solutions is required.

Accompanying editorial:


Study Design: Cross-sectional analysis (of 1,141,641 discharges for delivery) linked to a survey of anesthesia providers in 369 hospitals; study funded by the American Association of Nurse Anesthetists (AANA)
Conclusion: This study did not detect a difference in anesthesia-related or obstetric complications billed by ICD-9CM codes between hospitals that use only CRNAs, a combination of CRNAs and anesthesiologists, or anesthesiologist-only models. Note: A future study is needed that clearly describes the characteristics of the populations constructed by propensity scores, accounts for hospital transfers, adjusts for obstetric acuity, and provides specifics about the anesthesia-related complications.

See also:

Patient Safety

Study Design: Consensus document based on a two-stage web-based modified Delphi survey of over 250 international experts
Conclusion: This conceptual framework describes 10 components of a patient safety incident: incident type, patient outcomes, patient characteristics, incident characteristics, contributing factors/hazards, organizational outcomes, detection, mitigating factors, ameliorating actions, and actions taken to reduce risk for future incidents.


**Study Design:** International pre/post design (n=7,688 patients in 8 hospitals comprised of 2 groups of n=3,733 [patients before checklist] vs. n=3,955 [patients after checklist])

**Conclusion:** Following implementation of the surgical checklist, the death rate across all 8 institutions decreased from 1.5% to 0.8% (P=0.003); inpatient complications decreased from 11.0% to 7.0% (P<0.001).

Letters to the editor:


**Study Design:** Retrospective cohort (n=2,672 undesirable events in 19,560 anesthetics)

**Conclusion:** The rate of undesirable events (central and peripheral nerve injuries, inadequate oxygenation, vomiting/aspiration, technical failures of tracheal tube placement) was greater among trainees at the beginning of the academic year regardless of the trainee’s level of clinical experience. This suggests that several additional factors, such as knowledge of the working environment, teamwork, and communication, may contribute to the increase in undesirable events.

Accompanying editorial:

Barach P, Johnson JK: Variation in adverse events during the academic year: trainees need practice and mentorship, and graduated clinical responsibilities. BMJ 2009; 339: b3949


**Study Design:** Description and evaluation of an ongoing quality improvement program targeting perinatal patient safety in 16 delivery units

**Conclusion:** This perinatal patient safety program (which continues to evolve) produced improved outcomes from 2003 to 2008 including reductions in perinatal harm, a decrease in the number of claims, and a decrease in the costs of claims.


**Study Design:** Description and evaluation of a quality improvement program targeting perinatal safety in a major academic center

**Conclusion:** A systematic strategy to improve patient safety included outside expert review, protocol standardization, the creation of a patient safety nurse position and patient safety committee, and training in team skills, and fetal heart rate monitoring interpretation. These interventions significantly reduced the Adverse Outcome Index over time, P=0.01.


**Study Design:** Pre/post design (n=34 [events before team training] compared with n=28 [events post-training])

**Conclusion:** After introduction of annual multidisciplinary simulation training, median diagnosis-delivery intervals for cord prolapse decreased (from 25 to 14.5 minutes, P<0.001) and the rate of cesarean deliveries in which recommended actions had been performed increased (from 35 to 82%, P<0.003). Future RCTs are needed to confirm these results.


**Study Design:** Review article

**Conclusion:** This review evaluates obstetric emergency training programs from hospitals that have demonstrated improved outcomes to determine the active components of effective training. Common features identified were institution-level incentives to train, multi-professional training of all staff in their units, teamwork training integrated with clinical teaching, and use of high fidelity simulation models. Local training appeared to facilitate self-directed infrastructural change.


**Study Design:** Survey study (n=67 obstetric anesthesia directors in North America; response rate=55%)

**Conclusion:** Results from this survey suggest that the level of care provided for postanesthesia recovery from cesarean delivery in North American academic institutions may not meet the guidelines established by the American Society of PenAnesthesia Nurses.


**Study Design:** Survey study (n=158 of UK consultant-led obstetric anesthetic units; response rate=71%)

**Conclusion:** Survey results support the recommendation for a nationally standardized obstetric early warning scoring system (EWS). Using extracts from 9 unit responders, an EWS was devised and has been submitted to OAA for consideration.

**Study Design:** Description and evaluation of cumulative sum analysis as a tool to monitor rates of Apgar scores <7 and to target quality improvement efforts

**Conclusion:** Prospective and continuous monitoring of clinical outcomes using the CUSUM chart method may allow early detection and correction of adverse trends and may help to identify and target quality improvement efforts.

**Books**


This new edition is an up-to-date comprehensive resource for the practice of obstetric anesthesia.