
WHAT'S NEW IN OBSTETRIC ANESTHESIA FROM 2005?

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"If physicians would read two articles per day out of the six million medical articles published annually, in one year they would fall 82 centuries behind in their reading."

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Policies and Procedures

Staffing and Billing

- In an Anesthesia Patient Safety Foundation (APSF) newsletter there was a letter entitled *Epidurals for Labor Are Labor Intensive*. To quote in part "...by far the greatest cause of fatigue, stress, and sleep deprivation to me has been the escalating and incessant demands of obstetrical anesthesia....what was once a privilege of a few has become an entitlement to all.....If we, as a specialty, are serious about addressing the problem of fatigue caused by sleep deprivation, the obvious place to start would be to re-evaluate our professional obligation to perform these underfunded and non-essential procedures after hours....We should not have to "burn the candle at both ends" in order to appease one overly demanding group of patients by night and risk detriment to others who are entitled to our best efforts by day."ⁱ Although we all may have felt that way at 4am, this obviously comes across as unprofessional to any patient or hospital administrator who may be reading this. Several excellent responses followed fortunately.
- Most Colorado practices are undergoing a Medicaid audit of obstetric anesthesia billing practices. The ASA RVG describes 4 acceptable ways to bill for labor epidurals without specifically recommending one over another. They are:
 - 1) Base units plus patient contact time plus one unit hourly
 - 2) Base units plus time units, subject to a reasonable cap
 - 3) Single fee
 - 4) Incremental time-based fees (e.g., 0-2 hours, 2-6 hours, >6 hours)Clearly using #3 or #4 would reduce documentation concerns, but few insurers have been willing to accommodate that method thus far.

Elective Prophylactic Cesarean Delivery

- Obstetricians are in the midst of a debate as to whether a woman can choose a cesarean delivery for herself without any medical or fetal indication. 12% of American female obstetricians would choose an elective cesarean delivery for themselves, as would 35% of British female obstetricians. The move against vaginal delivery centers on longterm damage to the mother's perineum, need for emergency cesarean delivery during labor with its increased risk, intrapartum fetal hypoxia, and brachial plexus injury or forceps/vacuum-caused injury to the fetus. In contrast, elective scheduled cesarean delivery is very safe. As one editorial notes, "Vaginal birth may be nature's way, but nature's way has always been hazardous.....Even those who vehemently oppose elective prophylactic cesarean delivery cannot present evidence to demonstrate it is detrimental to either the woman or the fetus."ⁱⁱ
- A survey of maternal-fetal medicine specialists (MFM) and uro-gynecologists (UGS) found that 65% of MFM and 80% of UGS would perform elective primary cesarean delivery.ⁱⁱⁱ The actual incidence of these in the U.S. is unknown, but previous estimates are ~100,000 / year.

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- About 1 in 5 women in the U.S. will undergo induction of labor, often for unclear reasons, and induction with an unfavorable cervix increases risk of cesarean. An editorial points out that as physicians practicing evidence-based medicine, obstetricians have a responsibility to discourage elective inductions as part of decreasing the cesarean delivery rate.^{iv} Cesarean delivery in labor occurs more often after induction and increases costs (\$2137) compared with spontaneous vaginal delivery (\$1340) or scheduled cesarean delivery (\$1532).^v

Publications in the Lay Press

- It's always good to know what your patients have been reading! An article in USA Today reported that patients are having difficulty finding a hospital that will allow them to have a trial of labor after a previous cesarean delivery. One woman opted to have a home delivery of a 9-pound baby because the hospital in her town said she had to relocate to Denver or Omaha for a VBAC (both ~300 miles away from her other 5 children at home). Nowhere in Oklahoma can patients have a VBAC because no malpractice carrier will cover for it.^{vi}
- An article in *Fit Pregnancy* entitled "Epidurals: fact vs. fiction" has a good debunking of myths about labor epidurals. It could be a good reference for childbirth education classes.^{vii}
- A new book *Easy Labor, Every Woman's Guide to Choosing a Less Painful, More Joyful Childbirth* was actually written by an anesthesiologist! Finally a well-balanced approach to what we do. The author, Bill Camann, is Director of Obstetric Anesthesia at Brigham & Women's Hospital in Boston.
- 3-D ultrasounds sold to patients by commercial enterprises as "keepsakes" are very controversial in the obstetric world. They may be performed by noncertified personnel with inappropriate settings, yet ultrasound is thought to be safe and they may promote bonding between parents and infants. The American Institute of Ultrasound in Medicine (AIUM) is developing a statement assessing the legal, ethical, and professional ramifications of producing keepsake photos and videos in physicians' offices. Does selling these photos to patients cross the line between professionalism to hucksterism?^{viii}
- Should women continue to work full-time during pregnancy, or does that put them at risk? A study looking at risk of preterm labor found that physically demanding work (repeated lifting, standing at least 30 hours per week) was not associated with adverse outcomes. However, a 50% elevation in preterm delivery was seen in women who worked at night (10pm-7am). What should we do about shift work or night call?^{ix}

Labor Analgesia

IV Opioids and PCA

- Remifentanyl continues to generate interest as an option for parenteral labor analgesia. One study compared PCA remifentanyl (20-70 µg every 3 minutes)

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- to IV infusion meperidine (75 mg initial dose to a maximum of 200 mg). In the remifentanil group they found better VAS scores and patient satisfaction, fewer crossovers to epidural analgesia, and fewer fetal heart rate abnormalities. Neonatal outcome and maternal side effects were similar.^x
- Another study compared PCA remifentanil (40 µg with a 2-minute lockout) to PCA meperidine (15mg with a 10-minute lockout). They found better maternal satisfaction with remifentanil, but similar VAS scores, oxygen saturation and neonatal outcome between groups.^{xi}
 - Finally, an observational study of IV PCA remifentanil 0.5 µg/kg with a 2 minute lockout found VAS scores decreased from 6.9 → 4.6, side effects were minimal, and although placental transfer was documented, Apgar scores and cord gases were normal.^{xii} There was a high rate of crossover to epidural analgesia for inadequate pain relief in primiparous patients. The cost of remifentanil is about 10 times higher than meperidine or (more commonly used) fentanyl.
 - A comparison of meperidine (µ-receptor agonist), butorphanol (κ-agonist) or their combination for labor analgesia found that no group of mothers had meaningful pain relief, although pain intensity and affective magnitude were reduced. Combining the drugs did not improve therapeutic benefit.^{xiii}

Combined Spinal-Epidural Block

- Many of us feel that placing an initial spinal dose leads to improved epidural analgesia later in labor, and several earlier studies supported that result. However, a recent study comparing CSE without subarachnoid drug administration to conventional epidural analgesia (in other words, dural puncture or no dural puncture) did not improve labor analgesia (as measured by amount of PCEA drug used), reduce catheter manipulation or reduce replacement rate.^{xiv} It may be that administration of the spinal drug is what improves analgesia rather than just putting a hole in the dura.
- Giving an epidural bolus shortly after dural puncture during CSE can raise the level of anesthesia. A study investigating the change in CSF volume induced by epidural saline injection found 5, 10, and 15 ml boluses caused progressive decreases in CSF volume that persisted for at least 30 minutes.^{xv} Be cautious about epidural top-ups in the first half-hour after CSE placement.

Local Anesthetic and Opioid Dose

- The intrathecal minimum local analgesic dose (the spinal dose of local anesthetic alone needed for labor analgesia) is: Bupivacaine 2.4mg, Levobupivacaine 2.9mg, and Ropivacaine 3.6mg. At these doses there was greater motor block with bupivacaine and levobupivacaine.^{xvi} These are similar ratios for potency and motor block potential as we see with epidural analgesia. If you choose not to use opioid in your spinal dose, 1ml of 0.25% bupivacaine or 2ml of 0.2% ropivacaine should work.
- Chronobiology examines time-related phenomena in living organisms; for example how drugs behave at different times of the day. Continuing that work on labor pain and labor analgesia, intrathecal fentanyl 20µg lasted 27%

longer when given during the day (92 minutes) than when given at night (67 minutes).^{xvii} This has obvious implications for studying the duration of drugs used for labor pain. Similar results have also been shown for spinal sufentanil and epidural ropivacaine.

Postpartum Pain Management

- We tend to focus on intrapartum pain management, but vaginal delivery can result in significant pain in the postpartum period, especially with 3rd or 4th degree perineal injuries. A study randomizing patients to epidural saline, 1mg epidural morphine or 2mg epidural morphine found that patients receiving 2mg used significantly less oral pain medication in the first 24 hours postpartum with no significant side effects.^{xviii}

Social Issues Associated with Labor Pain Management

- Pain catastrophizing is defined as an exaggerated negative orientation to painful stimuli involving rumination (focusing on the pain), magnification (tendency to exaggerate the negative consequences of the pain) and helplessness. Although pain intensity (VAS scores) during labor did not predict postpartum maternal depression and adjustment at 6 weeks postpartum, pain catastrophizing did.^{xix}
- A nursing survey examined which factors led a woman to change her stated preference from an unmedicated to a medicated birth.^{xx} The study found that women changed their birth preference because of intense pain, length of labor, exhaustion, lack of preparation, not knowing what to expect, and not feeling support by the nurses. Anesthesiologists should realize that women might change their mind in labor, often because of a lack of knowledge or unrealistic expectations about labor.

Anesthesia for Cesarean Delivery

Spinal Anesthesia

- Most spinal anesthetics in the U.S. are performed using hyperbaric solutions. A double-blind study was done to compare hyper-, iso-, and hypo-baric solutions of bupivacaine in the lateral and sitting positions.^{xxi} Baricity had no influence on level in the lateral position. Patients receiving hypobaric solution in the sitting position had a slightly higher level (one dermatome on average), but significantly more hypotension and incidence of cervical blocks (24%). Motor block was less in the hyperbaric group.
- The ED₉₅ of isobaric (epidural) bupivacaine is 13mg, slightly higher than the ED₉₅ of 11mg for hyperbaric bupivacaine.^{xxii} Studies of both baricities added fentanyl and morphine to the mixture.
- We often assume spinal anesthesia is superior because of ease, safety and efficacy, and presumed safety for the fetus. A meta analysis of 27 studies examined umbilical cord gases after spinal anesthesia for cesarean compared with general or epidural anesthesia.^{xxiii} They found the cord pH was significantly lower with spinal than general or epidural, with the adverse

effect on base deficit indicating a metabolic cause. Most of that effect could be correlated with the increased amount of ephedrine used in the spinal anesthesia patients. The authors, and an accompanying editorial, conclude that phenylephrine should be used to treat hypotension to help eliminate the accompanying acidosis.^{xxiv}

Prevention and Treatment of Hypotension

- Studies have shown that aggressive treatment of hypotension and keeping the mother's blood pressure as close to baseline as possible provide the best acid-base outcome for the newborn. A randomized study compared rapid hydration and high dose phenylephrine infusion (100 µg/minute) to high dose phenylephrine alone after spinal anesthesia.^{xxv} The group receiving a rapid fluid bolus at the time of intrathecal injection had a 1.9% incidence of hypotension compared with 28% in the control group and required significantly less pressor overall. It appears the combination of rapid preload and high dose pressor is best.
- Various forms of colloid have been compared to crystalloid preload to prevent hypotension. Although it seems almost impossible to completely prevent hypotension after spinal anesthesia, use of colloid decreases the overall incidence of hypotension, and the incidence of clinical relevant and severe hypotension.^{xxvi} But then there's the cost.....
- Fast Fourier transforms of heart rate variability can be used to predict patients who will develop severe hypotension.^{xxvii} Women who had LF/HF ratios > 2.5, indicating higher sympathetic versus parasympathetic activity were significantly more likely to develop severe hypotension. Can we make this information clinically available to us, and is it worth it to know in advance?

Epidural and Combined Spinal-Epidural (CSE) Anesthesia

- If epidural ropivacaine is used for cesarean delivery, quality is improved by adding 20 µg sufentanil (or equivalent) to the 0.75% concentration, while 1.0% ropivacaine is adequate alone.^{xxviii,xxix}
- There are patients who require slow onset of sympathectomy (e.g., severe preeclampsia, stenotic cardiac lesions), and yet spinals can be more reliable than epidurals for surgical anesthesia. Using CSE, a low-dose spinal anesthetic (5-7.5 mg bupivacaine + 25 µg fentanyl) can be initiated to establish the block rapidly with incremental additions through the epidural catheter to raise the dermatome level as needed.^{xxx}

Premedication

- We all assume pregnant patients have increased gastric acidity, and these patients often have heartburn associated with decreased esophago-gastric sphincter tone. One hundred pregnant women at term and one hundred gynecological patients had gastric volume and acidity measured before induction of anesthesia.^{xxxi} Gastric volume was higher in the pregnant patients (~30 vs. 15 ml) and pH was lower (2.4 vs. 3.0). Cause? Pregnant patients were more anxious, but the serum gastrin level was not higher in the pregnant patients.

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- Pregnant patients are usually anxious before their cesarean, but we avoid giving them medication (such as midazolam) that might have newborn effects. One study randomized women to receive 100% oxygen or 40% nitrous oxide by face mask during placement of a spinal for cesarean.^{xxxii} Parturients receiving nitrous oxide had significantly lower anxiety scores and lower VAS scores at spinal injection, skin incision and uterine incision. Postop satisfaction scores were similar.
 - During cesarean delivery we have traditionally given antibiotics after cord clamp to prevent exposure of the fetus. However, the surgical literature is clear that antibiotics have maximum benefit when given 30 minutes before skin incision, and some institutions are now giving elective cesarean patients their antibiotic preoperatively. A randomized trial of 303 parturients who had labored and then required a cesarean delivery found no benefit for maternal or neonatal infectious morbidity whether antibiotics were given at skin incision or at cord clamp.^{xxxiii} Would there have been benefit if given 30 minutes before incision, or is it too late once the patient has been in labor?

Postoperative Pain Management

- Combining NSAIDs with narcotics improves postoperative pain control. Does it reduce opioid side effects? A meta analysis of 22 RCTs found adding NSAIDs to a morphine PCA regimen significantly decreased nausea and vomiting (by 30%) and sedation (by 29%).^{xxxiv} Pruritus, urinary retention and respiratory depression were not affected.
- When we use spinal opioids we trade off enhanced analgesia for side effects. Pregnant women were surveyed during childbirth classes about intra- and postoperative outcomes.^{xxxv} Pain was their greatest concern followed distantly by vomiting/nausea, cramping, pruritus and shivering. Optimizing pain control during and after cesarean should be our main goal. Although neuraxial opioids have clearly been shown to provide better analgesia than parenteral, their use is often limited by availability of appropriate care outside L&D. An excellent review of options for post-cesarean delivery analgesia was published this year.^{xxxvi}
- A multi-center RCT of DepoDur™ for pain management after elective cesarean delivery compared 5, 10, and 15mg epidural doses to 5mg conventional epidural morphine.^{xxxvii} Both the 10 and 15mg doses had better VAS pain scores at rest and with activity at 24 and 48 hours and used less rescue analgesics than the other groups. Side effects between groups were similar, rare and mild. Now, how do we maintain monitoring for 48 hours on our postpartum floors?! Plus, cost for a 10 mg dose is \$155 and for a 15 mg dose is \$170 compared to conventional preservative-free morphine at \$2.

Postpartum Tubal Ligation

- A review article on methods of contraception noted that half of all tubal sterilizations in the U.S. are performed postpartum.^{xxxviii} However many women who request a postpartum tubal ligation do not actually receive the procedure. A review found that 46% who expressed desire for the surgery did not undergo the PPTL.^{xxxix} Those least likely to receive the surgery were

21-25 years old, African American, had requested it during second trimester, and had a vaginal rather than cesarean delivery.

- General anesthesia for PPTL is usually performed with an endotracheal tube. A prospective observational study of the Proseal™ LMA in 90 women having PPTL at least 8 hours after vaginal delivery found no intraoperative complications.^{xi} All had successful gastric tube placement through the LMA, two required intubation due to intraoperative laryngospasm and 1 reported severe sore throat.
- Postoperative pain control after PPTL usually consists of oral pain medications, but some women can have severe pain.^{xii} Epidural morphine 2mg decreased the need for supplemental pain medications without increased treatment for side effects compared to an oral regimen.
- Women who have a spinal anesthetic for postpartum tubal ligation may also benefit from small doses of intrathecal morphine. When 50µg morphine was added to bupivacaine and fentanyl, patients had better pain control at rest and with movement and satisfaction was higher.^{xiii} Time to request for additional analgesia was longer and use of oral pain medications was decreased in the morphine group. Pruritus was more frequent. Whether or not long-term monitoring is needed with this small dose of morphine is unknown.

Anesthesia-related Complications

Recent Reviews

- Both the British and the Americans published updates on their maternal mortality data this year. The ASA Closed Claims Project published an update on 3 decades of obstetric anesthesia complications.^{xiii} Their primary findings were that maternal death and aspiration pneumonitis claims have dropped dramatically from the 1970s to the 1990s, while those for nerve injury and back pain have risen significantly. These trends parallel a decrease in use of general anesthesia with a rise in regional anesthesia. The top two causes of liability claims in obstetric anesthesia are now nerve damage (20%) and headache (14%). Maternal death is now #3 at 12% of claims.
- The Confidential Enquiries into Maternal Deaths (CEMD) in the United Kingdom 2000-2002 marked 50 years of this medical audit. Overall the leading cause of death was again thromboembolism as it is in the United States.^{xiv} There were seven deaths due to anesthesia, all involving general anesthesia.^{xv} Unrecognized esophageal intubation occurred in 3, all performed by trainees without senior back-up. Another two patients had hypoventilation inadequately managed leading to cardiac arrest. One obese woman died from aspiration after a difficult intubation scenario. One developed anaphylaxis, probably due to succinylcholine. There were another 20 deaths in which anesthesia management was felt to have contributed to the deaths, either because of lack of multidisciplinary cooperation, lack of appreciation of the severity of illness, poor perioperative care or inadequate response during major hemorrhage.

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- The CEMD also looks at intensive care issues for the obstetric patient.^{xlvi} A common theme is delay in recognition of the severity of their illness leading to delay in referral and transfer. The full CEMD report can be accessed on-line at: <http://www.cemach.org.uk/>.

General Endotracheal Anesthesia

- An NICHD study of 37,142 women undergoing cesarean delivery found that only 7% of patients received general anesthesia.^{xlvii} Most general anesthetics were administered when decision-to-incision interval was less than 15 minutes, although a 7-fold higher use was seen when ASA status was ≥ 4 . There was one anesthesia-related maternal death in the study that was due to failed intubation. This patient had a skeletal dysplasia and class F diabetes, and had cardiac arrest due to hypoxia during an **awake** intubation. The main complication associated with regional anesthesia was failure in 3%, more commonly with epidural than spinal anesthesia.
- Since general anesthesia is rarely used, and trainees are receiving little experience, simulation is receiving more attention. In a recent editorial, the authors note “Simulation-based team training will make anesthesiologists more familiar with emergency general anesthesia for cesarean section and may improve the safety and anesthetic management...”^{xlviii}
- An excellent review of “Airway Problems in Pregnancy” concludes with an important reminder: “Even if intubation is not possible, every effort should be made to maintain adequate ventilation and, more important, oxygenation of mother and fetus.”^{xlix} Patients don’t die from failure to intubate; they die because we fail to ventilate!

Local Anesthetic Issues

- Previous studies have found no transient neurologic symptoms (TNS) in obstetric patients having lidocaine spinals for cesarean delivery or postpartum tubal ligation.^{i,ii} These studies were included in a Cochrane review that concluded the risk of TNS with lidocaine was higher than other local anesthetics (RR 4.35) but there was no evidence of neurologic pathology and all symptoms disappeared by postoperative day 10.ⁱⁱⁱ For some reason, obstetric patients seem to be uniquely protected from TNS. A recent SOAP newsletter included a Pro-Con debate about use of lidocaine in obstetric practice.ⁱⁱⁱⁱ
- Subdural injection seems to present in several ways. In a case report, a laboring parturient received a single-orifice epidural catheter followed by a negative lidocaine-epinephrine test dose.^{liv} About five minutes later she received 5 ml 0.25% bupivacaine and became apneic and pulseless. ***There were no drugs or monitoring equipment in the labor room to proceed with ACLS, so she was transferred to the operating room for resuscitation!*** Following successful cesarean and recovery, subdural catheter placement was confirmed by fluoroscopy.

Anti-coagulation Issues

- The Factor V Leiden (FVL) mutation is the most common genetic cause of thrombophilia, present in ~5% of the U.S. population. FVL parturients are at risk for preeclampsia, abruption and pregnancy loss as well, and are commonly treated with LMWH. Because LMWH is difficult to monitor and reverse, parturients are changed to unfractionated heparin at ~36 weeks by ACOG guidelines. A review of 17 FVL parturients on LMW heparin therapy concluded there should be early anesthetic consultation to discuss analgesic/anesthetic options.^{lv}
- Neurologic complications may be unrelated to anesthetics or anti-coagulation. A parturient presented at 38 weeks with back pain and rapid progression to paraplegia.^{lvi} MRI revealed epidural hematoma from T6-9. She underwent rapid cesarean and laminectomy but required six months to regain neurologic function. The cause was not determined.

Post-dural Puncture Headache

- A survey of anesthesiologists in the United Kingdom asked about management of accidental dural puncture during labor.^{lvii} 85% have written guidelines; hospitals are about evenly split as to whether they do routine spinal catheterization with the epidural catheter, re-site the epidural, or allow either option. 71% perform blood patch after failure of conservative measures and 26% patch as soon as PDPH is diagnosed.
- A retrospective study compared hospital length of stay (LOS) and ER visits for PDPH after recognized dural puncture.^{lviii} They found that patients who had a “wet tap” stayed about a day longer in the hospital, and about 40% of patients returned to the emergency room for a first or second blood patch. They recommended aggressive use of blood patch prior to discharge and more research into preventive therapy.
- Headache is a frequent postpartum complaint. 985 women were followed postpartum for 3 days after delivery with a structured interview.^{lix} 39% of women developed headaches with median onset after 2 days. Risk factors were: known inadvertent dural puncture (but this only accounted for 4.7%), previous headache history, multiparity, and increasing age. Not all headaches are due to an anesthetic!
- Should anesthesiologists bill for epidural blood patch performed after accidental dural puncture during an anesthetic?^{lx} An excellent pro-con debate outlined the reasons some do (it’s a known complication the patient consented for) and some don’t (to reduce the risk of litigation).

Progress of Labor, Breast-Feeding

- Fetal heart rate changes are common after CSE or epidural analgesia and may lead to a change in delivery plan. 100 parturients were randomized to receive 25 mg IM ephedrine or placebo prior to CSE.^{lxi} The group receiving ephedrine had significantly fewer late decelerations but more fetal tachycardia accompanied by increased FHR reactivity.
- Another concern with regional analgesia for labor is that rotation and descent of the fetal head may be altered. A prospective study of 1562 women

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- included serial ultrasound of head position at admission, 4 hours later, at epidural administration (if used), and > 8 cm.^{lxii} They found a strong association of epidural analgesia with occiput posterior position at delivery (13% vs 3%), although these women did not have more OP positions at placement of the epidural. They suggest this may contribute to a lower rate of spontaneous vaginal delivery and a longer second stage of labor when epidural analgesia is used.
- Earlier work showed that women with more pain in latent phase labor are more likely to have a cesarean delivery. A comparison of women who presented in active phase (N >6000) or latent phase (N ~2700) labor found those presenting early had more cesarean deliveries (14% vs 7%), more active phase arrest (OR 2.2), oxytocin use (OR 2.3), invasive fetal monitoring and amnionitis (OR 2.7).^{lxiii}
 - A retrospective study of the effect of intrapartum analgesia on breast-feeding at hospital discharge found that the main association with failure to breast feed was higher doses of neuraxial fentanyl.^{lxiv} These results are similar to a prospective randomized study of women receiving epidural analgesia for labor.^{lxv} Higher cumulative doses of fentanyl (> 150 µg) were correlated with less breast-feeding at 6 weeks postpartum, especially in women who had breast-fed previously. As an editorial points out, there are certainly good reasons to include fentanyl in our epidural regimens (improved analgesia and decreased motor block), but perhaps those women receiving higher doses should receive additional assistance from our lactation consultants.^{lxvi} This is definitely a big concern for our childbirth educators, midwives and lactation consultants.

Surgery During Pregnancy

- Laparoscopic procedures are increasingly common during pregnancy. Surgical versus medical management of cholelithiasis is safe, reduces hospital days, and reduces the rate of preterm labor and delivery.^{lxvii, lxviii} When otherwise indicated, surgery should not be avoided because of the pregnancy.
- Whether anesthetics cause fetal neurons to commit suicide, i.e., apoptosis remains controversial.^{lxix} Certainly alcohol, which has similar mechanisms on GABA and NMDA transmission has been shown to initiate this apoptotic process. Much work still needs to be done, but this is very concerning for obstetric and pediatric medicine.
- When can the fetus feel pain? A systematic review concluded that fetal perception of pain is unlikely before the third trimester (29 weeks).^{lxx} This has major implications for abortions/terminations of pregnancy and fetal surgery.
- A comparison of diazepam and remifentanyl for fetoscopic surgery found the fetus was better immobilized with remifentanyl, which produced some mild maternal sedation and respiratory depression.^{lxxi} Diazepam produced better sedation in the mother with less respiratory depression, but more fetal movements.

Obstetric Complications

Overviews

- A CDC project narrowed in on a single state to identify all pregnancy-related deaths and determine which were preventable.^{lxxii} Overall 40% of deaths were preventable, but almost all deaths due to hemorrhage and exacerbations of chronic disease were considered preventable. In contrast, almost none of the deaths due to amniotic fluid embolism or stroke were preventable.
- Physiologic changes of pregnancy can interact with inherited or acquired predisposition to diseases and unmask a woman's potential for chronic disease.^{lxxiii} For example, preeclampsia may predict cardiovascular disease or stroke, gestational diabetes may herald progression to type 2 diabetes, and thrombophilias may first manifest during pregnancy. Pregnancy is an important screening opportunity.
- Two studies found that increasing maternal age is significantly associated with adverse pregnancy outcomes.^{lxxiv} Risks included: miscarriages, chromosomal abnormalities, congenital anomalies, gestational diabetes, placenta previa, cesarean delivery, abruption, preterm delivery, and perinatal mortality.^{lxxv}
- An entire supplemental issue of "*Critical Care Medicine*" was devoted to diseases in pregnancy and can serve as an excellent reference to physiologic changes, trauma, critical care, and co-existing respiratory, cardiac and neurologic diseases.^{lxxvi}

Obstetric Procedures

- A retrospective cohort study of >4000 operative vaginal deliveries found that shoulder dystocia and cephalohematoma occurred more often with vacuum-assisted deliveries while 3rd and 4th degree lacerations occurred more often with forceps.^{lxxvii}
- The role of cervical cerclage has become controversial in preventing preterm birth. A meta analysis of randomized trials found that it may be helpful in singleton gestations with short cervical length, especially with a prior second trimester loss or preterm birth.^{lxxviii} In contrast, cerclage was associated with an increase in preterm birth in twin gestations.

Hemorrhage

- Placenta percreta indicates placenta penetrating through the uterus into adjacent organs leading to life-threatening hemorrhage. When diagnosed antenatally, catheters can be placed before cesarean for balloon occlusion or embolization of the iliac or uterine arteries.^{lxxix} Performance of the cesarean in the Interventional Radiology suite requires advance discussion and planning with all services.
- Another approach to placenta accreta or percreta is to leave the placenta in situ with or without methotrexate as adjuvant therapy.^{lxxx} This may be appropriate for Jehovah's Witness patients or others who will not accept blood products.

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- Compressive/hemostatic uterine sutures (absorbable Vicryl), applied longitudinally and transversally may also be used for postpartum hemorrhage.^{lxxxix} A similar technique has been described previously, the B-Lynch suture.
 - Use of recombinant factor VIIa was described in 12 cases of life-threatening postpartum hemorrhage.^{lxxxii} Although there was good response in 11 patients, 5 women still needed arterial embolization for control of bleeding. The authors note that the cost of a single dose of rFVIIa in their institution is equivalent to the cost of 50 units of PRBC, the embolization procedure, or 2 days of ICU stay, so it may be cost-effective after all.
 - The arguments over cell salvage continue with pro-con debates in the British^{lxxxiii} and American^{lxxxiv} literature. The concerns against its use are centered around prevention of amniotic fluid embolism and how to make the blood “safe” since we don’t know the etiology of the syndrome. However, if banked blood cannot be matched or the patient refuses transfusion, use of cell salvage may make the difference between life and death.
 - Based on ultrasonography, MRI, and clinical factors patients can be classified as high or low suspicion for placenta accreta.^{lxxxv} Anesthesiologists should be prepared for massive hemorrhage in all suspected cases. The revised ASA Practice Guidelines for Perioperative Blood Transfusion and Adjuvant Therapies were approved in October 2005 and can be obtained from the ASA website (www.asahq.org).

Thrombotic Complications

- Thrombotic complications and embolism remain the #1 cause of pregnancy-related deaths in the U.S. Helical CT scanning is safe in all trimesters of pregnancy and gives the most rapid and accurate diagnosis of pulmonary embolism.^{lxxxvi}
- For patients who cannot be anti-coagulated through labor and are at high risk for thrombosis, a temporary or permanent vena cava filter can be placed antepartum or intrapartum.^{lxxxvii}
- Not only are patients with the Factor V Leiden mutation at high risk for thrombosis during pregnancy, they also have about twice the risk for developing preeclampsia, especially severe and early onset disease.^{lxxxviii} They should undergo careful surveillance throughout pregnancy.

Cardiovascular and Respiratory Disease in Pregnancy

- A review of 15 deliveries in women with severe pulmonary hypertension found the mortality was 36% despite modern treatment efforts. There did not seem to be any benefit to choosing one mode of delivery or type of anesthetic over another.^{lxxxix}
- Ventricular dysfunction due to peripartum cardiomyopathy can persist after delivery. Prognostic indicators for persistent LV dysfunction are: fractional shortening less than 20% and LV end diastolic dimension 6 cm or greater at the time of diagnosis.^{xc} In a case report, a patient with idiopathic cardiomyopathy and EF 32% was followed with trans-thoracic ECHO during labor. Use of intrathecal fentanyl and bupivacaine was well tolerated.^{xci}

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- Acute MI occurs 1:35,700 pregnancies, and can present antepartum (38%), intrapartum (21%) and postpartum (41%).^{xcii} Risk factors are: older age, multiparity, and non-Hispanic white or African-American race. Maternal mortality is 7.3%, higher when the MI occurs before or at delivery.
 - Other interesting cases this year included: acute aortic dissection^{xciii}, TEE during cesarean in a Marfan's patient with aortic dissection^{xciv}, cesarean anesthetics in a patient S/P Fontan procedure^{xcv}, and combined cesarean and pheochromocytoma resection.^{xcvi}
 - The risk of stroke during pregnancy is 34.2 per 100,000 deliveries but accounts for 5% of maternal deaths. Risk factors include: older age, African-American race, migraine headache (OR 17), thrombophilia (OR 16), SLE, heart disease, sickle cell disease, hypertension, thrombocytopenia, postpartum hemorrhage, preeclampsia and gestational hypertension, transfusion and postpartum infection (OR 25).^{xcvii}
 - Asthma exacerbation in pregnancy is common. Severe exacerbations occurred in 8% of women with mild asthma, 47% of women with moderate and 65% of women with severe asthma.^{xcviii} Stillbirth and low birth weight in male infants was increased, and maternal pregnancy weight gain was significantly lower. Risk factors for exacerbation included winter months, viral infection, and non-adherence to inhaled corticosteroid therapy.

Vaginal Birth After Cesarean Delivery

- A study of 308,755 women with a previous cesarean delivery compared those who chose elective repeat cesarean to those who chose trial of labor for a subsequent delivery.^{xcix} Women who chose trial of labor were more likely to have a uterine rupture, transfusion and hysterectomy, but women having an elective cesarean were more likely to have postpartum infection and in-hospital death. The relationship between trial of labor and adverse outcomes was stronger in units with < 500 births annually. They concluded that both choices carry risks.
- Another group determined the incidence and risk factors for uterine rupture during attempted VBAC.^c They found an incidence rate of 9.8 per 1000. Having a previous vaginal delivery lowered the risk of rupture, and sequential use of prostaglandins and oxytocin increased the risk.

Diabetes During Pregnancy

- Should gestational diabetes be treated? A randomized trial assigned women to routine care or glucose monitoring and insulin as needed.^{ci} They found that treatment reduced infant morbidity (perinatal death, shoulder dystocia, bone fracture, nerve palsy) and improved the women's mood and self-reported quality of life at 3 months postpartum. Cesarean delivery rates were equal (~32%).
- A retrospective review of the Kaiser Permanente database compared glyburide with insulin for treatment of gestational diabetes.^{cii} Glyburide achieved similar glucose control and similar birth weights, although there was an unexpected increase in preeclampsia and need for phototherapy in the oral agent group.

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- ACOG published a practice bulletin on management of pre-gestational diabetes this year noting that (among other things) cesarean delivery may be considered if the estimated fetal weight is > 4500 grams, but suspected fetal macrosomia is not an indication for induction of labor.^{ciii}

Obesity

- At least 4 studies looked at outcomes in obese women who become pregnant. The results are fairly consistent; obese parturients (BMI \geq 30) have increased risk of diabetes (OR 15.3), hypertension (OR 4.8), preeclampsia (OR 2.7), and cesarean delivery (OR 1.7).^{civ} Another study found an increased risk of neural tube defects, even after folic acid administration.^{cv} A statewide review from Utah found that 39% of parturients in 2001 were obese, an increase of 36% since 1991.^{cvi} They estimated that 1 in 7 cesarean deliveries in the state was due to obesity. Compared to normal weight women, the incidence of fetal death increases with obesity and with increasing gestational age.^{cvi} At weeks 28-36 the OR of fetal death compared to normal weight women was 2.1, at weeks 37-39 OR 3.5, and at 40+ weeks OR 4.6.
- Obesity also affects the outcome of vaginal birth after cesarean. After adjustments for other confounding factors, maternal BMI correlated inversely with successful vaginal birth, although there was no increase in scar separation.^{cviii} In another study, both BMI > 29 and pregnancy weight gain > 40 pounds decreased the chance of successful VBAC.^{cix} Overall success rate of VBAC was 77%, but with BMI > 29 the success rate was 68% and with > 40 lb weight gain the success rate was 67%.
- Two ACOG Committee Opinions this year addressed obesity. *The Role of the Obstetrician-Gynecologist in the Assessment and Management of Obesity* notes that all patients should have a BMI calculated and should be offered interventions and counseling when appropriate.^{cx} *Obesity in Pregnancy* addresses pre-conception counseling and peripartum care.^{cxii}
- Finally, yet another study in non-pregnant patients showed that preoxygenation in the head-up position was more effective at achieving higher oxygen tensions and an increase in the desaturation period.^{cxii} We should remember that for cesarean deliveries also!

The Fetus and Neonate

In Utero / Intrapartum Assessment

- What techniques can we use to improve fetal oxygenation during intrauterine resuscitation? Healthy women in labor were randomized to fluid bolus, position changes, or 10 L/min oxygen by facemask.^{cxiii} Fetal oxygen saturation was monitored by oximetry before, during and after therapy. A 1000 ml fluid bolus increased saturation by 5.2%. Saturation was highest in the lateral position (48.3% versus 37.5% when supine). Oxygen administration increased saturation by 8.7%, and the increase persisted for 30 minutes. All of these therapies have a place in intrauterine resuscitation.

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- An infusion of saline into the amniotic cavity (amnioinfusion) is frequently used for thick meconium staining to reduce the risk of severe meconium aspiration syndrome in the newborn. Almost 2000 women in labor with thick meconium were randomized to amnioinfusion or standard care, and there was no difference in the outcomes of severe meconium aspiration syndrome or perinatal death.^{cxiv} An accompanying editorial notes that most of these infants had probably already aspirated meconium before they presented in labor, and that the most important factor in decreasing meconium aspiration syndrome is a reduction in post-term delivery.^{cxv}
 - When mothers are chronic opioid users due to chronic pain or addiction, what effects can we expect to see on the fetus being monitored during labor? Forty women in a methadone treatment program were monitored with their fetuses in utero.^{cxvi} Although the mothers showed minimal effects at peak methadone levels, the fetuses had decreased heart rate, less variability, fewer accelerations and less motor activity on ultrasound. Would it be beneficial to the newborn to limit the amount of methadone mothers receive? A retrospective review found that infants whose mothers received high dose (mean 132 mg/day) versus low dose (mean 62 mg/day) methadone had no difference in neonatal withdrawal symptoms.^{cxvii} However, women in the high dose group were less likely to be using illicit drugs at delivery as measured by drug screening. Limiting methadone dose does not benefit the newborn and may have a negative effect on maternal drug abuse.
 - Two ACOG documents on intrapartum fetal care were released this year. The Committee Opinion *Inappropriate Use of the Terms Fetal Distress and Birth Asphyxia* notes that “fetal distress” should be replaced with “nonreassuring fetal status” followed by a further description of findings (eg, repetitive variable decelerations) and that “birth asphyxia” is nonspecific and should not be used.^{cxviii} The ACOG Practice Bulletin *Intrapartum Fetal Heart Rate Monitoring* discusses interpretation and management algorithms and describes the shortcomings and controversies in the use of fetal monitoring.^{cxix}

Management at Delivery

- Should pediatricians be present at every elective cesarean delivery? An analysis of 44,398 deliveries from a prospectively collected database found that only general anesthesia, fetal distress, and abnormal presentation (eg, breech) increased the need for resuscitation.^{cxx} An elective cesarean under regional anesthesia had no greater need for resuscitation than a spontaneous vaginal delivery.
- When umbilical cord blood gases are needed but not enough blood can be obtained, placental cord blood can be substituted.^{cxxi} Fetal base excess and hemoglobin were most accurate, with more error found in measurements of pO₂, oxygen saturation, pCO₂ and pH.
- Virginia Apgar’s 1953 paper entitled “A Proposal for a New Method of Evaluation of the Newborn Infant” was reviewed as a *Classic Papers Revisited*.^{cxxii} The reviewers point out that she proposed the 1-minute score as a way of focusing on the condition of the infant immediately after delivery

and the 5-minute score as a way of assessing the effectiveness of resuscitation. The score was not meant to measure perinatal asphyxia or later outcomes.

Newborn Resuscitation

- A meta analysis of trials comparing newborn resuscitation with 21% or 100% oxygen found that risk of mortality was lower using 21% oxygen (RR 0.71, 95% CI 0.54-0.94).^{cxxiii} A study in newborn piglets looked at whether inflammation (via exposure to endotoxin) makes them more vulnerable to hypoxia and compared resuscitation with 21% or 100% oxygen.^{cxxiv} Base deficit decreased more quickly when animals had been exposed to endotoxin prior to a hypoxic insult, but again, resuscitation with air was just as effective as 100% oxygen.
- An ongoing trial for treatment of newborn hypoxic ischemic encephalopathy with an abnormal EEG involves randomization to head cooling to a rectal temperature of 34-35°C or standard care.^{cxxv} Two earlier trials have shown potentially promising results.^{cxxvi, cxxvii} Hopefully these trials will provide a therapy for these infants.

Extreme Prematurity

- Two studies this year showed conflicting results for use of nitric oxide (NO) in preterm infants. An RCT of infants < 1500 g found no decrease in rates of death or bronchopulmonary dysplasia.^{cxxviii} However, there may have been benefit for those infants > 1000 g in a subgroup analysis. In contrast, a prospective longitudinal follow-up of premature infants who had received NO or placebo found improved neurodevelopmental outcomes at two years of age.^{cxxix} An accompanying editorial points out that short term use of NO cannot be seen as an effective rescue therapy for very preterm infants, but there may be benefit for less ill preterm infants in both the short and long-term.^{cxxx}
- Another long-term follow-up study of school age children (8 years old) born with extremely low birth weight (<1000 g) found these children had considerable long-term health and educational needs.^{cxxxi} Because more of these infants are surviving, this study has major research and health policy implications. A similar study of school-age children who had been born < 26 weeks gestation found disabling cerebral palsy in 12%, severe disability in 22%, moderate disability in 24%, and mild disability in 34%.^{cxxxii} Again, these results have major health care policy connotations for decision-making in these extremely premature infants.

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