Mechanisms, Equipment, Hazards

A 5-Year Audit of Accidental Dural Punctures, Postdural Puncture Headaches, and Failed Regional Anesthetics at a Tertiary-care Medical Center

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The most common obstetric anesthesia-related complications in labor and delivery involve epidural or spinal placement: that is, accidental dural puncture (ADP), postdural puncture headache (PDPH), and failed regional anesthesia, all of which can lead to more serious outcomes, including emergent general anesthesia. As part of a continuing quality-improvement audit, the authors reviewed obstetric anesthesia complications in 3 medical databases, matched with a perinatal database, to find the incidence of ADP, PDPH, and failed regional anesthesia and to determine factors contributing to their occurrences at a tertiary-care, teaching hospital over a continuous 5-year period.

All women delivered from January 3, 2002 to December 30, 2006, at Magee-Womens Hospital (with >9500 deliveries a year and an 89% regional anesthesia rate) were included. Women with any of the 3 conditions were placed in complications group; those without ADP, PDPH, or failed regional anesthesia were controls. Sources used to identify complications, outcomes, and contributing factors were an anesthesia electronic record, medical records showing complications, and postcomplication anesthesia forms used for patient follow-up. Data were analyzed and compared by Student t test, Mann-Whitney nonparametric test, and χ² or Fisher exact test.

Of 40,894 consecutive deliveries, 765 (2%) had documented anesthesia-related complications: 300 ADPs (39.2%); 201 PDPHs (26.3%), and 264 failed regional anesthetics (34.5%). There was no difference in ADP rates over the 5 years (P = 0.61), but there was a significant increase in the PDPH rate in 2004 and 2005, compared with 2002 and 2003 (P < 0.005). There was also a significant increase in failed regional rates in 2003, compared with 2002 (P < 0.005); in 2005, compared with 2003 and 2004 (P < 0.005); and in 2006, compared with all other years (P < 0.001). The other anesthesia-related complications were residual back pain (n = 39), numbness and tingling in lower extremities (n = 17), high spinal block requiring respiratory support (n = 6), and catheter broken during removal (n = 1). The 2 groups had similar demographic and delivery characteristics, although women with complications were somewhat heavier (mean weight, 189.7 lbs, vs. 182.9 lbs; P < 0.01), with higher body mass index, than controls. The complications group had a higher rate of epidural blocks (81.8%, vs. 74.4%; P < 0.01), although the spinal rates were not significantly different (13.1%, vs. 14.8%; P = 0.16). Controls had a slightly higher percentage of vaginal deliveries (75%, vs. 70%; P < 0.01). The ADP rate was highest among resident trainees (especially in the second year of training) compared with attending anesthesiologists (1.65% vs. 0.92%; P < 0.01), although the PDPH (residents 0.81%, vs. 0.91%; P = 0.50) and failed anesthesia (1.01% vs. 1.04%; P = 0.87) rates were similar.

The authors concluded that regional anesthetic complications are associated with increased weight and body mass index, epidural placement, and vaginal delivery; ADP also was somewhat related to procedures performed by trainee anesthesiologists. Possible reasons for increased PDPH and failed regional rates in the later years of the study include better electronic complication documentation and an increase in the number of residents working at the hospital. As a result of this study, the authors’ institution has implemented an obstetrical regional anesthesia didactic and simulation training workshop for all new anesthesia residents in their first year to prevent these complications.

COMMENT

This article by Singh et al is an overview of obstetric anesthesia (labor, vaginal delivery, and cesarean section) related complications at a tertiary-care teaching hospital for a period of 5 years. It is part of a quality improvement audit where anesthesia-related complications were reviewed from 3 medical databases. I think every large tertiary center, especially if it is a teaching institution, should have the discipline to publish this form of audit periodically to improve their performance quality.

The author’s institution is a large women’s hospital with more than 9500 deliveries per year and an 89% regional anesthesia rate. Women with 3 adverse situations, including ADP, PDPH, and failed regional anesthesia were included in the complications group. A group without these 3 adverse incidents was included as controls. Unfortunately both spinal and epidural are included in the study; however, ADP is not included as a spinal anesthesia complication.
The important findings of the study are:

1. Patients in the complications group are heavier than patients in the control group.
2. There is no difference in the ADP rate over the 5-year period.
3. There is a significant increase in the PDPH rate in 2004 and 2005 compared with 2002 and 2003.
4. There is a significant increase in the failed regional anesthesia rate in 2006 compared with 2002, 2003, 2004, and 2005.
5. More epidurals were performed in the complications group as compared with the control group (81.8% to 74.4%).
6. No significant difference is found in the rate of spinals between groups (13.9% to 14.8%).
7. The ADP rate is highest among the residents. The ADP rate is also highest in the second year of training compared with the first and third year.

I find several points which should be clarified:

1. ADP is not associated with spinal anesthesia.
2. It is true that obesity is a risk factor for ADP and initially failed labor epidural analgesia necessitating subsequent epidural placements. In a majority of cases, continuous spinal analgesia would be the proper approach.
3. The overall 5-year trend showed that the PDPH rate increased. The author’s blamed this on increased use of electronic records and an increase in the number of residents training at their institution; however, it is unclear how they can use these explanations when the ADP rate did not change during this time period.
4. It was surprising that the ADP rate was highest among the second year residents (compared with the first year residents) even though they are more experienced.

The authors should be commended for this audit and the results distinctly show they practice very diligently and safely. As I mentioned previously, I wish more institutions would publish these kinds of results periodically.

Comment by Sanjay Datta, MD

Mathematical Modeling of the Pain and Progress of the First Stage of Nulliparous Labor

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The contribution of individual factors to labor pain is hard to discern, given that pain is relative to each woman and its intensity changes as labor progresses. Several genetic polymorphisms, such as ethnicity, are thought to affect pain sensitivity and duration, leading the authors of this retrospective study to hypothesize that a patient’s self-identified ethnicity might predict labor pain and progress. They developed mathematical models to quantitatively evaluate 100 sequential deliveries from each of the 5 self-reported ethnic groups with major representation in their population (Asian, Black, Hispanic, White, and Other) to determine what, if any, demographic or obstetric variables (including cervical dilation), and pain scores were predictive of pain intensity and progress of labor. Pain was modeled as a sigmoid function of dilation by using a previously validated mathematical model. Progress was modeled with a biexponential function describing the latent and active phases of labor. Covariates, including ethnicity, were analyzed with Nonlinear Mixed-Effects Modeling.

Screening of delivery records at a university-affiliated hospital in New York identified 500 eligible parturients (100 in each ethnic group). Included were healthy, nulliparous women, 18 to 45 years old, with singleton infants having a birth weight of 2.5 to 4.0 kg, delivered vaginally at term by standard institutional protocols. Women with preclampsia and chronic pain syndromes were excluded. Data abstracted from medical records were demographics, labor characteristics and interventions, cervical dilation, pain scores, analgesia, and other treatments. Working backward from May 2008, the first 100 eligible women from each ethnic group were selected. Demographics and labor characteristics were compared among ethnic groups and continuous variables were assessed by the Kolmogorov-Smirnov test. Normally distributed data were analyzed by ANOVA. A population approach was used to model the progress of labor, which, in turn, was used in the model of labor pain.

All Hispanic and White women were delivered between May 2007 and May 2008, while the other 3 ethnic groups were delivered between October 2006 and May 2008. Gestational and maternal ages, height, weight, birth weight, and emotional status were similar throughout, while employment, marital status, and primary language varied. Most women had combined spinal-epidural analgesia or epidural alone, with induction, oxytocin use, and analgesia rates being similar among groups. The duration of second stage was significantly shorter in Black women (mean, 1.1 h) than others (averaged mean, 1.4 h); the longest was the “Other” category (1.9 h). Hispanic women had the highest rate of artificially ruptured membranes [relative risk (RR), 1.4]; and Asian women had slower active labor ($P < 0.01$) and reported less pain during labor ($P < 0.001$). Slower labor progress was associated with slower progression of pain, but this did not obviate the effect of Asian ethnicity on pain. Neuraxial analgesia and higher maternal weight were strongly associated with slower labor (each, $P < 0.0001$). The biexponential function described...