

Session: L205

Session: L435

What are the Current Alternative Options for Labor Analgesia?

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Disclosures: This presenter has no financial relationships with commercial interests.

Stem Case and Key Questions Content

A 43 year-old primigravida at 40 weeks and 3 days of gestation, is admitted to the labor and delivery floor for post-date induction. Upon admission, she is comfortable (pain score 0/10) and her blood pressure (BP) ranges between 100/55-140/84 mmHg. Her past medical history is significant for deafness with a cochlear implant. The patient is otherwise healthy and has had an uneventful pregnancy. She was admitted the day before because she had moderately painful contractions every 5-6 minutes, with cervical changes. On the following day at interdisciplinary rounds, the obstetric (OB) night team presents this patient saying she started to have extremely painful contractions overnight 1-2 minutes apart, and is now 5 cm dilated. The anesthesia team had not been consulted for labor analgesia as she desired a natural birth, and instead the patient received intravenous (IV) meperidine and promethazine as ordered by the OB team.

- What additional information would you like to obtain from the OB team?
- Are meperidine and promethazine recommended medications for labor analgesia in the pregnant patient?

After receiving the analgesic medications, the patient is extremely drowsy in between contractions, but her pain is only mildly relieved when the contractions occur. You would like to offer her neuraxial analgesia, however, because of the pain, the patient is not willing to put back her cochlear implant, and her extreme pain makes it impossible for you to adequately explain the procedure or obtain informed consent. During contractions, the pain is so severe she cannot try to read lips, and when the contractions are over she falls back asleep. Her husband requests the epidural for her since she is not tolerating the labor pain.

- What are the problems you are confronted with at this point in time?

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When you reassess your patient her mental status is improved and she is able to discuss labor analgesia options. She tells you she would like an epidural.

The OB team notifies you that the patient's blood pressures have been ranging between 133/75-149/93 mmHg, but they are not concerned.

- Do you proceed with the epidural or want more information? What tests would you request as part of determining your anesthetic plan for the patient?
- If you suspect this patient is preeclamptic, would this diagnosis impact your decision making for placement of neuraxial analgesia? If so, why?

In light of mildly elevated blood pressure readings, labs are ordered. Results are as follows Platelets 48,000/L, PT/INR 15 sec/1.3, and AST (aspartate aminotransferase) 205 IU/L, ALT (alanine aminotransferase) 190 IU/L. Patient not only is severely preeclamptic, but has HELLP syndrome (Hemolysis Elevated Liver Enzymes Low Platelets). The patient is started on magnesium therapy to prevent eclampsia.

- Do you still consider placing neuraxial analgesia?
- Since this patient is not a candidate for the placement of neuraxial analgesia, what else can you offer her?
- How do you order remifentanyl PCA (Patient Controlled Analgesia) and what are the specific risks and benefits of intravenous PCA during labor?
- Are there limitations in regards to the pump settings?

The patient is started on remifentanyl PCA and her husband explains to her with sign language what she needs to do to use the PCA to optimize her analgesia. Unfortunately, the PCA pump available on the floor has a minimal lock out of 5 minutes and her contractions are every 1-2 minutes. Ten minutes later the patient seems a little more comfortable, but she is still experiencing some painful contractions. Her pain score went from a 10/10 to 6/10.

- What other options can you offer? Infusion of dexmedetomidine vs. nitrous oxide vs. Transcutaneous Electrical Nerve Stimulation (TENS)
- How do you order dexmedetomidine infusion?
- How do you administer nitrous oxide and what are some of the safety considerations?
- How do you use TENS?
- What are the pros and cons of each alternate option for labor analgesia?

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Model Discussion Content

During interdisciplinary sign-out on Labor and Delivery your goal is to obtain information on each patient's status and determine who is high risk and might require an anesthetic intervention. You need to know if this patient is in active labor. The definition of active labor according to the Consortium on Safe Labor is as follows: it is part of the first stage of labor, begins when contractions become progressively more rhythmic and stronger, and when the cervical dilation reaches 5 cm for multiparous and 6 cm for nulliparous (1). This phase is characterized by rapid cervical dilation and descent of the presenting fetal part. Placement of an epidural during the latent phase is no longer contraindicated (2).

According to the American College of Obstetricians and Gynecologists (ACOG), a number of opioid agonists and opioid agonist-antagonists can be given in intermittent doses for systemic pain control. These include meperidine 25-50 mg intravenously (IV) every 1-2 hours or 50-100 mg intramuscularly (IM) every 2-4 hours, fentanyl 50-100 mcg IV every hour, nalbuphine 10 mg IV or IM every 3 hours, butorphanol 1-2 mg IV or IM every 4 hours, and morphine 2-5 mg IV or 10 mg IM every 4 hours (3). Meperidine (Demerol) is an opioid with a half-life of 2.5-4 hours and promethazine (Phenergan) is an H1 receptor antagonist whose variable half-life is 7-14 hours. Unfortunately, when used together, these medications have potentiation of their sedative effects, most importantly respiratory depression, in patients very often not adequately monitored to detect those side effects (4, 5).

The main issue you are confronted with is obtaining an informed consent. For that, you need to have a patient who is not under the influence of medications, and with who you can achieve efficient communication. In that regard, a deaf patient who received opioids and who refused to wear her cochlear implant, is definitely a challenge. If you are confronted with a similar situation, the consensus is to wait for the medications to wear off and hope that your patient will be then more amenable to facilitate the communication.

The ACOG recommendations regarding diagnosis and classification of preeclampsia have recently been revised. According to the new ACOG guidelines, the diagnosis of preeclampsia no longer requires the detection of high levels of proteinuria. Evidence shows end organ damage (kidneys, liver, eyes) can occur without proteinuria, and that the amount of protein in the urine does not predict how severely the disease will progress. Preeclampsia is now diagnosed by persistent hypertension that develops during pregnancy or during the postpartum period, associated or not with elevated levels of protein in the urine, new onset of thrombocytopenia, impaired liver or kidney function, pulmonary edema, or neurological sequelae such as seizures and/or visual disturbances. Evidence tells us that preeclampsia is a dynamic process, progressing at different rates in different women. Mild to moderate elevations in blood pressure (140-159 mm Hg systolic or 90-109 mm Hg diastolic measured on two occasions at least four hours apart) warrants close evaluation and monitoring. Blood pressures $\geq$ 160 mm Hg systolic or greater than or equal to 110 mm Hg diastolic is a feature of severe

preeclampsia (6). Your decision of using neuraxial analgesia might be affected by the diagnosis of preeclampsia, because of the risk of associated thrombocytopenia or coagulation impairment. To that regard, a CBC (complete blood count) and a coagulation panel should be sent.

Neuraxial analgesia is no longer an option because of the severe thrombocytopenia and the coagulopathy. In this situation, the risk of developing an epidural hematoma is high. One of the options you have is to use a remifentanyl infusion.

Remifentanyl is an ultra-short acting opioid that can be administered by the anesthesiologist with a more elaborated nursing care of the parturient. Additional monitoring requirements for the patient include a pulse oximeter, respiratory rate checks, as well as PCA pumps that can be programmed appropriately with a lock-out of 1-2 minutes to match the frequency of the contractions.

Pro: Provides better pain relief than intermittent pushes of longer lasting opioids. Because of its short half-life, it can be administered to patients with a contraindication to regional anesthesia throughout labor up until delivery. It can be started in triage if nursing staff is available to monitor the patient.

Remifentanyl PCA with a bolus dose in the range of 0.25-0.5 $\mu\text{g kg}^{-1}$ and a lockout time of 2 min appears to be a safe and effective option for use in labor with patient-controlled analgesia systems.

The technique appears to be most beneficial in multiparous women (7). Some centers suggest a baseline infusion rate with bolus on demand, but the risk of respiratory depression is even higher with this setting. The reason for that practice is mostly to palliate to the limitation of certain pumps that have a minimal lockout of 5 minutes, insufficient when the contractions happen every 1 or 2 minutes.

Con: Additional monitoring and closer observation are required during the therapy. This option requires pulse oximeter, respiratory rate monitoring and PCA pumps that can be programmed as needed, as well as a designated nursing staff. There is significant respiratory morbidity with remifentanyl IV PCA as periods of apnea occurred even when readings from the pulse oximetry did not show hypoxia ($\text{SaO}_2 < 94\%$). Thus the pulse oximetry is not a foolproof way of detecting periods of apnea and 1:1 nursing observation may be required (8). Unfortunately, the pumps limitation is their minimum lock-out time. It has to be short enough (1-2 minutes) to allow iterative bolus of remifentanyl as the contractions get closer one from each other. Otherwise the parturient will experience only partial relief.

The other alternatives for labor analgesia include the use of dexmedetomidine, nitrous oxide, and TENS.

Dexmedetomidine:

Dexmedetomidine is a highly selective α_2 -adrenoreceptor agonist that is an attractive medication due to its analgesic and sedative/anxiolytic properties with minimal respiratory depression.

Pro: It can also reduce the release of catecholamines, making it additionally useful when given to preeclamptic patients as it can help with blood pressure control (9). One of the methods to administer

this medication is to start with an infusion at a rate of 0.2 mcg/kg/hr and to increase it by 0.1 mcg/kg/hr every 30 minutes to a maximum of 0.5 mcg/kg/hr based on the patient's pain score with a goal of 0-3. Sedation is monitored with a goal Ramsay Sedation Score of 2-3 (10). Another recommended dose is to use a loading dose of 1 mcg/kg over 10-15 minutes, followed by an infusion at a rate of 0.2-0.7 mcg/kg/h. Dexmedetomidine is highly lipophilic and is greatly retained in the placenta, therefore less likely to pass into the fetal circulation and to cause fetal bradycardia (11). There is one study from Cairo that showed that the addition of dexmedetomidine to remifentanyl for labor analgesia, allowed for a narcotic reduction of 53.3% as compared to the group that only received remifentanyl. Additionally, there was significantly less incidence of desaturation and nausea in the combination therapy group, and there was a significant increase in satisfaction rate amongst the participants in this group (11).

Con: Bolus of dexmedetomidine or even infusion can cause bradycardia in patients, which could ultimately affect the blood flow to the fetus. It is unknown if an initial bolus dose is any better than just starting at a low infusion rate. Also, the decrease in catecholamines release could potentially trigger more episodes of uterine tetany, resulting in non-reassuring fetal heart rates.

Nitrous oxide: The most common concentration of nitrous oxide (N₂O) for labor pain management in clinical practice is 50 % nitrous oxide in 50% oxygen, which can be mixed from two separate gas sources with a blending device (e.g., Nitronox®) or premixed in a single cylinder (e.g., Entonox®) (12). Nitrous oxide is usually self-administered via a facemask on an intermittent basis, beginning about 30 to 60 seconds before each contraction. Self-administration could be supervised by the nursing staff caring for the patient. It is widely used outside of the United States, but in the US it is offered in a small number of centers including but not limited to the following: University of Colorado in Aurora, CO; the Birth Center at the University of California San Francisco Medical Center in San Francisco, CA; the University of Washington Hospital in Seattle, WA; St. Joseph's Regional Medical Center in Lewiston, ID; Okanogan Douglas Hospital in Brewster, WA; Vanderbilt University Medical Center in Nashville, TN; Brigham and Women's Hospital in Boston, MA, and soon to come in our institution.

Pro: It is safe for the mom and the baby and there is improved patient's satisfaction in many studies even if the pain relief is incomplete.

Con: A significant barrier is the need for a scavenging system (13) since it poses a risk to the staff working in areas where it is used without adequate scavenging facilities. However, the Nitronox® offers a built-in scavenging system, requiring only a wall suction outlet. The first study about air pollution and nurse exposure to N₂O with Nitronox®, comes from the University of Colorado, and seems to show no increased exposure of the staff (14). The other limitation is the availability of the

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blended mixture. Again, the Nitronox[®] has the advantage to mix both gases from external sources (hospital oxygen supply and nitrous oxide bottle), bypassing this limitation.

Transcutaneous electrical nerve stimulation (TENS) is the transmission of low-voltage electrical impulses from a handheld battery-powered generator on the skin via surface electrodes. TENS has long been used in much of the world to help control chronic or postsurgical pain as an adjunct to or in replacement for pain medication. TENS was introduced into maternity care in Scandinavia in the 1970s. Today it is widely used and rated highly by users in multiple countries including the United Kingdom, Scandinavia, and parts of Canada. In fact, some TENS units are designed for convenient use by the parturient. TENS is not yet widely used for labor analgesia in the United States, but some centers, including ours, offer it as an alternate option for pain management.

To relieve labor pain, one pair of electrodes is placed para-vertebrally at the level of T10-L1 and another at the level of S2 to S4. The woman controls the intensity of the current by turning a dial and can vary the stimulation pattern with a thumb switch or by adjusting dials on the TENS unit. The TENS machine causes a buzzing or prickling sensation that may reduce the patient's awareness of contraction pain. TENS device can be purchased, maintained on the labor floor, and self-administered after initial set up with nursing assistance.

Pro: TENS used for parturient may be a helpful adjuvant for labor analgesia, especially in situations where regional analgesia is not an option. The satisfaction expressed by women with TENS may relate to other factors besides pain relief. TENS allows the woman to be in control, to ambulate, has no effects on her mental state, and gives an option to those who wish to avoid or delay the use of medications (15, 16).

Con: There are few potential side effects from the TENS machine when used by healthy individuals. Although rare, if used with electronic fetal-monitoring equipment, TENS may interfere with the output from the monitor, in which case either the TENS or the monitor should be discontinued or used intermittently. TENS units have been expensive to rent or purchase, so it has been difficult for some Americans to obtain them for adjuvant labor pain relief. But now, affordable devices are available and the units can be purchased by the hospital. Only the disposable pads are billed to the patient.

References

1. Zhang J, Landy HJ, Branch DW, et al. Contemporary patterns of spontaneous labor with normal neonatal outcomes: consortium on safe labor. *Obstet Gynecol* 2010; 116: 1281-7.
2. Wang F1, Shen X, Guo X, Peng Y, Gu X; Labor Analgesia Examining Group. Epidural analgesia in the latent phase of labor and the risk of cesarean delivery: a five-year randomized controlled trial. *Anesthesiology*. 2009 Oct; 111(4):871-80.

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3. ACOG. American College of Obstetricians and Gynecologists Practice Bulletin. Obstetric Analgesia and Anesthesia. Clinical Management Guidelines for Obstetricians-Gynecologists. No 36. American College of Obstetricians and Gynecologists: Washington, DC; July 2002.
4. Ramin SM, Gambling DR, Lucas MJ, et al. Randomized trial of epidural versus intravenous analgesia during labor. *Obstet Gynecol*. Nov 1995; 86(5):783-9.
5. Sharma SK, Sidawi JE, Ramin SM, et al. Cesarean delivery: a randomized trial of epidural versus patient-controlled meperidine analgesia during labor. *Anesthesiology*. Sep 1997; 87(3):487-94.
6. ACOG. American College of Obstetricians and Gynecologists Task Force on Hypertension in Pregnancy, Hypertension in Pregnancy. November 2013.
7. J. M. Blair, D. A. Hill, J. P. H. Fee. Patient-controlled analgesia for labor using remifentanyl: a feasibility study. *Br. J. Anaesth*. (2001) 87 (3):415-420.
8. Stocki D. et al. "A Randomized Controlled Trial of the Efficacy and Respiratory Effects of Patient-Controlled Intravenous Remifentanyl Analgesia and Patient-Controlled Epidural Analgesia in Laboring Women." *Anesth Analg* 2014;118:589-97
9. Scheinin B, Lindgren L, Randell T, et al. Dexmedetomidine attenuates sympathoadrenal responses to tracheal intubation and reduces the need for thiopentone and perioperative fentanyl. *Br J Anaesth* 1992; 68:126-131
10. Abu-Halaweh SA, Al Oweidi AK, Abu-Mahlooh H, Zabalawi M, Alkazaleh F, Abu-Ali H, Ramsay MA. Intravenous dexmedetomidine infusion for labour analgesia in patient with preeclampsia. *Eur J Anaesthesiol*. 2009 Jan;26(1):86-7
11. Abdalla W, Ammar MA, Tharwat AI. Combination of dexmedetomidine and remifentanyl for labor analgesia: A double blinded, randomized, controlled study. *Saudi J Anaesth*. 2015 Oct-Dec; 9(4): 433-438.
12. Likis FE, Andrews JC, Collins MR, Lewis RM, Seroogi JJ, Starr SA, Walden RR, McPheters ML. Nitrous Oxide for the management of labor pain: A systematic review. *Anesthesia & Analgesia*. 2014 Jan;118 (1):153-67.
13. Rowland AS, Baird DD, Shore DL, Weinberg CR, Savitz DA, Wilcox AJ. Nitrous Oxide and spontaneous abortion in female dental assistants. *Am J Epidemiol* 1995;141: 531-38.
14. Wood, C, Hawkins J, Anderson JL. Nitrous oxide in labor and delivery: Protocol development and implementation. SOAP 2015 abstract T18.
15. Carroll D, Tramer M, McQuay H, Nye B, Moore A. Transcutaneous electrical nerve stimulation in labour pain: A systematic review. *Br J Obstet Gynaecol* 1997; 104:169 -75.
16. Kaplan B, Rabinerson D, Lurie S, Bar J, Krieser U, Neri A. Transcutaneous electrical nerve stimulation (TENS) for adjuvant pain-relief during labor and delivery. *Int J Gynaecol Obstet* 1998; 60: 251-5.