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INTERIM UPDATE: The content of this Practice Bulletin has been updated as highlighted (or removed as necessary) to include a limited, focused change to align with Practice Bulletin No. 207, "Thrombocytopenia in Pregnancy." In addition, new information on nitrous oxide and timing of unfractionated heparin is included.

Obstetric Analgesia and Anesthesia

Labor causes severe pain for many women. There is no other circumstance in which it is considered acceptable for an individual to experience untreated severe pain that is amenable to safe intervention while the individual is under a physician's care. Many women desire pain management during labor and delivery, and there are many medical indications for analgesia and anesthesia during labor and delivery. In the absence of a medical contraindication, maternal request is a sufficient medical indication for pain relief during labor. A woman who requests epidural analgesia during labor should not be deprived of this service based on the status of her health insurance. Third-party payers that provide reimbursement for obstetric services should not deny reimbursement for labor analgesia because of an absence of "other medical indications." Anesthesia services should be available to provide labor analgesia and surgical anesthesia in all hospitals that offer maternal care (levels I–IV) (1). Although the availability of different methods of labor analgesia will vary from hospital to hospital, the methods available within an institution should not be based on a patient's ability to pay.

The American College of Obstetricians and Gynecologists believes that in order to allow the maximum number of patients to benefit from neuraxial analgesia, labor nurses should not be restricted from participating in the management of pain relief during labor. Under appropriate physician supervision, labor and delivery nursing personnel who have been educated properly and have demonstrated current competence should be able to participate in the management of epidural infusions.

The purpose of this document is to review medical options for analgesia during labor and anesthesia for surgical procedures that are common at the time of delivery. Nonpharmacologic options such as massage, immersion in water during the first stage of labor, acupuncture, relaxation, and hypnotherapy are not covered in this document, although they may be useful as adjuncts or alternatives in many cases.

Background

Labor Pain

Like other types of visceral pain, the pain of the first stage of labor is diffuse and not as well localized as somatic pain. Although lower abdominal pain is a nearly universal feature of labor, a significant percentage of women also will experience lower back pain. Labor pain may be referred to iliac crests, buttocks, or thighs.

As the fetus descends in the late first stage or second stage of labor, distention of the vagina, pelvic floor, and perineum elicit stimuli through the pudendal nerve and the anterior primary divisions of sacral nerves S2 through S4 (2). This pain is predominantly somatic and, therefore, is better localized than pain that occurs earlier in labor.

There is a lack of an objective, universally applicable measure for intensity of pain. Most commonly, a self-reported instrument has been employed, such as the visual

analogue scale, although such instruments are problematic in a number of ways and difficult to validate using the standard psychometric methods (3). Medications commonly given for analgesia also may impair cognition, which further limits the reliability of verbal and visual scores reported by the patient. Finally, given varying expectations for pain control and labor experience, pain relief and satisfaction (with pain relief or with the experience of childbirth) are not the same. In a systematic review that examined women's satisfaction with childbirth, a discrepancy was found between the rating of pain and the rating of satisfaction with pain relief in one half of the trials (4).

Available Methods of Analgesia and Anesthesia

The American College of Obstetricians and Gynecologists recognizes that many approaches to analgesia are available for peripartum patients. None of the methods appear to be associated with an increased risk of cesarean delivery. The choice of technique, agent, and dosage is based on many factors, including patient preference, medical status, and contraindications. Decisions regarding analgesia should be coordinated closely among the obstetrician–gynecologist or other obstetric care provider, the anesthesiologist, the patient, and skilled support personnel.

Parenteral or Systemic Analgesia

Parenteral opioids continue to have a role in peripartum analgesia. They are inexpensive, and their use requires no specialized expertise. However, parenteral opioids have little effect on maternal pain scores, provide unreliable analgesia, and commonly have adverse effects such as nausea and vomiting (5).

In the United States, fentanyl, morphine, nalbuphine, butorphanol, and remifentanil are used commonly. These drugs may be given intramuscularly or intravenously. Fentanyl also has been given intranasally for labor (6). Remifentanil is an ultrashort-acting opioid and is administered only as a patient-controlled intravenous infusion. Table 1 lists the commonly used parenteral or systemic opioids along with their dosages, administration route, onset, duration of effect, and elimination half-life. Not all agents are available in all hospitals.

A Cochrane review failed to identify the ideal parenteral opioid. It concluded that, although there was some pain relief during labor, it was poor; that there were significant adverse effects—mostly nausea, vomiting, and drowsiness; and that there was no great difference between the various agents studied (7).

All opioids cross the placenta and may have adverse effects for the fetus or newborn. This may be reflected in loss of variability in the fetal heart rate (FHR), reduction in the FHR baseline, neonatal respiratory depression, or neurobehavioral changes. Drug elimination takes longer in newborns than in adults, so effects may be prolonged, particularly if administered near the time of delivery. The use of meperidine generally is not recommended for peripartum analgesia because its active metabolite, normeperidine, has a prolonged half-life in adults and a half-life of up to 72 hours in the neonate; the normeperidine effect cannot be antagonized by naloxone (8).

Nalbuphine and butorphanol are mixed agonist–antagonists and, therefore, are associated with less respiratory depression for an equianalgesic dose. Importantly, mixed agonist–antagonist (ie, pentazocine, nalbuphine, and butorphanol) or partial agonist

Table 1. Commonly Used Parenteral or Systemic Opioids for Labor Analgesia

Drug	Dosage and Route of Delivery	Onset	Duration	Elimination Half-life (Maternal)
Fentanyl	50–100 micrograms (every hour); Alternatively, as PCA, load 50 micrograms, then 10–25 micrograms Q 10–12 minutes	2–4 minutes IV	30–60 minutes	3 hours
Morphine	2–5 mg (IV); 5–10 mg (IM)	10 minutes (IV); 30 minutes (IM)	1–3 hours	2 hours
Nalbuphine	10–20 mg IV, SQ, or IM	2–3 minutes IV; 15 minutes SQ or IM	2–4 hours	2–5 hours
Butorphanol	1–2 mg IV or IM	5–10 minutes IV; 30–60 minutes IM	4–6 hours	2–5 hours
Remifentanil	0.15–0.5 micrograms/kg Q 2 minutes as PCA	20–90 seconds	3–4 minutes	9–10 minutes

Abbreviations: IM, intramuscularly; IV, intravenously; PCA, patient-controlled analgesia; Q, every; SQ, subcutaneous.

(buprenorphine) analgesics should be avoided in patients who have received or currently are receiving a full opioid agonist analgesic treatment course, including hydrocodone bitartrate. In such patients, the use of mixed agonist–antagonist and partial agonist analgesics may diminish the analgesic effect, trigger withdrawal symptoms, or both (9).

Remifentanil is an ultra-short-acting opioid without active metabolites. Its pharmacokinetics allow for easy titration during labor and for less risk of respiratory depression in the newborn. Remifentanil is administered intravenously by patient-controlled analgesia, seems to provide better pain relief during labor than other opioids (although less so than epidural analgesia), and has become increasingly popular as an option during labor (10, 11). However, in a small randomized controlled trial, maternal apneic episodes occurred in 26% of women receiving remifentanil by patient-controlled intravenous analgesia, which highlights the need for appropriate respiratory monitoring (12). Respiratory arrest has occurred with use of remifentanil patient-controlled analgesia, and consideration should be given to one-to-one nurse-to-patient ratios, respiratory monitoring, and provision of supplemental oxygen (11).

Nonopioid agents appear to be less effective than opioids. A Cochrane review analyzed a variety of agents, including antihistamines, antispasmodics, sedatives, and nonsteroidal anti-inflammatory drugs (NSAIDs) for pain relief during labor. Nonsteroidal anti-inflammatory drugs and antihistamines were even less satisfactory for pain relief during labor than opioids, although they were more satisfactory than placebo (13). A recent randomized clinical trial compared intravenous acetaminophen with morphine for pain relief in 40 women during the first stage of labor. There was no difference in visual analog scale scores or adverse effects between groups, but one half of the patients who received acetaminophen required rescue analgesia (14). The authors concluded that intravenous acetaminophen may be less effective for pain relief in early labor.

Regional (Neuraxial) Analgesia and Anesthesia

Neuraxial or regional options include epidural and spinal techniques and, unlike most other choices for pain relief, require administration by a qualified health care provider. The neuraxial approaches are suitable for labor analgesia and operative anesthesia. Regional techniques (eg, epidural, spinal) provide pain relief during labor with minimal maternal and neonatal adverse effects.

Solutions typically are comprised of local anesthetic with or without admixed opioids. The qualified anesthesia care provider may choose among several different local anesthetic agents in a variety of concentrations and from among several different opioids. Solutions may be administered as a single injection or infused by a catheter as bolus, continuous infusion, or using patient-controlled techniques.

More than 60% of women having a singleton birth in the United States select epidural or spinal analgesia (15). Higher rates of epidural and spinal analgesia are seen among women with higher education levels, white race, and early presentation for prenatal care, all of which suggest that these forms of analgesia are discretionary rather than solely for medical indications. Neuraxial analgesia does not appear to increase the cesarean delivery rate and, therefore, should not be withheld for that concern (16–20). Consideration should be given to early placement of a neuraxial catheter that can be used later for women undergoing labor after cesarean (also referred to as trial of labor after cesarean) (16).

Epidural Analgesia and Anesthesia

Epidural analgesia involves the placement of a catheter into the epidural space, allowing for repeated or continuous administration of medications. The medication mixture consists of a local anesthetic, often with an opioid, which allows for use of lower concentrations of each agent and thereby minimizes the potential for adverse effects. Lower concentrations of local anesthetic cause less motor blockade, whereas lower concentrations of opioids result in less systemic effect for the woman and fetus or neonate (21). The commonly used local anesthetics are bupivacaine and ropivacaine, and they are equivalent in outcome and adverse effects (22). The two opioids that are used are fentanyl and sufentanil (8).

In some centers, epinephrine may be added to the local anesthetic solution in very dilute doses (5 micrograms/mL, or 1 in 200,000) to prolong duration or increase reliability and intensity of epidural block. Sodium bicarbonate may be added just before administration because alkalinization has been observed to speed up onset of epidural blockade, intensify the effect, or both, especially in sacral dermatomes (8).

Epidural analgesia may be maintained using intermittent boluses, continuous infusion, or continuous infusion with patient-administered boluses (patient-controlled analgesia). Studies comparing regimens for maintenance of epidural analgesia are limited by the wide variety of solutions that may be employed. A systematic review concluded that there was no difference in cesarean delivery rates between continuous-infusion epidural (with or without patient-controlled epidural analgesia) and intermittent bolus administration and no difference in total duration of labor but a significantly shorter second

stage, slightly less total anesthetic dosing, and higher maternal satisfaction with intermittent bolus techniques (23). A Cochrane Review comparing epidural versus nonepidural or no analgesia for pain management concluded that pain intensity and need for additional pain relief was lower in women using epidural analgesia when compared with opioids (24).

Single–Injection Spinal Anesthesia

Single-injection spinal anesthesia involves injection of an opioid, local anesthetic, or both into the subarachnoid space. This technique is seldom chosen for labor except for patients for whom delivery is predicted to occur within an hour or so. However, spinal anesthesia commonly is employed for cesarean delivery. As with epidural, coadministration of opioid and local anesthetic decreases the total dose of each.

Because the spinal anesthetic for cesarean delivery is given as a single injection, it is impossible to titrate the level of blockade and to extend the duration of action. It does, however, provide rapid onset and dense sensory block. Local anesthetics used for this purpose include lidocaine, bupivacaine, and ropivacaine. Fentanyl, sufentanil, or morphine may be added to the mixture to improve intraoperative comfort, postoperative comfort, or both (8).

Continuous Spinal Analgesia

Continuous spinal analgesia is seldom used for labor because of concerns about postdural puncture headache and a U.S. Food and Drug Administration withdrawal of spinal microcatheters from the market in 1991 after reports of cauda equina syndrome (25). In cases of inadvertent dural puncture when epidural is attempted, the planned epidural may be converted to a continuous spinal epidural by threading the catheter into the subarachnoid space for continuous infusion. Deliberate continuous spinal techniques with specially designed catheters also have been investigated occasionally for labor and for conversion to anesthesia for cesarean delivery (25, 26). If chosen, caution should be taken with the labeling, use, dosage, and sterility of the intrathecal catheter.

Combined Spinal–Epidural Analgesia

The subarachnoid injection used in combined spinal–epidural analgesia may consist of a local anesthetic, an opioid, or both. In early labor, subarachnoid opioid alone (fentanyl or sufentanil) is sufficient for analgesia. As labor progresses and pain becomes more somatic, local anesthetic is required to achieve analgesia. This is usually bupivacaine, although ropivacaine may be used instead. Combined spinal–epidural analgesia is continued using the epidural catheter, similar to epidural alone. However, catheter placement cannot truly be verified until the spinal component has "worn off."

Combined Spinal–Epidural Versus Epidural Analgesia

The major advantage of combined spinal–epidural over epidural analgesia is the rapid onset of analgesia because of the initial spinal component (16, 27). A Cochrane review found no difference in patient mobility, labor augmentation, or cesarean delivery between traditional epidural (higher concentrations of local anesthetic) and combined spinal–epidural analgesia and less need for additional or rescue anesthesia interventions, instrumental delivery, and urinary retention with combined spinal–epidural analgesia (28). The same review compared combined spinal–epidural analgesia with low-dose epidural techniques, concluding that higher rates of pruritus occur with combined spinal–epidural analgesia than with epidural analgesia (average risk ratio, 1.80; 95% confidence interval, 1.22–2.65) and found no difference for other endpoints, including mode of delivery, patient satisfaction, and neonatal outcome.

There appears to be a higher incidence of fetal bradycardia with combined spinal–epidural analgesia than with epidural analgesia alone (29) but no increased rate of cesarean delivery for FHR abnormalities. Fetal bradycardia is attributed to intrathecal opioids and is independent of maternal hypotension (30). One proposed explanation is that faster onset of pain relief, especially with a higher dose of intrathecal opioid, quickly lowers maternal circulating levels of plasma epinephrine and beta-endorphins, leaving endogenous oxytocin and norepinephrine unopposed, which results in uterine hypertonus and a reduction in uteroplacental blood flow (31). Additionally, there are reports that the epidural catheter may become dislodged with change in maternal position (32).

Local Anesthesia

Local anesthetics are used for pudendal nerve blocks and for local infiltration of tissue for repair of lacerations. Pudendal block involves injecting local anesthetic transvaginally into the vicinity of the pudendal nerve below the ischial spines. Pudendal block is useful primarily in the second stage of labor or after delivery to facilitate repair of perineal lacerations. In a randomized trial of laboring women after cervical dilation of 7 cm, single-shot spinal anesthesia with bupivacaine and fentanyl produced better pain relief during labor and delivery than pudendal block, although the two techniques were largely equivalent for episiotomy repair (33).

Local anesthetics produce reversible blockade of nerve conduction by blocking sodium channels. They

vary in lipid solubility, potency, time to onset after injection, and duration of activity (34). The local anesthetics typically used for pudendal block or for local infiltration and their maximum recommended doses are presented in Table 2. Epinephrine may be added to local anesthetic solutions to delay absorption and increase duration of blockade by inducing vasoconstriction of the blood vessels in the area. Epinephrine also is useful because it serves as a marker for intravascular injection: an increase in heart rate or blood pressure suggests that the mixture has entered the maternal circulation. However, epinephrine should not be used in women with medical conditions, such as cardiac disorders, that necessitate the avoidance of maternal tachycardia.

Risks of local anesthetics include allergic reaction and toxicity. Anaphylaxis may occur with use of chloroprocaine and tetracaine but is unlikely with bupivacaine, lidocaine, and ropivacaine. Allergic reactions to preservatives (methylparaben) or antioxidants (sulfites) in prepared local anesthetic solutions are possible. Local anesthetic toxicity may occur from absorption of large amounts of local anesthetics or from accidental direct injection into the vasculature; accidental injection is more common. Toxicity may be manifested with neurologic symptoms (eg, seizures, coma) or cardiac symptoms (eg, arrhythmias, myocardial depression); central nervous system symptoms precede cardiac manifestations. Cardiovascular collapse or seizure should be treated in the standard evidence-based fashion. Hypoxemia and acidosis, which potentiate local anesthetic systemic toxicity, should be corrected quickly with intravenous lipid emulsion administered by an anesthesiologist (35).

Inhaled Agents

Nitrous oxide is an anesthetic gas that is used frequently during general anesthesia and has been used for labor and postpartum laceration repair analgesia for decades, although it has been used more extensively in the United Kingdom and other countries than in the United States (36). It is self-administered using a mouthpiece or facemask, with a 50% mix of nitrous oxide in 50% oxygen, either blended from two separate gas cylinders or the hospital's piped gas supply through a small regulator or from a single premixed cylinder (37). The apparatus must use a demand valve so that doses are given only when the patient inhales using the mask and must have scavenging equipment to limit others' environmental exposure. The analgesia provided by nitrous oxide is less effective than epidural analgesia when pain scores are the outcome of interest (38). However, there are several benefits. Nitrous oxide use does not preclude mobility for the patient, does not require additional monitoring, and allows the laboring woman to control the effect. Another advantage is its quick termination of effect once the parturient removes the mask. It is transmitted to the placenta but is eliminated rapidly by the neonate after he or she begins to breathe. Maternal adverse effects include nausea, vomiting, dizziness, and drowsiness. Nitrous oxide can be used safely with other forms of analgesia (39).

General Anesthesia

General anesthesia is uncommon for vaginal or cesarean delivery in contemporary obstetrics. Its use usually is limited to emergency cesarean deliveries or scenarios in which neuraxial anesthesia cannot be performed or has already failed.

The parturient is susceptible to aspiration of gastric contents and may have diminished functional residual capacity, increased minute ventilation potentially leading to rapid desaturation, and changes in anesthetic needs before and after delivery of the newborn. The standard approach for general anesthesia in the parturient is preoxygenation and administration of an induction agent (eg, propofol, ketamine) and a muscle relaxant (eg, succinylcholine, rocuronium), followed by intubation, usually with the application of cricoid pressure. After the airway is secure, anesthesia is maintained with low concentrations of inhaled volatile agents, generally sevoflurane or isoflurane, until delivery of the newborn. Concentrations are kept low because of the effect these agents have on uterine tone. Opioids such as remifentanil

Table 2. Maximum Recommended Doses of Local Anesthetics Commonly Used in Obstetrics

Local Anesthetic	Maximum Recommended Dose With Epinephrine	Maximum Recommended Dose Without Epinephrine
Bupivacaine	3 mg/kg	3 mg/kg
Lidocaine	7 mg/kg	5 mg/kg
Ropivacaine	2 mg/kg	2 mg/kg
2-Chloroprocaine	14 mg/kg	11 mg/kg

Box 1. Indications for Anesthesiology Consultation

The following are some of the most common indications for consultation with an anesthesiologist during the antenatal period or peripartum period. In many cases, a phone consultation may be sufficient; in other cases, a face-to-face consultation will be appropriate.

Cardiac Disease

- Congenital and acquired disorders such as repaired tetralogy of Fallot and transposition of the great vessels
- Cardiomyopathy
- Valvular disease such as aortic and mitral stenosis, tricuspid regurgitation, and pulmonary stenosis
- Pulmonary hypertension and Eisenmenger syndrome
- Rhythm abnormalities such as supraventricular tachycardia and Wolff–Parkinson–White syndrome
- Presence of an implanted pacemaker or defibrillator

Hematologic Abnormalities or Risk Factors

- Immune and gestational thrombocytopenia
- Coagulation abnormalities such as von Willebrand disease
- Current use of anticoagulant medications
- Jehovah's Witness

Spinal, Muscular, and Neurologic Disease

- Structural vertebral abnormalities and prior surgeries such as vertebral fusion and rod placement
- Prior spinal cord injury
- Central nervous system problems such as known arterial–venous malformation, aneurysm, Chiari malformation, or ventriculoperitoneal shunt

Major Hepatic or Renal Disease

- Chronic renal insufficiency
- Hepatitis or cirrhosis with significantly abnormal liver function tests or coagulopathy

History of or Risk Factors for Anesthetic Complications

- Anticipated difficult airway
- Obstructive sleep apnea
- Previous difficult or failed neuraxial block
- Malignant hyperthermia
- Allergy to local anesthetics

Obstetric Complications That May Affect Anesthesia Management

- Placenta accreta
- Nonobstetric surgery during pregnancy
- Planned cesarean delivery with concurrent major abdominal procedure

Miscellaneous Medical Conditions That May Influence Anesthesia Management

- Body mass index of 50 or greater
- History of solid organ transplantation
- Myasthenia gravis
- Dwarfism
- Sickle cell anemia
- Neurofibromatosis

have been used at induction to avoid intraoperative awareness (40, 41).

Airway management is more challenging in the pregnant patient because of the anatomic and physiologic changes that occur during pregnancy and labor. The rate of failed intubation after obstetric general anesthesia is much higher among pregnant patients (1 in 224 to 1 in 390) than among nonpregnant surgical patients (1 in 2,230) (42–44). In elective cases, awake intubation or videolaryngoscopy can be performed when a difficult

airway is anticipated, and the laryngeal mask airway is an alternative to endotracheal intubation in other cases.

Maternal Morbidity and Mortality Related to Analgesia and Anesthesia

Obstetric analgesia and anesthesia are associated with a low risk of maternal morbidity and mortality. A reduction in maternal deaths associated with anesthesia has been demonstrated over decades and anesthesia-related maternal death is rare in high-income countries (45, 46).

The Society for Obstetric Anesthesia and Perinatology established the Serious Complication Repository Project to estimate the frequency of severe adverse outcomes associated with obstetric anesthesia. Over a 5-year period ending in 2009, 30 U.S. institutions participated in data collection and documented a total of 157 prespecified complications that occurred during more than 300,000 recorded or reported deliveries (47). Use of analgesia and anesthesia was high in this cohort. Of women who had a vaginal delivery, 76% had neuraxial anesthetic technique; 63% were epidural analgesia, 37% were combined spinal–epidural, and less than 1% were spinal or continuous spinal techniques. Neuraxial anesthesia was employed in 94% of cesarean deliveries, with a failure rate of 1.7%; 5.6% of cesarean deliveries were performed under general anesthesia.

In this registry, none of the 30 maternal deaths were declared to be related to anesthesia, but two of the 42 cardiac arrests and both myocardial infarctions were deemed to be related to anesthesia. There were four cases of epidural abscess or meningitis for an incidence of fewer than 1 in 60,000; one epidural hematoma (1 in 250,000); 10 failed intubations (1 in 500) with no cases of aspiration; 58 high neuraxial blocks (1 in 4,000); 27 serious neurological injuries, seven of which were judged to be related to anesthesia (1 in 36,000); 25 respiratory arrests, of which 16 were considered to be related to anesthesia (1 in 10,000); and five cases of anaphylaxis, none of which were related to anesthesia (47).

High neuraxial blocks were nearly equally distributed between epidural and spinal techniques, though 24% were attributed to an unrecognized spinal catheter. The risk of postdural puncture headache was calculated at 0.7% of all neuraxial procedures that included dural puncture (spinal and combined spinal–epidural analgesia). More than one half (56%) of these headaches were treated with epidural blood patch, which currently is considered a standard therapeutic intervention (48).

Minor maternal adverse effects associated with neuraxial blocks include maternal hypotension from sympathetic blockade and pruritus from opioid binding to the μ-opioid receptor. Pruritus occurs in the vast majority of peripartum women who receive neuraxial opioids (49). Pruritus is more severe with neuraxial opioids than with intravenous formulations (50) and is more severe and more likely after use of intrathecal opioids than epidural opioids (8). Most cases of opioid-induced pruritus are self-limited. Pruritus may be treated with small doses of naloxone or nalbuphine, but these medications can reverse some of the analgesic effect. Antihistamines also have been used. Antihistamines have little-to-no effect on centrally induced pruritus but may increase drowsiness, leading to improvement in symptoms (49).

The likelihood of maternal hypotension depends on the speed of onset of the neuraxial block and the dose of anesthetic given. Approximately 10% of women will develop hypotension with low-dose neuraxial labor analgesia (8). Hypotension from sympathetic blockade can be prevented to some extent by preloading or coloading with crystalloid or by administering small doses of vasopressors, usually ephedrine or phenylephrine given intravenously. When hypotension does occur after spinal or epidural anesthesia, it can be treated with intravenous vasopressors. In a randomized trial, a combination of crystalloid coloading plus phenylephrine infusion reliably prevented hypotension after spinal anesthesia for cesarean delivery (51). In another randomized trial, a norepinephrine infusion was less likely to cause maternal bradycardia and more likely to preserve cardiac output than phenylephrine (52). Epidural, unlike spinal anesthesia, allows for a slow titration of the local anesthetic and is, therefore, less likely to cause hypotension.

Additional adverse effects of neuraxial techniques include nausea and vomiting (when opioids are used), temperature elevation or fever (epidural related), shivering, urinary retention, and reactivation of oral herpes (8). Respiratory depression is a risk whenever opioids are used, whether they are neuraxial or parenteral.

Fetal Risks Associated With Analgesia and Anesthesia

Fetal and neonatal risks generally relate to maternal effects such as hypotension or to transplacental passage of analgesic or anesthetic drugs. These risks should be assessed in the context of the potential benefits. Alleviation of maternal responses to untreated pain (eg, increased minute ventilation, hypocarbia, respiratory alkalosis, increased catecholamine and cortisol release) may have fetal and neonatal effects.

Because opioids cross the placenta, they carry an increased risk of newborn depression reflected in Apgar scores, respiratory depression, muscle tone, and suckling.

All are more pronounced when intravenous rather than neuraxial opioids are administered to the woman, and peak effects vary by drug. Alterations in the FHR tracing are common after administration of parenteral opioids. Specific effects of spinal and epidural opioids on the FHR are aforementioned. There is a distinction between epidural and combined spinal–epidural analgesia in their potential for effects on the FHR tracing. In a randomized trial of low-risk laboring women, elevated uterine tone was documented in approximately 42% of women receiving combined spinal–epidural analgesia, compared with approximately 17% of those who received epidural analgesia (53). Furthermore, nearly one third of women demonstrated FHR abnormalities (bradycardia or prolonged decelerations) in the first 15 minutes after combined spinal–epidural analgesia. These abnormalities were independent of maternal hypotension but significantly related to the speed of pain relief as measured by a decrease in visual analogue scale scores. Fetal heart rate abnormalities were treated with usual measures in this study, and rates of cesarean delivery, low Apgar scores, and neonatal acidemia did not differ between the two groups.

Clinical Considerations and Recommendations

▶ *Which obstetric patients are not candidates for regional analgesia?*

There are few absolute contraindications to regional or neuraxial techniques other than the patient declining regional anesthesia, but relative contraindications exist. Neuraxial techniques are contraindicated in the presence of coagulopathy because of concerns for development of a spinal or epidural hematoma. The exact frequency of this complication is not known, but it is rare. In a registry of more than 250,000 anesthetics used in obstetrics, most of which were neuraxial, only one spinal hematoma was reported (47). The American Society of Regional Anesthesia and Pain Medicine estimated that the overall risk of hematomas was less than 1 in 150,000 for women with epidural analgesia and less than 1 in 220,000 for women with spinal analgesia but cautioned that the risk probably has increased with increasing use of thromboprophylaxis (54). It appears that the risk of hematoma is higher with epidural techniques than with spinal techniques (54, 55) and that the risk of spinal hematoma is lower among obstetric patients than among older patients undergoing surgery.

Thrombocytopenia is a relative contraindication to neuraxial blockade, but a safe lower limit for platelet count has not been established. In a recent cohort study of 173 parturients with platelet counts under 100,000/microliter who received spinal, combined spinal–epidural, or epidural analgesia or anesthesia for delivery, no spinal–epidural hematomas occurred (56). The study extended the analysis with patient-level data from other studies and estimated the risk of spinal–epidural hematoma among obstetric patients undergoing neuraxial blockade as 0–0.6% when the platelet count was between 70×10^9/L–100×10^9/L but cautioned that data were insufficient to assess risk in the subgroup whose platelet count was less than 70×10^9 L (57). Importantly, among women with thrombocytopenia who were in labor and had cesarean deliveries under general anesthesia, the overall serious morbidity from general anesthesia was 6.5% (56). Epidural and spinal analgesia or anesthesia generally are considered acceptable in a patient with a platelet count greater than or equal to 70×10^9/L provided that the platelet level is stable, there is no other acquired or congenital coagulopathy, the platelet function is normal, and the patient is not receiving any antiplatelet or anticoagulant therapy (58). In some circumstances, epidural or spinal analgesia and anesthesia may be acceptable for patients with platelet counts below 70×10^9/L.

Recommendations about regional analgesia or anesthesia in a patient receiving anticoagulation treatment or thromboprophylaxis are addressed in other clinical questions. The use of low-dose aspirin (most commonly used in obstetrics for prevention of preeclampsia) is not a contraindication for neuraxial techniques (59).

The presence of a space-occupying brain lesion has been considered a contraindication to regional pain relief techniques because a dural puncture, whether intended or inadvertent, in the setting of increased intracranial pressure (ICP) may precipitate hindbrain herniation. Nevertheless, not all space-occupying lesions result in increased ICP, and if imaging shows no mass effect, hydrocephalus, or other feature suggestive of increased ICP, risk of herniation is minimal and epidural analgesia or anesthesia may be considered (60). Decisions should be individualized, and neurologic consultation should be considered in many cases. However, even for cases in which the risk of herniation is thought to be more than minimal, there are circumstances in which there may be compelling reasons to avoid general anesthesia for cesarean delivery, leaving epidural as the better option (60).

▶ *What is the role of systemic or parenteral agents during labor?*

Systemic or parenteral opioids may be used in place of regional techniques or as an initial intervention before neuraxial analgesia, but they do not work as well. Because parenteral opioids do not require an anesthesiologist or nurse anesthetist, they are almost universally available in

maternity settings, whereas use of neuraxial options may be more constrained by the availability of skilled anesthesia care providers. Some women, such as those receiving anticoagulation treatment for thromboprophylaxis, may not be ideal candidates for regional analgesia during labor and can be offered opioids as an alternative form of pain relief. There are limited data on women's preferences during labor. In a national survey of 2,400 women who had recently given birth, 67% reported that they had received epidural or spinal analgesia, 17% reported that they had used no pain medication, and 16% reported that they had received opioids. Another 7% reported that they received general anesthesia, 6% had nitrous oxide, 3% had local anesthesia, and 10% received opioids and regional analgesia (61).

▶ *What is the association between epidural analgesia and maternal fever?*

Although epidural analgesia has been associated with an increase in maternal temperature, it generally is unrelated to infection; however, it can cause diagnostic confusion when the maternal temperature rises to 38.0°C (100.4°F) or higher. Approximately 30% of parturients will experience an increase in maternal temperature (higher than 37.5°C [99.5°F]) with neuraxial analgesia (62); the rate increases with duration of epidural, and it is seen more commonly in nulliparous women. The phenomenon remains unexplained, but hypotheses include altered thermoregulation in the form of either increased heat production or less efficient heat dissipation; the effect of opioids in suppressing fever in the women in the comparison group who did not receive epidural analgesia; and infection or inflammation. Subsequent studies have failed to identify infection as the cause of the increase in maternal temperature (63). There is no difference in the rate of culture-positive or polymerase chain reaction-positive chorioamnionitis after epidural compared with other means of pain relief in labor (63). Giving prophylactic antibiotics before epidural does not reduce the risk of developing a fever (64), although there is a difference in rates of placental inflammation after epidural (65).

▶ *Does epidural analgesia affect the progress of labor or the rates of operative or cesarean delivery?*

The use of regional analgesia may alter the course of labor. A randomized study of intrathecal opioids (alone or combined with local anesthetic) versus systemic opioids found the first stage of labor to be 90 minutes shorter in women receiving intrathecal rather than systemic opioids (17). A meta-analysis of randomized clinical trials comparing epidural with no epidural analgesia in laboring women found that epidural analgesia prolongs the second stage of labor by a mean difference of 7.66 minutes without negative effects to the fetus and neonate (24).

Randomized trials and systematic reviews including thousands of patients have shown that the initiation of epidural analgesia at any stage during labor does not increase the risk of cesarean delivery (17, 19, 20, 24). The risk of instrumental vaginal delivery reportedly is increased when using epidural compared with no epidural analgesia; however, a post hoc subgroup analysis of trials conducted after 2005 failed to demonstrate a significant difference (18, 24). This may reflect a lower concentration of local anesthetics used in modern epidurals (24).

▶ *Does preeclampsia affect the choice of analgesia or anesthesia?*

Neuraxial anesthesia and analgesia generally are safe and well tolerated in women with preeclampsia. The reduction in circulating catecholamines during labor may make blood pressure easier to control after epidural or combined spinal–epidural analgesia. In a recent review, severe preeclampsia had a protective effect against developing hypotension after spinal anesthesia; when hypotension was present, it was less frequent and less severe (66). However, in women with severe preeclampsia, there is a potential for hypotension and fluid-associated risk of pulmonary edema with neuraxial anesthesia and analgesia.

In women with thrombocytopenia related to severe preeclampsia, eclampsia and the hemolysis, elevated liver enzymes, and low platelet count (HELLP) syndrome, the thrombocytopenia is secondary to accelerated platelet consumption. In some of these patients, the thrombocytopenia also is accompanied by impaired platelet function. As with normal laboring women, a safe lower limit for platelet count in preeclamptic women with thrombocytopenia who are receiving neuraxial analgesia or anesthesia has not been established (16). Still, epidural or spinal anesthesia generally is considered acceptable for normal and preeclamptic patients with platelet counts greater than or equal to 70×10^9/L. Neuraxial techniques are contraindicated in the presence of coagulopathy because of concerns for spinal or epidural hematoma. The insertion and removal of an epidural catheter should be avoided during coagulopathy. Any progression of thrombocytopenia or anticoagulated state must be factored into the timing of epidural catheter placement and removal.

A benefit of neuraxial techniques in women with preeclampsia is the avoidance of general anesthesia if cesarean delivery becomes necessary. Although the

agents used to induce and maintain general anesthesia do not worsen hypertension, the process of securing the airway—laryngoscopy and endotracheal intubation—are potent stimulators of the hypertensive response, which may increase risk of stroke and heart failure. If general anesthesia is needed, the spike in blood pressure may be attenuated with opioids and β-blockers (67). An additional concern is the increased risk of a difficult airway in women with preeclampsia because edema of the soft tissues or the larynx itself can make visualization and manipulation considerably more difficult (68).

▶ *Do analgesia and anesthesia affect breastfeeding?*

Breastfeeding is a complex process influenced by many factors, only some of which are related to peripartum events, including analgesia and anesthesia. A retrospective review of more than 18,000 births in Wales found that women were less likely to be breastfeeding by 48 hours postpartum if they had received prostaglandins for labor induction, intramuscular opioids, epidural analgesia, third-stage uterotonics, or general anesthesia (69). All of these effects were only modest and were dwarfed by the effect of parity, social class, or unemployment.

Many agents used for analgesia or anesthesia cross the placenta or can be found in breast milk, or both. When intravenous opioids are used, neonatal depression or drowsiness can interfere with suckling. Because neonatal metabolism and elimination are inefficient, drowsiness can be prolonged. Women considering opiate analgesia should be counseled regarding the potential effect on infant feeding behavior so that they can make an informed decision. Mother–infant pairs exposed to opiates during labor may need additional breastfeeding support. Aside from opioids, agents given for general anesthesia do not have a prolonged effect on the neonate and usually are not found in breast milk in concentrations above 2% of the original maternal dose (70). Women can breastfeed after general anesthesia as soon as they are awake, stable, and alert (71).

Early studies suggested that epidural analgesia, particularly with fentanyl, interfered with the initiation or continuation of breastfeeding (72, 73); however, these studies had methodologic flaws (74). Breastfeeding was studied as a secondary outcome of a randomized trial of combined spinal–epidural analgesia with low-dose infusion of bupivacaine and fentanyl compared with a traditional high-dose epidural with bupivacaine. A matched group of women who did not receive epidural analgesia also was included as a comparison, but this group was not randomized (75). There was no difference in initiation of breastfeeding in the hospital among the epidural, combined spinal–epidural analgesia, nonepidural with meperidine, and nonepidural without meperidine groups, and no statistically significant difference in duration of breastfeeding or in continued breastfeeding at 12 months. Neuraxial analgesia is associated with negligible maternal plasma concentrations of opioid medications and, thus, should have minimal effect on breastfeeding (71).

▶ *What anesthesia options are available for an emergent cesarean delivery?*

If a laboring woman requires an emergent cesarean delivery and already has a functioning epidural, conversion from labor analgesia to surgical anesthesia requires only a bolus dose of a higher-concentration local anesthetic into the epidural catheter. This often can be achieved during preparation for transport to the operating room. Under these circumstances, the median time to achieve a T4 dermatome level using lidocaine is 10 minutes; bupivacaine takes a few minutes longer (76). Conversion to satisfactory surgical anesthesia has been reported to fail in less than 6% of cases (77).

If an emergent cesarean delivery is indicated in a woman who has no epidural, there will not be time to place one and titrate the level carefully. Spinal anesthesia and general anesthesia are available as options in this scenario. In expert hands, adequate spinal anesthesia for emergent cesarean delivery has been reported to take only 8 minutes from the time the patient is positioned to the time a satisfactory block is achieved; one half of this time is spent waiting for the block to ascend to the desired level (78). The difficulty in conducting a randomized trial is obvious, but in a trial performed in a simulator, the calculated time to onset of an adequate level of spinal anesthesia was approximately 9 minutes, compared with 2 minutes for a general anesthetic, not including the usual 3-minute preoxygenation (79). Spinal anesthesia, combined spinal–epidural, or general anesthesia are suitable for emergent cesarean delivery when no epidural is in place.

If general and neuraxial anesthesia are not available, infiltration of local anesthetics is an option for emergent cesarean delivery. Lidocaine is the most commonly used local anesthetic, and systemic toxicity is rare if the recommended total anesthetic dose is not exceeded. Intravenous sedation may be needed as an adjunct to infiltration of local anesthetic.

▶ *What are alternative options when regional analgesia is ineffective for a cesarean delivery?*

If an existing labor epidural is insufficient to begin a cesarean delivery, options are to perform spinal anesthesia or convert to general anesthesia. The failure rate for spinal anesthesia for cesarean delivery has been reported to be

2–6% (80). If a spinal anesthetic that already has been administered for cesarean delivery is inadequate for surgical anesthesia, a second spinal or combined spinal–epidural anesthetic may be attempted, but the level of the block can be unpredictable. If the abdomen is already open when an epidural or spinal anesthetic is deemed unsatisfactory, the options are supplementation with intravenous or local agents and converting to general anesthesia. The choice will depend on the degree of pain reported by the patient and the point at which it occurs (predelivery or postdelivery), as well as the patient-specific risk concerning general anesthesia. The surgical technique may be modified, when feasible, if the level of sensory anesthesia is lower than ideal; for example, exteriorizing the uterus for repair of the hysterotomy incision requires a higher sensory level than repairing it in situ. Gentle tissue handling also may allow the procedure to be completed without conversion to a general anesthetic.

▶ *What are the optimal agents for analgesia after a cesarean delivery?*

Planning for postoperative analgesia should begin before or during cesarean delivery. If a cesarean delivery is performed using spinal or epidural anesthesia, postoperative analgesia is optimally achieved by the choice of the initial local anesthetic solution. Preservative-free morphine is used commonly to achieve short-term postoperative pain relief. When given by the intrathecal or epidural route, preservative-free morphine provides 12–24 hours of postoperative analgesia, but it is accompanied by a risk of adverse effects, including pruritus, nausea, and respiratory depression.

A local anesthetic may be given at the time of cesarean delivery in a number of ways: the wound may be infiltrated with local anesthetic, a nerve block may be administered either as an ilioinguinal or iliohypogastric (81) or transversus abdominis plane block (82), or continuous irrigation of the wound with local anesthetic may be undertaken. Technical skill is required to effect either of the nerve blocks, and ultrasonographic guidance may be helpful. In a randomized trial, transversus abdominis plane block with ropivacaine at the time of cesarean delivery was shown to decrease postoperative morphine requirements by more than 70% compared with saline controls (82). Transversus abdominis plane blocks are especially effective as an adjunct to analgesia with paracetamol and NSAIDs (83–85). However, transversus abdominis plane blocks do not improve pain relief when intrathecal morphine is given (86). Even wound infiltration with local anesthetic at the time of cesarean delivery decreases postoperative opioid consumption in the first 12–24 hours (87) and is easy to perform.

Postoperatively, opioids may be given intravenously, by patient-controlled intravenous techniques, or intramuscularly. A few preparations of NSAIDs also are available for parenteral use. Oral analgesics given after cesarean delivery include opioids, NSAIDs, or acetaminophen, alone or in combination. A recent systematic review concluded that there are few studies and that they are generally of poor quality, and data are too limited to determine the safest and most effective regimen for oral analgesia after cesarean delivery (88). Intravenous acetaminophen also can be given for postoperative pain relief. It has similar efficacy to oral acetaminophen and oral ibuprofen but is more expensive (89, 90).

Opioids are associated with adverse effects for the woman and the fetus or newborn, most significantly respiratory depression, so attention should be paid to respiratory status. Adverse maternal effects of opioids include sedation, nausea, vomiting, pruritus, and constipation. Central nervous system depression and death have been reported in breastfed infants exposed to opiate analgesics in breast milk (91). Several oral opiates are metabolized to their active form in the maternal liver, and ultrarapid metabolizers may achieve markedly higher levels of active drug in plasma and, thus, in milk. The U.S. Food and Drug Administration recommends that codeine use be avoided in breastfeeding women (92, 93). Oxycodone doses greater than 30 mg/d are not recommended in breastfeeding women (94). Women taking opiate pain medications should be counseled to monitor their infants for drowsiness, sedation, feeding difficulties, or limpness. Thus, a multimodal approach in which systemic opioids can be limited while still affording a patient good postoperative analgesia is optimal (95).

▶ *When is it appropriate to obtain an anesthesia consultation?*

All options for analgesia interventions and techniques should be discussed with the patient, preferably during the prenatal period. The obstetrician–gynecologist or other obstetric care provider, in collaboration with an anesthesia care provider, can help the patient make an informed decision about which types of analgesia to use based on her medical history, personal preferences, and a discussion of the potential benefits and risks of each intervention.

The anesthesiology service should be apprised in advance of patients whose peripartum care may be challenging or who are known to be at risk of significant morbidity. The most common indications for anesthesia consultation are listed in Box 1.

Standard practice in anesthesiology includes a focused history and physical examination before

initiating any anesthetic for peripartum pain relief (96). For elective cesarean delivery procedures, the anesthesia evaluation often can be performed on the day of surgery or scheduled in advance. In emergencies, this evaluation is performed immediately before surgery. For neuraxial analgesia during labor, the evaluation can be performed before placement of the regional anesthesia.

The anesthesiologist also should be made aware of whether a woman has preeclampsia with other complications such as thrombocytopenia, pulmonary edema, central nervous system symptoms, oliguria, or other markers of organ dysfunction. Similarly, the obstetrician–gynecologist or other obstetric care provider should notify the anesthesiologist of a woman in labor who has a complication such as breech presentation or multiple gestation because intrauterine manipulation may be required even for vaginal delivery, and the chance of cesarean delivery remains high.

Management of intrapartum and postpartum pain in patients who regularly use opiates or other drugs or are taking methadone or buprenorphine treatment can be challenging because of their increased drug tolerance and sensitivity to pain. A consultation with an anesthesiologist can be beneficial in pregnant women with substance use disorder or chronic opiate use to formulate a pain management plan tailored to the individual patient. A multimodal pain control approach with neuraxial analgesia and NSAIDs and acetaminophen typically is needed to provide effective intrapartum and postpartum pain relief.

▶ ***How soon after heparin or low-molecular-weight heparin use can regional analgesia be placed and how soon after regional analgesia can a dose be given?***

Therapeutic anticoagulation with either unfractionated heparin or low-molecular-weight (LMW) heparin requires either pharmacologic reversal or enough time since the last dose before neuraxial techniques are used. The Society for Obstetric Anesthesia and Perinatology Consensus Statement states that prophylactic subcutaneous unfractionated heparin in a dosage of 5,000 units twice daily is not a contraindication to neuraxial techniques (catheter placement or removal more than 4–6 hours since last dose). It is likely low risk to proceed with neuraxial anesthesia in the setting of intermediate-dose unfractionated heparin (7,500–10,000 units) more than 12 hours after the last dose and in the setting of high-dose unfractionated heparin (total daily dose greater than 20,000 units) more than 24 hours after the last dose with the activated partial thromboplastin time being within normal range or the anti-factor Xa level undetectable. In urgent cases in which the last dose of unfractionated heparin was administered before these established time cut offs, coagulation status should be assessed with an activated partial thromboplastin time or anti-factor Xa level and the relative risks of administering neuraxial anesthesia and spinal epidural hematoma should be weighed in the setting of normal laboratory values (97). If the patient was taking unfractionated heparin for more than 4 days, a platelet count should be assessed for possible heparin-induced thrombocytopenia before placement or removal of a neuraxial catheter. Subsequent unfractionated heparin dose can be resumed more than 1 hour after catheter removal. Additionally, the guidelines recommend that patients receiving thromboprophylaxis with LMW heparin have needle or catheter placement or removal delayed by at least 12 hours after the last dose; that patients receiving treatment doses of LMW heparin (eg, enoxaparin 1 mg/kg every 12 hours) have a 24-hour delay in catheter placement; and that, if a dose of LMW heparin has been administered within 2 hours preoperatively, neuraxial techniques should not be employed (54, 97). There are insufficient published data to recommend a specific interval between 12–24 hours to delay neuraxial anesthesia in the setting of intermediate dose LMW heparin. Subsequent LMW heparin thromboprophylaxis doses should resume more than 4 hours after catheter removal (97). The Society for Obstetric Anesthesia and Perinatology Consensus Statement does recommend the responsible medical professional consider all the circumstances presented by an individual patient and perform an individualized risk-benefit assessment (97).

Summary of Recommendations and Conclusions

The following recommendations are based on good and consistent scientific evidence (Level A):

- Neuraxial analgesia does not appear to increase the cesarean delivery rate and, therefore, should not be withheld for that concern.
- Opioids are associated with adverse effects for the woman and the fetus or newborn, most significantly respiratory depression, so attention should be paid to respiratory status.

The following recommendation and conclusion are based on limited or inconsistent scientific evidence (Level B):

- Spinal anesthesia, combined spinal–epidural, or general anesthesia are suitable for emergent cesarean delivery when no epidural is in place.

- Thrombocytopenia is a relative contraindication to neuraxial blockade, but a safe lower limit for platelet count has not been established.

The following recommendation and conclusion are based primarily on consensus and expert opinion (Level C):

- In the absence of a medical contraindication, maternal request is a sufficient medical indication for pain relief during labor.
- Epidural and spinal analgesia or anesthesia generally are considered acceptable in a patient with a platelet count greater than or equal to 70×10^9/L provided that the platelet level is stable, there is no other acquired or congenital coagulopathy, the platelet function is normal, and the patient is not receiving any antiplatelet or anticoagulant therapy. In some circumstances, epidural or spinal analgesia and anesthesia may be acceptable for patients with platelet counts below 70×10^9/L.

For More Information

The American College of Obstetricians and Gynecologists has identified additional resources on topics related to this document that may be helpful for obgyns, other health care providers, and patients. You may view these resources at www.acog.org/More-Info/ObstetricAnalgesiaAnesthesia.

These resources are for information only and are not meant to be comprehensive. Referral to these resources does not imply the American College of Obstetricians and Gynecologists' endorsement of the organization, the organization's website, or the content of the resource. These resources may change without notice.

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The MEDLINE database, the Cochrane Library, and the American College of Obstetricians and Gynecologists' own internal resources and documents were used to conduct a literature search to locate relevant articles published between January 1985–June 2018. The search was restricted to articles published in the English language. Priority was given to articles reporting results of original research, although review articles and commentaries also were consulted. Abstracts of research presented at symposia and scientific conferences were not considered adequate for inclusion in this document. Guidelines published by organizations or institutions such as the National Institutes of Health and the American College of Obstetricians and Gynecologists were reviewed, and additional studies were located by reviewing bibliographies of identified articles. When reliable research was not available, expert opinions from obstetrician–gynecologists were used.

Studies were reviewed and evaluated for quality according to the method outlined by the U.S. Preventive Services Task Force:

- I Evidence obtained from at least one properly designed randomized controlled trial.
- II-1 Evidence obtained from well-designed controlled trials without randomization.
- II-2 Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one center or research group.
- II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments also could be regarded as this type of evidence.
- III Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

Based on the highest level of evidence found in the data, recommendations are provided and graded according to the following categories:

Level A—Recommendations are based on good and consistent scientific evidence.

Level B—Recommendations are based on limited or inconsistent scientific evidence.

Level C—Recommendations are based primarily on consensus and expert opinion.

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