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Obstetric Analgesia and Anesthesia

Labor results in severe pain for many women. There is no other circumstance in which it is considered acceptable for a person to experience untreated severe pain, amenable to safe intervention, while under a physician's care. In the absence of a medical contraindication, maternal request is a sufficient medical indication for pain relief during labor. Pain management should be provided whenever it is medically indicated. The purpose of this document is to help obstetrician–gynecologists understand the available methods of pain relief to facilitate communication with their colleagues in the field of anesthesia, thereby, optimizing patient comfort while minimizing the potential for maternal and neonatal morbidity and mortality.

This Practice Bulletin was developed by the ACOG Committee on Practice Bulletins—Obstetrics with the assistance of Laura M. Goetzl, MD, MPH. The information is designed to aid practitioners in making decisions about appropriate obstetric and gynecologic care. These guidelines should not be construed as dictating an exclusive course of treatment or procedure. Variations in practice may be warranted based on the needs of the individual patient, resources, and limitations unique to the institution or type of practice.

Reaffirmed 2012

Background

Labor Pain

Uterine contractions and cervical dilation result in visceral pain (T-10 through L-1). As labor progresses, the descent of the fetal head and subsequent pressure on the pelvic floor, vagina, and perineum generate somatic pain transmitted by the pudendal nerve (S2–4). Ideally, methods of obstetric pain relief will ameliorate both sources of pain in the patient in labor.

Available Methods of Anesthesia and Analgesia

Parenteral

Various opioid agonists and opioid agonist–antagonists are available for systemic analgesia (Table 1). These agents can be given in intermittent doses on patient request or via patient-controlled administration. Recent reports suggest that the analgesic effect of parenteral agents used in labor is limited, and the primary mechanism of action is heavy sedation (1). In randomized trials compar-

Table 1. Parenteral Agents for Labor Pain

Agent	Usual Dose	Frequency	Onset	Neonatal Half-Life
Meperidine	25–50 mg (IV)	Q 1–2 h	5 min (IV)	13–22.4 h
	50–100 mg (IM)	Q 2–4 h	30–45 min (IM)	63 h for active metabolites
Fentanyl	50–100 μg (IV)	Q 1 h	1 min	5.3 h
Nalbuphine	10 mg (IV or IM)	Q 3 h	2–3 min (IV)	4.1 h
			15 min (IM)	
Butorphanol	1–2 mg (IV or IM)	Q 4 h	1–2 min (IV)	Not known
			10–30 min (IM)	Similar to nalbuphine in adults
Morphine	2–5 mg (IV)	Q 4 h	5 min (IV)	7.1 h
	10 mg (IM)		30–40 min (IM)	

Abbreviations: IM, intramuscularly; IV, intravenously; Q, every.

Data from Lieberman BA, Rosenblatt DB, Belsey E, Packer M, Redshaw M, Mills M, et al. The effects of maternally administered pethidine or epidural bupivacaine on the fetus and newborn. B J Obstet Gynaecol 1979;86:598–606; Koehntop DE, Rodman JH, Brundage DM, Hegland MG, Buckley JJ. Pharmacokinetics of fentanyl in neonates. Anesth Analg 1986;65:227–232; Kuhnert BR, Kuhnert PM, Philipson EH, Syracuse CD. Disposition of meperidine and normeperidine following multiple doses in labor. II. Fetus and neonate. Am J Obstet Gynecol 1985;151:410–415; Nicolle E, Devillier P, Delanoy B, Durand C, Bessard G. Therapeutic monitoring of nalbuphine: transplacental transfer and estimated pharmacokinetics in the neonate. Eur J Clin Pharmacol 1996;49:485–489; Chay PC, Duffy BJ, Walker JS. Pharmacokinetic-pharmacodynamic relationships of morphine in neonates. Clin Pharmacol Ther 1992;51:334–342; Lynn AM, Slattery JT. Morphine pharmacokinetics in early infancy. Anesthesiology 1987;66:136–139

ing intermittent intravenous meperidine (2, 3), intermittent nalbuphine (4, 5), intermittent butorphanol (6), or patient-controlled administration of meperidine (7) with regional analgesia, parenteral agents resulted in significantly higher visual analog pain scores. Except when large doses of meperidine are used via patient-controlled administration (mean dose: 139 mg; 24% >200 mg) (7), administration of parenteral agents results in absent-to-minimal reductions in pain scores (2–6). However, when women receive high doses of meperidine, the number of infants requiring naloxone therapy increases fourfold when compared with women receiving epidural analgesia (7).

Although regional analgesia provides superior pain relief, some women are satisfied with the level of analgesia provided by narcotics when large enough doses are used (7). However, patients exposed to doses of this magnitude are at increased risk of aspiration and respiratory arrest. The use of shorter-acting agents, such as patient-controlled administration of fentanyl, may decrease some of the neonatal risks posed by meperidine. The decision to use parenteral agents to manage labor pain should be made in collaboration with the patient after a careful discussion of the risks and benefits.

The American Society of Anesthesiologists (ASA) and the American College of Obstetricians and Gynecologists (ACOG) have received reports that some third-party payers have denied reimbursement for regional analgesia and anesthesia during labor unless a physician has documented the presence of a "medical indication" for regional analgesia and anesthesia (8). Of the various pharmacologic methods of pain relief during labor and delivery, regional analgesia techniques—spinal, epidural, and combined spinal epidural—are the most flexible, effective, and least depressing to the central nervous system, allowing for an alert, participating woman and an alert neonate. It is the opinion of the ASA and ACOG that third-party payers who provide reimbursement for obstetric services should not deny reimbursement for regional analgesia and anesthesia because of an absence of other medical indications.

Regional Analgesia

In obstetric patients, regional analgesia refers to a partial to complete loss of pain sensation below the T8 to T10 level. In addition, a varying degree of motor blockade may be present, depending on the agents used.

Epidural. Epidural analgesia offers the most effective form of pain relief (2–7) and is used by most women in the United States (9). In most obstetric patients, the primary indication for epidural analgesia is the patient's desire for pain relief. Medical indications for epidural analgesia during labor may include anticipated difficulty in intubation, a history of malignant hyperthermia, selected forms of cardiovascular and respiratory disease, and prevention or treatment of autonomic hyperreflexia in parturients with a high spinal cord lesion. A catheter is placed in the epidural space, allowing for continuous epidural infusion of local anesthetic agents or narcotics. The advantage of this method is that medication can be titrated over the course of labor as needed. In addition, epidural catheters placed for

labor analgesia can be used for cesarean delivery or postpartum tubal ligation. Modern epidural preparations that combine a low-dose local anesthetic, such as bupivacaine, levobupivacaine, or ropivacaine, with an opioid agonist are preferred because they decrease motor blockade and result in an increased rate of spontaneous vaginal delivery (10). Some women who receive epidural analgesia may be candidates for ambulation.

Spinal. Single-shot spinal analgesia provides excellent pain relief for procedures of limited duration, such as cesarean delivery, the second stage of labor, rapidly progressing labor, and postpartum tubal ligation. A long-acting local anesthetic often is used, with or without an opioid agonist. The duration of anesthesia is approximately 30–250 minutes depending on the drugs used (11). However, because of its inability to extend the duration of action, single-shot spinal analgesia is of limited use for the management of labor.

Combined Spinal Epidural. Combined spinal epidural offers the rapid onset of spinal analgesia combined with the ability to use the epidural catheter to prolong the duration of analgesia with a continuous epidural infusion for labor, to convert to anesthesia for cesarean delivery, or to provide postcesarean delivery pain control. This method of obstetric analgesia is increasing in popularity, especially with the advent of needle-through-needle techniques that eliminate the need for more than one skin puncture. In addition, the use of newer "atraumatic" spinal needles is associated with a dramatically decreased risk of spinal headache (12). The spinal component of combined spinal epidural may be an intrathecal narcotic plus a small amount of a local anesthetic. In one randomized, prospective study, intrathecal use of the short-acting, lipid-soluble narcotic sufentanil was associated with a small but increased incidence of profound fetal bradycardia within 60 minutes of the administration of the combined spinal epidural and an increased risk of cesarean delivery for nonreassuring fetal status (13). Emergency cesarean delivery for fetal bradycardia also occurred in 1.5% of cases in which combined spinal epidural was used, compared with none in cases using only epidural analgesia; the outcomes were the same in both groups. Increased fetal bradycardia after the use of intrathecal fentanyl also was seen in a retrospective study (14) but it was not significant because of the small sample size of the study. Failure of the spinal component occurs at a rate of 4% with combined spinal epidural (12, 15), but the block can be supplemented with the epidural catheter.

Side Effects of Regional Analgesia. Common side effects of regional analgesia are described in Table 2. The most common side effect is hypotension, which cannot be wholly prevented with prehydration with crystalloid or the use of prophylactic ephedrine (16, 17). It is common practice, however, to prehydrate women with 500–1,000 mL of nonglucose-containing isotonic crystalloid. Uterine perfusion also should be maximized at the time of cesarean delivery by maintaining left uterine displacement before delivery. Although prophylactic ephedrine is not commonly administered before epidural analgesia for labor pain, obstetrician–gynecologists should be prepared for the frequent occurrence of hypotension that should be treated with intravenous ephedrine to prevent decreased uterine perfusion. There is a reported 8% incidence of transient fetal heart rate deceleration, which often is related to epidural analgesia and is responsive to conservative management techniques, such as hydration, discontinuation of the epidural infusion, repositioning the woman so she is lying on her side, administration of oxygen, or administration of ephedrine (14).

Postdural puncture headache is possible with spinal analgesia but also can occur with combined spinal epidural and epidural analgesia (12, 15). Early conservative therapy for headache includes analgesics, supine positioning, and hydration. However, in 36% of cases, postdural puncture headache after spinal or combined spinal epidural is severe enough to require an autologous epidural blood patch (12). This rate is higher after unanticipated dural puncture during epidural analgesia (wet tap) because of the larger needle size. The initial blood patch procedure is approximately 61–75% effective in the treatment of postdural puncture headache (18, 19).

Transient neurologic symptoms—painful sensations in the buttocks or lower extremities—can occur with spinal anesthesia, although the incidence is low, occurring in approximately 3–7% of cases (20). Pruritus is extremely common after intrathecal or epidural opioids but it can be treated, as needed, with either naloxone or nalbuphine (10, 21). Approximately 10% of patients will have inadequate anesthesia with an epidural block but this often can be managed with further epidural boluses (22). Because a portion of an epidural narcotic enters the systemic circulation, close attention to the patient's total narcotic dosage over the course of parturition is important. Total spinal blockade, epidural or spinal hematoma, abscess, and neurotoxicity are all rare complications of regional analgesia. Fever (temperature >100.4°F) is one of the most common side effects of epidural analgesia; it occured in 24% of nulliparous women randomized to epidural analgesia compared with 5% of nulliparous women receiving parenteral narcotics (23). Although the overall risk of fever in multiparous women is not significantly higher than in controls (4% versus 3%), the risk of fever increases with the duration of labor; therefore, multiparous women who experience prolonged labor are at increased risk (23, 24).

Table 2. Complications of Regional Analgesia

Complication	Incidence (%)
Hypotension (in prehydrated women undergoing cesarean delivery)	
Spinal	25–67[1,2]
Epidural (in prehydrated women in labor)	28–31[3–5]
Epidural	8.5–9[6,7]
Fever >100.4° (excess rate over women treated with narcotics)	
Nulliparous women	19[8]
Multiparous women	1[8]
Postdural puncture headache	
Spinal	1.5–3[9,10]
Epidural	2[11]
Combined spinal epidural	1–2.77[11–13]
Transient fetal heart decelerations	8[14]
Pruritus (with added opioid only)	
Epidural	1.3–26[11,15]
Spinal and combined spinal epidural	41–85[16,17,11,18]
Inadequate pain relief: epidural	9–15[19,6]

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General Anesthesia

Because general anesthesia results in a loss of maternal consciousness, it must be accompanied by airway management by trained anesthesia personnel. Nitrous oxide may be supplemented with halogenated hydrocarbons, such as isoflurane, desflurane, and sevoflurane, at low concentrations. The use of intravenous agents, such as sodium pentothal, followed by rapid sequence induction is used to minimize the risk of aspiration. All inhaled anesthetic agents readily cross the placenta and have been associated with neonatal depression. Ideally, induction-to-delivery time should be minimized when general anesthesia is used. One study reported that fetal exposure of more than 8 minutes was associated with increased neonatal depression (25).

Halogenated agents are potent uterine relaxants when administered in high inhalation concentrations. This property can be useful to obstetricians in circumstances in which uterine relaxation is desirable, such as management of uterine inversion, internal podalic version, or fetal entrapment (either during vaginal or cesarean delivery), although intravenous nitroglycerin and terbutaline may achieve the same goal with fewer side effects. Increased uterine relaxation, however, is a concern because of its potential for increasing blood loss during cesarean delivery. Although some investigators have reported increased blood loss (26), especially with higher dosages (27), others have found no increased risk when women at high risk were excluded (28).

Local

Various local anesthetic agents are available for local infiltration of the perineum and vagina to provide analgesia before episiotomy and during repair of lacerations. Common rapidly acting agents include lidocaine (1–2%) and 2-chloroprocaine (1–3%), which provide local anesthesia for a duration of 20–40 minutes. Toxic effects of local anesthetic agents are rare and include seizures, hypotension, and cardiac arrhythmias. Toxicity is highest with intravascular injection; therefore, it is critical to aspirate for blood before injecting a local anesthetic into the vascular tissues of the vagina and perineum. The total dosage of plain lidocaine should not exceed the recommended dosage because of the increased incidence of lidocaine toxicity.

Local anesthetic agents also can be used by an obstetrician–gynecologist to perform a pudendal block (a type of regional block), an adequate form of temporary pain relief that can aid outlet operative vaginal deliveries in women not using regional analgesia. Complications from pudendal block include intravascular injection of anesthetic agents, hematoma, and infection. Paracervical blocks have been strongly associated with fetal bradycardia (29).

Infiltration of local anesthesia, although time consuming, has been used for cesarean delivery in rare circumstances when adequate general or regional anesthesia is unavailable (30). In slightly more common but still rare situations, practitioners have initiated a cesarean delivery under local anesthesia until the regional anesthesia has taken effect.

Maternal Mortality

Complications of anesthesia remain an important and often preventable cause of pregnancy-related mortality (31), accounting for more than 5% of maternal deaths (32). Anesthesia-related maternal mortality has decreased with time and is currently estimated at 1.7 per 1,000,000 live births (33). The removal from the market of 0.75% bupivacaine by the U.S. Food and Drug Administration in 1984 coupled with the increase in popularity of fractionated dosing of local anesthetics led to a sharp decrease in deaths from local anesthetic toxicity. The increased safety of regional analgesia has increased the relative risk of general anesthesia; the case fatality rate of general anesthesia for cesarean delivery is estimated to be approximately 32 per 1,000,000 live births compared with 1.9 per 1,000,000 live births for regional anesthesia (33). Failed intubation occurs in 1 out of 250 cases of general anesthesia administered to pregnant patients (34). This rate is approximately 10-fold higher than it is in the nonpregnant population. The significant added morbidity of general anesthesia over regional anesthesia for cesarean delivery suggests that regional anesthesia is the preferred method of pain control and should be used unless a contraindication to regional anesthesia is present (see box). Although general anesthesia may be indicated in some cases of fetal heart rate abnormality, the severity of the abnormality should be considered before incurring the excess risk of maternal mortality associated with general anesthesia. In patients with an increased risk of urgent cesarean delivery (eg, severe intrauterine growth restriction), it is reasonable to encourage early regional analgesia during labor. This approach has the potential benefit of reducing the need for emergent general anesthesia and its attendant risks.

Absolute Contraindications to Regional Anesthesia

- Refractory maternal hypotension
- Maternal coagulopathy
- Maternal use of once-daily dose of low-molecular-weight heparin within 12 hours
- Untreated maternal bacteremia
- Skin infection over site of needle placement
- Increased intracranial pressure caused by a mass lesion

Clinical Considerations and Recommendations

▶ *What factors should be considered in the choice of parenteral agent for labor pain?*

Historically, meperidine has been the most widely used systemic opioid. However, the use of drugs in the opioid agonist–antagonist class has become more popular because they are associated with less nausea and vomiting (35, 36) and respiratory depression is less likely, even when higher doses of nalbuphine are used (37). Conversely, nalbuphine has been associated with increased maternal sedation (35, 36). Fentanyl also has been used during labor as an alternative drug because of its relatively short half-life; it is associated with significantly less nausea, vomiting, and sedation than meperidine (38). Butorphanol may increase blood pressure levels and should be avoided in patients with chronic hypertension or preeclampsia (39).

There is significant transplacental passage of all parenteral drugs. A recent meta-analysis of several randomized trials revealed that parenteral analgesia is associated with a twofold to threefold increased risk of Apgar scores lower than 7 at 5 minutes and a fourfold increased need for neonatal naloxone (40), although the overall incidence of both was low. Although most neonatal depression is short-lived and can be treated as needed with naloxone, the long neonatal half-life of normeperidine (63 hours), an active metabolite of meperidine, has raised concerns regarding the prolonged duration of neonatal sedation following the administration of parenteral meperidine during labor (41, 42). Infants exposed to meperidine during labor demonstrate dose-dependent neurobehavioral depression that can be demonstrated on day 2 (43) and day 3 (44, 45) of life. Unlike other parenteral drugs, the neonatal effects of meperidine increase with a prolonged drug-to-delivery interval because of the accumulation of normeperidine (44, 45). Neonates exposed to transplacental nalbuphine are demonstrated to have a decreased response to sound and decreased tone and alertness for more than 24 hours after birth (35). Fentanyl also crosses the placenta but has not been associated with neonatal neurobehavioral depression (38).

All parenteral drugs can have a significant effect on intrapartum fetal heart rate tracing. Meperidine (46, 47), fentanyl (38), and nalbuphine (48) have all been associated with decreased heart rate variability. Nalbuphine and fentanyl also have been associated with transient sinusoidal fetal heart rate tracings (49, 50). Caution should be used in administering these drugs in the setting of diminished short- or long-term fetal heart rate variability. Naloxone is a pure opioid antagonist that is the drug of choice in the treatment of maternal respiratory and neurobehavioral depression secondary to opioid agonist drugs. Studies have suggested that naloxone may be associated with neonatal withdrawal seizures, especially in women who are opioid dependent (51). Because it is a pure antagonist, it does not cause additional respiratory depression. Naloxone should be given intravenously when possible; intramuscular or subcutaneous administration may delay absorption in the neonate who is stressed and vasoconstricted. Because naloxone has a relatively short duration of action, it may be necessary to repeat the dose.

▶ *What is the role of patient-controlled epidural analgesia during labor?*

The goal of epidural analgesia is to provide satisfactory pain control for labor with the lowest dose of analgesic drugs needed to minimize motor blockade and simultaneously reduce the potential side effects of epidural analgesia during the course of labor. Patient-controlled epidural analgesia provides pain control similar to that of standard epidural analgesia (52–54). Intermittent bolus patient-controlled epidural analgesia results in lower total dosages of anesthetic agents than continuous infusion epidural (52, 53, 55) and results in less motor blockade (53). When compared with practitioner-administered intermittent bolus techniques, some studies have found an increased use of anesthetic agents with patient-controlled epidural analgesia (53), while others have found no difference (55, 56). Motor blockade appears to be similar between patient-controlled epidural analgesia and intermittent bolus epidural analgesia (53, 54). Patient-controlled epidural analgesia is an acceptable alternative method of labor analgesia but does not appear to have additional benefits over standard epidural techniques. Patient satisfaction with all epidural techniques is high and is not significantly improved with patient-controlled epidural analgesia in most studies (53–55).

▶ *Is chronic back pain associated with epidural use?*

Retrospective studies have found an association between epidural analgesia and chronic back pain (57–59). One proposed explanation is that motor block of the lower back and legs leads to prolonged periods of poor posture and decreased perception of muscle strain. However, retrospective studies are plagued by recall bias and patients' perceptions of an association between epidural analgesia and chronic back pain. Prospective cohort studies and one small, randomized controlled trial have found no significant association between epidural analgesia and chronic back pain (60–62).

▶ *What is the effect of epidural analgesia on maternal fever?*

No well-designed, randomized trial has specifically addressed the issue of epidural-associated fever. However, studies in which women were randomized to receive epidural analgesia or parenteral drugs for other objectives have consistently shown an increased rate of fever in the epidural group (2, 7, 23). In three randomized studies with mixed populations of nulliparous and multiparous women, the relative risk for fever in the epidural group was between 4.0 and 4.6 (2, 7, 23). In the one randomized study in which logistic regression was performed to control for potential confounders, the risk of fever in the population receiving epidural was fourfold higher (95% confidence interval, 2.0–7.7) (23).

The mechanism for fever is not known. Theories include thermoregulation and chorioamnionitis. In one study, placental inflammation was more common with epidural analgesia (63). Epidural-related fever is not benign. Although there is no increased risk of neonatal sepsis, there is a statistically significant increase in neonatal sepsis evaluations (23, 24). Epidural-related fever results in a statistically significant risk of maternal antibiotic treatment (64, 65) and a statistically significant increase in neonatal antibiotic treatment (23).

▶ *Does epidural analgesia increase the rate of operative delivery?*

Although neuraxial techniques (epidural, spinal, and combined spinal epidural) provide the most effective and least depressant analgesia for labor, the question of whether their use is associated with an increased risk of cesarean delivery remains controversial. Several randomized prospective studies have shown an increased risk of cesarean delivery with epidural analgesia (2, 3), while others have shown no increased risk with epidural analgesia (7) or combined spinal epidural analgesia (13). Limitations to analysis of these studies include high crossover rates between study populations, substantial bias, and small numbers of patients.

Less controversial is the causal role epidural analgesia plays in prolonging labor by 40–90 minutes (2, 7, 13, 40) and in the approximate twofold increased need for oxytocin augmentation (3, 7). These findings are supported by most prospective studies as well as meta-analysis (40, 59). An increased risk of a second stage of labor longer than 2 hours (2, 13) in women with epidural analgesia likely contributes to the higher rates of operative vaginal delivery seen in most prospective studies. The four best prospective studies, in which elective forceps use was not permitted (2, 3, 7, 13), yielded a combined relative risk of 1.9 (95% confidence interval, 1.4–2.5) of forceps delivery in women who received epidural analgesia. Some investigators have found a decreased risk of operative delivery with combined spinal epidural when compared with low-dose epidural (66). This finding is difficult to interpret, because elective forceps were not excluded in this study, and the rate of forceps use was high (28–40%). Excessive operative vaginal deliveries have been implicated in the increased rate of third- and fourth-degree lacerations seen in women with epidural analgesia (67).

▶ *What is the effect of the timing of epidural analgesia on the course of labor and the risk of cesarean delivery?*

Reports regarding the effect of the timing of epidural analgesia on the course of labor offer conflicting results. Several retrospective studies have shown an increased risk of cesarean delivery in nulliparous women in whom epidural analgesia was administered before cervical dilatation of 4 cm (68) or 5 cm (69). Another retrospective study found an increased risk of cesarean delivery with higher station at epidural placement—but not related to cervical dilatation—after using logistic regression to control for potential confounders (70). A prospective trial comparing laboring women who were randomized to either an epidural group or an intravenous meperidine group, reported a 25% cesarean delivery rate in the epidural group and a 2.2% cesarean delivery rate in the narcotic group ($P<0.05$) (3). Limitations of this study included the small number of patients randomized in each group, as well as the small number of patients who required cesarean delivery. Another prospective randomized trial of 334 nulliparous women found no difference in the cesarean delivery rate for early (10%) compared with late (8%) epidural placement (4). This study was limited by only a small difference in timing and cervical dilatation between both groups, a median of 4 cm cervical dilatation for early administration and 5 cm for late administration. Other studies have shown conflicting results, and further studies are needed to identify whether early placement of epidural analgesia significantly increases the risk of cesarean delivery and to prospectively determine the risk at each level of cervical dilatation.

At this time, it appears to be possible that very early placement of epidural analgesia may increase the risk of cesarean delivery and that the risk decreases with delayed epidural placement. After weighing this conflicting data, the ACOG Task Force on Cesarean Delivery Rates recommended that, when feasible, obstetric practitioners should delay the administration of epidural analgesia in nulliparous women until cervical dilatation reaches 4–5 cm and that other forms of anal-

gesia be used until that time (71). However, 4 cm of dilatation is an arbitrary cutoff because decreased risk with increased cervical dilatation is a continuum. Therefore, the decision of when to place epidural analgesia should be made individually with each patient, with other factors, such as parity, taken into consideration. Women in labor should not be required to reach 4–5 cm of cervical dilatation before receiving epidural analgesia.

▶ *How can the risks of epidural or spinal hematoma be minimized?*

Epidural or spinal hematoma is a rare but morbid complication of regional analgesia. Patients at higher risk include those with underlying bleeding dyscrasias or thrombocytopenia and those taking medications that may affect coagulation. Although it is not necessary to obtain a platelet count before using regional analgesia in healthy women experiencing normal labor (72), certain groups of patients may benefit from such evaluations, including those with severe preeclampsia, idiopathic thrombocytopenic purpura, known placental abruption, or other risk factors for disseminated intravascular coagulation.

Most anesthesiologists will administer regional analgesia to a patient with a platelet count higher than 100,000/μL. However, the management of patients with platelet counts lower than 100,000/μL is controversial. Several studies reported no complications in women who received epidural analgesia with platelet counts between 50,000–99,000/μL (73–75).

Patients who are taking anticoagulants also are at risk for epidural or spinal hematoma. Patients on unfractionated heparin therapy should be able to receive regional analgesia if they have a normal activated partial thromboplastin time (aPTT). Patients taking prophylactic doses of unfractionated heparin or low-dose aspirin are not at increased risk (76, 77) and can be offered regional analgesia. Low-molecular-weight heparin has been associated with multiple case reports of epidural and spinal hematoma, and the U.S. Food and Drug Administration has issued a public health advisory on this issue (78). Low-molecular-weight heparin has a longer half-life than standard heparin, and its anticoagulant activity is not reflected in the aPTT. In patients receiving once-daily, low-dose low-molecular-weight heparin, regional anesthesia should not be offered until 12 hours after the last injection of low-molecular-weight heparin (79). In addition, low-molecular-weight heparin should be withheld for at least 2 hours after the removal of an epidural catheter. The safety of regional analgesia in patients receiving twice-daily low-molecular-weight heparin has not been studied sufficiently, and it is not known whether delaying regional analgesia for 24 hours after the last injection is adequate. Because the onset of labor often is difficult to predict, it may be reasonable to convert patients to unfractionated heparin as they approach term.

▶ *How does preeclampsia influence the choice of analgesia or anesthesia?*

Regional anesthesia is preferred for women with preeclampsia and eclampsia—both for labor and delivery (80). A secondary analysis of women with severe preeclampsia in the National Institute of Child Health and Human Development's Maternal–Fetal Medicine Units Network trial of low-dose aspirin reported epidural anesthesia was not associated with an increased rate of cesarean delivery, pulmonary edema, or renal failure (81). Moreover, general anesthesia carries more risk to pregnant women than does regional anesthesia (33).

Regional analgesia in women with preeclampsia is associated with an overall 15–25% reduction in systemic mean arterial pressure (82–84). Although the peripheral vasodilation seen with regional analgesia may be helpful in decreasing severe hypertension, hypotension that requires cautious treatment with ephedrine may occur (83, 84). In addition, prehydration with crystalloid combined with intraoperative fluid boluses for hypotension results in an average additional fluid challenge of 600–800 mL in women with preeclampsia receiving regional analgesia (82, 84).

▶ *How can the risk of maternal aspiration be minimized?*

There is insufficient evidence to address the safest level of maternal oral intake during labor. The ASA Task Force on Obstetric Anesthesia recommends allowing a modest intake of clear liquids in patients experiencing normal labor (72). However, a fasting period of 6–8 hours for solids is preferable before elective cesarean delivery.

For both elective and indicated cesarean delivery, agents to decrease gastric acidity should be used. Sodium citrate with citric acid has been shown to neutralize the gastric contents of 88.5% of women undergoing cesarean delivery (85) and should be administered when the decision is made to perform cesarean delivery.

▶ *What are the potential negative effects of analgesia and anesthesia on breastfeeding?*

Although it is clear that both maternally administered opioids and local anesthetics used either parenterally

(45, 86) or in epidural analgesia (87–89) enter the fetal bloodstream, the effects on breastfeeding have not been well studied. Intrapartum opioid use may decrease neonatal rooting reflexes and delay initiation of breastfeeding (86, 90); however, there is limited evidence that these delays affect the ultimate success of breastfeeding. Few studies have examined the more clinically relevant outcomes of short- or long-term breastfeeding success. More recently, a study that controlled for potential confounders found no relationship between either parenteral opioids or epidural analgesia and breastfeeding success of neonates at age 6 weeks (91).

Postdelivery analgesia also has the potential to affect breastfeeding success because of the ongoing delivery of narcotics to breast milk (41). Postcesarean patient-controlled analgesia with morphine results in less neurobehavioral depression than meperidine (42), possibly because of the accumulation of the slowly metabolized active metabolite of meperidine (normeperidine) in the neonatal bloodstream. Postoperative analgesia via the epidural route decreases maternal opioid requirements (42). Additionally, continuous bupivacaine epidural analgesia results in significantly increased milk production and greater infant weight gain when compared with diclofenac suppositories alone for postcesarean pain management (92). Further studies are needed to address the effect of postoperative pain control on breastfeeding success, milk production, and infant weight gain.

▶ *What are the optimal agents for postoperative analgesia?*

Opioid therapy is the mainstay of postoperative pain management. Various routes of administration are available, including intravenous, intrathecal, and epidural (with or without local anesthetics). For patients undergoing cesarean delivery with spinal or epidural anesthesia, the most cost-effective regimen of pain management for the first 24 hours is preservative-free morphine hydrochloride placed in the intrathecal space at the time of the initial spinal anesthesia (93, 94) or after delivery when using epidural anesthesia. This method provides effective pain control in the first 12–24 hours following cesarean delivery (95, 96) without the added cost associated with an infusion pump. Initial concerns regarding the possibility of delayed respiratory depression with intrathecal morphine have led to a lowering of the standard dosage to 100–250 µg (95–98).

In patients undergoing cesarean delivery under epidural anesthesia, patient-controlled epidural analgesia for the first 24 hours is a reasonable choice. This strategy minimizes the dosage of maternally administered opioids (99, 100) and maternal sedation (99) compared with intravenously administered opioids (patient-controlled administration) and uses the preexisting catheter. Although patient-controlled epidural analgesia using a combination of opioid and local anesthesia reduces the cumulative opioid dosage, it results in increased motor weakness (101, 102), which may inhibit patient mobilization. Even low concentrations of local anesthesia result in significant motor weakness and can make ambulation difficult in up to 43% of patients (103). Consideration should be given to removing the epidural catheter after 24 hours to reduce side effects, such as urinary retention (100) pruritus and infection risk, as well as to minimize costs. All intrathecal and epidural opioid administration is accompanied by a dose-dependent, 35–56% incidence of maternal pruritus severe enough to require treatment (104–107). Effective treatment includes intravenous nalbuphine (105, 108, 109), prophylactic oral naltrexone (110), and intravenous ondansetron (111, 112).

In institutions where patient-controlled epidural analgesia is not available or in patients who received general anesthesia intraoperatively, intravenous patient-controlled administration is a reasonable choice because it is associated with increased patient satisfaction (113) and decreased sedation levels compared with intramuscular narcotics (113, 114). Morphine, hydromorphone hydrochloride, and fentanyl are all acceptable drugs for intravenous patient-controlled administration. Meperidine should be avoided because of the accumulation of its slowly metabolized active metabolite normeperidine in the neonate and its subsequent neurobehavioral effects (42).

An important goal of postoperative pain management should be minimizing the cumulative maternal opioid dosage to reduce maternal sedation and neonatal side effects. Maternal nonsteroidal antiinflammatory drugs are useful in achieving this goal and are effective at reducing maternal opioid consumption by 30–39% (115, 116).

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

Failed intubation and pulmonary aspiration remain the leading causes of anesthesia-related maternal morbidity and mortality (34). Identifying women with risk factors for failed intubation or other complications of anesthesia and referring them for antepartum anesthesia consultation may reduce this risk, although this has not been studied (see box).

Risk Factors that May Prompt Anesthetic Consultation

Anesthetic consultation may be considered when any of the following risk factors are present:

- Marked obesity
- Severe edema or anatomical abnormalities of the face or neck or spine, including trauma or surgery
- Abnormal dentition, small mandible, or difficulty opening the mouth
- Extremely short stature, short neck, or arthritis of the neck
- Goiter
- Serious maternal medical problems, such as cardiac, pulmonary, or neurologic disease
- Bleeding disorders
- Severe preeclampsia
- Previous history of anesthetic complications
- Obstetric complications likely to lead to operative delivery, eg, placenta previa or high-order multiple gestation

American Academy of Pediatrics, American College of Obstetricians and Gynecologists. Guidelines for perinatal care. 4th ed. Elk Grove Village, Illinois: AAP; Washington DC: ACOG, 1997

Summary of Recommendations

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

- Regional analgesia provides a superior level of pain relief during labor when compared with systemic drugs and, therefore, should be available to all women.
- Parenteral pain medications for labor pain decrease fetal heart rate variability and may limit the obstetrician–gynecologist's ability to interpret the fetal heart rate tracing. Consideration should be given to other drugs in the setting of diminished short- or long-term fetal heart rate variability.

The following recommendations are based on limited or inconsistent scientific evidence (Level B):

- Patients with platelet counts of 50,000–100,000/μL may be considered potential candidates for regional analgesia.
- Regional analgesia is preferred in women with preeclampsia unless a contraindication to regional analgesia is present.
- Breastfeeding does not appear to be affected by the choice of anesthesia; therefore, the choice should be based on other considerations.

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

- It is not necessary to routinely obtain a platelet count before administration of regional analgesia or anesthesia in a pregnant patient without complications.
- Clear liquid intake may be allowed in patients in labor without complications.
- Sodium citrate should be administered promptly to neutralize gastric contents following the decision to perform a cesarean delivery.
- Identifying women with risk factors for failed intubation or other complications of anesthesia and referring them for antepartum anesthesia consultation may reduce this risk.
- To avoid respiratory depression, close monitoring of the cumulative narcotic dosage given to a patient antepartum, intrapartum, and postpartum is essential.
- The decision of when to place epidural analgesia should be made individually with each patient, with other factors, such as parity, taken into consideration. Women in labor should not be required to reach 4–5 cm of cervical dilatation before receiving epidural analgesia.

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The MEDLINE database, the Cochrane Library, and ACOG's own internal resources and documents were used to conduct a literature search to locate relevant articles published between January 1985 and April 2001. 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 could also 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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