Newer techniques of labor analgesia

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Nonregional analgesic techniques

Patient-controlled intravenous analgesia

Patient-controlled intravenous analgesia (PCIA) was given a trial in the late 1960s but never became established as a method of labor analgesia because of the poor efficacy of intravenous opioids, neonatal effects [1,2], and cost. It continues to be reserved for situations in which regional analgesia is either contraindicated (eg, severe preeclampsia with profound thrombocytopenia) or technically difficult (eg, musculoskeletal deformity, previous spinal surgery). Intravenous administration achieves a rapid and more predictable plasma level than intramuscular injection, and nalbuphine, alfentanil, and fentanyl all lack the undesirable metabolites of meperidine. Fentanyl (loading dose 50–100 Microgm, demand bolus 20–25 Microgm, lockout time 5 minutes) is more popular than meperidine because it has a more rapid onset and is associated with less nausea and sedation. The efficacy of fentanyl is better than alfentanil [3]. Compared with epidural analgesia, pain relief is less effective and neonates spend longer periods at low oxygen saturation [1]. With PCIA, cumulative fentanyl doses often exceed several hundred micrograms, such that moderate neonatal depression and requirement for naloxone is common [2].

Renewed interest in PCIA has followed the release of remifentanil, an opioid with a favorable pharmacodynamic and pharmacokinetic profile [4]. Analgesic concentrations are achieved in 1 to 2 minutes, so short lockout times allow demands coincident with the onset of contractions. Rapid esterase metabolism and fetal redistribution result in a short neonatal elimination half-life [4]. The 3-minute context-sensitive half-life (ie, the time for a 50% fall from the steady-state level) is independent of the duration of infusion, so maternal recovery from its effect is also rapid. Initial case reports and small series reported were enthusiastic, although efficacy was sometimes poor. Recent controlled trials provide better evidence as to its potential, and a bolus of 0.25 to 0.5 Microgm/kg with a 2-minute lockout and no concurrent infusion is a suitable regimen [5]. Analgesia and neonatal outcome are better than with meperidine, and pain scores fall to less than 3 in one third of parturients [5,6]. Efficacy varies greatly and 10% of women experience no relief, so many parturients also use nitrous oxide or change to epidural analgesia [5]. Maternal drowsiness is prominent if boluses exceed 0.5 Microgm/kg and apnea between contractions may occur. Remifentanil is also expensive, small overdoses

are potentially dangerous (profound respiratory depression and chest wall rigidity), and modification of regimens according to response, monitoring of oxygen saturation, and easy access to naloxone are advisable. Because the safety of remifentanil PCIA has yet to be established, it seems likely that PCIA will remain a technique reserved for specific cases in which a high level of vigilance can be guaranteed.

The antinociceptive effects of É»-opioid agonists are particularly marked at polymodal visceral nociceptors that have been sensitized by chemical or thermal stimuli [7]. Women are more sensitive to these opioids, probably because of sexual dimorphism with regard to opioid receptor function. It remains to be seen whether these peripherally acting drugs will reach clinical trial status.

Patient-controlled inhalational analgesia

Except for nitrous oxide, the use of subhypnotic concentrations of other inhalational anesthetic agents for labor analgesia has been confined mainly to the United Kingdom. Purpose-designed inhalers for trichlorethylene and methoxyflurane were widely available until 1984, when approval for midwifery-managed patient-controlled inhalation was withdrawn. Recent investigations show that low concentrations of isoflurane (0.2%–0.25%) or desflurane (1%–4.5%) with 50% nitrous oxide provide better analgesia than nitrous oxide alone but cause more sedation and amnesia [8,9]. Sevoflurane has yet to be evaluated in parturients, but it attenuates the analgesic effects of nitrous oxide in volunteers [10]. A commercially prepared premixed cylinder that contains 50% nitrous oxide and 0.25% isoflurane in oxygen as a stable homogenous mixture has been evaluated for up to 13 hours [9]. No woman became unconscious, which compares favorably with inhalation of 70% nitrous oxide, and neonatal condition appeared unaffected. Fourteen percent of the parturients requested epidural analgesia and 8% were intolerant of side effects or disliked the smell. This preparation circumvents problems such as the need for dedicated vaporizers, but the issues of maternal monitoring, scavenging to avoid excessive atmospheric pollution, and adverse effects on attending staff also require attention. It is uncertain whether this method will spread beyond a few UK centers.

Other techniques

In countries in which regional analgesia is not readily available, intravenous ketamine offers a cheap and satisfactory alternative. A bolus of 0.25 mg/kg followed by an infusion at 0.25 mg/kg/h reduces pain scores to less than 3 of 10

without causing confusion or incoherence [11]. The acceptability of this method, in terms of quality of analgesia and side effects, has not been tested in randomized or blinded trials in Western cultures.

A technique apparently unique to Scandinavian countries is intracutaneous or subcutaneous sterile water injection over the sacrum for low back pain during labor [12]. Compared with injection of saline or “dry needling,” up to 50% of parturients in early labor experience pain scores of less than 3 that last 45 to 90 minutes [12]. These injections are transiently painful and require repetition, and the method has not been evaluated in other populations.

Regional analgesic techniques

Lumbar sympathetic block

Despite knowledge since the 1940s that lumbar sympathetic block is an effective method of pain relief during the first stage of labor, it has received little attention. Reasons include lack of familiarity with the technique among most anesthesiologists; more pain associated with the method than uneventful epidural needle insertion [13]; failure to provide second stage analgesia; and the potential for complications, such as total spinal block (intrathecal injection), local anesthetic toxicity (intravascular injection), and trauma to adjacent organs.

Sympathetic innervation of the cervix and uterus enters the sympathetic chain at L2-3. A lumbar sympathetic block is classically achieved with bilateral injection of local anesthetic (eg 15 mL of 0.25%–0.5% bupivacaine on each side) at the anterolateral aspect of the vertebral body of L2. After lumbar sympathetic block, the progress of labor is augmented without motor block, possibly because of a shift in the balance of autonomic effects on the myometrium. A lumbar sympathetic block only blocks the tocolytic sympathetic efferent activity, and sparing sacral parasympathetic innervation (which is, in contrast, blocked by epidural analgesia). In a recent randomized comparison with epidural analgesia, cervical dilatation was significantly faster in the latent phase and the second stage of labor [13]. Lumbar sympathetic block was recommended for selected parturients, for example, women with spinal pathology in which access to the vertebral canal is difficult and women with poor progress of labor. It seems unlikely, however, that lumbar sympathetic block will establish a major role in current practice.

Paracervical block

Paracervical block was once widely used by obstetricians but was abandoned in most countries many years ago because of unexpected intrauterine deaths. In Australia, adverse publicity after cases of fetal death and injury saw its demise in the late 1980s, but in some Scandinavian countries paracervical block is still used extensively, especially if epidural services are unavailable or as a more effective method than intramuscular meperidine [14]. Paracervical block interrupts uterine sympathetic afferent activity through the posterior cervical and superior hypogastric plexuses, which results in acceptable relief of first-stage pain in 50% to 70% of parturients for 5 to 90 minutes after injection [14–17]. Insertion of a purpose-designed needle at the 3 and 9 o'clock positions of the lateral vaginal fonices to a depth of no more than 3 mm with careful aspiration and injection of 5 mL of 0.125% plain bupivacaine on each side, 5 minutes apart, is as effective and causes fewer fetal heart rate changes than 0.25% bupivacaine [16]. The close proximity of the uterine vessels and fetal presenting part create the potential for complications, such as intravascular injection, fetal injury, fetal bradycardia secondary to uterine artery vasoconstriction, direct local anesthetic toxicity, and uterine hypertonus. Modifications that improve safety (by reducing dose and slowing absorption of local anesthetic) challenge the assumption that this block is unsafe [15–17]. Approximately 10% of healthy fetuses experience mild bradycardia and 2% experience transient late decelerations, usually within 10 to 30 minutes [16], an incidence similar to epidural analgesia [15]. Although such changes are usually transient and benign, uterine artery impedance increases after paracervical block compared with epidural analgesia. This finding supports restriction of paracervical block only to the healthy woman and fetus (when the fetal head is not closely applied) and makes it unlikely it will return to popularity.

Continuous spinal analgesia

Continuous spinal analgesia was described in 1951 but remained unpopular because of a 10% incidence of severe postdural puncture headache. A brief resurgence in the late 1980s after the discovery of subarachnoid opioid analgesia and the development of microspinal catheters was dampened by reports of cauda equina syndrome (although not in obstetrics). Microspinal catheters were withdrawn in the United States in 1992, but several remained licensed in other countries or have been rereleased recently, including a 28-gauge catheter inserted through a ramped 22-gauge Sprotte needle (Kendall, Mansfield Massachusetts), a 23-gauge Crawford needle (Portex, Boots Healthcare Kent, United Kingdom), and a 22-gauge catheter inserted over a 27-gauge spinal needle (Spinocath, B.Braun Melsurgen AG, Germany). The catheter over needle design aids insertion and identification of correct placement, gives better function, and results in fewer technical failures (catheter kinking) [18]. Apart from postdural puncture headache,

the complication rate of continuous spinal analgesia is acceptable [19], and advantages over epidural analgesia include the speed and quality of analgesia and low drug doses [20]. The high incidence of postdural puncture headache and issues such as cost, technical difficulty, and high levels of anesthetic involvement generally limit microspinal catheter continuous spinal analgesia to a select group of parturients [20,21]. Continuous spinal analgesia is particularly suited to parturients in whom opioid alone is desirable (eg, cardiac disease in which sympathetic block is unlikely to be well tolerated, allergy to local anesthetic) or situations in which placement and function of an epidural catheter is likely to fail (eg, severe musculoskeletal deformity, spina bifida, previous spinal surgery).

The most common application of continuous spinal analgesia is after accidental dural puncture with an epidural needle. Reinsertion of an epidural catheter is associated with a significant risk of high block and mandates a high level of anesthetic involvement. Deliberate intrathecal placement of the epidural catheter offers high efficacy, control, flexibility, and possibly a reduction in the severity of subsequent postdural puncture headache. The reduction in headache may be a result of symptomatic relief (intrathecal opioid) and more rapid closure of the dural hole after removal because of an enhanced inflammatory response. Two prospective but nonrandomized studies found lower rates of epidural blood patch after subarachnoid catheterization [22,23].

The epidural catheter must be labeled clearly as a subarachnoid (spinal) catheter and safe drug administration must be addressed. Good labor analgesia is achieved initially using intermittent opioid injection (eg, sufentanil 5 Microgm) [24], and continuous infusion or patient-controlled spinal analgesia have been used. The efficacy of an opioid, if used alone, declines as acute tolerance develops and the nature of labor pain changes, with somatic nerve and AÉ¬ nociceptive involvement [25], so addition of local anesthetic optimizes efficacy in late labor [26].

Combined spinal-epidural analgesia

History and introduction

Combined spinal-epidural analgesia (CSEA) in labor is arguably the most important “new technique” in obstetric analgesia in the past decade. Although considered 20 years ago after the first clinical use of spinal morphine, interest gained momentum during the 1990s as a consequence of North American research into subarachnoid opioids, practical experience with CSEA in Britain and Europe, and acceptance of newer spinal needle designs that dramatically reduced the incidence of postdural puncture headache. CSEA in labor has become routine in many countries, with

surveys from the late 1990s indicating its widespread availability in parts of Europe, North America, and Australasia.

The purported advantages of CSEA over epidural analgesia (Table 1) include more rapid pain relief, better perineal analgesia, higher ambulatory potential, and lower drug use. CSEA embodies many of the features identified as important to maternal satisfaction (minimal numbness, immobility or impairment of micturition, and spontaneous vaginal delivery) while reliably providing excellent pain relief. The technical familiarity has seen many obstetric anesthesiologists embrace CSEA and consumer acceptance was rapid. Controlled comparison with modern epidural techniques suggests that the differences are subtle [27–29]. Quicker pain relief is appreciated by parturients in late labor but is of little relevance in early labor, and changes in motor function initially are similar. Until prolonged pain relief (several hours) can be achieved from the initial spinal analgesic injection, the merit of a deliberate breach of the dura mater during labor continues to be debated [30].

Table 1. Comparison of combined spinal-epidural analgesia and epidural analgesia during labor

	Combined spinal-epidural analgesia	Epidural analgesia
Onset	1–5 min	10–20 min
Median pain score	60–90 min	0	0–3
Duration of effect	60–240 min	60–120 min
Observable mild leg weakness	0–40%	5%–40%
Hypotension	5%–10%	5%–10%
Fetal heart rate changes	10%–20%	10%–20%
Maternal pruritus	50%–80%	0–80%
Maternal respiratory depression	Rare	Rare
Postdural puncture headache	0.2%–1%	0.3%–1%

Techniques and spinal analgesic drugs

Combined spinal-epidural analgesia is usually performed at a mid-to-low-lumbar intervertebral space using a needle-through-needle technique. Careful selection of a low interspace is essential if the risk of injury to the spinal cord is to be minimized [31]. Although the lateral position for insertion limits cephalad sensory change, in the seated parturient the efflux of cerebrospinal fluid is more rapid. Successful identification of the subarachnoid space approaches 95% [28,32] and in the event of failure, alternate positioning may be tried or the procedure converted to epidural analgesia alone.

Profound pain relief sometimes precedes the next contraction, and 80% to 90% of parturients are pain free within 5 minutes, in contrast with 10 to 20 minutes after epidural local anesthetic alone [33–36] and 10 to 15 minutes after high-volume low-dose epidural bupivacaine and lipophilic opioid [27]. Median pain scores of zero persist for at least 60 minutes [29] and in the second stage of labor approximately 75% of parturients have minimal pain but retain an urge to bear down. The duration of spinal analgesia also depends on parity and is significantly shorter in advanced labor (eg, sufentanil-bupivacaine 120 minutes versus 160 minutes in early labor) [37]. Combinations provide analgesia of similar or longer duration than higher doses of the same drugs given epidurally [34,35], and the addition of bupivacaine increases the duration of opioid alone by approximately 25% [26,36].

Local anesthetic alone (bupivacaine 2.5–5 mg) is not recommended because analgesia is often unsatisfactory and profound motor block occurs [26,38]. Opioid-induced spinal analgesia may be potentiated by progestagenic effects during pregnancy. Spinal morphine alone is unsuitable, however, because of its slow onset and the high incidence of pruritus and nausea, and spinal meperidine is also unsuitable because of higher rates of nausea and hypotension compared with other lipophilic opioids [25,32]. Alfentanil and diamorphine seem satisfactory, and sufentanil has a longer duration than fentanyl [39]. Sufentanil, 5 to 10 Microgm, is probably above the effective dose95 (ED95) and gives good relief for at least 90 minutes in 80% of parturients in active labor [26,34]. Fentanyl, 15 to 25 Microgm, also represents an ED95 dose that produces analgesia of similar quality to sufentanil and is more cost effective [39], although neither are reliable in late labor [25]. Spinal analgesia is more effective than analgesia achieved with epidural bupivacaine, 25 to 30 mg [33,34]. Dose-response studies indicate that the optimum dose of sufentanil for combination with bupivacaine is approximately 2.5 to 5 Microgm [40] and of fentanyl is 15 to 20 Microgm. For bupivacaine, doses of 1.25 mg may be preferable to 2.5 mg in terms of less motor block but at the expense of duration of analgesia [36,41,42]. Ropivacaine is significantly less potent than bupivacaine, but 2 mg seems to be an adequate dose when combined with opioid and does not cause leg weakness [43,44]. The new local anesthetic agent levo-bupivacaine shares similar potency to racemic bupivacaine but results in significantly less motor block after subarachnoid administration of 2.5 mg combined with opioid and epinephrine [45].

The maximum duration of spinal analgesia is achieved with multiple drug mixtures. Epinephrine, 2.25 to 200 Microgm, extends the effect of intrathecal bupivacaine and sufentanil [45–47] but increases motor block in a dose-dependent fashion. Clonidine is also a safe and effective alpha2-adrenergic spinal analgesic, despite potential hemodynamic effects. Clonidine, 15 to 45 Microgm, added to bupivacaine, 2.5 mg, and fentanyl, 25 Microgm, produces a dose-dependent increase in the duration of spinal analgesia, but a median duration of only 2 hours

suggests that this is of little clinical significance [48]. The combination of spinal bupivacaine, fentanyl, and morphine, 250 Microgm, currently provides the longest duration of pain relief, with more than 3 hours of satisfactory analgesia and in some cases almost 6 hours of pain relief [49].

Side effects associated with combined spinal-epidural analgesia

On direct questioning up to 80% of parturients report opioid-induced pruritus on the chest and trunk, which usually commences within 10 to 30 minutes but diminishes within an hour. The incidence is higher with intrathecal versus epidural injection [35], although few women request treatment. Antihistamines are generally ineffective, whereas opioid antagonists (naloxone, 50–100 Microgm intravenously or 200 Microgm intramuscularly) and propofol, 10 to 20 mg intravenously, show modest efficacy.

Hypotension may occur after spinal opioid or local anesthetic administration, and reductions in blood pressure of 20% from baseline are seen in 15% to 30% within 10 minutes [34,47,50–53]. These changes require vasopressor therapy no more frequently than after epidural analgesia (3%–13%) and transient, readily correctable falls seem benign [26,32,34,50,52]. Hemodynamic changes are mediated by local anesthetic-induced sympatholysis or opioid-induced preganglionic sympathetic block within the spinal cord, attenuation of spinally mediated pressor responses, and fall in circulating catecholamines secondary to profound pain relief [52].

Respiratory depression is a rare complication of intraspinal opioid administration during labor [54,55], although sufentanil may be associated with an incidence as high as 1 in 2000 [56]. Prior systemic opioid exposure warrants special caution [54], and all parturients should have respiration and conscious state monitored for at least 30 minutes (continued intermittently if epidural opioids are administered). A low threshold for naloxone administration is recommended if an opioid-related complication is suspected.

The low incidence of lower limb weakness led to CSEA being dubbed the “walking epidural” [57]. This is a misnomer, because the ability to walk during epidural analgesia with low-dose local anesthetic and opioid combinations was known in the 1980s but apparently was not permitted except in a few Australian maternity units [58,59]. Between 85% and 95% of parturients can bear weight after standard spinal opioid and local anesthetic epidural regimens [60], although the intensity of leg weakness and postural instability increases once maintenance epidural analgesia

is commenced [61]. Any initial impairment of leg strength resolves within an hour [33], and micturition is usually unimpaired. In contrast, 10 mL of 0.25% epidural bupivacaine results in profound leg weakness in more than one third of parturients [33]. In early labor, similar retention of mobility is achieved with low-dose combination epidural solutions [27,29,35] and approximately 75% of women can bear weight during the first few hours of patient-controlled epidural analgesia (PCEA) [62]. CSEA is more likely to retain normal mobility in advanced labor, when concentrated local anesthetic is more often required to establish epidural pain relief [41].

The safety of ambulation in the presence of regional analgesia is well established. After bupivacaine, 2.5 mg, and fentanyl, balance function is not impaired compared with pregnant controls [63], although an epidural test dose and subsequent doses may have an effect. Ambulation does not alter the duration of labor or obstetric outcome [64]. Although most women in the author's community do not wish to walk, 50% consider retention of mobility during labor important and appreciate the ability to stand, sit, or assume various postures at delivery. Provided that sensible criteria are applied (no demonstrable loss of motor power or postural hypotension, direct supervision, confidence when bearing weight), it is safe to permit ambulation, with no mishaps in several thousand parturients who received CSEA or low-dose epidural analgesia [65,66].

Segmental sensory changes, unrelated to extension of the block to the high thoracic and cephalic level, are common (50%) after sufentanil, bupivacaine, or both [26,34,50,67]. Rarely, distressing symptoms such as transient facial numbness, dyspnea, and dysphagia result [67]. These symptoms are believed to be caused by the cephalad spread of lipiphilic opioids within the cerebrospinal fluid and direct É -opioid receptor activation rather than local anesthetic activity [50,67]. Dextrose-free bupivacaine, fentanyl, and sufentanil behave as hypobaric agents within cerebrospinal fluid and spread to higher levels when injected in the sitting position, whereas hyperbaric opioid solutions are less effective. If high sensory changes occur, the degree of clinical impairment should be assessed and appropriate treatment instituted pending anticipated resolution over 10 to 60 minutes. Other causes of high block after CSEA, such as passage of an epidural catheter into the cerebrospinal fluid, are rare and transdural transfer of epidural drug into the cerebrospinal fluid is not usually clinically relevant, but both require consideration.

Neurologic complications after regional techniques are usually transient and of alternate etiology. Infective complications, such as meningitis, were reported after CSEA for labor was first introduced, including 2 in only 1500 labor CSEA techniques within a single institution over a 6-month period [68]. Parturients are at risk of bacteremia, a risk factor for the development of meningitis after dural

puncture in animal models, but meningitis is also a complication of epidural analgesia, accidental dural puncture, and spinal anesthesia. Despite a dramatic increase in the use of CSEA, such serious complications seem rare, although large prospective series [69] reported to date do not permit quantification of risk. Spinal cord injury is a feared complication that warrants close attention to anatomic detail when performing CSEA [31], and a recent British survey estimated the incidence as 1 in 20,000 after CSEA and spinal techniques [70].

Severe headache secondary to spinal needle dural puncture occurs in 1 in 150 to 200 cases with fine-gauge pencil-point needles, although rates as low as 1 in 700 have been claimed [71,72]. Although experienced anesthesiologists are likely to have a higher incidence of postdural puncture headache with CSEA compared with epidural analgesia, in teaching units the incidence seems similar [28,32]. Lower rates of “dural tap” reported with CSEA may reflect a selection bias because a recent large quasi-randomized series found no difference [28].

Combined spinal-epidural analgesia management during labor and effect on the neonate

After CSEA in late labor, many parturients deliver before commencement of epidural analgesia. The latter can be achieved by intermittent bolus, patient-controlled, or infusion delivery. Parturients should be warned to request epidural solution as soon as pain develops or increases, or a continuous infusion should be started shortly after spinal analgesia is initiated. Testing to exclude subarachnoid placement of the epidural catheter is feasible once lower limb power has been assessed. Where anesthetic assistance is readily available and the initial therapeutic dose of epidural bupivacaine is less than 15 mg, an argument can be made for omitting a test dose and allowing initial epidural administration by a midwife, the patient, or an infusion pump. Epidural catheters placed for CSEA are more likely to prove reliable than stand-alone catheters [73].

The anticipation of high spontaneous vaginal delivery rates with CSEA has not been met. Compared with epidural analgesia, more rapid cervical dilatation may occur. Large studies comparing these two techniques report no difference in the progress of labor or mode of delivery [74,28], however, except for an increase in instrumental delivery if epidural analgesia is achieved with local anesthetic alone [74].

Although uterine artery flow is unchanged after subarachnoid sufentanil, fetal heart rate changes independent of hemodynamic disturbance occur in 10% to 20%, a similar incidence to that after epidural analgesia [53,75]. The principal mechanism

may be the fall in plasma epinephrine that favors norepinephrine-induced increased uterine tone [75]. Although most changes respond to short-term tocolysis and intrauterine resuscitation, fetal monitoring for at least 40 minutes after CSEA, especially in association with induction of labor, has been recommended, because such changes can be severe [51] and suggest compromised fetal well-being. Whether emergency cesarean section because of fetal distress is increased by CSEA is uncertain, with studies reporting no difference or an increased rate compared with systemic analgesia [69,76] and no difference compared with epidural analgesia [28]. Neonatal respiratory effects depend primarily on epidural opioid exposure, with 200 to 400 Microgm of fentanyl having no effect on neonatal respiration [77].

Opinions vary regarding the place of CSEA and epidural analgesia, with marked national, regional, and within-unit differences in usage. Some units use one or other approach exclusively and others offer both. Some anesthesiologists favor CSEA in early labor, although the author's preference is to offer it selectively where the clinical advantages seem greatest, namely at request for regional analgesia in late labor or in established multiparous labor, for complicated vaginal delivery, or cases in which epidural analgesia has proved unsatisfactory.

Epidural analgesia in labor

Initiation of epidural analgesia

Although techniques have not changed, the approach to solutions for the initial bolus and for subsequent infusion has been modified in many units based on investigations of dose response, potency, and efficacy. For sparing of bolus local anesthetic, fentanyl, 3 Microgm/mL, may be the optimum dose [78], and in early labor the lowest dose to provide effective analgesia is fentanyl, 50 Microgm, with 10 mg (8 mL 0.125%) bupivacaine, or fentanyl, 100 Microgm, with bupivacaine, 7.5 mg. A 15 mg dose of bupivacaine with fentanyl ensures adequate analgesia in approximately 85% of parturients [79] while producing less motor block and higher satisfaction than 25 mg delivered as 10 mL of 0.25% bupivacaine [79,80]. An alternative approach is to administer a test dose of 3 mL 1.5% lidocaine with epinephrine, 5 Microgm/mL 3 mL and then fentanyl 100 Microgm .

The supine position with left tilt is associated with a more reliable block than when epidural local anesthetic is given in the full left lateral position [81]. When CSEA is used, it is best to initiate an epidural infusion with concentrations of bupivacaine of less than 0.1% combined with fentanyl, 2 Microgm/mL, to minimize motor block. After low-dose solutions for epidural analgesia or CSEA, an infusion must be

commenced shortly thereafter and patient-administered boluses are recommended at the first increase in pain score.

Patient-controlled epidural analgesia

Patient-controlled epidural analgesia (PCEA) is currently a well-established approach to the maintenance of analgesia, although surveys indicate that delivery by intermittent bolus or continuous infusion still predominate. PCEA is as effective as continuous infusion epidural analgesia and may provide more consistent relief than intermittent bolus epidural analgesia (Table 2)[62]. As consumer-driven changes in practice occur, PCEA seems likely to increase in use, if only because it fulfills many of the requirements identified as important for maternal satisfaction during childbirth. These requirements include the feeling of control (control of panic, pain, and involvement in decision making) and the psychological benefits of having immediate access to epidural solution and self-titration to individually determined endpoints. A survey of 500 women who used either PCEA or intermittent bolus epidural analgesia identified PCEA as independently associated with higher levels of satisfaction [82], although such findings may reflect selection bias if PCEA is reserved for parturients most likely to benefit.

Table 2. Comparison of appropriate epidural low-dose combination solutions administered by patient-controlled epidural analgesia, intermittent bolus epidural analgesia, or continuous infusion epidural analgesia delivery

	Patient-controlled epidural analgesia	Intermittent bolus epidural analgesia	Continuous infusion epidural analgesia delivery
Quality of analgesia	Equivalent	Equivalent-lowest?	Equivalent
Drug utilization	Lowest	Intermediate	Intermediate-highest
Supplementation rate	Intermediate	Lowest	Highest
Motor block	Lowest	Lowest-intermediate	Highest
Maternal satisfaction	? Highest-equivalent	Equivalent	Equivalent
Risk of hypotension	Intermediate	Highest	Intermediate
Risk of local anesthetic toxicity or high block	? Lowest	? Highest	? Intermediate

Staff workload and drug usage are lower [62] and recent metaanalysis confirms less need for supplementation or intervention with PCEA [83]. This may indicate fewer episodes of unrelieved pain and more efficient use of midwifery and anesthesia time, although such advantages depend on the approach used and can be lost when management is not ideal. Local anesthetic use is reduced by 25% to 50% compared with other methods of administration when a demand-only approach is used [62].

Patient-controlled epidural analgesia is also ideal when parturients wish to retain unimpaired mobility, because low-dose local anesthetic with opioid is associated with retention of full hip and knee flexion for 3 to 4 hours and less motor block than continuous infusion of similar solution [61,84].

Drugs and methods of patient-controlled epidural analgesia

Patient-controlled epidural analgesia is best achieved with low-concentration local anesthetic (0.0625% bupivacaine or 1 mg/mL ropivacaine) combined with opioid. These solutions are as effective as higher concentrations and minimize the dose delivered [85]. Fentanyl and sufentanil are suitable and unlikely to cause significant neonatal effects at typical rates of 8 to 20 Microgm/h (fentanyl) or 5 to 15 Microgm/h (sufentanil). Epinephrine is of no benefit and increases motor block [62], although low doses of clonidine seem free of clinically relevant maternal sedation or hypotensive effect and may slightly improve pain relief [62].

The patient-controlled analgesia variables prescribed must be safe with respect to maximum hourly dose permitted but should provide an adequate volume and allow a further demand after 10 or more minutes. A range of volume and lockout time combinations seems effective [86] and although high-volume demand boluses of up to 12.5 mg of bupivacaine have been advocated [87], the safety of this approach has been questioned. Depending on the technique used, 10% to 50% of parturients require a supplement, although usually only one. A demand-only or continuous infusion with patient demand technique is effective [62], although in the United States most units use a concurrent background infusion to reduce the supplementation rate further [84].

Management issues with patient-controlled epidural analgesia

Patient-controlled epidural analgesia provides good hemodynamic stability, similar to that of continuous infusion epidural analgesia, and hypotension is rare after demand boluses of bupivacaine 5 to 15 mg [62,88,89]. Blood pressure shows better stability when the parturient is upright or walking [88], and monitoring of hemodynamics and dermatomal sensory change is similar to that for continuous infusion epidural analgesia. As with alternative methods of administration, approximately 20% of parturients have sensory changes at the T8 dermatome and 5% to 10% above it [62]. The latter may require revision of variables (eg, reduction of background infusion rate or demand bolus dose).

The excellent safety record of PCEA during labor is not surprising given the small bolus doses and the low hourly dose rates required. Local anesthetic toxicity, high subarachnoid block, severe maternal respiratory depression, and pump mishaps have not been reported and seem to pose low risk, even should catheter "migration" into the subarachnoid space occur. Staff and parturient education is important so that unusual events are identified at an early stage and potentially dangerous practices, such as proxy demands, are prohibited.

Although PCEA has little advantage with respect to efficacy, especially with up-to-date approaches to alternative drug delivery methods [90], it can be used selectively or as a routine and satisfies the wishes of many parturients. Electronic and disposable purpose designed pumps for PCEA that are compact and light-weight and are able to accommodate a large reservoir volume and higher pressures during injection are readily available.

Summary

In maternity units in which central neuraxial techniques are frequently used, newer methods of epidural drug delivery (continuous infusion, patient-controlled) are well established and combined spinal-epidural analgesia is commonly used. Continuous spinal analgesia has reemerged as a useful approach after accidental dural puncture. Lumbar sympathetic block has been revisited and the safety of paracervical nerve block improved.

The analgesic properties of systemic opioid in labor are poor, but PCIA at least has psychological benefits and allows rapid drug titration. PCIA is again under investigation because of the potent antinociceptive effects of the short-acting É - opioid agonist, remifentanil. The premixing of nitrous oxide and a subanesthetic concentration of volatile anesthetic for patient-controlled administration has been tested under control of midwifery staff and without direct medical supervision.

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Article footnote

* Conflict of Interest: The author is currently on an Advisory Board of Abbott Australasia Pty Ltd. in relation to levo-bupivacaine.

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