

Effective Epidural Analgesia during Labor: A Feasible Method to Decrease Unnecessary Cesarean Deliveries in Thailand

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ABSTRACT

Thailand has reported a high rate of cesarean delivery (45%–55%), prompting global concern about an increase in cesarean delivery rates. Fear of labor pains is one of the most common reasons pregnant women opt for cesarean delivery. Labor pain is associated with cervix dilation and fetal descent into the birth canal, which is exacerbated by ischemic pain caused by uterine contraction. Modern medical and non-medical techniques have demonstrated efficacy in reducing pain and ensuring safety during labor and delivery. Neuraxial labor analgesia is a highly effective medical pain relief method but has no effect on the rate of cesarean or assisted vaginal delivery. Medication administration for pain relief during labor, using a combination of a local anesthetic and an opioid, was observed to be transmitted across the placenta to the fetus, but had no significant effects on fetal outcomes in mothers who chose epidural analgesia. There are several techniques for administering neuraxial labor analgesia that can be customized for each pregnant woman. To achieve the most wonderful feasible labor and delivery experience, effective epidural labor analgesia is a crucial technique for reducing anxiety and suffering about labor pain. It is safe, widely used world-wide, and effective. Implementing a policy to increase public and medical providers awareness and acceptance of labor pain relief, as well as establishing a safe obstetric anesthesia service provided by obstetric anesthesiologists, could improve maternal and neonatal safety while significantly lowering the rate of unnecessary cesarean deliveries.

Keywords: Cesarean delivery; labor pain; neuraxial labor analgesia; obstetric anesthesiologists (Siriraj Med J 2024; 76: 541-549)

INTRODUCTION

The global rise in the cesarean delivery rate is currently a significant concern.¹ Although the World Health Organization (WHO) does not specify an optimal cesarean delivery rate, reported cesarean delivery rates of more than 10% at the population level do not contribute to reductions in maternal and newborn mortality.² Thailand has reported a high rate of cesarean delivery,

approximately 45%–55%.^{3,4} Higher rates of cesarean deliveries are associated with an increase in adverse maternal and perinatal outcomes.⁵ The Royal Thai College of Obstetricians and Gynecologists has declared that addressing this issue is a foremost concern, and they are actively advocating for policies to reduce the incidence of cesarean deliveries in Thailand.⁶ Several studies conducted in Thailand⁶⁻⁸ aimed to investigate the factors influencing

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the preference of Thai pregnant women for cesarean delivery over natural vaginal delivery. These factors include the fear of childbirth, particularly the pain associated with labor and the uncertainty that arises during the waiting period for delivery. This preference is also influenced by safety concerns, such as underlying medical disease or advanced age, which can make vaginal delivery unsafe. Negative previous birth experiences and the belief that cesarean delivery is safer for babies, despite evidence to the contrary, may contribute to this preference. Finally, it is desirable to schedule a delivery date and time that is mutually convenient for both the healthcare professionals and the pregnant woman, rather than one related to the superstitious belief in auspicious birth dates and times.^{6,7} Insufficient knowledge about the mode of delivery among Thai pregnant women may facilitate the decision to support their selection of cesarean delivery.⁸

One of the common reasons pregnant women opt for cesarean deliveries is a fear of labor pains. Historically, childbirth has been a painful experience for pregnant women. Modern medical and non-medical techniques, such as massage, controlled breathing, water immersion, focused guided imagery, and skilled labor support personnel, have proven effective in reducing pain and ensuring safety during the labor and delivery process.⁹ It is thus unnecessary to endure pain indefinitely.

Labor epidural analgesia is one of the most effective medical pain relief methods recommended by ACOG (The American College of Obstetricians and Gynecologists) to support better maternal and neonatal outcomes.^{10,11} The encouragement of sustainable increases in vaginal delivery rates by increasing access to safe labor epidural analgesia, supported by the establishment of the nongovernmental No Pain Labor & Delivery (NPLD) global health initiative in China, resulted in a decrease in the cesarean delivery rate and postpartum complications, such as episiotomy, postpartum blood transfusion, and newborn NICU admission.^{12,13} In this article, we provide basic knowledge regarding labor epidural analgesia, also known as painless labor analgesia, to ensure that pregnant women and healthcare professionals have a greater understanding of this valuable resource.

Essential basic knowledge of labor pain¹⁴

There are three phases to labor: the dilation of the cervix in the first stage, the birth delivery in the second stage, and the placenta delivery in the third stage. The first and second stages of pain will manifest as distinct types of pain.

The pain experienced during the first stage of labor is visceral pain and is associated with the dilation of the

cervix and fetal descent into the birth canal. This pain is characterized by various types of referred pain and cannot be specifically localized to a certain area. Sensitization of the central and peripheral pain-signal pathways is most likely the cause of its gradual amplification during labor progression. Pain sensation arising from stretching and distension in the lower uterine segment and cervix is transmitted through visceral afferent nerve fibers from the paracervical region, hypogastric nerve, and lumbar sympathetic chain and enters cell bodies located in the thoracolumbar dorsal root ganglia (DRG) at the T10-L1 level. In the late phase of this first stage, the innervation of the surface of the cervix is also transmitted to cell bodies in the sacral DRG at the S2-S4 level. The adjuvant pain is intensified by the inflammation process that arises from uterine contractions, leading to myometrial ischemia and the release of various inflammatory substances, such as potassium, bradykinin, histamine, and serotonin, which may stimulate pain.¹⁵

During the second stage of labor, the pain persists and is transmitted through the same activated afferent pathway. Additionally, somatic pain comes along, which is transmitted through the pudendal nerve in the vagina and perineum to enter to the spinal cord at the S2 to S4 segments. In this particular type of pain, the parturient may experience localized discomfort in a specific area (Fig 1).

Pregnant women with high levels of estrogen and progesterone hormones may experience a reduced analgesic response to opioids.¹⁴ This phenomenon is caused by the influence of estrogen, specifically the estrogen-dependent suppression of supraspinal analgesia. However, this exclusively impacts the supraspinal μ -opioid receptor. Opioid receptors are crucial in the management of intense pain. According to the theory of opioid receptors, the μ -opioid receptor is only found in the central nervous system (spinal and supraspinal region) and is not present in peripheral nerves. For this reason, we do not combine opioids with a local anesthetic medication when doing a local infiltration. Furthermore, the κ -opioid receptor is present in visceral organs. Medications that act as κ -opioid receptor agonists can alleviate visceral pain. Thus, the utilization of intrathecal opioids is successful in the first stage of labor but could be less effective in the second stage.¹⁶ This is due to their inability to effectively mitigate somatic pain, which is particularly pronounced during this stage.

Neuraxial labor analgesia

Neuraxial labor analgesia is now recognized as the most effective approach to relieve labor pain during

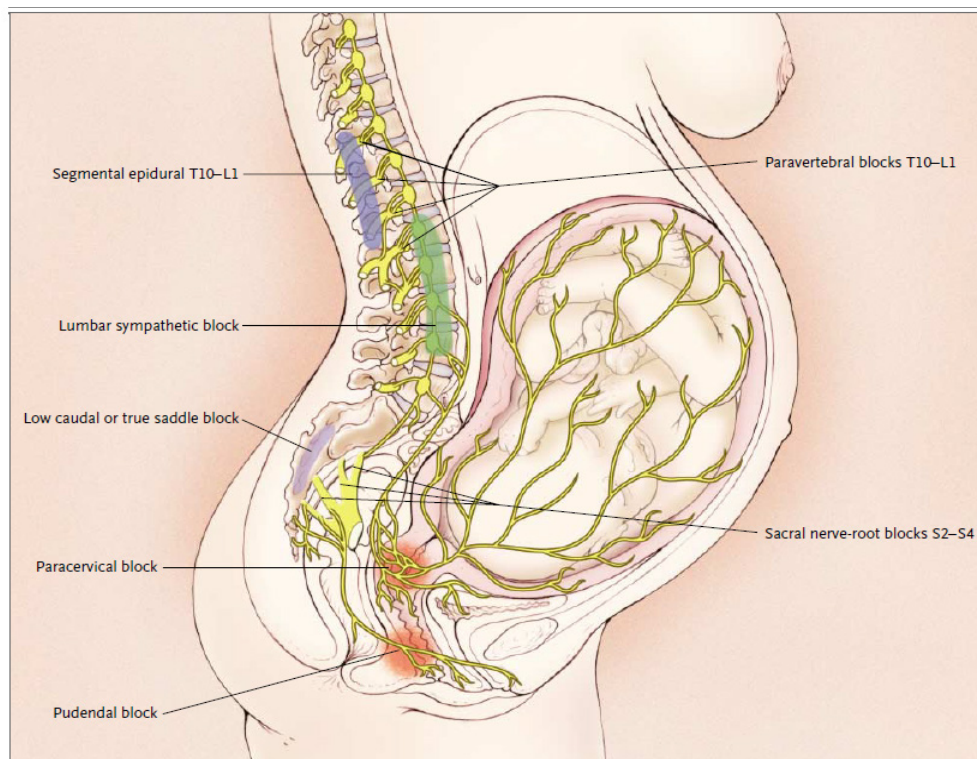


Fig 1. Pathway of labor pain. These pathways could be mapped successfully by a demonstration that blockade at different levels along this path (sacral nerve-root blocks S2 through S4, pudendal block, paracervical block, low caudal or true saddle block, lumbar sympathetic block, segmental epidural blocks T10 through L1, and paravertebral blocks T10 through L1) can alleviate the visceral component of labor pain. **Source:** Figure reprinted with permission From Eltzschig HK, Lieberman ES, Camann WR. Regional anesthesia and analgesia for labor and delivery. *N Engl J Med* 2003; 348:319-32.¹⁵

childbirth.¹⁷ There is evidence suggesting that the utilization of neuraxial labor analgesia can significantly reduce maternal plasma catecholamine levels.¹⁸ This decrease is a result of reduced sympathetic activity elicited by painful stimuli. Catecholamines exert effects on both alpha- and beta-adrenergic receptors, leading to a decrease in uteroplacental perfusion, and adverse effects on fetal well-being. Regarding the benefits of neuraxial labor analgesia, women typically request it to alleviate pain. Neuraxial analgesia is the ability of local anesthetic agents to block voltage-gated Na⁺ channels, suppressing action potentials in excitable tissues and preventing pain signals from reaching the spinal cord. Complete analgesia can be obtained by covering the levels T10 to L1 in the first stage of labor and S2 to S4 in the second stage. There are a variety of techniques for administering neuraxial labor analgesia, which can be adjusted for each individual pregnant woman (Fig 2).¹⁹ Table 1 depicts the points to consider for each technique.

Epidural analgesia

The epidural space is a tiny cavity that can expand with the addition of fluid. It is situated outside the dural sac and contains loose connective tissue, adipose tissue,

lymphatics, spinal nerve roots, and the internal vertebral venous plexus. For many previous decades, the widely used method for labor analgesia was lumbar epidural analgesia. Epidural analgesia (EPL) is a technique that involves inserting an epidural needle (Touhy epidural needle) into the lumbar epidural space using a loss-of-resistance technique, followed by threading an epidural catheter into the epidural space.¹⁵ The purpose of this procedure is to administer pain medications, generally through intermittent bolus injections or continuous infusions of a local anesthetic drug, often combined with a lipid-soluble opioid. Lipid-soluble opioids and local anesthetics are used together to minimize unwanted side effects by enabling the use of lower doses of each agent.^{18,20} Furthermore, the adjunctive containing lipid-soluble opioid contributes to the improvement of the analgesia quality by reducing latency and extending analgesic duration. Epidural analgesia is achieved approximately 15–30 minutes after injecting a bolus dose of a local anesthetic drug into the epidural space, which then spreads in both upward (cephalad) and downward (caudad) directions, affecting the nerve tissues in that area. After that, maintenance epidural analgesia is used to manage pain until delivery. In current labor

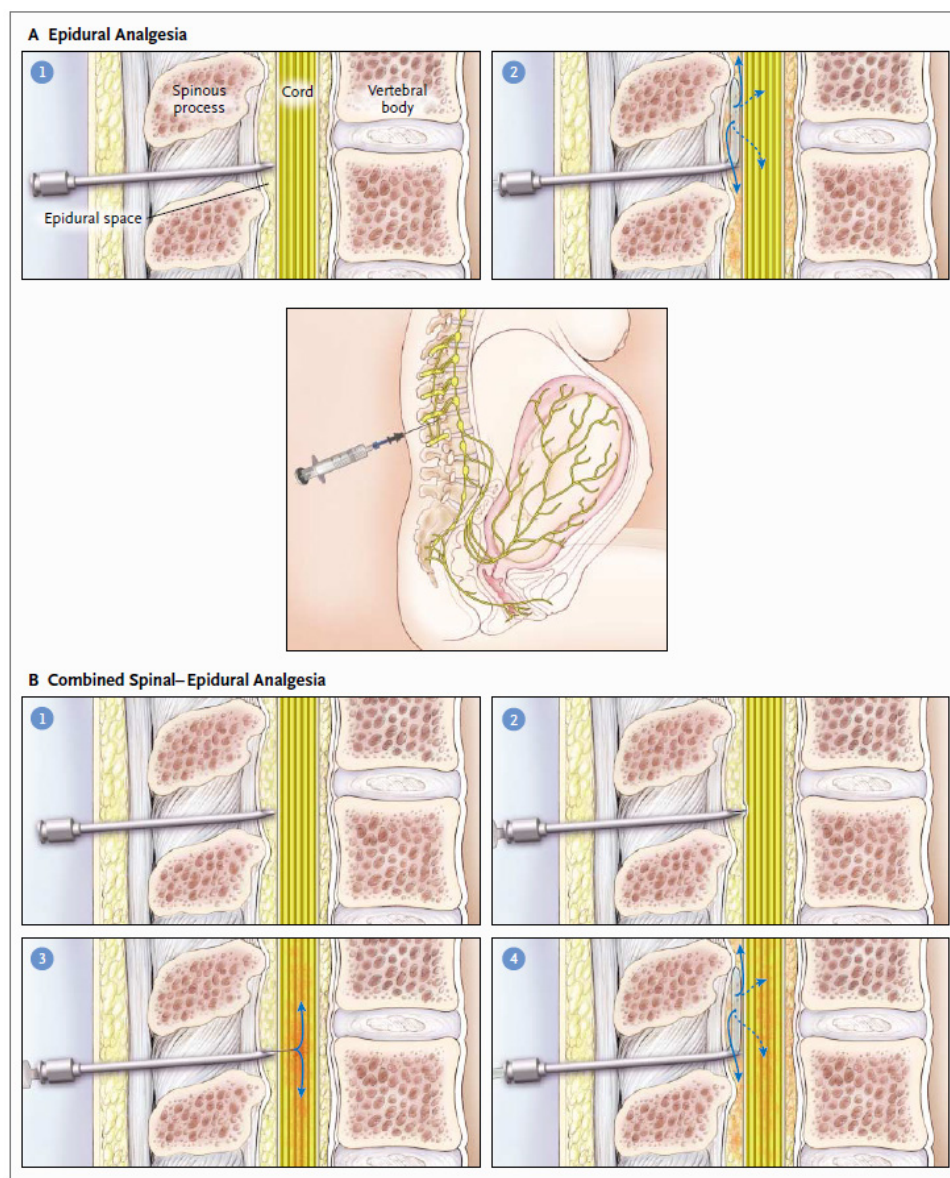


Fig 2. Techniques of epidural analgesia and combined spinal-epidural analgesia.

Panel A: Epidural analgesia; 1: An epidural needle is placed in the epidural space; 2: An epidural catheter is advanced into the space, and solutions of a local anesthetic, opioids, or a combination of the two can then be administered through the catheter.

Panel B: Combined spinal-epidural analgesia; 1: The lumbar epidural space is identified with an epidural needle; 2: A spinal needle is introduced through the epidural needle into the subarachnoid space; 3: Correct placement can be confirmed by the free flow of cerebrospinal fluid. A single bolus of a local anesthetic, opioid, or a combination of the two is injected through this needle into the subarachnoid space; 4: Subsequently, the needle is removed, and a catheter is advanced into the epidural space through the epidural needle. When the single-shot spinal analgesic wears off, the epidural catheter can be used for the continuation of pain relief.

Source: Figure reprinted with permission From Eltzschig HK, Lieberman ES, Camann WR. Regional anesthesia and analgesia for labor and delivery. *N Engl J Med* 2003; 348:319-32.15

analgesia, the continuous infusion of low-dose local anesthesia and opioid solutions results in more stable analgesia and reduced side effects. For breakthrough pain that the patient can treat with self-administered boluses (PCEA, or patient-controlled epidural analgesia), instead of continuing with continuous epidural infusion, programmed intermittent epidural boluses (PIEBs) with rescue pain and PCEA are becoming increasingly popular.^{21,22} In certain cases, especially when using a

vacuum or forceps to assist with delivery, pain can be intensified. However, an epidural catheter can be used to administer additional medication to alleviate pain during instrumental vaginal delivery.²³

Combined spinal-epidural analgesia

The process of conducting combined spinal-epidural analgesia (CSE) seems similar to performing an epidural technique. It involves puncturing the dura mater using

TABLE 1. Key implementation aspects of commonly used neuraxial labor analgesia.

Type	Key points	Recommendation: common drugs and dosage
EPL	<p>It will take around 15 to 30 min to feel pain relief.</p> <p>Sacral blockade is often unreliable.</p> <p>Typically, sensory rather than motor blockade.</p> <p>Risk of hypotension with bolus dose.</p> <p>May result in a slightly prolonged second stage of labor.</p> <p>No impact on the rate of cesarean delivery or assisted vaginal delivery.</p>	<p>Mode of delivery system PIEB + PCEA</p> <p>Local anesthetic drug and opioid use bupivacaine (0.0625%–0.125%) ± fentanyl (1.5–3 µg/mL)</p> <p>Initial bolus dose 10–15 ml of low-dose local anesthesia and opioid solutions</p> <p>Maintenance of epidural analgesia</p> <p><i>Regimen 1</i> PIEB: 9 mL every 45 min (first bolus 30 min) + PCEA: 10 mL, 10 min lockout</p> <p><i>Regimen 2</i> PIEB: 8 mL every 45 min (first bolus 15 min) + PCEA: 6 mL, 10 min lockout</p>
CSE	<p>Rapid onset of analgesia within 5–10 min.</p> <p>May be related with fetal heart bradycardia.</p> <p>Uterine hypertonus is a rarely reported condition that occurs after CSE.</p> <p>Risk of pruritus is higher than with EPL.</p> <p>Catheter placement cannot be confirmed until the effects of the spinal component have subsided.</p> <p>May result in a slightly prolonged second stage of labor.</p> <p>No impact on the rate of cesarean delivery or assisted vaginal delivery.</p>	<p>Intrathecal dose Bupivacaine 1–2.5 mg + fentanyl 10–25 µg</p> <p>Maintenance of epidural analgesia Start PIEB + PCEA without initial bolus dose</p>
DPE	<p>Pain relief starts more quickly than with EPL, but it starts more slowly than with CSE.</p> <p>Less bupivacaine is needed to achieve effective initial analgesia compared to EPL.</p> <p>Better sacral spread and bilateral coverage compared to EPL or CSE.</p> <p>Reduced incidence of maternal hypotension compared to CSE.</p> <p>Risk of pruritus is higher than with EPL.</p>	Same dose as with EPL

Abbreviations: CSE: Combined spinal–epidural; DPE: Dural puncture epidural; EPL: Epidural analgesia; min lockout: A minute after a demand dose, a patient cannot press the button to receive a dose; PIEB: Programmed intermittent epidural bolus; PCEA: Patient-controlled epidural analgesia.

Source: Modified from Chau A, Tsen L. Neuraxial labor analgesia: Initiation techniques. *Best Pract Res Clin Anaesthesiol.* 2022;36(1):3-15.¹⁹, Smith A, Laflamme E, Komanecky C. Pain Management in Labor. *Am Fam Physician.* 2021;103(6):355-64.⁴⁹, Carvalho B, George RB, Cobb B, McKenzie C, Riley ET. Implementation of Programmed Intermittent Epidural Bolus for the Maintenance of Labor Analgesia. *Anesth Analg.* 2016;123(4):965-71.²²

a spinal needle inserted through an epidural needle. This allows for the administration of an opioid or a combination of an opioid and a local anesthetic into the subarachnoid space, followed by the insertion of an epidural catheter.¹⁵ This technique was introduced to enhance the prompt onset of analgesia in comparison to epidural analgesia.^{17,24} Intrathecal opioids can effectively relieve visceral pain in the first stage of labor. For somatic pain in the late first and second stages, a combination of local anesthetics is typically required. Women who present in the late active first stage with severe labor pain and need immediate pain relief can benefit from the rapid onset of CSE. Some studies have suggested a correlation between CSE and fetal heart bradycardia, which often leads to the requirement for an emergency cesarean delivery.^{19,25,26} Ultimately, it is crucial to carefully evaluate the potential risks and benefits and determine the appropriate dosage for implementing this technique.

Dural puncture epidural analgesia

The dural puncture epidural (DPE) technique is a slight modification of both the standard epidural procedure and CSE, and involves puncturing the dura with a spinal needle, but without the administration of intrathecal drugs. The objective is to accurately locate the epidural space and enhance the delivery of epidural medications by puncturing the dura, allowing medications to reach the intrathecal space. This will result in a faster onset of pain relief and improve the effectiveness of the analgesia by a better sacral spread.^{19,27-30} The DPE technique is particularly useful when there is a requirement for rapid-onset pain relief but a desire to avoid any potential negative effects associated with CSE.

Effect of neuraxial analgesia on the mode of delivery

Previously, obstetricians, anesthesiologists, and midwives who were unfamiliar with neuraxial labor analgesia held the belief that it increased the likelihood of cesarean delivery. This belief served as a barrier to the widespread application of effective pain relief to many women. However, numerous studies have demonstrated there is no significant difference in the incidence of cesarean delivery among women who received labor epidural analgesia compared to other methods of analgesia.^{31,32} This finding was also supported by a recent study, which showed that the incidence of cesarean delivery was slightly lower in mothers who received labor epidural analgesia.^{33,34} The primary determinant of the increased incidence of cesarean delivery associated with epidural analgesia is the extent of motor block achieved during the procedure, which can lead to a prolonged second stage of labor and

ineffective maternal expulsive efforts.³⁵ For this reason, current standard practice is to use low concentrations of local anesthetics to prevent motor block while still achieving effective pain relief. Moreover, a previous belief held that the early administration of epidural analgesia during labor could lead to an increase in the incidence of cesarean delivery. According to more recent evidence and current standard practice, the timing of neuraxial labor placement can be carried out whenever the expectant mother requests it or if there is a medical indication, even if she is in early labor with cervical dilation of less than 4 cm. This will not raise the incidence of cesarean delivery.^{36,37} Thus, current evidence supports that there is no increased incidence of cesarean delivery caused by neuraxial labor analgesia. The evidence regarding the heightened probabilities of instrumental delivery remains inconclusive. Several studies have suggested that using epidural analgesia with a low concentration of local anesthetic drug might result in a greater probability of instrumental vaginal delivery, consequently prolonging the second stage of labor.^{31,32,38} However, other studies have found no evidence of an increased risk.^{39,40}

Effect of neuraxial analgesia on fetal outcome

Medication administration for achieving pain relief during labor through a combination of a local anesthetic and an opioid has been observed to be transmitted across the placenta to the fetus, as evidenced by reports of these drugs in umbilical cord blood tests.⁴¹ The impact of depression, particularly in relation to opioid use, was assessed using the Apgar score. However, the results did not show any significant effects on the babies of mothers who opted for epidural analgesia.^{33,40} In contrast, the use of parenteral opioids for labor analgesia may result in maternal and fetal opioid-related side effects, such as lowered Apgar scores, feeding difficulties, altered thermoregulation, and possibly the requirement for naloxone administration. The babies of mothers who received epidural analgesia rarely, if ever, require naloxone administration,⁴² because the small amount of opioid used during typical labor epidural analgesia results in minimal opioid transfer to the neonate. Maternal fever is associated with neonatal outcomes such as a low Apgar score and the need for immediate resuscitation. There is evidence indicating that the occurrence of maternal fever is associated with the use of epidural analgesia during labor, although the exact mechanism of this relationship remains unknown. The imbalance of body temperature that may occur with an epidural is unlikely to be caused by an infection. However, when a clinician detects maternal fever, they should investigate the source

of the infection, such as chorioamnionitis, in order to make any necessary appropriate clinical adjustment.^{15,21,43}

Complication of neuraxial labor analgesia

Neuraxial labor analgesia provided by an experienced obstetric anesthesiologist is extremely safe. The incidence of severe complications is unlikely.⁴⁴ Occasionally, there may be minor and temporary side effects, such as pruritus, nausea, and vomiting, related with intrathecal opioid administration. Postdural puncture headache (PDPH) is the most common complication associated with epidural labor analgesia.^{15,45} This headache is characterized by pain in both the frontal and occipital regions of the head, which worsens when sitting up and improves when lying down. It is accompanied by symptoms such as nausea, dizziness, neck pain, changes in vision, and occasionally ringing in the ears, hearing loss, or pain radiating down the arms. The condition is caused by a decrease in the volume of cerebrospinal fluid due to a leak at the site where the dura was punctured. The documented occurrence of PDPH was estimated to be approximately 0.7%–1%, with an even higher probability of developing PDPH, approximately 52%–60%, in cases involving an unintentional dural puncture occurring during the insertion of an epidural needle, rather than with a spinal needle.⁴⁵ Initial symptom management involves the use of basic pain relievers, either taken orally or administered intravenously, along with adequate hydration. It is also important to avoid sitting upright. These symptoms can be resolved spontaneously within a period of one to two weeks. Often, symptoms are intense and enduring, necessitating intervention using an epidural blood patch.

Serious complications of neuraxial anesthesia do occur but are rare. In a large survey in USA sponsored by the Society for Obstetric Anesthesia and Perinatology (SOAP) evaluating over 257,000 anesthetics, the most serious complications were high neuraxial block, respiratory arrest, and unrecognized spinal catheter migration. Incidences of these complications ranged from 1:3,000 to 1:25,000 anesthetics.⁴⁴ The majority of these complications occurred in patients with risk factors, such as obesity or replacement of epidural after a previous failed epidural. Efforts to reduce these complications include clinician education, enhanced monitoring, lower and more dilute concentrations of local anesthetics, fractionation of doses and appropriate test-dose protocols. Additional complications such as epidural abscess or hematoma were too infrequent to provide reliable estimates of incidence. Additional data can be obtained by large nationwide database or registry analysis. This is being established

in USA by the American Society of Anesthesiologists (ASA). A similar effort in Thailand would add great perspective on the incidence of these complications.

Current status of access to labor epidural in Thailand

Neuraxial labor analgesia is crucial for effectively managing pain during labor and can also serve as an important motivation for pregnant women to opt for vaginal delivery. Neuraxial labor analgesia is additionally beneficially utilized to facilitate a transition to cesarean delivery, if required, during labor.⁴⁶ It has been found that countries with a high frequency of vaginal deliveries also tend to have a greater prevalence of neuraxial labor analgesia.³⁴ Meanwhile in Thailand, there is a high rate of performing cesarean deliveries under general anesthesia. This is mainly due to the fact that anesthetic services in Thailand are primarily provided by nurse anesthetists, who are not authorized to administer regional anesthesia. Consequently, the rate of performing neuraxial labor analgesia is quite extremely low.⁴⁶ Neuraxial labor analgesia is exclusively provided in Thailand's medical hospitals that are affiliated with universities. For demonstration, Siriraj Hospital, the largest medical institution in Thailand, has an annual neuraxial labor analgesia rate of merely 2.5%–3.4% and solely for educational purposes.⁴⁷ Which consistent with the declining trend of vaginal deliveries and the growing rate of cesarean deliveries at Siriraj Hospital.⁴⁸ The negative attitudes of obstetricians toward neuraxial labor analgesia during labor, the attitudes, fears and lack of education of patients, together with the scarcity of obstetric anesthesiologists pose significant barriers to the implementation of epidural analgesia services in Thailand.

The situation in China was previously similar to that of today in Thailand. Rates of neuraxial pain relief were low, and rates of cesarean delivery were high, although there were and still exist pockets of individual variation in these rates within each country. The reasons for these practice patterns in China were similar to the issues facing Thailand today. Namely, fear and lack of education of the potential side effects, both to mother and baby, of neuraxial analgesia, among both patients and physicians alike. In addition, lack of physician manpower resources to provide neuraxial analgesia. In response to this, an educational effort was begun in China called “No Pain Labor and Delivery” (NPLD).¹² This was a large effort to provide education to both patients and clinicians regarding the safety of neuraxial analgesia. NPLD efforts included institution of written protocols for neuraxial analgesic techniques, goal-oriented and evidence-based educational programs, and institution

of appropriate safety checklists. The NPLD program has resulted in favorable results in China with regard to both maternal and neonatal outcomes.¹³ Rates of neuraxial analgesia have increased, and this has been associated with a decrease in cesarean deliveries as well as fewer NICU admissions for the babies.

CONCLUSION

The implementation of centralization in large hospitals with sufficient human resources is an essential goal in ensuring the provision of safe care to women during pregnancy and childbirth. This concept plays a significant role in establishing obstetric anesthesia services to promote patient comfort, facilitate vaginal delivery, and minimize the occurrence of unnecessary cesarean deliveries. Multidisciplinary teams, consisting of obstetricians, anesthesiologists, and nurses, should collaborate to make this goal a reality. Many women find that the relief of pain is the best way to increase their enjoyment of childbirth. To achieve the most wonderful feasible labor and delivery experience, effective epidural labor analgesia is a crucial technique for reducing anxiety and suffering from labor pain. It is safe, widely used world-wide, and effective. Implementing a policy to raise public and medical providers awareness and acceptance of labor pain relief and establishing a safe obstetric anesthesia service provided by obstetric anesthesiologists can enhance maternal and neonatal safety and effectively reduce the rate of unnecessary cesarean deliveries.

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