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Review Article

Pharmacological and non-pharmacological modes of labour analgesia: Recent updates and literature review

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ABSTRACT

Pain management is a central aspect of modern obstetric care, achievable through various methods, including manual techniques, neuraxial approaches, systemic medications, and inhalational analgesics. This review focuses on the latest findings regarding the effectiveness and safety of these options. Over the past decade, obstetric regional analgesia has evolved significantly due to advancements in safer local anesthetics, rapid-acting opioids, combined spinal-epidural needles, patient-controlled analgesia devices, and ultrasound guidance technology. The most successful approach, according to recent meta-analyses, is epidural analgesia, which is linked to improved maternal satisfaction and advantageous safety profiles for both the mother and the fetus.

In this review article the author discusses common misconceptions and debates surrounding the initiation, maintenance, and cessation of epidural anesthesia.

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1. Introduction

Opium and related substances have been utilized for pain relief during childbirth for thousands of years, alongside various traditional remedies, reflecting a long-standing acknowledgment of the intense pain associated with labor. Women with multiple births (multiparous) often report more intense pain during the second stage of labor, while first-time mothers (nulliparous) typically experience heightened sensory discomfort earlier in the process.^{1,2}

Labor pain has both somatic and visceral components. During the first stage, pain arises from uterine contractions and cervical dilation, which transmit signals to the T10 to L1 spinal regions through small, unmyelinated C-fibers within the sympathetic nerves, often localizing discomfort in the sacrum and lower abdomen. As labor progresses, ischemic pain, carried by thick, myelinated A fibers to the

S2 to S4 nerve roots in the pudendal and perineal branches, results from the stretching of the vaginal wall, perineum, and cervix, producing sharp somatic pain in the perineal area.

In addition to being unpleasant labour discomfort can be harmful to both the mother and the unborn child. Catecholamines are released in response to pain, constricting uterine blood vessels and decreasing blood flow. Hypocapnia can also result from maternal hyperventilation, which narrows these blood vessels even more and reduces the mother's ability to provide oxygen during contractions. Fetal hypoxaemia and metabolic acidosis may arise from this sequence of reactions that impair the fetus's oxygen supply.

Premature bearing down during labor can risk injury to the baby and may harm the birth canal. Regional anesthesia helps mitigate the negative impacts of labor pain on the sympathetic nervous system and respiratory functions. However, the use of parenteral opioids may increase the

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risk of respiratory depression in the mother. Effective labor analgesia should therefore not only alleviate maternal pain but also reduce fetal acidity, enhancing the safety of the delivery process for both mother and infant.

2. Non-Pharmacological Techniques

Various non-pharmacological methods can help alleviate mild labor pain, including massage, psychological relaxation, transcutaneous electrical nerve stimulation (TENS), aromatherapy, hypnosis, sterile water injections, acupuncture, deep breathing exercises, and hydrotherapy. However, much of the evidence supporting these techniques is anecdotal or based on limited research studies.

A various systematic review studies indicated that women reported high satisfaction levels with relaxation techniques and water immersion. Additionally, both relaxation and acupuncture were associated with fewer forceps and ventouse-assisted deliveries, while acupuncture was also linked to a reduction in cesarean sections. Despite these findings, there is insufficient data to definitively confirm the effectiveness of methods such as hypnosis, biofeedback, sterile water injections, aromatherapy, and TENS for managing labor pain.

3. Pharmacological Techniques

For many years, a 50% nitrous oxide and oxygen combination called Entonox has been utilised as labour analgesic. Although it reduces pain to some extent, many women have adverse effects including nausea, vomiting, or drowsiness. Furthermore, the metabolism of vitamin B12 may be adversely affected by nitrous oxide, and healthcare professionals may be exposed to it at work; however, these dangers can be reduced with the use of appropriate scavenging devices. Although Entonox is easy for patients to self-administer, about 30% to 40% of individuals find it inadequate for pain relief on its own.³ As a potential alternative to Entonox, sub-anesthetic doses of sevoflurane (0.8% in oxygen) have been explored. Many women prefer it since it causes less cases of nausea and vomiting, even though it has no analgesic effects and may make increase sedation. Its appeal is, however, constrained by worries about environmental contamination, fetal toxicity, and even loss of consciousness. Potent opioids like intramuscular pethidine are frequently recommended, although they can have negative side effects include respiratory depression, nausea, vomiting, and somnolence. One should be careful while using the opioids as it will affect the newborn's respiration. The attending pediatrician should be aware of usage of opioids on the pregnant women.

Usually administered intravenously using a patient-controlled analgesia pump, remifentanyl is an ultra-short-acting opioid with a half-life of around three minutes.⁴ Studies have indicated that remifentanyl is

superior than injectable pethidine in terms of maternal satisfaction and the time to receive rescue analgesia. Crucially, Apgar scores were comparable in both groups, and there were no instances of sedation, apnea, or oxygen desaturation.

Various studies have shown that, the drug remifentanyl considerably decreases the requirement for epidural conversions as compared to pethidine.⁴ The regular use of pethidine as a first-line opioid for labour pain should be avoided as newer and safer drugs are available in the market. Remifentanyl is a good substitute for epidurals in patients with conditions including backache, coagulopathy, or fixed cardiac output conditions, even if its analgesic effects are not better than those of an epidural. The opioid Remifentanyl is now a part labour analgesia in various hospitals throughout the world.⁵

4. Neuraxial Analgesic Techniques

Epidural analgesia is the most popular type of labour analgesia in the world. As it is an invasive technique a proper consent from the patient is mandatory and one should be careful while performing the procedure.

The safety of epidural analgesia has been improved by recent developments in medications and technology, and our knowledge regarding how it affects the obstetric outcomes has expanded. Bupivacaine is more cardiotoxic than more recent amide local anaesthetics as levobupivacaine and ropivacaine. Lower concentrations of local anaesthetics, in combination with lipophilic opioid drugs like fentanyl or sufentanil have replaced the higher concentrations of bupivacaine.⁶ By reducing adverse effects like motor blockage and hypotension, this modification has made it easier for women to move and sustain a slight sensation of uterine contractions, which will help in pushing the baby during the second stage of labour.

In one of the comparative obstetric mobile epidural trial it was confirmed that low-dose epidural infusions dramatically decreases the rate of assisted vaginal birth.⁷

Various studies have showed that, use of local anaesthetic in lower dosages will shorten the second stage of labour and also reduces the assisted vaginal deliveries. To understand the best analgesic effect, several research were conducted using various drug combinations. The study by Sinha S⁸ was a double-blind, randomised controlled experiment with 100 parturients split into two groups, Group M and Group C, each with 50 participants. In addition to an epidurally administered bolus dosage of 8 ml of 0.1% bupivacaine, each subject got 15 microgrammes of fentanyl intrathecally.

In one study the comparison of bupivacaine with fentanyl and ropivacaine with fentanyl showed that the combination of ropivacaine (0.125%) and fentanyl (2 mcg/ml) was a good alternative medication for labour analgesia with few adverse effects, according to the study by Gupta A.⁹

Another research by Pawar S¹⁰ on the effectiveness of fentanyl versus sufentanil for labour pain relief and its comparison with injectable tramadol revealed that sufentanil caused analgesia to start earlier. In the tramadol group, there were higher VAS ratings (>4), a delayed onset, and a shorter overall labour time.

The observational longitudinal study on the combination of epidural bupivacaine and fentanyl for labour analgesia by Najeeb R¹¹ found that epidural labour analgesia using a continuous infusion technique and low doses of bupivacaine (0.0625%) and fentanyl (2.5 mcg/ml) gives good pain relief to the parturient in labour with increased maternal satisfaction without significant maternal or fetal side effects.

Maintaining neuraxial analgesia with an implanted epidural catheter can be achieved through various methods, including patient-controlled analgesia, continuous infusion, intermittent top-ups, and programmed intermittent epidural boluses (PIEB). Continuous infusion gained popularity in the early 1980s because it reduces variability in analgesic effects during labor, particularly as high concentrations of local anesthetics were replaced by lower doses combined with lipophilic opioids.

But not every patient is a good fit for this delivery strategy. Even after a great deal of research done on different combinations of infusion rates, local anaesthetic concentrations, and additives, some patients still need top-ups that are given by the doctor or have motor block that is unacceptable.

5. Patient-Controlled Epidural Analgesia

This technique was first established in 1988, which enables patients to self-administer boluses of 4–8 mL of an epidural mixture as needed, with a 10- to 20-minute lockout period. It makes sense that patients could be best adapted to handle their own pain management given the extremely fluctuating intensity and shifting nature of labour pain. According to recent data, genetic variations may potentially affect how labour progresses and how people react to analgesia. Over the past 20 years, this technique has been thoroughly researched and modified, and it permits a certain amount of self-titration.^{12,13}

Based on the previous studies, in comparison to continuous epidural infusion, PCEA typically results in less motor blockage, reduced anaesthetic intervention, and lower local anaesthetic dosages.^{14,15} PCEA devices provide several advantages over conventional continuous infusion pumps however the patient understanding is also prime important. It is also important to know that the user should understand the concept of PCA before it is being utilized.

6. Computer-Integrated Patient-Controlled Epidural Analgesia

Using a computer software that automatically modifies the infusion rate based on the quantity of local anaesthetic given in the preceding hour is a novel method of figuring out the background infusion rate during patient-controlled epidural analgesia (PCEA). By connecting a laptop to a PCEA pump, this technology enables the pump to respond to the patient's analgesic demands in a dynamic manner. This should, in theory, increase effectiveness while using less local anaesthetic for background infusions.

Promising outcomes have been seen in preliminary investigations of this computer-integrated background infusion PCEA (CIPCEA). In a research that contrasted CIPCEA versus demand-only PCEA, the CIPCEA group reported greater maternal satisfaction but showed similar local anaesthetic usage.^{16–18}

7. Programmed Intermittent Epidural Boluses

Boluses of an epidural local anaesthetic mixture are delivered at predetermined intervals using a novel technology called programmed intermittent epidural boluses. Compared to continuous infusion techniques, this approach can improve analgesia because the local anaesthetic is given in high-pressure boluses, which allows for a larger solution dispersion.¹⁹ A computer-controlled system that controls both automatic and manual boluses has been created. Studies show that compared to PCEA with a continuous background infusion, this "programmed intermittent mandatory epidural bolus" in conjunction with a PCEA regimen has a number of benefits. In particular, it prolongs the duration of analgesia and increases maternal satisfaction while using a lower total dosage of local anaesthetic. Nevertheless, the prevalence of breakthrough pain did not significantly differ between the two approaches.^{20,21}

8. When Should an Epidural Catheter be Placed?

Recent studies have substantially addressed concerns about the introduction of epidural analgesia during early labour (when cervical dilatation is less than 4 cm). According to Wong et al,²² early neuraxial analgesia reduces the length of labour and improves pain relief more than systemic analgesia, but it does not raise the rate of caesarean births. This is corroborated by the most recent Cochrane analysis, which found that the results of early and late initiation of epidural are comparable across all criteria.²³

Based on the recent guidelines by American Society of Anaesthesiologists one should not wait till the cervical dilation reaches up to 4 to 5 cm before administering an epidural. It is important to note that mother's request is a legitimate justification for seeking pain relief during labour.

The decision to provide regional anaesthesia when birth is near should be made individually, considering the woman's parity, the health of the fetus, and any potential second-stage difficulties, such as macrosomia or fetal malposition. According to the Royal College of Anaesthetists, there should be a backup anaesthetist accessible after the initial 30-minute wait for the anaesthetist to arrive following an epidural request.²⁴

One should discontinue epidural analgesia in the later part of labour to prevent unnecessary catheter related problems.^{25,26}

Although various pharmacological and non-pharmacological techniques are available for the labour pain, pharmacological technique is superior as it gives nearly 100% pain relief. Epidural analgesia may be safely provided at any stage of labour without adversely affecting the rates of instrumental or caesarean births, and a maternal request is a legitimate cause to begin it if there are no medical contraindications. Additionally, when epidural analgesia is not appropriate, remifentanyl-based opioid approaches are becoming more and more common as a substitute.

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10. Conflict of Interest

None.


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