NEURAXIAL ANALGESIA: EFFECTS ON THE PROGRESS AND OUTCOME OF LABOUR

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INTRODUCTION

Labour is one of the most painful situations a person can experience. It was rated more painful than cancer pain and as painful as amputation of a digit without anaesthesia.

![McGill Pain Questionare](image)

Neuraxial techniques are the gold standard for intrapartum labour analgesia. There have been a number of trials that have compared neuraxial analgesia with systemic opioids, nitrous oxide or both. The results have shown lower maternal pain scores and higher maternal satisfaction with neuraxial analgesia.\textsuperscript{2-5} Due to the advantages of excellent pain control, safety and the benefit improving the physiology of the mother and foetus \textsuperscript{10-12}, the use of neuraxial analgesia and increased tremendously over the past 30 years. In America it has increased from 21% to 77% and in the UK it has increased to 33%.
Table 1:
The Positives and Negatives of neuraxial labour analgesia

<table>
<thead>
<tr>
<th>Advantages</th>
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<tbody>
<tr>
<td>Patient has the benefit of complete analgesia</td>
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<tr>
<td>• There is no maternal sedation and the mother can there more fully participate and enjoy the birth and is better able to bond with baby</td>
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<tr>
<td>• Decreases negative responses to pain</td>
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<tr>
<td>• There is little or none neonatal sedation which decreases the risk and need for neonatal resuscitation</td>
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<tr>
<td>• In the event of a need for surgical intervention, labour analgesia can easily be converted to surgical anaesthesia. This also decreases the risk of having to convert to a general anaesthetic, which carries its own risk in the obstetric patient.</td>
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<table>
<thead>
<tr>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>• The service needs to be provided by a skilled anaesthetist</td>
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<tr>
<td>• There is the risk of the failed block</td>
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<tr>
<td>• Neuraxial analgesia causes a sympathectomy which may lead to maternal hypotension. The consequence of which could lead to decreased utero-placental flow</td>
</tr>
<tr>
<td>• There is the risk of prolonged 2nd stage of labour and possible increased risk of instrumental vaginal delivery or the need for surgical intervention</td>
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<tr>
<td>• Neuraxial techniques are contraindicated in patients with coagulopathy or receiving anticoagulants</td>
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HISTORY

The “birth” of obstetric anaesthesia dates back to 19 January 1847. Sir James Simpson was an eminent Scottish obstetrician and Professor at the University of Edinburgh. He initially used ether for childbirth. He then began experimenting with chloroform. Labour analgesia became more recognised and accepted when it was used on Queen Victoria during the birth of her eighth child. Unfortunately, it was not widely accepted by religious leaders as they believed childbirth was intended by God to be painful.

Most recently however, the American Society of College of Obstetricians and Gynaecologists put out the statement: “Labour results in severe pain for women. There is no other circumstance where it is considered acceptable for a person to experience severe pain amenable to safe intervention while under a physician’s care. Maternal request is sufficient justification for pain relief during labour.” Three Neuraxial techniques of regional anaesthesia for caesarean section have evolved to be most commonly utilized:

(1) Spinal anaesthesia,
(2) Epidural anaesthesia,
(3) Combined spinal-epidural anaesthesia
EFFECTS OF EFFECTIVE ANALGESIA ON MOTHER AND FOETUS

There are a number of studies that show that epidural analgesia in labour decreases or blocks the rises in stress hormones such as adrenaline, cortisol, ACTH, peptide hormones, and angiotensin II.\textsuperscript{10-12}

This effect of epidural analgesia, plus the added benefit of decreasing harmful maternal hyperventilation, all help to account neonatal acid base benefits.

Maternal Benefits

Painful labour produces many negative changes in the physiology & biochemistry of the parturient.

- During the first stage of labour, the mother's respiration increases by 75-150%.
- Uterine contractions result in severe pain. This in turn causes an increase in minute volume and oxygen consumption, the consequence of which is a respiratory alkalosis and a shift to the left of the oxygen-haemoglobin dissociation curve.
- During labour the sympathetic system is activated due to pain. This results in an increase in the level of catecholamines. It also increases cardiac output and systemic vascular resistance. These may lead to a decrease in blood flow to the uterus. Neuraxial analgesia is beneficial because it decreases catecholamine surges.
- Uterine contractions cause auto-transfusion of blood from uterus into the circulation. While this is well tolerated in the normal population this, may be disastrous in parturients with limited cardiac reserve. The utero-placental unit is perfused only during uterine diastole. The decrease in uterine blood flow during contractions that occurs against a background of utero-placental insufficiency may not be tolerated by the foetus. Effective pain relief may contribute to better outcomes in these situations.
- A painful labour can interfere with maternal-neonatal bonding, affect future sexual relationships and cause postpartum depression.
- Pregnant patients are at increased risk of DVT. Epidural analgesia helps attenuate the hypercoagulable state of pregnancy.
Table 2. Physiologic Changes In Pregnancy

| Cardiovascular          | Increased cardiac output  
|                        | Increased blood volume    
|                        | Increased resting heart rate 
|                        | Decreased peripheral resistance 
|                        | Decreased blood pressure (second trimester) 
| Pulmonary              | Increased respiratory rate 
|                        | Decreased functional residual capacity 
|                        | Increased tidal volume    
|                        | Increased minute ventilation 
|                        | Respiratory alkalosis     
| Gastrointestinal       | Decreased gastric motility 
|                        | Decreased esophageal sphincter tone 
| Musculoskeletal        | Increased ligament laxity  

Physiology of pain during labor

- Loss of Morale
- Anxiety
- Increased O₂ Consumption
- Hyperventilation
- Hypocarbica
- Catecholamine release
- Impaired uterine contractions
- Decreased uteroplacental blood flow

Sympathetic Stimulation
- Increased Cardiac Output
- Increased Peripheral Resistance
- Increased Blood Pressure
- Delayed Gastric emptying
- Increased Adrenocortical output
- Increased Lactic Acid
- Free fatty acid
- Decreased Fetal pH
- Decreased Fetal O₂
- Maternal metabolic acidosis

Foetal effects
The cause of foetal bradycardia after combined spinal epidural remains unclear. It may be related to a decrease in the circulating maternal catecholamine levels which results from the quick onset of analgesia. It appears also that the dose of intrathecal opioids affects the incidence of prolonged decelerations that require emergency caesarean section.\textsuperscript{45, 47} When high doses of intrathecal opioids were used (50-75\textmu g of fentanyl or 7.5-10\textmu g of sufentanil), the incidence of prolonged decelerations were between 3.9-12\%. When lower doses were used, CSE analgesia did not show any adverse outcome for the baby.

Table 3 Maternal changes produced by neuraxial analgesia that may affect the baby\textsuperscript{20}

<table>
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<tr>
<th>UNFAVOURABLE EFFECTS</th>
<th>FAVOURABLE EFFECTS</th>
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<tbody>
<tr>
<td>Decreased maternal blood pressure</td>
<td>No drug transfer across the placenta</td>
</tr>
<tr>
<td>Increased maternal temperature</td>
<td>Less episodes of desaturation</td>
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<tr>
<td>Increased need for oxytocin</td>
<td>Increased uterine blood flow due to the vasodilation from the block</td>
</tr>
<tr>
<td>Increased length of second stage of labour</td>
<td>Decreased maternal pain and therefore decreased maternal hyperventilation and stress</td>
</tr>
<tr>
<td>Risk of increased need for instrumental delivery</td>
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NEURAXIAL ANALGESIA AND LABOUR OUTCOMES

Effects on Caesarean Rates
Wong et al. published a trial using 750 nulliparous women at term. These parturients were in spontaneous labour or had spontaneous rupture of membranes and had a cervical dilation of less than 4 cm. At random, these patients were to receive either intrathecal fentanyl or systemic hydromorphone at the first request for analgesia. At the second request for analgesia, epidural analgesia was initiated in the group that had received intrathecal fentanyl. In the group that had initially received only hydromorphone, epidural analgesia was initiated when cervical dilation was 4cm and greater or at the third request for analgesia.

The primary outcome was the rate of caesarean delivery. Investigators looked at the rate of Caesarean deliveries which were shown to not be significantly different between the groups (17.8 % after intrathecal analgesia vs. 20.7 % after systemic analgesia; 95% confidence interval for the difference, -9.0 to 3.0 percentage points; P=0.31) It was also found that median time from the beginning of analgesia to complete dilatation was significantly shorter after intrathecal analgesia than after systemic analgesia (295 minutes vs. 385 minutes, P<0.001), as was the time to vaginal delivery (398 minutes vs 479 minutes, P<0.001).

Pain scores after the first intervention were significantly lower after intrathecal analgesia than after systemic analgesia (2 vs. 6 on a 0-to-10 scale, P<0.001). The incidence of one-minute Apgar scores below 7 was significantly higher after systemic analgesia (24% vs 16.7%, P=0.01).

Conclusion: Neuraxial analgesia in early labour did not increase the rate of caesarean delivery, and it provided better analgesia and resulted in shorter duration of labour than systemic analgesia.

Effects on the rate of Instrumental Deliveries
There are many factors that affect the rate of instrumental vaginal delivery. These include maternal pain and the urge to bear down, neuraxial analgesia-induced motor blockade, and position of the foetal vertex and station. Due to these many confounding factors it is difficult to interpret data that suggests a link between neuraxial labour analgesia and instrumental vaginal delivery. A study was done at Tripler Army Hospital. It compared the rate of instrumental vaginal delivery in patients receiving epidural analgesia and those who did not.

Results showed that there was no increase in the rate of instrumental delivery in the epidural group vs the non-epidural group (11.1% vs 11.9%) Similarly, a study conducted at National Maternity Hospital in Dublin, showed that the rate of instrumental delivery remained unchanged in spite of there being a greater than five-fold increase in epidural rate. These findings were confirmed in a systematic review of seven impact studies involving more than 28 000 parturients, which showed no difference in instrumental vaginal delivery rates (mean change, 0.76%; 95% CI –1.2 to 2.8).
On the other hand, there are also conflicting results from a meta-analysis conducted by Halpern and Leighton. Although, the rate of Caesarean Section was the primary outcome, this study showed that neuraxial analgesia is associated with an increased risk of instrumental delivery. Also confusing is the effect other factors (e.g. the technique used, the concentration of the local used, the total dose of anaesthetic) have on the degree of analgesia provided by neuraxial techniques. Studies have also investigated the effect of bupivacaine concentration on the rate of instrumental vaginal delivery, with conflicting outcomes.

James and colleagues noted that women randomly assigned to receive epidural bupivacaine 0.1% with fentanyl 2 mg had a lower incidence of instrumental vaginal delivery than women who received epidural bupivacaine 0.25% (6% vs 24%, P<0.03). Similarly, in a larger study by Olofsson and colleagues, women randomized to ‘low-dose’ bupivacaine 0.125% with sufentanil had a lower instrumental vaginal delivery rate compared with those who received ‘high-dose’ bupivacaine 0.25% with adrenaline. The choice of how epidural analgesia is maintained is also another factor that affects the density of the block.

Continuous infusion techniques tend to result in higher total doses of bupivacaine (and, thus a greater degree of motor blockade) when compared with intermittent bolus techniques. Smedstad and Morris conducted a trial that compared to determine the rate of instrumental delivery when a continuous infusion was used compared to bolus injections. Results showed a higher rate of instrumental delivery with the infusions. However, two later studies (a 2006 study by Wong and colleagues and the COMET study) showed that there was no difference in the instrumental vaginal delivery rate between groups who received ‘low-dose’ bupivacaine/fentanyl by either intermittent bolus or continuous infusions.

Other studies have looked at what the impact of specific neuraxial techniques (i.e. CSE vs epidural) had on instrumental vaginal delivery rates. Collis and colleagues found no difference in the rates between parturients randomized to receive ‘low-dose’ CSE (intrathecal bupivacaine/fentanyl followed by intermittent boluses of epidural bupivacaine 0.1%/fentanyl 2 mg ml21) vs traditional ‘high-dose’ epidural (0.25% bupivacaine). These findings show that the impact of specific neuraxial techniques on the degree of neuraxial blockade, and therefore the incidence of instrumental vaginal delivery, is still unclear.
Figure 3: Neuraxial vs. systemic opioid analgesia and mode of vaginal delivery

Table 2: Impact of Neuraxial analgesia on labour outcomes: available evidence

<table>
<thead>
<tr>
<th>Labour outcome</th>
<th>Evidence</th>
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<tbody>
<tr>
<td>Incidence of Caesarean delivery</td>
<td>When neuraxial analgesia is started in the latent stage of labour the risk of C/S does not increase</td>
</tr>
<tr>
<td>Incidence of instrumental vaginal delivery</td>
<td>Many factors affect the rate of instrumental delivery. No consensus reached</td>
</tr>
<tr>
<td>Duration of first stage of labour</td>
<td>There is no increase or difference noted in the first stage of labour</td>
</tr>
<tr>
<td>Duration of the second stage of labour</td>
<td>Evidence shows that effective neuraxial analgesia DOES increase the length of second stage</td>
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EPIDURAL ANAESTHESIA AND PRE-ECLAMPSIA

Whether epidural analgesia is appropriate for use in severely preeclamptic women has been controversial. Although there is no question that this method of analgesia provides better pain relief than parenteral opioids and pudendal block, some obstetricians have withheld epidural analgesia from their preeclamptic patients because of fear of severe hypotension and foetal distress.\textsuperscript{65,66,67} Recently, the safety of epidural analgesia for preeclamptic parturients has been established. In a large retrospective review of parturients with severe preeclampsia, Hogg et al found no difference in the incidence of caesarean section for foetal distress between patients who received epidural analgesia and those who did not.\textsuperscript{69, 70} None of the patients in either group experienced pulmonary oedema or renal failure.

In a randomized controlled trial of 738 patients that compared epidural analgesia to intravenous opioid analgesia, Lucas et al found no difference in the total incidence of caesarean delivery or caesarean delivery for foetal distress between the groups.\textsuperscript{55, 56, 57} Neonatal outcome, as measured by need for intensive care, Apgar scores, and umbilical artery pH, was similar. Of note, there was a 20-fold increase in the use of naloxone in neonates in the intravenous opioid group.\textsuperscript{58} Analgesia was superior in the epidural group. Current evidence suggests that epidural analgesia is safe and desirable for parturients with preeclampsia provided that there is no contraindication (such as severe coagulopathy) and blood pressure is maintained appropriately. The direct benefits include excellent pain relief for the parturient without concomitant neonatal depression. In some patients, general anaesthesia can be avoided by placing an epidural catheter early in labour.\textsuperscript{55-60}

MATERNAL HYPER-PYREXIA

The cause of fever in labouring women receiving neuraxial analgesia is unclear. There are however, many theories. One such theory, is that an increase in maternal temperature is as a result of a non-infectious inflammatory process. Increases in maternal cytokine levels supports this theory. It is postulated that labour analgesia either starts or worsens this increase in maternal temperature.\textsuperscript{55} Other studies by Frolich et. al., suggest that non-anaesthetic factors may play a role in increasing maternal temperature. These include Body Mass Index and time from rupture of membranes to delivery. This study did not observe an epidural effect on the change in maternal temperature.\textsuperscript{56} There have also been some recent literature that suggest that epidural labour analgesia may be linked to intrauterine inflammation and that this may lead to neonatal neurologic injury.
BREASTFEEDING

There has always been controversy as to whether neuraxial analgesia hampers the initiation of successful breastfeeding. In a study by Beilin et.al. 177 healthy multiparous parturients with uncomplicated pregnancies were divided into three groups during labour and all received epidural analgesia.\(^{21, 55, 68}\)

(i) Received no fentanyl in their epidural
(ii) Intermediate-dose fentanyl (150ug or less)
(iii) High dose fentanyl (more than 150ug)

Neonatal outcomes and breastfeeding outcomes were looked at by investigators. They found that 24 hours after delivery, the rate of difficulty with breastfeeding was similar between all the groups. At 6 weeks postpartum, a telephonic survey found that the mothers in the high dose group had the most difficulty with breastfeeding. Wilson et.al. published a trial involving 1054 healthy nulliparous pregnant patients who had uncomplicated pregnancies.

These patients were divided randomly into various groups:

(i) Control group – which received high-dose, bupivacaine-only labour epidural
(ii) Low-dose bupivacaine with fentanyl
(iii) Combined spinal-epidural with fentanyl
(iv) No neuraxial analgesia (351 patients)

In the group not receiving neuraxial analgesia, 151 received pethidine and 200 received other forms of analgesia or none at all. The investigators collected data on breastfeeding within 2-48 hours postpartum and 12 months postpartum. The results showed that the group receiving pethidine had the most difficulty with breastfeeding. When comparing the epidural groups overall and the patients that had neither a neuraxial technique nor pethidine, there was no difference in the breastfeeding initiation rate. These two trials provide the only evidence that neuraxial labour analgesia does not significantly affect breastfeeding. Therefore, considering the evidence we can conclude that neuraxial labour analgesia using low dose/low-dose fentanyl regime does not affect breastfeeding and should be offered to mothers wanting to breastfeed their babies.
RISK OF POST TRAUMATIC STRESS DISORDER

One often hears the statement “pain never killed anyone” on the labour floor. Severe, prolonged pain may cause serious psychological and potentially physical damage to the parturient, however. In susceptible patients, the birth experience may trigger posttraumatic stress disorder. This disorder, characterized by fear, helplessness, and other psychological disturbances such as flashbacks, avoidance behaviour, and poor sleep, was first described among veterans of the Vietnam War.

Subsequently, it has been recognized in numerous traumatic settings, including childbirth. During the event, the person feels seriously threatened by death or severe injury and is often helpless to prevent it. Women are more susceptible to posttraumatic stress disorder if they suffered previous trauma. Although the exact incidence is unknown, predisposing factors include lack of consent for procedures, lack of a sense of control, and a sense of powerlessness. The incidence also is correlated with the amount of physical pain experienced.

The psychological impact of posttraumatic stress disorder can vary greatly; however, it may manifest in future pregnancies. Women may choose to have an abortion instead of reliving the experience of a vaginal delivery. Some women also request a caesarean delivery without “medical” indication. In one series, 30% of women who requested a caesarean section for personal reasons cited fear of excruciating, unrelieved pain as the reason. These women place themselves at higher risk than necessary because of their past traumatic experience.\textsuperscript{55,60,65}
CONCLUSION

The amount of pain experienced by a woman during labour is influenced by many factors. Neuraxial labour analgesia has the potential to affect the course, duration and outcome of labour. Although there are known risks and side effects, there are many benefits and the problems are attributed to the technique without appropriate scientific assessment. Some observations, such as the increased use of forceps and prolonged second stage of labour, are associated with epidural analgesia, but there is not enough evidence to categorically state whether the technique caused the problems. These topics warrant continued investigation.

There is no single, universal way of managing labour pain that will fit all circumstances or fulfil every parturient’s needs. However, modern epidural techniques & medications have resulted in more consistent, predictable & effective analgesia during labour. There have recent advancements in new delivery systems and new drugs that allow us to provide safe and effective analgesia during labour. The use of low concentrations of local anaesthetics, combined with lipid-soluble opioids does not impede the progress of labour or depress the new-born. The addition of patient-controlled epidural analgesia and innovations using new technologies enhance patient satisfaction. Ultimately, it is each anaesthetist’s responsibility to take into consideration all these factors and to provide the parturient safe and effective labour analgesia.
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