

## **Establishing an epidural service for labour analgesia in a variable resource environment**

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### **Summary**

The health of women correlates strongly with the social and economic well-being of a community. However, pain during childbirth is undertreated in variable resource environments. Epidurals provide safe and efficient provision of anaesthesia for unplanned or emergent cesarean delivery. This article will focus primarily on establishing an epidural service to provide labour analgesia and anaesthesia for nonscheduled cesarean delivery. The development of a labour epidural service should encompass patients' safety as its key tenant. Developing a high quality epidural service requires a well-trained, cooperative multidisciplinary team, an adequately equipped unit, and dedicated leadership whose role is to ensure the service maintains high standards. Ongoing monitoring and evaluation of the service will create the best environment for continued improvements and longevity of a means to strive towards provision of excellent care for parturients and their babies.

### **INTRODUCTION**

The health of women correlates strongly with the social and economic well-being of a community or society. Acute pain during childbirth is undertreated in variable resource environments (VRE).<sup>1</sup> Women are dying in childbirth from treatable conditions because they don't have access to the most basic surgeries and perioperative care, including analgesia. Pain associated with labour and delivery is the most important anesthetic-related concern for expectant mothers in high income countries.<sup>2</sup> Epidurals are widely regarded as the gold standard for labour analgesia with their analgesic efficacy confirmed many times.<sup>3-5</sup> Titration of low-dose, low-concentration local anaesthetics produces safe, reliable analgesia during labour and delivery. Epidurals provide safe and efficient provision of anaesthesia for unplanned or emergent caesarean delivery. A properly monitored labour epidural has a low incidence of side effects or serious complications to the parturient or fetus.<sup>6</sup>

In the year 1900, subarachnoid injection of cocaine was described with the result of total lower body anaesthesia in six parturients in labour.<sup>7</sup> Years of innovation, including needle design, catheter development, and medication discovery, have led to modern day epidural analgesia. In the past 40 years new developments in epidural delivery pumps have shaped current practice in high resource environments.<sup>8,9</sup> Current estimated rate of neuraxial labour analgesia use ranges from 66-82% in the United States.<sup>10</sup> Estimates of neuraxial labour analgesia usage in

VRE are challenging. However, one study estimated that only 2.2% of parturients at a South African public hospital received neuraxial labour analgesia.<sup>11</sup> Barriers to neuraxial analgesia include lack of skilled anaesthesia personnel, knowledgeable support staff, and equipment.

This article will focus primarily on establishing an epidural service to provide labour analgesia and anaesthesia for non-scheduled caesarean delivery. Considerations for two other neuraxial techniques, such as single-shot spinal analgesia and combined spinal epidural (CSE), will be covered briefly. An overview of neuraxial analgesia techniques will be followed by discussion of various elements critical to successful establishment of an epidural service, safety considerations, and highlighting challenges within VRE. Every epidural provides analgesia; a managed epidural service provides analgesia, anaesthesia, and conveys a level of safety to women within the service. The development of a labour epidural service should encompass patients' safety as its key tenant. Articles covering the broader topic of establishing an obstetrical anaesthesia service exist for the interested reader.<sup>4,12</sup>

### **CURRENT EPIDURAL TECHNIQUE FOR LABOUR ANALGESIA**

Neuraxial labour analgesia has been provided via single shot epidural or intrathecal injections, continuous epidural infusions, and, much less frequently, through

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**Table 1:** Highlighted comparisons between epidural, single-shot spinal, and CSE techniques for labour analgesia. Adapted from Report of Best practice in the management of epidural analgesia in the hospital setting.<sup>45</sup>

	<b>Epidural</b>	<b>Single-shot Spinal</b>	<b>CSE</b>
<b>Site of medication injection</b>	Epidural space	Subarachnoid space	Both epidural and subarachnoid spaces
<b>Duration of effect</b>	Can provide analgesia as long as epidural catheter remains in situ	Limited duration, depending on medication choice, dose and volume injected <sup>15</sup>	Subarachnoid injection is of limited duration, but can continue to provide analgesia as long as epidural catheter remains in situ
<b>Advantages</b>	<ul style="list-style-type: none"> <li>In situ catheter allows for titration of medication throughout labour, can control the spread and duration of analgesia and anesthesia</li> <li>Can extend use to provide anesthesia for instrumental or cesarean delivery<sup>15</sup></li> <li>Predictable spread of sensory blockade</li> <li>Technically easier in obese parturients (versus spinal)</li> <li>Does not require dural puncture</li> </ul>	<ul style="list-style-type: none"> <li>Rapid onset</li> <li>Does not require ongoing availability of anesthesia providers</li> <li>Technically simple procedure</li> </ul>	<ul style="list-style-type: none"> <li>See advantages of epidural</li> <li>Lower failure rate (versus epidural)<sup>13</sup></li> <li>Allows for more rapid onset of analgesia and anesthesia (versus epidural alone)<sup>15</sup></li> </ul>
<b>Disadvantages</b>	<ul style="list-style-type: none"> <li>Requires knowledgeable healthcare providers to monitor for appropriate use and potential complications</li> <li>In situ catheter has potential for misuse (e.g. being mistaken for an intravenous catheter) if not clearly labelled</li> <li>Greater quantities of medications required (versus spinal)</li> <li>Increased risk of maternal local anesthetic toxicity (versus spinal) if catheter positioned intravascularly<sup>15</sup></li> </ul>	<ul style="list-style-type: none"> <li>Limited duration</li> <li>May result in greater degree of motor blockade</li> <li>Inadequate analgesia for second stage of labour</li> <li>May result in greater sympathectomy, resulting in maternal hypotension</li> </ul>	<ul style="list-style-type: none"> <li>See disadvantages of epidural</li> <li>Delayed ability to detect non-functioning epidural catheter<sup>15</sup></li> <li>Increased maternal pruritus if intrathecal opioids administered (versus epidural alone)<sup>15</sup></li> <li>Requires dural puncture, although does not appear to impact incidence of PDPH<sup>15</sup></li> <li>Potentially increased rate of fetal bradycardia, but not associated with increased cesarean delivery rate<sup>13</sup></li> </ul>

continuous intrathecal infusions. Epidural analgesia is a technical procedure, performed under aseptic technique, where medication is injected into the epidural space with the intention of providing analgesia to a specific region of sensory dermatomes.<sup>13</sup> Alternatively, spinal analgesia is obtained via injection of medication into the subarachnoid space.<sup>7</sup> For applications in labour analgesia, single-shot spinal typically consists of small doses of local anaesthetic, lipophilic opioid (e.g. fentanyl), or a combination of both.<sup>14</sup> These techniques can be combined and analgesia performed with a CSE, which combines aspects of both spinal and epidural techniques.<sup>13</sup> Table 1 highlights several key differences between these neuraxial procedures. All three of these neuraxial techniques share the benefit of avoiding maternal sedation, which may occur with labour analgesia provided via parenteral opioids or inhaled nitrous oxide.<sup>15</sup>

## INDICATIONS

A joint statement by the American Society of Anaesthesiologists (ASA) and the American College of Obstetricians and Gynaecologists (ACOG) highlights the patient centered aspect of labour analgesia.<sup>16</sup>

They suggest that patient preference is all that is necessary for an indication to provide labour analgesia; “Labour causes severe pain for many women. There is no other circumstance where it is considered acceptable for an individual to experience untreated severe pain, amenable to safe intervention, while under a physician’s care. In the absence of a medical contraindication, maternal request is a sufficient medical indication for pain relief during labour. Pain management should be provided whenever medically indicated”.<sup>16</sup>

There are certain maternal comorbidities, such as mitral stenosis and other cardiac conditions, that would benefit haemodynamically from labour analgesia.<sup>17</sup> Patients with stenotic valvulopathies do not tolerate the tachycardia that may accompany labour pain. By providing analgesia via epidural, the increase in heart rate secondary to pain can be mitigated, which allows for improved haemodynamic stability. However, one must be cautious to avoid excessive sympathectomy in these preload-dependent lesions.<sup>18</sup> A more common example of maternal disease that may benefit from labour analgesia would be preeclampsia, along with other hypertensive disorders of pregnancy.<sup>12</sup> Adequate analgesia can play an important

**Table 2:** Relative contraindications to neuraxial labour analgesia. Adapted from Silva & Halpern.<sup>13</sup>

Systemic infection
Low platelets without coagulopathy(19)
Cardiac lesions resulting in fixed cardiac output (e.g. severe aortic stenosis)
Progressive neurological disease
Raised intracranial pressure (e.g. secondary to intracranial mass)
Significant, uncorrected maternal hypovolemia

role in blood pressure control, and a labour epidural can be used to provide surgical anaesthesia in the event of an urgent caesarean delivery, thereby avoiding general anaesthesia and the sympathetic surge associated with manipulation of the airway.<sup>6</sup>

Absolute contraindications to neuraxial analgesic techniques include patient refusal or inability to cooperate, lack of experienced provider, lack of necessary medications and equipment, coagulopathy (including ongoing use of anticoagulant medication), and infection of skin or soft tissues at the site of injection.<sup>13</sup> Relative contraindications to epidural procedures are listed in Table 2. It is important to note that preeclampsia without coagulopathy is not a contraindication to neuraxial techniques. When it comes to the matter of the thrombocytopenic parturient, a recent multicenter report suggests that the risk of epidural haematoma in patients with platelet counts between 70,000mm<sup>-3</sup> to 100,000mm<sup>-3</sup> is less than 0.2%, suggesting that it would be reasonable to consider neuraxial techniques in these cases.<sup>19</sup>

### REQUIRED RESOURCES

The resources required to establish an epidural service are not limited to equipment and medications, but also include people, policies, and infrastructure. There are a variety of prepackaged epidural and spinal anaesthesia kits that contain all the required procedural equipment. This can reduce costs but this generally requires continuous demand to become cost efficient. A cost-effective and safe prepackaged option may not be available in most variable resourced countries. The procedural equipment (listed in Table 3) can be acquired individually and combined safely, in a sterile manner, immediately prior to the procedure.

**Table 3:** Procedural equipment to perform LEA. Adapted from Kodali et al.<sup>12</sup>

Aseptic solution (e.g. chlorhexidine 0.5%)(46)
Epidural or spinal needles (disposable or reusable, as long as sterility maintained)
Epidural catheters (disposable)
Sterile dressings to secure catheter
Loss of resistance syringe (if using loss of resistance technique)
Local anesthetic
Lipophilic opioid (optional)
Labels for clear identification of epidural catheter (optional)

**Table 4:** Minimum equipment and medications for provision of safe LEA. Adapted from Kodali et al.<sup>12</sup>

Supplemental oxygen source
Suction supply and related equipment
Self-inflating bag and mask, able to provide positive-pressure ventilation
Airway equipment (for maintaining airway patency and for intubation)
Monitors: non-invasive blood pressure cuff, pulse oximeter
Intravenous catheter (in situ), with fluids, tubing, syringes, and needles available
Vasopressor medications (ephedrine, phenylephrine)
Emergency medications (epinephrine, atropine, intralipid)
Defibrillator or "crash cart" (must be immediately available)

Safe provision of labour analgesia necessitates the ability to manage any potential complications or emergencies that may arise. Resuscitative equipment and medication must be available in the event of hypotension, high or total spinal anaesthesia, local anaesthetic toxicity or cardiopulmonary arrest.<sup>12</sup> The ASA guidelines for neuraxial anaesthesia in obstetrics recommend the following list to be available for safe provision of labour epidural analgesia (LEA)<sup>17</sup>: qualified anaesthesia provider, established intravenous access in situ, appropriate resuscitation equipment and medications, presence of a healthcare provider (HCP) able to perform an operative vaginal or caesarean delivery, monitoring of maternal vital signs and fetal heart rate, availability of a HCP (other than the maternal anaesthesia provider) with newborn resuscitation skills, and a policy to assure availability of other HCP's to manage potential complications as appropriate. The resuscitation equipment and drugs listed by ASA includes an oxygen supply, suction, equipment to maintain airway patency and perform intubation, a method for provision of positive pressure ventilation, and the medications and equipment necessary for cardiopulmonary resuscitation.<sup>17</sup> These guidelines should be adapted to local context and may need modification. Table 4 lists equipment and drugs that should be available, at minimum, in order to provide safe LEA.

Consideration should be given to institutional infrastructure. If LEA is to be offered, it should take place in a location that is reasonably close to the obstetrical operating theatre to enable rapid patient transfer. It would be unrealistic to expect that all facilities offering obstetrical care would also have neurosurgical capabilities. However, there should be a policy in place to obtain appropriate imaging and neurosurgical consultation in a timely fashion in the event that epidural haematoma or abscess is suspected.

Another aspect of institutional infrastructure concerns personnel. Apart from the personnel mentioned above, it would be advantageous from an organizational perspective to identify an individual, often a senior anaesthesia provider, to act as lead for the epidural service.

Finally, continuous quality improvement protocols should be established and followed. Continuous quality improvement is an integral aspect of patient safety and will allow for identification of problems that could contribute to increased morbidity and mortality. The ideal format of quality improvement should be determined

on an institutional or departmental basis, but indicators of safety of neuraxial analgesia need to be determined, measured and acted upon. A system of regular evaluation and response should be put in place, which includes efficacy, patient satisfaction and feedback, incidence of complications, and adherence to institutional protocols. All relevant department members should have the opportunity to be involved in the process. In the instance of a poor outcome or near miss, emphasis should be placed on determining systemic issues to prevent future similar errors, rather than any penalizing action against a specific individual. This places emphasis on a systems approach to medical error, rather than a person approach, and is much better suited to the healthcare setting.<sup>20</sup>

**Table 5:** Complications of neuraxial analgesia and anesthesia in obstetrical population. Adapted from D'Angelo et al (2014)<sup>21</sup>

Post-dural puncture headache	1:114
Epidural abscess/meningitis	1:62, 866
Epidural hematoma	1:251, 463
Serious neurologic injury	1:35, 923
High neuraxial block	1:4, 336
Unrecognized intrathecal catheter (intended to be epidural)	1:15, 435

## POTENTIAL COMPLICATIONS

Maternal hypotension, pruritus, fetal bradycardia, maternal fever, urinary retention, and shivering have all been reported as adverse effects related to neuraxial analgesia.<sup>6,15</sup> Estimates of incidence for these adverse effects are related to the type and dose of medications used to provide analgesia.<sup>15</sup> A combination of low-dose local anaesthetic (for example, bupivacaine) and lipid-soluble opioid results in good analgesia with minimal adverse effects.<sup>21</sup> There is a dearth of large obstetrical anaesthesia databases, which makes it very challenging to estimate the incidences of serious complications. The Society for Obstetrical Anaesthesia and Perinatology has begun a repository project to better document serious complications related to obstetrical anaesthesia and we have summarized selected complications in Table 5.<sup>21</sup> It is important to note that these incidences cannot be generalized to all high income countries, and that incidences in VRE, where LEA may not yet be commonplace, are not widely available at this time. Ensuring appropriate continuous quality improvement measures are in place will help to determine what the incidence of each complication and guide efforts to reduce them.

## AWARENESS & EDUCATION

In countries where labour analgesia is not widely utilized the first step in establishing an LEA service is to educate both patients and HCPs involved in the care of parturients. If HCPs are not educated about benefits, risks, and options for labour analgesia, they cannot be expected to pass along information to their patients. If patients are not aware of their options for labour analgesia, they cannot be expected to request it or provide informed consent.

Several studies have demonstrated low levels of awareness amongst parturients regarding epidural analgesia in Saudi Arabia<sup>22</sup>, India<sup>23</sup>, Uganda<sup>24</sup>, Nigeria<sup>25,26</sup>, and Hong Kong.<sup>27</sup> One study by Ogunleye

et al.<sup>28</sup> compared preferences between American-born parturients and parturients immigrated from Sudan and Somalia and found that only 12.5% of Sudanese women would prefer epidural analgesia during labour, compared to 66.7% and 64% of American and Somali women, respectively. The study did not further explore attitudes regarding epidural analgesia, so it is unclear why there was such a significant difference in preference amongst Sudanese women, but it seems reasonable to suspect that lack of knowledge surrounding the benefits and risks of LEA may have contributed.

Even in countries where LEA is widely accepted, many patients still have misconceptions about the procedure and its risks.<sup>29,30</sup> Many parturients turn to the internet to find out information related to various aspects of pregnancy, including LEA.<sup>31,32</sup> A recent study by Espitalier et al.<sup>33</sup> found that the quality of information regarding LEA on both English and French language websites was poor overall.

Ogboli-Nwasor et al.<sup>34</sup> surveyed HCPs in Zaria, Nigeria, and found that although the vast majority (94.8%) agreed that pain relief should be provided during labour, only half of the respondents actually provided labour analgesia during the 8 weeks preceding the study's survey. This highlights a gap between the attitudes and practices of HCPs in that setting. Many of the reasons cited for non-provision of labour analgesia, such as lack of resources and skills, are challenges encountered in many other VRE. In many VRE, midwives or non-traditional healers are often primary care providers for parturients. Special attention should be paid to involving and engaging our midwifery colleagues in discussions around labour analgesia.

Educating non-anaesthesia HCPs regarding LEA extends beyond explaining the procedure's risks and benefits. There must also be education surrounding how to monitor for post-procedural complications. Epidural haematoma and abscess are emergencies that require timely diagnosis and treatment to minimize mortality and long-term morbidity.

Although extremely rare, there is potential for delayed respiratory depression following administration of intrathecal morphine.<sup>35</sup> Lipophilic opioids, such as fentanyl, may be safer alternatives when using neuraxial opioids;<sup>35</sup> but low dose intrathecal morphine has been shown to prolong duration of labour analgesia when combined with bupivacaine and fentanyl.<sup>15</sup> It should also be noted that there is only limited research on this complication within the obstetrical population.

Post-dural puncture headache (PDPH) typically does not present immediately after performance of a neuraxial procedure, and can create significant short-term morbidity for patients.<sup>13,36</sup> This particular complication requires that non-anaesthesia HCPs are able to recognize potential symptoms in order to alert the anaesthesia providers, and there should be an established process for follow-up of PDPH patients to ensure resolution of symptoms. These examples illustrate that the window for potential complications following LEA extends beyond the time that the epidural catheter is discontinued.

Finding an effective method of knowledge translation is heavily dependent on local context.<sup>37,38</sup> It is critical for anaesthesia providers to access the most appropriate methods to increase knowledge of patients and other healthcare providers. Ongoing communication

between anaesthesia providers, other HCPs, patients, and their families, will undoubtedly enhance knowledge translation efforts. Social media may facilitate health education and knowledge translation in VRE, however currently misinformation and lack of credible sites may contribute to negative outcomes.<sup>39</sup>

## SAFETY CONSIDERATIONS

Patient safety should be the top priority as we plan to provide pain relief. Availability of resuscitation equipment, development of institutional protocols, setting of minimum required levels of training, fostering communication among members of the multidisciplinary team, and initiating quality control measures all play key roles in the safe provision of epidural services.

### Development of institutional protocols

Protocols are used to standardize clinical practice; their use has been associated with improvement in patient outcomes.<sup>40</sup> The development of epidural protocols should be multidisciplinary, involving nurses, anaesthesia providers, obstetricians, patient advocates, and hospital administrators. Usually these protocols are adapted from local national guidelines, or speciality governing bodies like the Society for Obstetrical Anaesthesia and Perinatology and the Obstetric Anaesthetists' Association (OAA). Each hospital must develop their own protocols, adapted to the local setting and context. Table 6 shows an example of what information should be addressed in a protocol. Documentation of the epidural procedure should include the date and time when the procedure was performed, consent (including alternatives, risks, and benefits discussed with the patient), the name of the person performing the procedure, relevant patient history, vital signs relevant to the pharmacodynamics of the specific medication, medications used,

**Table 6:** Recommended information to be addressed within epidural protocol. Adapted from Report of Best practice in the management of epidural analgesia in the hospital setting<sup>45</sup>

Overall management of patients with epidural infusions
Instructions for the use of the pump/ boluses
Description of the drug concentrations used in the hospital
Description of infusion rates and how to adjust them
Instructions for changing epidural solution bags or syringes
Frequency of observations
Maintenance of intravenous access throughout the infusion period
Identification and management of early and late complications
Management of inadequate analgesia
Management of accidental catheter disconnection
Instructions for removal of the epidural catheter and monitoring for complications
Insertion and removal of epidural catheters in patients receiving anticoagulants
Pain management after cessation of the epidural infusion
Management of opioid and local anaesthetic toxicity
Mobilization after epidural removal (e.g. during enhanced recovery programs)

a description of the epidural insertion itself, the time of catheter removal, and any complications or side effects of the procedure.

Standardized order forms help to improve quality of patient care by having preset safety checks available, hence improving on clinical decisions and health outcomes.<sup>41</sup> However, this may be a challenge in variable resource settings where printing of order forms may not be possible.

### Patient education

As emphasized in the section regarding awareness, patient education is critical for successful implementation of a LEA service. Information regarding labour analgesia options should be available to patients as early as possible, ideally during antenatal care. This information can be in the form of pre-printed epidural cards, from HCPs during antenatal visits, word of mouth from friends, and internet sources from official institutional web sites. In order to control the quality of information given to the patients, there should be means of educating all HCPs that play a role in the service through departmental Continuing Medical Education opportunities. The information given to the patient should include: an explanation of the procedure, possible benefits, risks, and alternatives (such as opting for no LEA). The OAA website has an example of patient information about labour epidurals and is also available in a printable format.<sup>42</sup>

## CONCLUSION

Setting up a high quality epidural service requires a well-trained, cooperative multidisciplinary team (anaesthesia providers, obstetricians, midwives, nursing, and paediatricians), an adequately equipped unit, and dedicated leadership whose role is to ensure the service maintains high standards. Several studies in East Africa have identified lack of monitoring equipment, lack of local protocols, and low staffing as major challenges in providing obstetrical anaesthesia services.<sup>43, 44</sup> Despite those undeniable challenges, the authors believe that the provision of labour analgesia by working towards establishing an epidural service should remain an important goal for anaesthesia departments worldwide. Ongoing monitoring and evaluation of the service will create the best environment for continued improvements and longevity of a means to strive towards provision of excellent care for parturients and their babies.

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