Augmentation of epidural analgesia for caesarean section

Dan Benhamou
Professor of Anaesthesia and Intensive care
Hôpitaux Universitaires and Faculté de Médecine Paris-Sud

Augmentation of low dose epidural analgesia is a potent technique which can provide rapid and safe anaesthesia for emergency caesarean section. Using a concentrated solution of local anaesthetic, preferably lidocaine with adrenaline (20 ml) with or without fentanyl and/or bicarbonate, a sensory block up to T4-T5 can be obtained within 10 minutes. This upper level is generally achieved whatever the level of the sensory block determined before augmentation. No significant haemodynamic impairment is observed. Augmentation thus allows avoidance of general anaesthesia and its attendant risks in more than 95% of patients, provided it is used in patients who have had an epidural catheter in place for labour that has been working well. The top up should be administered as soon as possible and the injection can be safely started before the patient leaves the labour room, especially for a category 1 caesarean section where there is immediate threat to the life of the woman or her fetus. Obviously, augmentation can be used only in women who already have a working epidural in place. To ensure this situation, one has either to promote greater use of epidural analgesia during labour, whatever the patient's condition, or organise a method of effective communication with the obstetric team on the labour ward to identify those parturients at high risk of delivering by caesarean section sufficiently early to provide epidural analgesia in advance.

Introduction

The study by Price et al, from Felicity Reynolds and Barbara Morgan's group at Queen's Charlotte Hospital in London, published in the first issue of the International Journal of Obstetric Anesthesia in 1991, has revolutionised the practice of obstetric anaesthesia [1]. This study described a cohort of 36 consecutive women in whom an epidural had been previously placed to control pain during labour and for whom a decision to proceed to urgent caesarean section was made. Epidural catheters were injected with lidocaine 2% 20 ml with 1/200,000 adrenaline in every patient whatever the pre-existing obstetric and/or anaesthetic situation. The remarkable result was that an upper sensory level of anaesthesia to T4 (the level required to achieve adequate pain control from peritoneal afferents) was obtained within 12 minutes in all women and in 60% of parturients within 7.5 minutes.

Importantly, these results were obtained irrespective of the extent of spread of analgesia before augmentation and irrespective of the upper level of the sensory block. Moreover, haemodynamic changes were not apparent as few women experienced arterial hypotension that might have compromised maternal or fetal outcome. This very reproducible result obtained with so simple a recipe changed the way we managed anaesthesia for emergency caesarean section. Before this study was published, each practitioner had his or her own method for managing this situation. This needed to take into account the patient’s height, the dose and the concentration of the local anaesthetic used during labour, the level of the sensory block, the duration of the epidural anaesthesia, the urgency of the clinical situation as indicated by the midwife or the obstetrician and the anaesthetist's own perception of the situation at the time. This led to a method of dosing of epidural anaesthetic that was unique to each patient, very difficult to explain and reproduce and associated with an ill-defined success rate, although each practitioner believed that his or her method to establish the correct dose was the best one! Very often the worries associated with the perceived consequences of rapidly injecting a large dose of local anaesthetic led to a limitation of the total volume of local anaesthetic given. Often in such circumstances the volume was limited to 15 ml or less. Because of poorly defined rules governing what to inject and the administration of too small a dose, women often felt pain at the time of incision. In 1979, Milne et al. described the anaesthetic management of 722 consecutive cases of intrapartum caesarean section and reported an overall success rate for conversion of epidural labour analgesia to epidural anaesthesia for caesarean section of 69%, regarded as too low a rate to ensure adequate, safe practice [2]. This high failure rate frequently resulted in the need to administer rescue injections intraoperatively where again, each physician had his or her own recipe. Some were more familiar with and adopted the use of low dose ketamine or a small dose of a rapidly acting benzodiazepine or opioid, whereas others preferred immediate induction of general anaesthesia. Both strategies have their own intrinsic risks, including that of sedation with subsequent respiratory depression and aspiration of gastric contents or difficult tracheal intubation. Tracheal intubation after induction of general anaesthesia was regarded as the preferred method in some hospitals.
in which clear-cut management plans were advocated whereas there were probably numerous physicians preferring to use escalating levels of sedation. When the father was encouraged to be present during emergency caesarean section, partial failure of the epidural led to the father’s incomprehension and it was rather difficult for the anaesthetist to explain that his (her) technique was not working as expected. Alternatively, complete failure necessitated asking the father to leave the room for the rest of the procedure, often with no time to explain clearly what was happening (and why). The father was thus left alone outside, anxious and sometimes protested as a result. These imperfect strategies explain why, during this period, lectures discussed the relative advantages or drawbacks of each choice, however none was adequate enough to be universally accepted. An additional drawback was the feeling of urgency and uncertainty the anaesthetist perceived when he or she was called to proceed to urgent caesarean section. The risk of failure of augmentation was at the back of everyone’s mind and was undoubtedly a major contributory stress factor. The well known notion of the stress that emergency caesarean engenders is largely a consequence of the uncertainties and risks surrounding it. Indeed, many anaesthetists have probably left the field of obstetrics to avoid just this situation.

Times have now changed and as mentioned above, this evolution was initiated when the study by Price et al. was published [1]. Immediately after its publication, many physicians changed their practice and applied the 20 ml rule. Discussion at staff meetings rapidly confirmed the effectiveness of this strategy although several physicians were (and are still) reluctant to use as much as 20 ml as a rapid top up. New questions then arose which have been discussed in the intervening twenty years.

**Which anaesthetic technique should be used for emergency caesarean section when a functional epidural catheter is not already in place?**

This question is not a trivial one because in many countries the utilization of epidural analgesia for labour is not particularly high. Although the published epidural utilization rate during labour may be as high as 70% in France (2010) [3] or 61% in the USA in 2008 [4], this rate is lower in the United Kingdom and has not changed significantly over the last twenty years and where it is closer to 25-30% [5]. The epidural rate may even be lower in other countries such as Denmark or the Netherlands where less than 5% of deliveries are associated with the use of an epidural for labour. In such situations, placing an epidural catheter de novo is an unrealistic prospect, not only because the quality of anaesthesia is likely to be less profound compared with an equivalent single shot spinal anaesthetic but also because the onset time is likely to be too long to accommodate the requirements of an emergency caesarean section [6]. Morgan et al, in their classic paper describing effective communication with the obstetric team, showed that attending three rounds per day with midwives on the delivery ward permitted discussion of the clinical status of labouring women and was a very effective way to identify those parturients at high risk of delivering by caesarean section a few hours later [7]. In these women, establishing an epidural early facilitated subsequent anaesthetic management should an emergency caesarean section become necessary. If an epidural was declined by the parturient, the duty anaesthetist was at least in a position to perform a better pre-anaesthetic review (including an assessment of the airway) should a general anaesthetic become necessary thereafter.

**When and where should the epidural top-up be injected?**

Once the mother arrives in the operating theatre, there is no guarantee that even an epidural known to be working well can be topped up in time to allow delivery of the fetus if a rapid delivery is needed, for example, when a severe fetal heart rate abnormality has been detected. There has been much debate whether or not the epidural can be topped up before leaving the labour room. Concerns regarding a lack of monitoring during transfer between the labour ward and the operating room and the risks associated with local anaesthetic systemic toxicity and hypotension have been aired [8]. The prevailing view is that experts now accept that augmentation can be performed during preparation and transport [9] because the risk benefit ratio associated with this manoeuvre is so well established, especially for caesarean sections in which there is an immediate threat to the mother or the fetus.
Risk factors associated with failure of augmentation

Several studies have indicated that topping-up an epidural that has been working well during labour is very likely to provide adequate surgical anaesthesia after augmentation. Orbach-Zinger et al studied 101 parturients undergoing caesarean section who had been transferred to the operating room from the delivery ward with a functioning epidural in place, and in whom 20% required conversion to general anaesthesia [10]. The authors used a multivariate analysis to assess the risk factors for failure to extend labour epidural analgesia to achieve epidural anaesthesia for caesarean section. They found that younger, more obese parturients at a later gestational age, requiring more top-ups during labour and in whom higher visual analogue scale (VAS) pain scores were recorded in the 2 hours before surgery were at greater risk of failed augmentation. Similarly Campbell and Tran showed that ineffective epidural labour analgesia was identified as a risk factor for unsuccessful conversion to satisfactory surgical anaesthesia [11], however, Riley and Papasin found that most epidural catheters that had been inserted to provide analgesia for labour could be used to provide a surgical block [12]. Factors associated with failure of the epidural block were an increased requirement for supplemental local anaesthetic boluses during labour in order to provide adequate analgesia and when the anaesthetist attending the caesarean delivery was not a specialist in obstetric anaesthesia.

Which drug(s) should we use?

In a recent meta-analysis, Hillyard et al set out to identify the best epidural top-up solutions to provide anaesthesia for emergency Caesarean section with respect to the rapidity of onset and the requirement to provide additional supplementation of the block intraoperatively [13]. The rate of supplementation of epidurals once the surgery has been commenced and/or conversion to general anaesthesia lies somewhere between 3 and 20%. The fact that different studies have found very different rates is attributed to the use of a variety of study designs and endpoints. Hillyard et al found that lidocaine and adrenaline, with or without fentanyl, resulted in a significantly faster onset of sensory block. Bupivacaine or levobupivacaine 0.5% were the least effective solutions. Indeed, both solutions were associated with a significantly increased likelihood of the requirement for intraoperative supplementation compared with ropivacaine. Addition of fentanyl to the local anaesthetic solution used to top up the epidural resulted in a significantly faster onset but did not alter the need for intraoperative supplementation. The authors suggested that if the speed of onset is important, then a lidocaine and adrenaline solution, with or without fentanyl, appears optimal. If the quality of epidural block is paramount, then 0.75% ropivacaine is advocated. One possible explanation that may account for the lack of apparent benefit observed in the emergency situation when fentanyl has been added to the top-up mixture is because the fentanyl contained in the epidural solution used for labour may have already produced a near maximal effect [14]. These results have been challenged by other authors who suggest that a combination of lidocaine/adrenaline/bicarbonate is the most effective solution which should be used for every patient [15]. Two studies have confirmed that this mixture has a fast onset and achieves a block to cold to T4 in 7 minutes [16,17]. A study conducted in the United States compared this mixture with 3% chloroprocaine and found that in parturients with pre-existing epidural catheters, chloroprocaine has an even faster onset than lidocaine. Whilst it was acknowledged that both drugs provided excellent anaesthesia, the difference in the onset of a satisfactory block was only 1.3 minutes [18]. Further studies with chloroprocaine have not been widely performed because this drug is not available in many parts of the world.

What is an emergency caesarean section? Decision to delivery interval (DDI) and type of anaesthesia

A major dilemma arising from attempts to identify the best anaesthetic technique lies in the fact that emergency caesarean section is a generic term with no precise meaning that should really be better defined. The search for a better definition started a long time ago, not only because clinicians experienced difficulty in precise communication when using this term but also because of the medicolegal consequences when it was recognized that in many cases intrapartum deliveries by caesarean section for fetal distress were not being achieved within 30 minutes of the decision [6]. In the USA and the United Kingdom the 30 minute rule defining the time interval between decision and delivery has prevailed but is clearly inadequate when used alone because not all caesarean sections need to be done within 30 minutes. In 2000, Lucas and colleagues proposed a four-grade classification to take into account the spectrum of clinical situations and degrees of emergency [19]. This classification was endorsed by the Royal College of Obstetricians and Gynaecologists (RCOG) and the Royal College of Anaesthetists (RCA) in the UK in 2010 [20]. It was recognised that “encouraging universal use of a nationally accepted classification of urgency of caesarean section would facilitate local and national data collection, minimise communication difficulties relat-
ing to urgency of delivery, between and within teams and facilitate retrospective audit of outcomes”. The RCOG and RCA also “formalised the concept that urgency of caesarean section represents a continuum of risk. Four broad categories of risk are defined. All staff should be aware that, within each category, the degree of risk in individual cases can vary. This variance in degree of risk requires an individual, case-by-case approach in deciding the specific decision-to-delivery interval (DDI).”

These Colleges also proposed a coloured spectrum (red-orange-green) to be used to emphasise that continuum of risk. This coloured classification that had previously been used in France is simple and has a great potential to facilitate communication between team members [21].

Category 1 caesarean delivery (i.e. immediate threat to life of woman or fetus, also called “red code”) represents the main problem as it causes major stress to the health care system. Numerous studies have shown that when the 30 minutes rule is applied in this circumstance, most units are not capable of reacting rapidly enough. In a French study, The proportion of DDI ≤ 30 minutes was 0% in maternity units where obstetricians and anaesthetists were not permanently on site, 67% when only the anaesthetist was always present and 88% for units where both were always present [22]. Interestingly however, the neonate’s condition did not differ significantly according to the DDI. The anaesthetic technique also plays a significant role in attaining (or not attaining) the time interval defined for a given level of urgency. McCaughan and Catling noted that the mean time for surgical readiness was 15.4 minutes (2–44 minutes) for general versus 27.6 minutes (13–55 minutes) for spinal anaesthesia [23]. Cerbinskaite et al also noted that use of general anaesthesia shortened the DDI for grade 1 caesarean section [24]. Although epidural anaesthesia placed de novo has no place in this context, augmentation of an established well functioning low dose epidural which has been successfully used during labour should accommodate the time frame required. Sayegh et al grouped category 1 and 2 caesarean deliveries in their retrospective audit of 274 procedures performed within a six-month period in a French university teaching hospital [25]. Analysis of their data according to the type of anaesthesia showed that the mean decision-to-delivery interval was 30 minutes (17–45 minutes) under general anaesthesia, 33 minutes (12–132 minutes) for top-up epidural analgesia. Moreover, they showed that in these stressful circumstances, the success rate was 97%. Lim et al in Singapore also showed that both general anaesthesia and extension of a previously placed epidural block are acceptable modes of anaesthesia and do not delay delivery of the fetus in category 1 cases [26].

Hemodynamic effects of augmentation

Hypotension is an important consequence associated with the use of spinal anaesthesia for caesarean section. Hypotension (defined as a systolic blood pressure < 100 mmHg in general) occurs in more than two thirds of cases involving spinal anaesthesia and requires vasopressor administration. Ephedrine or phenylephrine is often administered in huge amounts to counteract spinal anaesthesia-induced hypotension in order to avoid compromising the mother and fetus. The situation is clearly different when an emergency caesarean section is performed under epidural top up because hypotension is much less of a problem. A long time ago, Brizygys et al showed that augmentation of epidural anaesthesia for emergency caesarean section was associated with a significantly reduced incidence of hypotension (i.e. 30%) [27]. It was postulated that hypotension was encountered less frequently because of the less dramatic onset of the sympathetic block and because of the protective effect of the increased cardiac output during labour. The finding of a lower incidence of hypotension (and reduced need for vasopressors) associated with epidural anaesthesia has been reproduced in many studies. Because of the consistency of reports in the literature only a few have been selected for special mention: In the randomized study by Goring-Morris and Russell evaluating the relative efficacy of a top up with 0.5% bupivacaine or lidocaine/adrenaline/fentanyl mixture, they reported that although nearly half of their patients had at least one measurement of systolic blood pressure < 100 mmHg, the dose of ephedrine required to rectify the situation was only 15 mg and 12 mg in the respective groups [28]. In another study in which the efficacy of bupivacaine, a bupivacaine-lidocaine mixture and a lidocaine with adrenaline solution were compared, it was found that the mean dose of ephedrine required ranged between 6 and 9 mg in the three groups [29]. When ropivacaine was compared with bupivacaine for augmentation of epidural analgesia for caesarean section, Sanders et al found a need for a dose of ephedrine of 6 and 3 mg respectively [30].
Hence, these studies concur that hypotension is a limited problem during augmentation of epidural analgesia. Given the high success rate, it can be concluded that augmentation of a low dose epidural for labour and its conversion to an anaesthetic suitable for emergency caesarean section is a technique that is extremely useful, safe and easy-to-implement.

**Key learning points**

- Augmentation of a low dose epidural that has been used to provide analgesia during labour is extremely effective and safe.
- Lidocaine 2% 20 ml with adrenaline 1:200,000, with or without fentanyl or bicarbonate is likely to be the most effective and safe recipe.
- Effective anaesthesia is obtained in more than 95% of cases provided the epidural was functioning properly during labour.
- Usually no significant hypotension is observed.
- The epidural top-up dose should be injected before or during transfer to the operating room for a category 1 caesarean section.
- Effective communication between members of the obstetric team (including the anaesthetist) allows anticipation of and preparation for difficult situations.

**References**


