Conversion of Labour Epidural Analgesia to Anaesthesia for Caesarean Delivery

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KEY POINTS

- The presence of an epidural catheter for labour analgesia can facilitate rapid provision of surgical anaesthesia if intrapartum caesarean delivery is required.
- Fast extension of epidural analgesia to caesarean delivery anaesthesia can be achieved with 3% 2-chloroprocaine or 2% lidocaine solution with epinephrine and bicarbonate for emergency intrapartum caesarean deliveries.
- The addition of fentanyl or sufentanil to epidurally administered local anaesthetics improves the quality of the surgical block and decreases visceral pain.
- Evaluating the quality of an existing neuraxial block during labour is vital before extending it for caesarean delivery.
- Early manipulation or replacement of a poorly functioning epidural during labour improves the chances of successful conversion to surgical anaesthesia.
- When epidural conversion fails, it is important to understand the risks associated with alternate anaesthesia techniques to reduce serious complications.

INTRODUCTION

Neuraxial anaesthesia is the technique of choice for caesarean deliveries (CDs). However, an intrapartum CD may necessitate unplanned general anaesthesia with the risk of consequent airway complications. With the increasing use of epidural analgesia for labour, anaesthesia for intrapartum CD can be achieved by "topping up" the existing epidural catheter with a concentrated local anaesthetic (LA) combined with adjuvants. When well-functioning epidural catheters are bolused with appropriate doses, anaesthesia can be achieved rapidly to facilitate delivery in intervals comparable to induction of general anaesthesia.[1] However, epidural conversion may fail, and subsequent alternate techniques carry the risks of a high neuraxial block, unplanned general anaesthesia and failed intubation. In this tutorial, management strategies for conversion, as well as prevention and management of a failed conversion, will be discussed.

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CONVERTING LABOUR EPIDURAL ANALGESIA TO SURGICAL ANAESTHESIA FOR CD

Preconversion Assessment

Evaluating the quality of neuraxial blockade and pain relief with the existing epidural catheter during labour is an essential first step. Difficulty obtaining satisfactory analgesia during labour, the presence of a unilateral or patchy block and the requirement for an increased number of boluses for breakthrough pain indicate a poorly functioning catheter and are examples of epidurals that should be avoided for conversion.

Second, the time from the last epidural top-up is important. An interval of less than 30 minutes may increase the risk of a high block if spinal anaesthesia is used for replacement.[2] With the use of programmed intermittent epidural bolus pumps, it may be worthwhile to check the volume and time of the last bolus delivered.

Third, visually inspecting the catheter insertion site and applying gentle aspiration to rule out catheter migration before topping up are essential. Misplaced epidural catheters, when bolused with high doses of LA required for conversion to CD, can lead to high spinal, subdural block or LA systemic toxicity (LAST).

According to the Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology, an unrecognised spinal catheter is one of the most common serious complications related to obstetric anaesthesia. Almost one-quarter of the high neuraxial blocks noted in this project resulted from unrecognised spinal catheters, and the majority (93%) of these were labour epidurals.[3]

Finally, airway examination and management planning remain a vital part of the assessment as the risk of a high neuraxial block, LAST, and the potential for urgent conversion to general anaesthesia is always a possibility during labour epidural conversion to surgical anaesthesia.

Location of Epidural Top-up

The preferred location of administering epidural top-up for CD, either in the labour room (LR) or operating room (OR), varies across institutions. Both practices have their inherent risks and benefits. Administration of the epidural dose in the LR may facilitate the rapid onset of surgical anaesthesia by the time the parturient is relocated to the OR. However, the remote location of the LR may delay the diagnosis and management of complications such as LAST, high spinal block or hypotension. On the other hand, initiating the epidural dose in the OR may delay the onset of adequate surgical anaesthesia for emergent CD.

The decision to initiate the epidural top-up in the LR or the OR should be based on the urgency of CD and availability of skilled personnel, monitoring and resuscitation facilities in their respective environments and during transit. Table 1 describes the classification of CD based on its urgency.[4]

In the opinion of many authors, a balanced approach is to initiate the epidural top-up in the LR with a test or fractionated dose (3-5 mL) of 2% lidocaine with epinephrine or 3% 2-chloroprocaine. The parturient should be immediately moved to the OR accompanied by the anaesthesiologist and with multiparameter monitoring. After confirming progressive bilateral cephalad block in the OR, a further epidural dose should be administered to achieve the desired block.[5,6]

Epidural Drugs for Surgical Anaesthesia

An upper sensory block at the level of T10 is often desired for epidural labour analgesia using a combination of low-concentration LAs (bupivacaine 0.0625%-0.1% or ropivacaine 0.08-0.1%)[7] and lipid-soluble opioids such as fentanyl or sufentanil. Conversion to surgical anaesthesia requires a dense sensory and motor blockade. A sensory block extending from sacral segments to the T4 level is desirable for CD. The absence of touch sensation at the T6 level indicates an adequate block to proceed without pain or discomfort in most cases.[6] Motor block in the lumbosacral segments is commonly assessed by the Bromage scale. For epidural conversion to CD anaesthesia, 15 to 20 mL of high-concentration LAs combined with 1 or more adjuvants is usually required to achieve an adequate block.

Grade	Definition
1. Emergency	Immediate threat to life of woman or foetus
2. Urgent	Maternal or foetal compromise that is not immediately life-threatening
3. Scheduled	Need for early delivery but no maternal or foetal compromise
4. Elective	At a time to suit the woman and maternity team

Table 1. Classification for Urgency of Caesarean Delivery.[4]

Local Anaesthetics

The choice of LA is decided by the urgency of delivery, onset and duration of action and safety profile of LAs. A recent Bayesian network meta-analysis showed that epidural 2% lidocaine with bicarbonate and 3% 2-chloroprocaine have the fastest onset to surgical anaesthesia for CD. They are hence suitable for emergent and urgent CDs. The onset times of these 2 drugs were not directly compared.[8] Adding sodium bicarbonate to a mixture of lidocaine and epinephrine further shortens the onset of surgical anaesthesia.[9] As a result, lidocaine-epinephrine-bicarbonate (LEB) solution is commonly used to extend epidural analgesia to surgical anaesthesia.[10,11] Because 3% 2-chloroprocaine has a short duration of action (40-60 minutes vs 75-100 minutes for lidocaine-epinephrine), intraoperative supplementation of anaesthesia is frequently required. As it is metabolised rapidly by plasma esterase, LAST is rare with 3% 2-chloroprocaine.[10] Ropivacaine 0.75%, bupivacaine 0.5% and levobupivacaine are generally not the preferred agents for conversion to CD anaesthesia, as they are slow in onset and carry a higher risk of LAST. Their use for conversion has decreased in the past decade, although some Scandinavian countries still use 0.75% ropivacaine and 2% lidocaine.[8,10,12]

Adjuvants

Commonly used adjuvants with LA are epinephrine, sodium bicarbonate and opioids. They increase the speed of onset, duration of action and quality of anaesthesia.

Epinephrine

Epinephrine causes vasoconstriction of the epidural venous plexus and reduces the absorption of LA into the systemic circulation. Thus, it prolongs the duration of action of LA and decreases the risk of LAST by reducing the peak plasma concentration. Epinephrine combined with epidural LA increases the duration and improves the quality of anaesthesia. It intensifies the surgical block, resulting from stimulation of α_2-adrenergic receptors located at the superficial laminae of the spinal cord.[10,13] Epinephrine is more effective when combined with lidocaine than bupivacaine, and the commonly used dilution is 5 μg/mL (1:200000) into lidocaine.[13] The addition of epinephrine to 2-chloroprocaine prolongs the duration of epidural analgesia and sensory motor block; however, this combination is not used routinely.[14]

Sodium Bicarbonate

The addition of 1 mL of 8.4% sodium bicarbonate (1 mEq/mL) to 10 mL of 2% lidocaine increases the speed of onset of LA. As the pH of the LA solution is raised closer to its pKa value, an increased fraction of unionised LA molecules are available to cross the neuronal lipid membranes. This shortens the onset of anaesthesia. Onset time as fast as 5.2 minutes has been achieved for surgical anaesthesia when bicarbonate is added to the epidural lidocaine-epinephrine-fentanyl solution versus 9.7 minutes for this solution without bicarbonate in emergency CD.[9] The addition of bicarbonate to bupivacaine, ropivacaine or levobupivacaine causes precipitation and should not be done.[6] Alkalinisation of 2-chloroprocaine with sodium bicarbonate increases the speed of onset of epidural analgesia slightly (12 minutes with bicarbonate versus 14 minutes without bicarbonate)[15]; however, there is a lack of studies comparing the effects of alkalinisation of 2-chloroprocaine versus LEB solution on epidural anaesthesia for CD.

Common practice is to use epidural 2-chloroprocaine at a higher (3%) concentration and without any additive for emergency CD. This provides the faster onset of action required and avoids the delay in preparing the mixture when time is crucial.

Opioids

Lipophilic opioids such as fentanyl (50-100 μg) and sufentanil (10-20 μg) are commonly combined with LA for rapid conversion to epidural anaesthesia. They increase the speed of onset, improve the quality of anaesthesia and provide analgesia for intraoperative visceral pain.[10]

Novel Adjuvants

The neuraxial addition of several drugs such as clonidine, dexmedetomidine, neostigmine, ketamine and magnesium has been proposed to enhance postcaesarean analgesia. However, their neuraxial use is still off-label. Neuraxial clonidine can cause hypotension, bradycardia and sedation at higher doses and is not recommended in obstetric patients in the United States. Further studies on neurotoxicity, analgesic superiority and side effects profile are required for these novel agents before their use as neuraxial adjuvants is recommended.[16]

The steps to convert labour epidural analgesia to surgical anaesthesia are summarised in Table 2.

Step	Summary	Procedures
1	Educate and reassure	• Discuss with the patient different anaesthesia options: EA vs spinal vs GA • Explain risks: failed block, high block, difficult airway • Reassure and instill confidence that maternal-foetal safety and comfort would be top priorities
2	Prepare and check	• Provide acid aspiration prophylaxis for high-risk patients: those with obesity or diabetes, solid food intake <6 h, difficult airway • Ensure adequate IV access • Check epidural catheter function: sensory level, time and dose of last bolus • Visually inspect epidural catheter position for migration
3	Bolus and transfer	• Bolus the epidural with 5 mL of 3% 2-chloroprocaine or 2% LEB mixture in LR • Transfer the patient to the OR with left uterine displacement • Monitor vitals for hypotension and high block while in transit
4	Assess and top-up	• Attach monitors in the OR • Assess motor and sensory block • Ensure bilateral dense block is progressing cephalad before administering further dose • Administer additional dose incrementally up to a total volume of 15-20 mL • Aim for dermatomal level of T6 to loss of touch or T4 to first feeling of sharp sensation
5	Start and maintain	• Allow surgical incision • Maintain dense block by using epidural opioid or additional LA bolus of 4-7 mL 20 min after initial dose to prevent visceral pain • Before block starts to regress, administer repeat dose about 50% of initial volume after 30-35 min for 3% 2-chlorprocaine or after 60 min for LEB to prevent break through pain

Table 2. Steps to Convert Labour Epidural Analgesia to Anaesthesia for Caesarean Delivery. EA indicates epidural anaesthesia; GA, general anaesthesia; IV, intravenous; LA, local anaesthetic; LEB, lidocaine-epinephrine-bicarbonate; LR, labour room; OR, operating room.

FAILURE TO CONVERT EPIDURAL LABOR ANALGESIA TO ANAESTHESIA FOR CD

The failure of epidural conversion is suggested by the need for conversion to general anaesthesia or another form of anaesthesia. However, the definition is not standardised, and this is likely reflected in the wide range of reported failure rates in the literature.[17] A systematic review and meta-analysis in 2012 reviewed 13 observational trials between 1994 to 2009, which included 8628 patients. They reported general anaesthesia in 5%, a second anaesthetic technique (spinal, repeat epidural or general anaesthesia) in 7.7% and intravenous or inhalational supplementation in 10.7% of patients with a preexisting labour epidural catheter for CD.[18]

Risk Factors for Failed Conversion

Several risk factors have been reported to be associated with epidural conversion failure, including obesity, height, length of epidural use and epidural technique.[18] However, the 3 risk factors that are consistently reported in the literature include the management of epidural from a nonobstetric anaesthesiologist, the number of additional epidural boluses for breakthrough pain during labour and the urgency of CD.[17]

Obstetric anaesthesiologists possibly manage labour epidurals more actively, ensuring a well-functioning catheter throughout the labour. They are likely to manipulate or replace a suboptimal epidural catheter before the decision for delivery is made. Nonobstetric anaesthesiologists are more likely to induce general anaesthesia and less likely to manipulate the epidural catheter or opt for other neuraxial techniques if conversion to surgical anaesthesia fails.[17,18]

A poorly functioning epidural catheter may result in breakthrough pain requiring additional unscheduled epidural boluses. Such a catheter is likely to fail if used for surgical conversion. In patients with 1 or more additional unscheduled boluses, the failure rate is increased 3-fold.[18] Breakthrough pain may also indicate dysfunctional labour, and the need for obstetric intervention should be evaluated.[18]

The urgency of CD is a 40-fold risk factor for epidural conversion failure as there is less time to wait for block onset. Conversion to general anaesthesia is highest in emergent CDs.[18]

Prevention of Failed Conversion

Active Management of Labour Epidurals

In addition to continuous labour epidural management, active communication with the obstetric team and LR staff may improve awareness of the dynamic circumstances that occur on labour and delivery. Epidural block quality, breakthrough pain, if any, and the requirement for additional top-ups should be considered along with obstetric factors (eg, progress of labour, foetal heart status, maternal well-being, maternal risk factors) to anticipate operative delivery and the need to convert to surgical anaesthesia. This active involvement provides an opportunity to optimise the epidural block quality and replace poorly functioning catheters before the decision for CD is made. Epidural conversion failure and the use of general anaesthesia can therefore be prevented in some situations. Such comprehensive management of labour analgesia also improves the level of patient satisfaction.[19]

Key Recommendations to Decrease the Risk of Failed Conversion

- Engage in active communication with the obstetrician to identify parturients at risk of CD.
- Troubleshoot inadequate labour epidural blockade with timely optimisation or replacement of the poorly functioning catheter with a new epidural or a combined spinal epidural (CSE).
- Confirm the catheter location by visual inspection and by administration of a test dose before shifting to OR.
- Assess the block in the OR. Do not administer more than half of the full dose of LA if the block is not progressing cephalad bilaterally.[5] Consider an alternative anaesthetic technique if this occurs.
- Use LA agents with the shortest onset time, such as 3% 2-chloroprocaine or LEB solution with an opioid for urgent/emergent CD.

MANAGEMENT OF FAILED EPIDURAL CONVERSION

The epidural block may fail to provide adequate anaesthesia even after a correctly performed procedure, adequate assessment and active management. If inadequate surgical anaesthesia is recognised after surgery has been allowed to start, the only management options left are intravenous supplementation or conversion to general endotracheal anaesthesia with its attendant risks. Therefore, it is essential to ensure adequate neuraxial blockade before surgical incision. According to a review of litigation for inadequate analgesia during CD in the United Kingdom, pain during regional anaesthesia for CD is one of the most common causes of negligence claims against obstetric anaesthesiologists. Epidurals have a higher failure rate than spinals do. It is prudent to believe the patient if she complains of pain and accept failure. The inability to manage pain during CD may lead to psychological disturbances including posttraumatic stress disorder and affect long-term well-being. Among parturients who had pain during CD, the psychological harm was moderate in 89% and permanent in 11%.[20]

There are no practice guidelines for the optimal management of a failed labour epidural for CD. The advantages, disadvantages, risks and risk management strategies of alternative anaesthetic options are discussed in Table 3.

The neuraxial techniques for subsequent management are listed in the following sections.

Single-Shot Spinal Anaesthesia

Spinal anaesthesia injected after failed epidural conversion carries 2 major risks: the risk of failure and the risk of a high neuraxial block.

The epidural space may be filled with LA boluses injected for surgical conversion. Compression of the dural sac below the termination of the spinal cord by this epidural fluid volume may lead to difficulty in obtaining cerebrospinal fluid (CSF). Epidural LA may flow back through the spinal needle and be wrongly identified as CSF. This increases the risk of failure of spinal anaesthesia. On the other hand, if the dural puncture is made successfully, the injected spinal LA may cause a high or total spinal block. This may result from cephalad CSF displacement secondary to dural sac compression or passage of LA from the epidural space into the subarachnoid space through the dural hole.[5] It has been suggested that high spinal can be avoided by injecting a reduced dose of spinal anaesthetic 30 minutes after the last epidural bolus and by delaying supine positioning[2]; however, the optimal dose of spinal anaesthetic is not known, and delaying supine position may be impractical. Cases of high spinal have been reported as late as 40 minutes to 1 hour after the last epidural bolus.[17]

CSE Anaesthesia

Combined spinal epidural (CSE) is a safer option as it allows a reduced spinal dose to reduce the risk of high spinal block. The block, if inadequate, can be extended by giving LA boluses through the epidural catheter.

Anaesthesia Techniques After Failed Epidural Conversion	Advantages	Disadvantages and Risks	Risk Management Strategies
General anaesthesia	• Fast onset	• Failed intubation • Aspiration • Accidental awareness • Poor neonatal outcomes (low Apgar scores) • Decreased uterine tone • Increased postoperative pain • VTE risk	• Active management and early replacement of poorly functional labour epidurals to avoid GA • Readiness with an emergency intubation cart and a video laryngoscope • Provision of aspiration prophylaxis
Spinal anaesthesia	• Less time to perform vs epidural or CSE • Fast onset • Low risk of LAST	• Risk of high or total spinal • Risk of failure	• Early identification of conversion failure before giving a full dose of epidural LA to reduce epidural fluid volume • Reducing spinal LA dose if converting after epidural analgesia • Injecting spinal anaesthetic more than 30 min after the last dose of epidural bolus • Selecting this technique, preferably after removing poorly functional epidural catheter without using it for surgical conversion
CSE anaesthesia	• Fast onset • Allows reduced-dose spinal LA • Ability to extend the block intraoperatively	• Longer time to perform • Untested epidural catheter carries risk of failure • Risk of LAST with epidural doses	• Excluding CSF backflow from epidural catheter by careful aspiration before injecting epidural top-up
Epidural anaesthesia	• Ability to extend the block intraoperatively	• Longer time to perform • Delayed onset • Risk of LAST	• Use of fast-acting LAs
Continuous spinal anaesthesia	• Fast onset • High success rate • Allows reduced initial dose of spinal LA • Ability to extend the block intraoperatively • Low risk of LAST	• High risk of PDPH • Risk of high spinal • Risk of infection	• Desirable in patients with difficult spinal anatomy to avoid risk of failure and in patients with difficult airway (eg, morbidly obese) to avoid GA

Table 3. Advantages, Risks and Risks Management Strategies of Anaesthesia Techniques Following Failed Epidural Conversion. CSE indicates combined spinal epidural; CSF, cerebrospinal fluid; GA, general anaesthesia; LA, local anaesthetic; LAST, local anaesthetic systemic toxicity; PDPH, postdural puncture headache; VTE, venous thromboembolism.

Epidural Anaesthesia

Removing the existing catheter after failed conversion and placing a new epidural catheter is another option; however, the risk of LAST increases with subsequent epidural dosing. Placing a new epidural catheter may be technically more difficult and time-consuming.[10]

Continuous Spinal Anaesthesia

Dural puncture with an epidural needle and placement of the catheter intrathecally is a comparatively faster technique. It may be an option for rapid rescue in urgent CD in patients with difficult spinal anatomy and difficult airway, in whom avoidance of general endotracheal anaesthesia is desirable. Inadequate block, if any, can be extended with further doses through the spinal catheter. The risk of LAST is low; however, the risk of postdural puncture headache and high neuraxial block is high.[10,17]

SUMMARY

The use of labour epidural catheter for conversion to surgical anaesthesia for intrapartum CDs is a common practice. Careful preoperative assessment and active management of epidurals during labour increase the success rate of this technique. Commonly used agents are 2% lidocaine and 3% 2-chloroprocaine. Adjuvants such as sodium bicarbonate, fentanyl or sufentanil further improve the onset and quality of the block. Urgent CD, care delivered by nonobstetric anaesthesiologists and increased boluses during labour are common risk factors for failed conversion. If a labour epidural fails to provide surgical anaesthesia, identifying the risks of different rescue anaesthesia techniques is crucial to avoid serious complications such as LAST, high spinal and failed intubation.

REFERENCES

1. Popham P, Buettner A, Mendola M. Anaesthesia for emergency caesarean section, 2000-2004, at the Royal Women's Hospital, Melbourne. *Anaesth Intensive Care*. 2007;35:74-79.
2. Dadarkar P, Philip J, Weidner C, et al. Spinal anesthesia for cesarean section following inadequate labor epidural analgesia: a retrospective audit. *Int J Obstet Anesth*. 2004;13(4):239-243.
3. D'Angelo R, Smiley RM, Riley ET, et al. Serious complications related to obstetric anesthesia: the Serious Complication Repository Project of the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology*. 2014;120:1505-1512.
4. Lucas DN, Yentis SM, Kinsella SM, et al. Urgency of caesarean section: a new classification. *J R Soc Med*. 2000;93:346-350.
5. Desai N, Carvalho B. Conversion of labour epidural analgesia to surgical anaesthesia for emergency intrapartum caesarean section. *BJA Educ.* 2020;20(1):26-31.
6. Tsen LC, Bateman BT. Anesthesia for cesaeran delivery. In: Chestnut DH, Wong CA, Tsen LC, et al., eds. *Chestnut's Obstetric Anesthesia: Principles and Practice*. 6th ed. Philadelphia: Elsevier; 2020:568-626.
7. Toledano RD, Leffert L. What's new in neuraxial labor analgesia. *Curr Anesthesiol Rep*. 2021;11(3):340-347.
8. Reschke MM, Monks DT, Varaday SS et al. Choice of local anaesthetic for epidural caesarean section: a Bayesian network meta-analysis. *Anaesthesia*. 2020;75(5):674-682.
9. Lam DT, Ngan Kee WD, Khaw KS. Extension of epidural blockade in labour for emergency caesarean section using 2% lidocaine with epinephrine and fentanyl, with or without alkalinisation. *Anaesthesia*. 2001;56(8):790-794.
10. Ituk U, Wong CA. Anesthetic choices for intrapartum cesarean delivery in patients with epidural labor analgesia. *Adv Anesth*. 2020;38:23-40.
11. Potter TE, Desai N. Extension of labor epidural analgesia for emergency cesarean section: a survey of practice in the United Kingdom. *J Obstet Anaesth Crit Care*. 2021;11:130-131.
12. Wildgaard K, Hetmann F, Ismaiel M. The extension of epidural blockade for emergency caesarean section: a survey of Scandinavian practice. *Int J Obstet Anesth*. 2016;25:45-52.
13. Bucklin BA, Santos AC. Local anesthetics and opioids. In: Chestnut DH, Wong CA, Tsen LC, et al., eds. *Chestnut's Obstetric Anesthesia: Principles and Practice*. 6th ed. Philadelphia, PA: Elsevier; 2020:271-311.
14. Feng SW, Cao Y, Wang WG, et al. Addition of adrenaline to chloroprocaine provides a moderate duration time for epidural anaesthesia in elective caesarean section. *J Int Med Res*. 2012;40(3):1099-1107.
15. Chestnut DH, Geiger M, Bates JN, et al. The influence of pH-adjusted 2-chloroprocaine on the quality and duration of subsequent epidural bupivacaine analgesia during labor: a randomized, double-blind study. *Anesthesiology*. 1989;70(3):437-441.
16. George RB, Carvalho B, Butwick A, et al. Postoperative analgesia. In: Chestnut DH, Wong CA, Tsen LC, et al., eds. *Chestnut's Obstetric Anesthesia: Principles and Practice*. 6th ed. Philadelphia: Elsevier; 2020:627-669.
17. Mankowitz SK, Fiol AG, Smiley R. Failure to extend epidural labor analgesia for cesarean delivery anesthesia: a focused review. *Anesth Analg*. 2016;123(5):1174-1180.
18. Bauer ME, Kountanis JA, Tsen LC, et al. Risk factors for failed conversion of labor epidural analgesia to cesarean delivery anesthesia: a systematic review and meta-analysis of observational trials. *Int J Obstet Anesth*. 2012;21(4):294-309.
19. Bauer ME, Mhyre JM. Active management of labor epidural analgesia is the key to successful conversion of epidural analgesia to cesarean delivery anesthesia. *Anesth Analg*. 2016;123(5):1074-1076.
20. McCombe K, Bogod DG. Learning from the law: a review of 21 years of litigation for pain during caesarean section. *Anaesthesia*. 2018;73(2):223-230.

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