

Anaesthesia for Caesarean Section. Part 2 Caesarean Section under Regional Anaesthesia

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A series of three tutorials exploring the management of caesarean section.

Part 1: Introduction and Overview

Part 2: Caesarean Section under Regional Anaesthesia

Part 3: Caesarean Section under General Anaesthesia

Extracts of these tutorials have contributed to:

Brown JPR. Recent Developments in Anaesthesia for Caesarean Section in the UK. *Update in Anaesthesia*. 2008; **23**: 3-7

Self Assessment – Case Based Discussion:

Q1.

You are called to the labour room to assess a nulliparous 32 year old woman. She has spontaneously ruptured her membranes but failed to progress despite syntocinon infusion and has been 6cm dilated since her last vaginal examination 4 hrs ago. The fetal CTG trace has been reassuring. She has an epidural in-situ for labour pain placed uneventfully by a colleague on the previous shift and you are told the woman has been comfortable since. The obstetricians would like to do an urgent (category 2) caesarean section.

- a) *What anaesthetic options are available to anaesthetise this patient to undergo caesarean section?*
- b) *What are the advantages and disadvantages of each?*
- c) *What further information would you like to know prior to deciding on which method to employ?*
- d) *If the fetal CTG trace had been concerning and this was a category 1 caesarean section would you have chosen a different method of anaesthesia?*

Q2.

On further questioning, the epidural has been working “reasonably”, with a background of 8mls/hr of premixed Bupivacaine 0.1% and Fentanyl 2mg/ml, with the women requiring brief use of entonox prior to a top up of 5+5mls of Bupivacaine 0.25% administered by the midwifery staff 2 hours previously. You test the block with ice and it is at T10 on the right side and T8 on the left. You decide on topping up the epidural to provide anaesthesia.

- a) *What local anaesthetic mixtures are suitable for epidural top up?*
- b) *What are the advantages and disadvantages of each?*
- c) *Where would you top up the epidural? In the labour room or in theatre?*
- d) *What other precautions will you take with this woman prior to transferring her to theatre?*
- e) *What block levels are you looking to achieve prior to commencement of surgery and how will you test its adequacy?*
- f) *What are the possible complications of a migrated epidural catheter?*

Q3. You decide to top up the epidural in the theatre and you give 4x5ml boluses of plain Bupivacaine 0.5%, each spaced by several minutes whilst you observe for any complications and assess the onset of the block. You measure the block with cold (ice cube) to be at T4 bilaterally and soft touch to T6 bilaterally. The woman is appropriately positioned with left lateral tilt and is cardiovascularly stable. Surgery commences, several minutes after starting the woman becomes very distressed and complains of pain.

What possible options are available for the immediate management of this woman?

Key Points

- The majority of patients undergoing caesarean section in the UK will receive a regional anaesthetic technique (77% of emergencies and 91% of elective cases)
- Epidurals for labour pain are increasing in popularity and can be 'topped up' to provide anaesthesia for caesarean section in the majority of these patients.

Advantages of Regional Anaesthesia over General Anaesthesia

- Reduced maternal mortality
- Risk of potential failed intubation avoided
- Reduced risk of aspiration
- Avoids pressor response of intubation (*Exaggerated in pre-eclampsia*)
- Reduced haemorrhage
- Reduced stress response from surgery
- Allows mother to experience birth of child
- Improved postoperative analgesia, mobility and potentially reduced thromboembolic complications

Contraindications to Regional Anaesthesia

- Active heavy bleeding
- Uncorrected coagulopathy (e.g. HELLP syndrome (Haemolysis, Elevated Liver Enzymes, Low Platelets) associated with pre-eclampsia)
- Thrombocytopenia
- Systemic sepsis
- Local sepsis at site of insertion
- Patient refusal

Complications of neuraxial Anaesthesia

Please see [TOTW Complications of Regional Anaesthesia](#)

- Needle related
 - Post Dural Puncture Headache (PDPH) (1 in 100)
 - Neurological sequelae
 - Neuropathy
 - temporary (1 in 1000)
 - permanent (1 in 13000)
- Drug related
 - Local Anaesthetic
 - Hypotension (sympathetic blockade)
 - High block (total spinal)
 - Systemic toxicity
 - seizures
 - cardiotoxicity
 - Urinary retention
 - Shivering
 - Opioids

- Pruritis
 - Nausea and vomiting
 - Respiratory depression
 - Sedation
- Inappropriate preparation
 - Arachnoiditis
- Infection
 - Epidural / Spinal abscess (1 in 50 000)
 - Meningitis (1 in 100 000)

Methods of Testing Adequacy of Block prior to Caesarean Section

Pain during caesarean section under regional anaesthesia has replaced awareness under general anaesthesia as the most likely reason for medico-legal action against the obstetric anaesthetist in the UK. Testing and documentation of block adequacy is considered a “standard of care”.

There is currently debate over the most accurate method of assessing sensory block to confirm adequacy of anaesthesia. The debate is mainly focused on which sensory modality is the best indicator. The upper limit of the modalities is usually at different levels with loss of light touch sensation the lowest. This is variable but usually

Touch < Pin prick < Cold Sensation

After spinal anaesthesia cutaneous current thresholds have shown:

- Touch and pressure carried by A-beta to recover 1st
- Pinprick carried by A-delta to recover 2nd
- Cold carried by C fibres to recover 3rd

It has been demonstrated that although pain is not carried by A-beta fibres, pain can be felt prior to clinically detectable return of A-delta and C fibres. This suggests that only partial return of these modalities is required for the pain to be sensed. These findings support the use of light touch as the more reliable predictor of block height and adequacy of anaesthesia. Cold alone however is still used by approximately half of all obstetric anaesthetists in the UK.

Suggested standard – the presence of:

- Loss of light touch from sacral levels to T5 and loss of cold to T4
- Bilateral lower limb motor block

A problem with assessing touch to T5 is the lack of a reliable anatomical landmark. This makes it less readily identifiable compared with T4 (nipples) and increases individual observer variation. There is also debate over where to record the level. The level of “some” sensation and “normal” sensation may vary by 2-3 dermatomes. Intrathecal opioids may reduce the level of block required.

Management of Hypotension associated with Regional Anaesthesia

This is more pronounced with spinal rather than epidural anaesthesia.

There are several elements to its prevention and management

- **Patient positioning** – during surgery the patient should be positioned with a 15° left lateral tilt to reduce aorto-caval compression and hypotension from a reduction in pre-load. This is achieved either with a wedge under the right hip or tilting a mechanical table. Patient positioning at the time the regional technique is performed may also influence the speed of onset of sensory block and incidence of hypotension e.g. sitting, lateral or Oxford position (*discussed in more detail later*).
- **Pre loading** – intravenous fluid preloading with either crystalloid or colloid. Colloid is more likely to reduce the incidence of spinal induced hypotension and has the advantage of remaining in the intravascular space for longer than crystalloid but has the disadvantage of the associated risk of anaphylaxis.
- **Use of vasoconstrictors** - There has been a shift from the long held belief that vasoconstrictors should be limited following subarachnoid block because of possible detrimental effect on uterine blood flow. This previously held opinion was largely the result of sheep studies and led to the belief that ephedrine was the vasopressor of choice. There is now a growing body of evidence that alpha-adrenergic agonists (e.g. phenylephrine and metaraminol) help better prevent spinal induced hypotension and result in improved umbilical artery pH. Ephedrine appears to contribute to fetal acidosis by crossing the placenta and increasing fetal metabolic activity. The alpha-adrenergic agonists should be given pre-emptively and titrated to maintain maternal blood pressure near to baseline levels. Maternal bradycardia can be anticipated as a result of activation of the baroreceptor reflex.
- **Thromboembolic stockings** - may serve a dual purpose of maintaining maternal blood pressure (preventing venous pooling) and contributing to thromboprophylaxis.
- **Epidural Volume Extension (EVE)**. A technique that may reduce hypotension and vasopressor requirements following spinal anaesthesia through combination of a reduced spinal dose of local anaesthetic with epidural volume extension (EVE) using a combined spinal epidural (CSE) technique. A volume of either local anaesthetic or saline is instilled into the epidural space shortly after the spinal injection to manipulate the desired spread of intrathecal local anaesthetic. The epidural injection is believed to compress the spinal space resulting in a tailored increased spread. EVE may be beneficial for patients at risk of cardiovascular instability e.g. pre-eclampsia or maternal cardiac disease; however the technique may be associated with undesirable effects, including increased risk of intra-operative pain and reduced duration of action

Spinal Anaesthesia for Caesarean Section

Considerations

A single shot spinal should reliably produce adequate anaesthesia within 10-20 minutes of injection. It is the technique of choice for most obstetric anaesthetists for caesarean section where there is no existing labour epidural. Depending on additives used it may provide post operative analgesia for up to 24 hours. It can be used in the elective and in all but the most urgent of cases where general anaesthesia may be more appropriate. Spinal spread is greater in pregnant compared with non-pregnant women. This is due to the higher intra-abdominal pressures transmitted via the inferior vena cava to the epidural veins which compress the spinal space and produce a higher block for the same volume of local anaesthetic injected into the intrathecal space.

Technique

Patient positioning

- Sitting
 - Identification of the midline easier
 - CSF pressure higher and therefore flow faster
 - Less incidence of post spinal hypotension and requirement for vasopressors
- Lateral
 - Sometimes performed in right lateral to promote spread as patient later positioned in left lateral or with leftward tilt on operating table
 - Time to onset of block may be quicker than sitting or Oxford position
- Oxford Position
 - In this position the spinal is inserted with the woman left lateral with slight head down tilt with her head and shoulders supported to produce an upward curve in the thoracic spine to minimise spread to higher thoracic levels. Following spinal injection the woman is turned to the exact same position on the right side and remains in that position until block is adequate for surgery.
 - By remaining in the lateral position aorto-caval compression is reduced
 - Turning the woman after spinal block can be difficult especially if raised body mass index (BMI)
 - Limited evidence that this positioning technique has any advantage over lateral or sitting positions

Needle

- Pencil Point (e.g. Whitacre, Sprotte)
 - Less likely to cause PDPH
- Cutting (e.g. Quincke)
 - If used, use smallest possible gauge and insert cutting edge in sagittal plane. During dural puncture the fibres are parted rather than cut.
- Gauge

- PDPH is related to size of needle – 25G and 27G pencil point commonly used

Introducer

- Reduces deviation of small gauge spinal needles
- Orientation of introducer needle
 - Cutting edge in saggital plane

Approach

- Midline
 - Shortest distance to dura, least distance to travel through epidural space (reducing risk of damage to structures travelling through the space)
- Paramedian

Baricity of local anaesthetic solution

- Hyperbaric Bupivacaine 0.5% produces a more consistent block.
 - Allows height of the block to be more readily manipulated by positioning

Dose

- 2.2 – 2.5 mls of Hyperbaric Bupivacaine 0.5% is commonly used for a single shot spinal. Lower doses are often effective, may reduce the risk of hypotension but may lead to lower block heights and difficulties if surgery is prolonged.
- In the event an epidural top up for caesarean section results in inadequate sensory block and a spinal is then considered for surgery, there is debate as to the volume of intrathecal local anaesthetic that should be given. There are reports of high blocks in patients where a normal volume (e.g. 2.5mls) is used. This is thought to occur because of the compressive effect on the theca from an epidural space now filled with local anaesthetic. The danger with using a reduced spinal dose is that the second anaesthetic technique might also be inadequate for surgery. Retrospective analysis has shown however that if a normal volume of spinal is used a high block is rare and with appropriate positioning a normal dose can be safely used. Perhaps the best way of dealing with this challenging situation is to avoid finding yourself in it in the first place by not topping up an inadequate epidural!

Barbotage

- CSF is aspirated and seen mixing with the local anaesthetic before re-injecting into the subarachnoid space
- Used as a technique for ensuring needle placement throughout injection (by repeated aspiration and barbotage)
- May increase spread

Speed of injection

- Does not appear to affect spinal spread or the incidence of hypotension

Intrathecal opioids

Intrathecal opioids have a synergistic effect with local anaesthetic agents and act directly on opioid receptors in the spinal cord. They may:

- Reduce intraoperative discomfort
- Prolong spinal analgesic action
- Provide postoperative analgesia and reduce postoperative opioid requirements

Without them approximately 25% of patients undergoing caesarean section with spinal will have unacceptable discomfort intraoperatively. Numbers Needed to Treat (NNT) of 3.6.

Complications

- Pruritis (up to 80%)
 - If this is causing severe maternal distress it can be reduced with low dose naloxone. This can be given as a repeated bolus intravenously of 100mcg or by infusion 500mcg/hr. The half life of opioids is longer than that of naloxone. It is a balance of preserving the desired analgesic effects and reducing the pruritis.
- Nausea and vomiting
- Delayed respiratory depression
- Sedation

The clinical effects are dictated by the physiochemical properties of the opioids. Lipid solubility dictates ease of penetration of neuronal tissue, onset of action and spread within the cerebrospinal fluid (CSF).

Low dose intrathecal opioids do not appear to have an adverse impact on neonatal condition. However they may contribute to neonatal depression if given in high dose.

Fentanyl

A dose of 15 - 20 mcg provides a balance between reducing intraoperative discomfort and side effects; however postoperative analgesia is short lived (up to 4 hours).

Diamorphine

Commonly used in the UK though not available in many parts of the world. A dose of 200 - 300 mcg provides a balance between analgesia and side effects. May last up to 19 hours. It is presented as a powder for dilution increasing preparation time (relevant in emergencies).

Sufentanil

A dose of 2.5 – 5 mcg has been shown to be as effective as fentanyl. It is similarly a lipophilic synthetic opioid with equivocal onset of action and duration of post operative analgesia.

Morphine

100-200mcg preservative free morphine provides postoperative analgesia for up to 24 hours. As a result of its low lipid solubility morphine remains in the CSF longer and has a relatively lower affinity to fix to the spinal cord. This leads to the highest incidence of delayed respiratory depression and other opioid side effects.

Hourly post operative monitoring for respiratory depression has been suggested for 12 hours following diamorphine and 24 for morphine (NICE). The use of non-steroidal anti-inflammatories (NSAIDs) for opioid sparing reduces pruritis.

There is the possibility of combining intrathecal opioids to take advantage of their different pharmacokinetic profiles e.g. fentanyl for rapid onset and morphine for duration of analgesia.

Non-opioid spinal additives

Ketamine (preservative free)

Reduces onset time of sensory and motor block (similar to fentanyl). Does not provide analgesia in the postoperative period.

Clonidine (alpha-2 agonist)

Prolongs analgesia however increased risk of hypotension and sedation in doses required to reduce pain.

Advantages of spinal compared with epidural anaesthesia for caesarean section

- Quicker to perform
- Produces more reliable block with faster onset
- Less trauma to epidural space
- Avoids epidural catheter related complications

Disadvantages compared with epidural

- Increased risk of hypotension and placental insufficiency
- No means of top up if surgery is prolonged

Epidural Anaesthesia for Caesarean Section

Considerations

Epidural top up is an increasingly popular technique for providing anaesthesia for caesarean section as a result of the rising numbers of epidurals inserted for labour pain relief. The quality of the block is often inferior to spinal anaesthesia and should be carefully tested and documented prior to commencement of surgery. Not only should the upper and lower sensory block be documented but also the interceding area as there is a risk of a missed segments leading to a "patchy" block. If labour analgesia from the epidural has been poor then an alternative technique should be considered before the epidural is topped up.

Technique

- Positioning

- Sitting allows easier identification of midline (especially in the obese) but may sometimes be difficult for maternal comfort reasons
- Approach
 - Midline (commonest utilised)
 - Paramedian, (less than 5% in UK)
 - May reduce dural puncture (increased distance between ligamentum flavum and dura relative to midline)
 - If dural puncture does occur may reduce incidence PDPH
 - Increases probability of cephalad catheter placement
- Loss of resistance to saline (LORS) increasingly advocated for identifying the epidural space.
 - Arguably allows more reliable identification of the epidural space, leads to less patchy block and has fewer associated complications
 - Possibly reduced dural tap (saline pushes dura away from needle tip)
 - Reduced risk of venous air embolism
 - Reduced risk of pneumocephalus (dural puncture with LOR air)
 - Many other techniques for identifying the epidural space have been postulated. Recently there has been interest in the use of ultrasound.
- Continuous resistance technique
 - LORS lends itself to continuous resistance (compared with intermittent technique with LOR to air) as saline is non compressible.
 - Safety margin between ligmentum flavum and dural puncture is reduced in pregnancy.
- Predistention of the epidural space with 5 ml saline prior to catheter insertion may reduce epidural vein cannulation and unblocked segments.
- Limiting the length of epidural catheter to 4-5 cm within the epidural space reduces missed segments and risk of catheter knotting.
- Epidural needle should not be rotated
 - Increased risk dural puncture (sometimes tents dura at insertion)
- Epidural catheter should not be withdrawn though needle as risk of “sheering” catheter. If necessary they should be removed together.

Choice of Top up Mix for Caesarean Section

Common regimes for topping up an epidural

- 20 mls 0.5% Bupivacaine or Levobupivacaine
- 20 mls 50/50 0.5% Bupivacaine / 2% Lidocaine with 1:200,000 Adrenaline
- 20 mls 2% Lidocaine with 1:200,000 Adrenaline
- 20 mls 0.75% Ropivacaine

Adrenaline may improve block quality by reducing systemic absorption from the epidural space. It may also aid in identifying inadvertent intravenous injection.

25mcg adrenaline produces a short-lived increase in maternal heart rate of over 10 bpm.

Alkalinisation by addition of *sodium bicarbonate* (e.g. 2mls of 8.4%) is used to improve speed of onset of the block, although evidence supporting its use is limited.

A prospective double blind randomised controlled trial (RCT) comparing the first 3 of the regimes showed no difference with respect to time taken to achieve a block to cold at T4. Bupivacaine was found to be the most reliable and showed the most consistent onset time. More of the lidocaine group required conversion to general anaesthesia or suffered from high blocks. Ropivacaine has been demonstrated to have similar effects to Bupivacaine. More recently a 2% lidocaine-bicarbonate-adrenaline mix was shown to halve the onset time of block for caesarean section compared with levobupivacaine 0.5%.

Recent evidence suggests that there is no advantage in a bolus of fentanyl in patients requiring top-ups for caesarean section who have been receiving labour epidural analgesia with solutions of local anaesthetic containing fentanyl. It does not increase speed of onset or reduce intraoperative supplementation but may increase nausea and vomiting. This is probably due to the maximal opioid effect already being reached with the labour epidural.

More complicated regimes take more time to prepare and increase risk of drug error and this should be considered when selecting a mix for epidural top up.

Top up in the delivery room or in theatre?

Topping up in the delivery room increases the time to build a rapport with the patient and to discuss past medical history and what is about to happen. It may save time whilst the rest of theatre staff and midwives prepare for surgery. It may also reduce the time in theatre with sometimes over expectant obstetric staff. The disadvantage is limited maternal monitoring and potential difficulty dealing with a subsequent case of systemic toxicity from local anaesthetic or a high block.

Speed of injection

It is suggested that top ups of no more than 5 ml of anaesthetic agent spaced by at least 5 minutes will reduce the risk of complications from inadvertent intravenous or intrathecal migration of the epidural catheter and allow for its recognition, reducing the risk of high block or systemic toxicity. Top ups over a shorter period of time are usually acceptable and injection of 20 ml over 3-5 min has been shown to be safe.

Advantages compared with spinal

- If epidural in-situ, prevents risk of undergoing a further procedure.
- Hypotension less pronounced
- Ability to maintain anaesthesia if prolonged procedure

- Option for postoperative analgesia

Disadvantages compared with spinal

- Increases time taken to establish block suitable for surgery
- Less dense block and possibility of missed segments and intraoperative pain
- Sacral block can be problematic
 - Lower extent of block should be documented

It is usually slower to establish an adequate sensory block with an epidural top up compared to spinal or general anaesthesia. The onset time however is often achievable within 10-15 minutes which is generally acceptable in all but the most emergent situations.

Timing of removal

To reduce the risk of epidural haematoma, epidural removal must be timed with dosing of Low Molecular Weight Heparin (LMWH). Removal (or insertion) should be at least 12 hours after last dose of prophylactic LMWH and 4 hours before next dose required. If therapeutic doses of LMWH are used the margin should be greater (at least 24h after last dose)

Combined Spinal / Epidural (CSE) for Caesarean Section

Advantages

- Combines advantages (and disadvantages) of both techniques
 - Rapid onset of spinal block
 - Ability to modify / top-up / prolong anaesthesia with epidural component
 - Spread of spinal anaesthetic can be increased with injection of saline into the epidural space (compression effect of dural sac)
 - Option for post-op analgesia
- Reduces need for conversion to general anaesthetic in event of spinal failure
- Able to use lower dose spinal and modify if required, potentially reducing spinal induced hypotension
 - Advantageous in some cardiac conditions (e.g. aortic stenosis)
 - Arguably advantageous in pre-eclampsia
 - Advantageous in failed labour epidural, normal dose spinal may lead to a high block
- Can produce a denser block than either technique in isolation

Disadvantages

- Potential increased risk – two procedures
- Higher failure rate than individual procedures
- Increased time to perform

- CSE kits more expensive
- Theoretical increased risk of meningitis (breached dura and indwelling catheter)

There are differing techniques and equipment available for CSE. Each have advantages and disadvantages.

- Separate needle same lumbar space
- Separate needle separate lumbar space
- Needle through needle. The epidural space is located as usual with a Touhy needle. A long spinal needle is then placed through the epidural needle and advanced beyond the tip in to the subarachnoid space. Specific kits are available for this technique which enable the spinal needle to be 'locked' on to the epidural needle to reduce the risk of movement of the spinal needle during spinal injection. These kits are usually more expensive. Specific designs and techniques differ:
 - Some allow the epidural catheter to be sited prior to spinal injection, others require it to be positioned afterwards.
 - With or without "backeyes"
 - A hole in the Huber tip of the epidural needle to guide the epidural catheter away from dural puncture site

Considerations

- Performing spinal **before** epidural catheter insertion
 - Problems may arise on inserting epidural catheter after spinal has been performed (e.g. needle through needle technique)
 - Cannulation of epidural vein
 - Resistance to advancement of epidural catheter
 - During the time taken to adjust the epidural catheter the anaesthetist may be distracted from potential hypotension following the spinal injection
 - Theoretical possibility of inserting epidural catheter through spinal dural puncture site
 - Difficulty excluding intrathecal epidural placement since local anaesthetic 'test dose' not possible until the spinal has worn off
 - Risk of inadvertent neuronal damage as warning sign of paraesthesia may be prevented by spinal
 - If procedure performed in the sitting position, prolonged attempts at epidural insertion may result in a low spinal block due to the influence of gravity and hyperbaric local anaesthetic
- Performing spinal **after** epidural catheter insertion
 - Theoretical risk of catheter damage with spinal needle
 - Even if using separate site this is not prevented (with midline approach up to 60% of epidural catheters curl and turn. This may be reduced by limiting the amount of catheter left in the epidural space)

- If saline was used to locate the epidural space this may be falsely identified as CSF resulting in a failed spinal
- Spinal needles used in needle through needle kit are longer and of small gauge (higher resistance)
 - Less “feel” for tissue planes
 - Time is required for CSF flow to be apparent
 - Sitting position may increase CSF pressure and flow
- Possible subarachnoid spread of epidural drugs through dural puncture, with unpredictable response
 - Increased with techniques performed at the same level
 - Subarachnoid pressure is normally greater than epidural, but epidural pressure is increased by drug administration into the epidural space and contractions.

Caesarean section under local anaesthetic infiltration

This is a rarely performed technique

- May be indicated when both general and regional techniques are contraindicated
- May be required in areas where anaesthetic resources, including anaesthetic expertise are limited
- Local anaesthetic toxicity is a significant risk due to requirement for potentially large volumes
- The surgeon must take account of the limitations of this anaesthetic technique to minimise patient discomfort. E.g. gentle handling of tissues, avoiding exteriorisation of the uterus etc.

Self Assessment: Answers / Discussion

A1.

Nulliparous women are more prone to failure to progress than multiparous and at higher risk of intervention for delivery.

- a) and b) The main options available are
- Epidural top up
 - Advantages
 - Avoids further anaesthetic procedure (and potential increased complications) as epidural already in place and working well
 - Better cardiovascular stability compared with spinal
 - Arguably quickest technique as top up can commence immediately, although appropriate availability of monitoring is required.
 - Able to use for postoperative analgesia
 - Disadvantages
 - There is a higher failure rate than with spinal anaesthesia as the block is not as dense and there may be missed segments

- Spinal
 - Advantages
 - Reliable block
 - Able to add opiates for postoperative analgesia
 - Disadvantages
 - Further technique, increased risk of complications
 - Cardiovascular instability
- General Anaesthetic
 - Advantages
 - Speed – not required in this case
 - Indicated if coagulopathy or other contraindication to regional anaesthesia – not apparent in this case.
 - Disadvantages
 - Higher risk of mortality and morbidity to mother and neonate
 - Risk of aspiration
 - Risk of failed intubation

c) It is important to take a full anaesthetic focused history and examination. If a regional technique is chosen there is the possibility of a conversion to general anaesthetic, this may be required quickly. Particular attention should be made to airway assessment and any history suggestive of potential cardiovascular compromise (e.g. Rheumatic Heart Disease). The wishes and expectations of the patient are important and part of informed consent prior to any procedure.

An assessment of the labour epidural is required; Has it been working? Has there been any missed segments / is it patchy? What level is the block at currently? Has the women required other analgesia? Has she required regular top ups for labour analgesia? Have they worked? Has she had a top up recently?

If the analgesia from the labour epidural has been poor then it is highly likely that the anaesthetic block provided will be accordingly poor. An alternative technique should be considered. Requirements for additional analgesia and requests for regular top ups are a useful indicator of epidural effectiveness. If there is doubt about the quality of epidural block then a spinal is a good alternative. There is debate about whether the epidural catheter should be left in situ whilst performing this, or removed prior. There is a theoretical risk of trauma to the epidural catheter with the spinal needle and an increased infection risk although both rare. The epidural could still be used to provide postoperative analgesia. Provided the block level of the labour epidural is not inappropriately high it has little bearing on top up dose given, because the low doses used do not provide a good enough quality of block for surgery. There is debate over how long after an epidural top up a spinal anaesthetic can be safely given without the risk of a high spinal and what dose reduction if any should be used.

This effect occurs because of the compressive effect of fluids in the epidural space on the subarachnoid space. It is common practice not to attempt a spinal following failure of an epidural top up with 20 mls of solution for this reason.

- d) Communication of how urgent the category 1 section is should be ascertained. The same three options still exist. It may be just as quick to top up a working epidural as it is to perform a single shot spinal or a general anaesthetic. The block quality from an epidural top up is not as good as with a spinal and there is a risk of failure requiring supplementation of analgesia or possibly a general anaesthetic (GA) which would delay delivery. Therefore there should be a lower threshold for spinal or GA if there is doubt over the quality of the epidural.

A2.

- a) There is debate over which solution is best for epidural top up (see text). To some extent it is matter of personal preference and local availability. Practice varies significantly. The author's preference is for plain 0.5% levobupivacaine.
- b) The advantages for this are:
- It does not require dilution and mixing with the possible associated drug errors
 - It takes longer to mix if using more than one drug.
 - Single enantiomer levobupivacaine has a better cardiotoxicity safety profile compared with bupivacaine.
 - The tachycardia associated with addition of adrenaline to identify inadvertent intravenous injection is difficult to interpret in an anxious patient in labour about to undergo an unexpected emergency procedure and arguably offers little advantage.
 - Limited evidence that lidocaine or addition of sodium bicarbonate improves onset time of anaesthetic block.
 - Some evidence that the block produced by bupivacaine alone is more reliable and predictable.
 - There is evidence that a slow bolus of 20 mls of bupivacaine is safe and will produce anaesthesia within 15 mins.

Opioids can also be used as part of an epidural top up. There is some evidence that if opioids (in this case fentanyl) have been used as part of the maintenance epidural infusion then there is little to be gained by a further dose as local receptors are already maximally occupied. 50 mcg bolus of fentanyl is still commonly given epidurally.

- c) Commencing the anaesthetic in the labour room is controversial. If it is a category 1 caesarean section then time is valuable. The risk is that the woman is not as well monitored as she would be in the theatre

environment. Management of complications of epidural catheter misplacement (high spinal, inadvertent intravenous injection leading to seizures or cardiovascular collapse) may be more challenging.

- d) Preparation for the caesarean section can commence as soon as the decision is made. Thromboprophylaxis and antacid prophylaxis should be given although should not delay transfer to theatre (i.e. thromboembolic stockings, H₂ antagonists and sodium citrate).
- e) As discussed in the text there is some debate over the most reliable and reproducible method of checking the block to predict pain free surgery. A combination of a good motor block, cold testing to T4 and arguably most reliably soft touch to T5 is suggested. When checking an epidural block it is important to check the lower extent of the required block and the interceding segments. It is important to document these levels.
- f) The epidural catheter can migrate out of the epidural space (*failure, unilateral block*), into an epidural blood vessel – engaged in late pregnancy and especially mid contraction (*inadvertent intravenous injection*) or into the spinal space (*high spinal – injection of dose intended for the epidural space into the subarachnoid space*).

A3.

Ongoing communication with women undergoing regional techniques for caesarean section especially in the emergency setting is essential. It is important to set expectations and to prepare the woman that she will still feel sensation of pressure and for short-lived times this may be uncomfortable (e.g. fundal pressure at time of delivery). Pain has a subjective element and can be difficult to assess. There are various options to supplement analgesia / anaesthesia and choice depends on the degree of discomfort and how far into the operation the pain occurs

- Temporarily stop operating
- Entonox
- Local infiltration of lidocaine by the surgeons
- General anaesthetic
- Following delivery a fast acting opiate (e.g. alfentanil in 50mcg increments, titrated to pain)
- The short acting nature of Remifentanil makes it is a possibility even prior to delivery of neonate. Beware of respiratory depression.
- Good communication with frequent reassurance and passing the baby to the mother will often help reduce the sensations of discomfort

Attending paediatricians need to be aware of opiates given to mother and naloxone should be available.

Pain experienced during caesarean section under regional anaesthesia is increasingly becoming a reason for litigious action against the obstetric anaesthetist. All women should be warned that pain can occur though this is uncommon if the block is adequately tested. Documentation of pain during regional anaesthesia and what was done about it is vital.

Recommended reading

Yentis S, May A, Alhotra S. Analgesia, anaesthesia and pregnancy. A Practical Guide. *Cambridge University Press*. 2007

Levy DM. Emergency Caesarean Section: Best Practice. *Anaesthesia*. 2006; **61**: 786-791

Confidential Enquiry into Maternal and Child Health <http://www.cemach.org.uk/>

Royal College of Obstetricians and Gynaecologists' Clinical Effectiveness Support Unit. The National Sentinel Caesarean Section Audit Report. *London RCOG*, 2001 http://www.rcog.org.uk/resources/public/pdf/nscs_audit.pdf

NICE guidelines for caesarean section
<http://www.nice.org.uk/guidance/index.jsp?action=download&o=29331>

Cook TM. Combined spinal-epidural techniques. *Anaesthesia* 2000. **55**; 42-64

Loo CC, Dahlgren G, Irestedt L. Neurological complications in obstetric regional anaesthesia. *International Journal of Obstetric Anaesthesia* 2000; **9**: 99-124

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