

# RECENT DEVELOPMENTS IN ANAESTHESIA FOR CAESAREAN SECTION

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## Introduction

This article reviews current best practice for delivery of safe anaesthesia for obstetric services. Many of the recommendations are based on standards set within the UK, and the vast majority of these are relevant to practice in any country around the world. Resource limitations may make adherence to some suggested practices impossible, but these are included for educational value.

## United Kingdom practice

Over the last ten years the rising caesarean section rate in the developed world has stimulated discussion of best anaesthetic and obstetric practice. Much of the impetus for improving obstetric care in the UK has been driven by the findings of the Confidential Enquiry into Maternal and Child Health (CEMACH),<sup>1</sup> formerly the Confidential Enquiry into Maternal Death (CEMD). Over a three year period, CEMACH reports the deaths of UK women while pregnant or within 42 days of the end of pregnancy. An extensive audit of the management of caesarean sections in the UK was reported in 2001.<sup>2</sup> These findings contributed to the development of guidelines by the National Institute for Health and Clinical Excellence (NICE), an independent agency set up by the Department of Health with the responsibility of advising on best clinical practice. NICE published guidance on caesarean section in 2004 and made recommendations that, for UK practice, form a standard of care on obstetric and anaesthetic aspects of management.<sup>3</sup>

## Worldwide practice

The World Health Organisation (WHO) recommends an optimum caesarean section rate of 5-15% to ensure best outcome for mother and neonate.<sup>4</sup> Rates in Sub-Saharan Africa are a lot lower than this, possibly as low as 1%.<sup>5</sup> This is a reflection of availability of resources and distance from medical facilities and trained staff. This low rate contributes to a high maternal and neonatal morbidity and mortality. Maternal mortality has been estimated to be over 1% in West Africa and severe maternal morbidity as high as 9%.<sup>6</sup> These mortality and morbidity rates are over 30 times those of the developed world.

It has been suggested that, as a minimum standard, a health service should aim to provide caesarean section for all maternal indications, if not neonatal. The main maternal indications are obstructed labour, placental abruption, previous caesarean section, eclampsia, placenta praevia and malpresentation.<sup>5</sup> In areas where HIV is prevalent, caesarean section may



*The rate of caesarean section in developing countries is increasing. Where facilities exist this is performed under spinal anaesthesia.*

increasingly be indicated to reduce risk of transmission from mother to child.<sup>2</sup>

Caesarean section itself is associated with a significant mortality and morbidity and improvements in surgical and anaesthetic management can reduce this. In a prospective study conducted in Latin America, which investigated more than 105,000 deliveries, mothers delivered by caesarean section were over two times more likely to suffer from severe maternal morbidity compared with vaginal delivery. Neonatal mortality was also increased by over 1.7 times. In breech presentation caesarean section was found to be protective.<sup>7</sup>

Important issues that are influencing current practice in obstetric anaesthesia for caesarean section in the UK are outlined below. Many of these are also relevant to practice around the world.

## Categorisation of urgency of caesarean section

The traditional categorisation of elective and emergency caesarean section has limitations both for optimal communication in the clinical setting and for post-delivery audit. A four tier classification, shown in table 1, has been proposed and broadly accepted.<sup>8</sup>

The suggested standard for a category 1 caesarean section is delivery within 30 minutes of the time of decision. It is debatable whether there is evidence linking this time period with neonatal outcome<sup>9</sup> and

Table 1: Categorization of urgency of caesarean section

Grade	Definition
Category 1	Immediate threat to life of woman or fetus
Category 2	Maternal or fetal compromise, not immediately life threatening
Category 3	Needing early delivery but no maternal or fetal compromise
Category 4	At a time to suit the woman and maternity team

for some category 1 caesareans, delivery may need to be well within the 30 minute threshold.

### General anaesthesia for caesarean section

As a result of the increased mortality and morbidity associated with general anaesthesia, 84% of caesarean sections in the UK are performed under neuraxial anaesthesia (i.e. spinal, epidural or combined spinal/epidural).<sup>2</sup> Of concern is the fact that CEMACH/CEMD has reported an increase in maternal deaths from general anaesthesia over the last three enquiries. General anaesthesia is now only indicated if the woman refuses a regional technique, if there is a specific medical condition which precludes neuraxial blockade (e.g. coagulopathy) or when it is felt there is not enough time available to provide a regional anaesthetic. In many poor resource settings availability of appropriate equipment, such as spinal needles, local anaesthetic and vasopressor drugs will strongly influence the proportion conducted under neuraxial blockade.

### Rapid sequence induction

It is widely accepted that rapid sequence induction is required for general anaesthesia for caesarean section however there is debate as to the best choice of agents to allow effective and safe control of the airway. The traditional practice of cricoid pressure, thiopentone, suxamethonium and avoidance of opiates remains the most common approach by obstetric anaesthetists in the UK; however the emergence of new agents and techniques may challenge this accepted technique in the future.

### Induction agent

There is vast experience of thiopentone in this setting and it is currently the induction agent of choice for caesarean section. A dose of 4mg/kg (up to 500mg) has been suggested to avoid awareness, minimize maternal hypertension and prevent delayed waking in the event of failed intubation. Propofol is an alternative agent for caesarean section however in one study it has been associated with more maternal hypotension, possibly increased risk of maternal awareness and worse Apgar scores in the neonate when compared with thiopentone.<sup>10</sup> Other studies

however have shown no difference. No studies have shown superiority of propofol. Ketamine has a place in the management of the hypovolaemic obstetric patient requiring caesarean section and experience and confidence with this drug is likely to be far greater in many under-resourced areas than in the UK.

### Muscle relaxant

Suxamethonium is currently the muscle relaxant of choice. It produces excellent intubating conditions quickly and reliably and in the event of a failed intubation there is rapid offset. Where available rocuronium (an aminosteroid) is becoming increasingly popular with obstetric anaesthetists in place of suxamethonium.<sup>10</sup> A disadvantage is the need for prolonged ventilation in the event of failed intubation; however rocuronium avoids many of the potential side effects and complications of suxamethonium and produces equivalent intubating conditions although the onset may be slower.

The imminent arrival on the market of a specific reversal agent for rocuronium (Sugammadex) will likely reduce the use of suxamethonium for caesarean section in more affluent health systems. Expense and availability may potentially be restrictive in the short term.

### Depth of anaesthesia monitoring

General anaesthesia for obstetric patients is associated with a higher incidence of awareness compared with the general population and this has led to consideration of depth of anaesthesia monitoring for this patient group.<sup>11</sup> There are several commercially available devices, most based on technology that processes EEG (electroencephalogram) waves and presents them in a readily interpretable manner e.g. Bispectral Index (BIS) monitoring. Although depth of anaesthesia monitoring in caesarean section is not routinely practiced in the UK, its use may potentially increase in the future.

### Regional anaesthesia for caesarean section

#### Management of hypotension

There has been a shift from the long held belief that vasoconstrictors should be avoided following subarachnoid block, because of a possible detrimental effect on uterine blood flow. Studies on sheep had previously shown this and as a result ephedrine was felt to be the vasopressor of choice. There is now a growing body of evidence that alpha-adrenergic agonists (e.g. phenylephrine and metaraminol) prevent spinal induced hypotension more effectively and result in improved umbilical artery pH.<sup>12</sup> Ephedrine appears to contribute to fetal acidosis by crossing the placenta and increasing fetal metabolic activity. The alpha-adrenergic agonists are now preferred, if available, and 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.

Another technique that may reduce hypotension and vasopressor requirements following spinal anaesthesia is through combination of a reduced spinal dose of local anaesthetic with epidural volume extension (EVE), using a combined spinal epidural (CSE) technique.<sup>13</sup> 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.

#### *Testing of adequacy of block*

(See also 'Assessment of spinal anaesthetic block' in Update 22).

Spread of subarachnoid and epidural local anaesthetic varies between patients and may be influenced by the volume of anaesthetic used, patient positioning and local anaesthetic baricity. It is essential to test the adequacy of sensory block prior to commencement of surgery to prevent pain during caesarean section.

Sensory modalities of light touch, temperature (cold) and pinprick are transmitted by different nerve fibres and are frequently found to be at inconsistent levels relative to each other following spinal local anaesthetic injection. Traditionally cold, as it is transmitted with pain in the spinothalamic tracts, has been used to document block adequacy, however there is evidence that the sensation of pain returns prior to a clinically detectable return of cold at any given level. Over the last decade light touch has been increasingly regarded as the modality that confers the best indication of pain free surgery with a block to T5 considered the acceptable target.<sup>14</sup> Both the most accurate method of assessing touch sensation and also the exact location of the T5 dermatome, remain unclear.<sup>15</sup>

#### **General issues**

##### *Use of oxytocic drugs*

Bolus administration of syntocinon (oxytocin) following caesarean delivery reduces the risk of post-partum haemorrhage (PPH). In addition, many obstetric units now routinely give an infusion in the immediate postoperative period (e.g. 10 IU syntocinon/hour for 4 hours). Syntocinon causes vasodilation and tachycardia and bolus injection has been associated with catastrophic collapse in vulnerable parturients. In light of these cases a reduction in dose from 10 IU to 5 IU, given slowly following caesarean delivery, has been recommended.<sup>1</sup> In women at very high risk, for example women with significant cardiac disease, syntocinon should be avoided, or, if clearly indicated, given in a dilute infusion over 10 to 15 minutes.

#### **Major obstetric haemorrhage**

(See also 'Obstetric haemorrhage' in Update 21).

This was highlighted by CEMACH as a significant cause of maternal mortality, especially given the rising caesarean section rate. Previous caesarean section increases the incidence of low lying placenta and the chance of placenta accreta.

There have been several advances in management of major obstetric haemorrhage:

##### *Drugs to improve uterine tone*

- Further syntocinon (oxytocin) - given slowly IV.
- Ergometrine (IM) - acts on smooth muscle (causes vasoconstriction / hypertension).
- Carboprost (e.g. hemabate) IM or directly into myometrium – a prostaglandin (avoid in asthmatics, risk of bronchospasm / hypertension) .

##### *Interventional radiology*

- Use of arterial balloons or embolisation to prevent or control PPH.
- Balloons can be placed electively prior to high risk cases (e.g. suspected placenta accreta) or used in an emergency to reduce the need for hysterectomy, requirement for blood products and ICU admission.<sup>16</sup>

##### *Intraoperative cell salvage*

- This is a technique that collects and washes the patient's own red blood cells. The cells are then processed in a suspension, filtered and returned to the patient. This reduces the requirement for transfused blood.
- Concerns over amniotic fluid embolus appear unproven.

##### *Use of recombinant activated Factor VIIa (rFVIIa / Novoseven ®)*

- There is a growing number of reports of rFVIIa being successfully used to treat coagulopathy associated with massive obstetric haemorrhage, but to date there are no randomised controlled trials.
- rFVIIa binds to tissue factor at the site of endothelial damage initiating localised haemostasis.<sup>17</sup>
- There is an unsubstantiated concern that it may lead to an increased incidence of systemic thrombotic events.
- The cost of a standard single 90mcg/kg dose in the UK is about £4000.

##### *Thromboelastography (TEG)*

- Many patients with obstetric haemorrhage develop an associated coagulopathy. TEG is a near-patient testing device that provides dynamic information on all aspects of coagulation and can help guide appropriate replacement of blood products.

### *Blood transfusion*

- In the obstetric setting there is a decreasing trend in use of blood transfusion outside the setting of major haemorrhage.
- This follows the TRICC study, a large trial in critically ill (non-obstetric) patients, proving the outcome of patients treated with a restrictive transfusion strategy (only transfusing at a haemoglobin level of less than 7g/dl) was at least as good as those treated with a liberal strategy.<sup>18</sup> This reduces exposure to the risk of transfusion in otherwise healthy individuals.

### **Fetal monitoring**

Cardiotocography (CTG) consists of an external transducer that continuously records fetal heart rate and uterine contractions. It is commonly used in higher risk labours although it has a relatively low specificity and sensitivity for identifying fetal distress. The diagnosis of fetal compromise from CTG is one factor felt to contribute to the increased rate of emergency caesarean sections. Methods of improving sensitivity, such as combining CTG with fetal electrocardiography (fetal ST segment analysis, STAN®) or increased use of fetal blood sampling to detect fetal acidosis (pH<7.2) as supporting evidence for diagnosis of fetal distress, have been suggested.

### **Postoperative analgesia**

Single shot spinals are the most frequently used technique for both elective and emergency caesarean sections in the UK.<sup>19</sup> The practice of adding preservative free opiates (e.g. morphine, diamorphine) extends postoperative analgesia and is now common practice in the UK. Maternal side effects include pruritus, sedation and delayed respiratory depression, particularly if other opiates are co-administered.

Following general anaesthesia for caesarean section, regional techniques such as bilateral ilioinguinal, rectus sheath blocks or transversus abdominus plane (TAP) blocks may be useful to improve postoperative analgesia.<sup>20</sup>

Post-caesarean pain relief should be multimodal using simple analgesics including regular paracetamol and non-steroidal anti-inflammatory drugs to help reduce opiate requirements. Effective analgesia is important for early mobilisation and prevention of thromboembolic events.

### **Thromboprophylaxis**

Thromboembolic disease (TED) consistently represents the leading cause of direct maternal death in the UK. Its prevention and a low threshold for investigation and treatment of suspected cases are essential. The Royal College of Obstetricians has recommended thromboprophylaxis guidelines based on risk stratification of obstetric patients.<sup>2</sup> Rising rates of obesity in the UK are contributing to the increasing obstetric risk of TED. Caesarean section

is an independent risk factor for TED with a relative risk of 3.8.<sup>2</sup> Simple measures such as graduated thromboelastic stockings, adequate hydration and early mobilisation should be considered for all patients. Prophylactic, once-daily low molecular weight heparin is routinely given in the UK. Timing of this relative to neuraxial anaesthesia and removal of epidural catheters must be considered.

### **Issues in training**

With the reduced number of caesarean sections performed under general anaesthesia and the increased rate of failed intubation in this population, it is essential that failed intubation drills are regularly practiced and there is immediate availability and familiarity with alternative emergency airway equipment.

The experience of the aviation industry in using high-fidelity simulation to train and demonstrate competency is increasingly used in anaesthesia training in the UK.<sup>22</sup> This may have a role in practising anaesthetic management of uncommon events including failed obstetric intubation and obstetric collapse.

### **Conclusion**

With the rate of caesarean section increasing in the developed world it is likely that the absolute number of complications from obstetric surgery and anaesthesia will increase. Best practice must be constantly debated, adopted and audited to reduce morbidity and mortality.

The issues and advances above are relevant to obstetric anaesthesia throughout the world though, for now, limitations in availability of equipment and resources may preclude their full implementation. Africa accounts for 47% of global maternal mortality;<sup>23</sup> this can be reduced with systematic improvement in education, training, funding and resources.

### **Recommended Reading**

- Levy DM. Emergency caesarean section: Best practice. *Anaesthesia*. 2006; 61:786-791
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