

Anaesthesia for Caesarean Section. Part 1

Introduction and Overview

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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**

Self Assessment

Q1

When considering indications and categorisation of caesarean sections:

- a) Caesarean section carries an overall higher neonatal mortality compared with normal delivery?
- b) Recommended population caesarean section rates are less than 5%?
- c) Breech presentations should routinely be booked for a Category 4 caesarean section?
- d) A category 1 caesarean section should aim to be delivered within 45 mins to prevent detrimental fetal outcome?
- e) Category 1 caesarean sections should be delivered under general anaesthetic where immediately available?

Q2

In relation to Oxytocic drugs:

- a) Syntocinon is a synthetic analogue of the naturally occurring oxytocin which is released from the anterior pituitary gland?
- b) 10 units of syntocinon should be given as an i.v. bolus on delivery of the baby at caesarean section?
- c) If given for a prolonged period of time syntocinon can result in convulsions?
- d) The half life of syntocinon is 10 mins?
- e) Ergometrine is commonly combined with syntocinon as an intravenous preparation as a second line treatment of uterine atony?

Q3

You are called urgently to the labour room to assess a woman with fetal distress. Your immediate actions may include:

- a) Assessing the severity of fetal distress?
- b) Establishing intravenous access?
- c) Ensure the mother is always placed in the left lateral position (using a wedge)?
- d) Methods to reduce uterine contraction strength and frequency?
- e) Assessment and preparation of the patient for consideration of appropriate anaesthetic technique?

Q4

Recommendations from the latest Confidential Enquiry into Maternal and Child Health (CEMACH) to prevent maternal and neonatal mortality and morbidity include:

- a) Pre-conception counselling?
- b) Routine medical assessment prior to 20 weeks?
- c) Women who have had previous caesarean section should be booked for a category 4 section?
- d) The report suggests medical, midwife and obstetric staff are good at early recognition of critical illness in obstetric patients?
- e) The report found overall maternal mortality of 1:1000 in the UK?

Key Points

- Caesarean section is undertaken to improve maternal or fetal outcome.
- There is an increasing rate of caesarean section. Currently 1 in 5 pregnant women are delivered by caesarean in the UK.
- Many factors influence the method of anaesthesia used. There is an informed trend towards regional anaesthesia in the majority of cases.
- Good communication between the multidisciplinary team is essential, especially in the emergency situation where urgency is best communicated by a universally understood categorisation system.

Introduction

Caesarean section is undertaken to improve maternal or fetal outcome, or to reduce anticipated complications from spontaneous labour and vaginal delivery.

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), 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. These findings contributed to the development of guidelines by the National Institute for Health and Clinical Excellence (NICE), a UK agency responsible for advising on best clinical

practice. NICE published guidance on caesarean section in 2004 and made recommendations that form a standard of care on obstetric and anaesthetic aspects of management.

WHO recommends an optimum caesarean section rate of 5-15% to ensure best outcome for mother and neonate. Rates in Sub-Saharan Africa are a lot lower than this, possibly as low as 1%. 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%. These mortality and morbidity rates are over 30 times those of the developed world.

It has been suggested that as a minimum, a health service should aim to provide caesarean section for maternal indications, if not neonatal. The main maternal indications being obstructed labour, placental abruption, previous caesarean section, eclampsia, placenta praevia and malpresentation. In areas where HIV is prevalent, caesarean section may be increasingly indicated to reduce risk of transmission from mother to child.

Caesarean section itself is associated with a significant morbidity and mortality 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 2 times more likely to suffer from severe maternal morbidity compared with vaginal delivery. Neonatal mortality was also increased by over 1.7 times. Caesarean section was found to be protective in breech presentation.

Indications for Caesarean Section

- Previous Caesarean Section*
- Malpositions* (Breech)
- Fetal Distress*
- Dystocia (Failure to progress during labour) *
- Maternal Disease
 - Worsening pre-existing disease (e.g. cardiac)
 - Associated with pregnancy (e.g. pre-eclampsia)
- Placenta Praevia or abruption
- Multiple Pregnancy
- Cord Prolapse
- Maternal Choice

* indicates 4 commonest reasons (constituting over 70% of Caesarean Sections)

Categories of Caesarean Section

The traditional categorisation of caesarean section into 'elective' or 'emergency' has limitations for both optimal communication in the clinical setting and for post-delivery audit. A four tier classification has been proposed and broadly accepted.

Grade	Definition
Category 1	Immediate threat to life of woman or fetus <i>(e.g. Placental Abruption, Uterine Rupture, Active Bleeding, Severe Fetal Compromise)</i>
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

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

Communication between members of the multidisciplinary team is vital, especially the required urgency which will influence anaesthetic technique. It should be possible to identify and prepare a plan for at risk patients on the labour ward who may become an emergency. This may make the difference between the possibility of planned, timely regional anaesthesia and an emergency general anaesthetic.

The Emergency Caesarean Section (Category 1)

The majority of category 1 caesarean sections (63%) performed in the UK are for fetal compromise.

Fetal Distress

Fetal distress is severe fetal hypoxia resulting in fetal acidosis and potential long term cerebral complications. In-utero fetal resuscitation may be required prior to caesarean section and the following simple (**SPOILT**) steps should be undertaken:

Syntocinon off

Position – Left lateral *(if persists try right lateral or knee-elbow position-umbilical cord compression may be the cause rather than aortocaval compression)*

Oxygen

I.v. infusion: 1 litre crystalloid

Low Blood Pressure – i.v. ephedrine

Tocolysis: terbutaline 250mcg s.c./i.v (selective β -agonist)/ GTN 2 puffs s.l.

(not if antepartum haemorrhage or abruption)

Intrapartum Fetal Monitoring

Fetal wellbeing is commonly assessed with cardiotocography (CTG). CTG monitoring 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.

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 recommended.

CTG Monitoring

- Reassuring signs are of variability of the fetal heart of 5-25 beats/min and accelerations with fetal movement or uterine contractions.
- Concerning indicators include reduced heart rate variability, fetal tachycardia and late decelerations in fetal heart rate.

Decelerations are classified as:

- *Early* – worst at peak of uterine contraction
- *Variable* – follow contractions, but timing is erratic. Normally reflection of umbilical artery obstruction (more common with oligohydramnios).
- *Late* – worst after the peak of uterine contraction. This is a reflection of fetal hypoxia.

Fetal heart rate abnormalities may be seen in up to 20% after regional analgesia. This may be due to subsequent supine positioning.

The Elective Caesarean Section (Category 4)

Normally planned for 39 weeks, balancing advantage of maximising gestational age and risk of mother going in to spontaneous labour. Prior to 39 weeks there is an increased risk of respiratory morbidity in the neonate.

The Surgical Approach

The recommended approach is the “Joel Cohen” incision. A straight transverse incision 3cm above the pubis symphysis (usually L1 dermatome).

Advantages

- Less postoperative pain
- Shorter operating time
- Better cosmetic effect (compared with midline)

In a classical caesarean section the uterine incision is vertical. This increases surgical access but is associated with a higher risk of haemorrhage, infection, and uterine rupture with subsequent pregnancies.

Externalisation of the uterus following delivery has been shown to increase postoperative pain, increase nausea and vomiting and may induce a vagal response. It is also a risk factor for air embolism. Intraperitoneal uterine repair is therefore recommended.

Complications of Caesarean Section

- **Surgical**
 - Intraoperative
 - Mother
 - Haemorrhage
 - Damage to surrounding structures
 - Air / Amniotic Fluid Embolus
 - Fetus
 - Trauma
 - Delayed Delivery – associated risk hypoxia
 - Postoperative
 - Thromboembolic events
 - Infection
 - Retained products
 - Adhesions
 - Risk for subsequent caesarean sections
 - Low lying placenta and placental Accreta
- **Anaesthetic**
 - Specifically related to regional anaesthesia – *See tutorial 2*
 - Pain during procedure
 - High block etc
 - Specifically related to general anaesthesia – *See tutorial 3*
 - Failed intubation
 - Awareness etc
 - Anaphylaxis
 - Exacerbation of pre-existing maternal disease
 - Valvular heart disease (e.g. Rheumatic Fever associated)
 - Exacerbation of pregnancy related disease
 - Pregnancy related cardiomyopathy

Factors Influencing decision for method of anaesthesia for Caesarean Section

As with all anaesthetic techniques there is a risk / benefit balance that must be considered, taking into account all pertinent factors relating to mother and fetus.

- Maternal preference
- Presence of effective labour epidural
- Maternal conditions precluding regional anaesthesia e.g. Pre-eclampsia with clotting abnormality
- Airway considerations – potential or previous difficult airway

- Urgency of caesarean section
- Experience and preference of attending anaesthetists

General Management of Women for Caesarean Section

Preoperative Assessment

- Essential for identifying potential problems and for producing an acceptable management plan.
- Potential difficulties identified by obstetric staff early in pregnancy, should ideally be referred to a senior anaesthetist in a timely manner to jointly consider available options. E.g. significant cardiac disease, obesity, difficult airway.

Check Haemoglobin

- A preoperative full blood count is advised for all patients undergoing caesarean section. Blood group and save should be performed in those considered at risk of perioperative blood loss or with pre-existing anaemia.

Large Gauge Intravenous Access

- Reliable large gauge intravenous access should be established (ideally at least 16G). A second IV should be considered in all individuals considered at additional risk of haemorrhage.

Antacid Prophylaxis

- Antacid prophylaxis should be prescribed to all women undergoing caesarean section.
- A combination of H₂ antagonist (e.g. ranitidine) and metaclopramide is frequently prescribed orally if time permits and can be given IV in the emergency situation.
- These measures aim to increase gastric pH and reduce gastric volume. Acid aspiration syndrome is more common if volume aspirated >25mls and pH<2.5.
- Sodium citrate 30ml immediately prior to the procedure further reduces the acidity of gastric contents.

Fasting

- Women for elective caesarean section should be starved for 6 hours. It is suggested that women in active labour or having requested opioid analgesia should refrain from solids or semi-solids.

Patient Positioning

- Supine positioning should be avoided in all women presenting for caesarean section.
- Left lateral tilt reduces aortocaval compression and hypotension secondary to reduction in preload.

Patient Monitoring

- Continuous pulse oximetry, non-invasive blood pressure monitoring and ECG – for induction/regional injection, maintenance and recovery.
- Fetal monitoring should ideally continue during preparation for surgery where there are concerns with fetal well-being.

Prophylactic Antibiotics

- Prophylaxis may reduce the risk of fever, endometritis, wound infection, urinary tract infection and serious infection post caesarean section.
- No difference has been shown with more than one dose or between amoxicillin and different generation cephalosporins.

Use of Antiemetics

- Emesis is often a response to hypotension secondary to regional anaesthesia; this should be actively managed and where possible prevented.

Use of Oxytocic Drugs

- Bolus administration of syntocinon (oxytocin) following delivery reduces the risk of post-partum haemorrhage.
- Many units now routinely give an infusion in the immediate postoperative period (e.g. 10 iu syntocinon / hour for 4 hours).
- Syntocinon causes vasodilatation and tachycardia and bolus injection has been associated with catastrophic collapse in vulnerable parturients. 5 iu i.v should be given slowly following caesarean delivery.
- In women at very high risk, e.g. the parturient with significant cardiac disease, syntocinon may sometimes be best avoided, or given in a dilute infusion over 10 to 15 minutes.

Thromboprophylaxis

- Thromboembolic disease (TED) consistently represents the leading cause of direct maternal death in the UK.
- Measures aimed at prevention and a low threshold for investigation and treatment of suspected cases are essential.
- Rising rates of obesity in the UK are contributing to increasing obstetric risk of TED. Caesarean section is an independent risk factor for TED with a relative risk of 3.8.

Increased Risk

- Emergency caesarean section
- Maternal age over 35
- Weight over 80 kg
- Pre-existing or family history of thrombophilia
- Other medical conditions
 - Diabetes

- Neurological disorders / other disorders reducing mobility
- Multiple pregnancies
- Pre-eclampsia

Interventions

- Hydration
- Good analgesia to encourage early mobilisation
- Graduated elastic compression stockings (TEDS)
- Low Molecular Weight Heparin (once daily) – Timing with neuraxial anaesthesia must be considered
- Active calf compression devices

Postoperative analgesia

- Post-caesarean pain relief should be multimodal using simple analgesics including regular paracetamol and NSAIDs to help reduce opiate requirements. Effective analgesia is important for early mobilisation and prevention of TED.
- Choice of postoperative analgesia will be influenced by local experience, support and familiarity with techniques.

Various post operative regimes can be employed and will depend on the original anaesthetic technique used.

- Single shot spinals are the most frequently used technique for both elective and emergency caesarean sections in the UK. The practice of adding preservative free opiates (e.g. morphine, diamorphine) extends postoperative analgesia and is now common practice. Maternal side effects include pruritus, sedation and delayed respiratory depression. Risk of delayed respiratory depression is increased if other opiates are co-administered.
- A working epidural can be left in situ and utilised or long acting opiates added to an epidural prior to removal.
- Emergency caesarean sections performed under general anaesthetic often require an ongoing opiate regime either orally, intramuscularly or intravenous (continuous or intermittent-Patient Controlled Analgesia (PCA)). Alternative regional techniques such as bilateral ilioinguinal, rectus sheath blocks or transversus abdominis plane (TAP) blocks may be useful to supplement postoperative analgesia.

The choice of postoperative analgesia will be influenced by local experience, resources, nursing support and familiarity with techniques.

Postoperative monitoring

All patients receiving intrathecal or epidural opioids should be clinically observed for evidence of respiratory depression and sedation. Naloxone should be available if required. The aims of postoperative monitoring are to ensure:

- Recovery from regional or general anaesthesia

- Detection of PPH and other complications of procedure
- Adequate pain relief

Transfusion Triggers

- Blood loss of >1000mls occurs in 4-8% of caesarean sections. It is more common with general anaesthesia than regional techniques.
- Unless there is ongoing active bleeding current opinion is for restrictive use of blood transfusion. In otherwise fit patients there is no advantage in transfusing at Hb levels of above 7-8 g/dL and it may have added risks.

Drugs and Breast Feeding

In general many drugs are excreted in the breast milk but no problems from transfer to the neonate through breast feeding are seen in the commonly used anaesthetic or analgesic agents. Limited trial data leads universally to manufacturers advising caution.

- **Anaesthetic agents**
 - *Thiopentone, Propofol, Volatile Agents*
 - Insignificant quantities in breast milk
 - Benzodiazepines
 - No problem with single dose, prolonged use not advised
 - *Muscle relaxants*
 - Not excreted in breast milk
- **Analgesics**
 - *Paracetamol / NSAIDS / Opiates*
 - Not known to cause harm in therapeutic doses
- **Antiemetics**
 - All advise use with caution, not known to cause harm
- **Anticoagulants**
 - No apparent problem with short term LMWH given prophylactically post operatively, manufacturer advises to avoid

Training in Obstetric Anaesthesia

The Use of Simulators

With reduced hours available for training in many developed countries, concerns have been raised about how anaesthetists can attain relevant skills in obstetric anaesthesia especially with respect to management of caesarean sections performed under general anaesthesia. It is essential that each department has a failed intubation drill that is regularly practiced and there is immediate availability and familiarity with alternative emergency airway equipment.

Training through simulation may contribute to development and retention of such skills. 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. This may have a role in practicing anaesthetic management of uncommon events including failed obstetric intubation and obstetric collapse.

Self Assessment Answers

A1

- A: T In large cohort studies neonatal mortality has been shown to be increased by 1.7 times in neonates delivered by caesarean section compared with normal vaginal delivery.
- B: F Caesarean sections are undertaken to improve maternal or fetal outcome. WHO recommends an optimum caesarean section rate of 5-15%. It is higher than this in the UK and much lower in Sub-Saharan Africa.
- C: T Caesarean section is protective, reducing neonatal mortality associated with breech presentation. Accurate diagnosis requires a reliable and timely ultrasound assessment of fetal presentation. Increased planned caesarean delivery for breech may reduce the skills of obstetricians in vaginal delivery of the woman presenting fully dilated with undiagnosed breech.
- D: F A category 1 caesarean section should aim to be delivered within 30 minutes of the time of decision. A category 1 section is indicated if there is an immediate threat to the life of mother or fetus.
- E: F While most category 1 caesareans demand rapid delivery with general anaesthesia, there may be occasions where regional anaesthesia may be more appropriate depending on the individual circumstances. This should normally be provided by a single shot spinal.

A2

- A: F Syntocinon is a synthetic analogue of oxytocin but it is released from the posterior pituitary gland. Its physiological role is to increase the force and frequency of contractions by acting on specific receptors in the uterine myometrium. It also promotes lactation.
- B: F It is now recommended that only 5 units of syntocinon should be given routinely at delivery of the baby. This should be given as a slow bolus to reduce the cardiovascular side effects. Patients with fixed cardiac output states are particularly vulnerable to these effects (e.g. aortic / mitral stenoses), a consideration in areas where rheumatic heart disease is prevalent. A further slow bolus of 5 units can be given for uterine atony.
- C: T Although this is a rare complication. Syntocinon has an antidiuretic effect and if combined with overzealous hydration can produce dilutional hyponatraemia leading to seizures.
- D: T The half life of oxytocin is 10 mins, this is why it is commonly given as an infusion to augment labour or following caesarean delivery to attempt to reduce uterine atony and post partum haemorrhage.
- E: F Ergometrine acts by promoting smooth muscle contraction. This affects all smooth muscle and can provoke severe bronchospasm, vomiting and hypertension. It is commonly combined with oxytocin and given via the intramuscular route. It can be given directly into the uterine myometrium. It

is rarely given intravenously because of the side effect profile, if it is, it is given as titrated small doses.

A3

- A: T Assessment of fetal distress is routinely interpreted from fetal heart rate often using the cardiotocogram (CTG). It has a low specificity and sensitivity in identifying fetal distress. This can be improved, if the equipment is available locally and there is felt to be time to employ it. i.e. Fetal blood sampling or Fetal ST segment analysis (STAN[®]). The speed of response to simple measures to improve fetal condition is important. Communication with the maternity and obstetric staff is vital.
- B: T Reliable large gauge intravenous access (ideally 16g) is important for several reasons: Intravenous fluid and pharmacological treatment of hypotension (e.g. ephedrine) may improve placental blood flow and reduce fetal distress. It can be used in the event of requiring an urgent general anaesthetic. Whilst cannulating there is an opportunity to draw blood for FBC and Group+Save.
- C: F The left lateral position is appropriate for the majority of patients to reduce the cardiovascular effects of compression of the great vessels. However, if umbilical cord compression is the cause of fetal distress then other positions may improve fetal heart rate (e.g. right lateral or knee elbow position).
- D: T The blood flow to the vulnerable fetus is most compromised during contractions. Methods of reducing uterine contraction strength and frequency are to turn off any syntocinon infusions (if being used to augment labour) or to promote tocolysis with the use of β -agonists (e.g. terbutaline) or smooth muscle relaxants (GTN).
- E: T Fetal distress may settle with conservative methods, but there is still a risk that this patient may require a Category 1 caesarean section if the situation progresses. Appropriate plans should be made for this eventuality. This includes an anaesthetic assessment, especially of potential airway difficulties. Potential anaesthetic techniques should be discussed with mother, explaining that events may happen rapidly in the event of further fetal difficulties. The mother should be prevented from eating solids and antacid prophylaxis should be given (commonly H₂ antagonists).

A4

- A: T Pre-existing medical or mental health conditions may be aggravated by pregnancy and contribute to a poor outcome. Included in this is obesity (BMI>30). The risks are further increased in those undergoing assisted fertility treatment.
- B: F Women should be assessed prior to 12 weeks gestation. Women booking after 20 weeks had a significantly higher direct and indirect mortality. It is highlighted that this is particularly important in immigrant populations

- because of the higher prevalence of concurrent undiagnosed medical conditions.
- C: F There is no recommendation that women who have had a previous section must have a repeat section. Although in practice the majority do. They are at increased risk of uterine rupture, placenta accreta and obstetric haemorrhage. As such women should be appropriately counselled and it is recommended that placenta location and praevia should be excluded. Evidence of accreta should be actively sort and an appropriate management plan put in place.
- D: F Because of the rarity of critical illness in the obstetric population and the physiological changes associated with pregnancy, there have been instances where critical illness has been missed, with detrimental effect. The report suggests the use of an early warning system, Modified Obstetric Early Warning System (MEOWS). A nationally recommended chart is in development (suggested version available in the latest CEMACH report). Charts similar to this have been successfully used in the critical care setting and for general ward nurses to identify patients “at risk” who require outreach intervention. The chart takes various physiological parameters e.g. HR, BP, Respiratory Rate, Temp, urine output and GCS. It gives each a score and when totalled together provides a recommendation for any required intervention e.g. contact a doctor immediately. When performed regularly it provides a useful trend as to whether the woman is improving or deteriorating. It is also lends its self to audit of practice.
- E: F The report found an overall mortality of 14 in 100,000 (1:10,000 rather than 1:1,000). Maternal mortality rate was associated with lower socio-economic group. It also showed how obesity in the UK is becoming an increasing problem with over 50% of patients who died being clinically obese. Thromboembolic disease was the lead cause of direct maternal mortality, followed by pre-eclampsia/eclampsia and sepsis. Pre-existing cardiac disease was the lead cause of indirect mortality.

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>

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