General anaesthesia for Caesarean section

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Key points

General anaesthesia for Caesarean section is still decreasing in incidence.

General anaesthesia may be indicated due to urgency, maternal refusal of regional techniques, inadequate regional block, or regional contraindications.

Obstetric indications, which were once considered absolute indications for general anaesthesia, such as placenta praevia, are now being routinely performed under regional anaesthesia.

Major complications include failed intubation, aspiration of gastric contents, increased blood loss, and awareness.

Difficulty in intubation is encountered 10 times more often than in the non-obstetric population.

The National Sentinel Caesarean Section Audit analysed data from 99% of the total births in England and Wales during 2001. There were 32,222 births by Caesarean section out of 150,139 maternities. The Caesarean section rate for England and Wales was 21% compared with a rate of 4% in the early 1960s. The Royal College of Anaesthetists audit book suggests that fewer than 15% of emergency and fewer than 5% of elective Caesarean sections should be performed under general anaesthesia.

Indications

Regional anaesthesia is the most common method of providing anaesthesia for Caesarean section. When general anaesthesia is used, the most common indications are urgency (~35% of cases in a non-teaching hospital), maternal refusal of regional techniques (20%), inadequate or failed regional attempts (22%), and regional contraindications including coagulation or spinal abnormalities (6%). Obstetric indications, such as placenta praevia, were in the past considered absolute indications for general anaesthesia. There are now multiple reports of these cases being performed safely under regional anaesthesia.

A classification for the urgency of Caesarean section is described in Table 1.

Conduct of general anaesthesia

Pre-assessment

Pre-assessment is paramount in maintaining safety, especially in the emergency situation. In addition to normal anaesthetic history taking, a thorough evaluation of the airway is mandatory. Particular attention is directed to the cardiorespiratory system, searching for murmurs. Obstetric conditions, such as placental abruption or pre-eclampsia, are noted. A recent full blood count and confirmation that a group and save sample is held in the laboratory should be sought. Cross-matched blood may be ordered at this point, if necessary.

Informed consent

Consent for general anaesthetic is often difficult because it is frequently administered in an emergency. Women who are at high risk of a general anaesthetic for delivery should be counselled as early in pregnancy as is practical. Work from consent in regional anaesthesia for Caesarean section illustrates that women want to know common, but relatively minor, side-effects and devastating, albeit rare, complications. Suggested topics for specific mention are: the practice of rapid sequence induction (particularly pre-oxygenation and cricoid pressure), sore throat, awake extubation, increased recovery period, poorer pain relief, increased blood loss, more postoperative nausea, more neonatal depression, and failed intubation. Commonly used patient resources for regional anaesthesia (e.g. Obstetric Anaesthetists’ Association’s leaflets) have well-documented numerical risk. However, there is a paucity of hard data surrounding the complications of general anaesthesia.

Prophylaxis against acid aspiration

Efforts are made before operation to reduce the volume and acidity of gastric contents. This issue arises in part due to the reduced lower oesophageal sphincter tone caused by the effect of progesterone and partly due to the physical effect of the gravid uterus on the stomach. Pain or opioids given to treat pain may hamper gastric emptying. To reduce gastric acidity and the attendant risk of chemical pneumonitis, most UK units provide antacid prophylaxis with H2 receptor antagonists (ranitidine 150 mg orally or 50 mg i.v.). Some units routinely use proton...
pump inhibitors (e.g. pantoprazole 40 mg i.v.). Sodium citrate 0.3 M (30 ml) is routinely used, having the advantage of instantaneous efficacy. However, its short duration of action may mean it has worn off at emergence. I.V. antacids in the Grade 1 Caesarean sections are important for their effect at emergence not induction of anaesthesia. Despite the emergency nature of many general anaesthetics in labour obstruction of the upper airway by semi-solid residual gastric matter is rare. The use of prokinetic agents for this goal (e.g. metoclopramide 10 mg orally) is not as widespread as it once was. An orogastric tube should be considered in a patient who has had a recent meal to reduce aspiration risk at extubation.

**Induction**

Anaesthesia for Caesarean section traditionally takes place in the operating theatre itself to reduce the time from induction to delivery of the infant; 70% of UK obstetric units never use anaesthetic rooms for Caesarean section. Induction is usually carried out with the patient catheterized, the abdomen draped, and surgeons scrubbed. The patient is positioned with left lateral tilt to avoid aortocaval compression. Some practitioners prefer a 30° head-up tilt, arguing improvement to maternal well being through an increased functional residual capacity (FRC), reduced breast interference to intubation, and reduced gastro-oesophageal reflux.

FRC reduces by up to 40% towards the end of pregnancy and oxygen consumption increases by 20%. Oxygen reserves are rapidly depleted which warrants pre-oxygenation with oxygen 100% via a tight fitting mask. There is little consensus regarding the conduct of pre-oxygenation. Recognized techniques include tidal volume breathing for 3 min or performing 4, 5, or 8 vital capacity breaths. Adequacy of pre-oxygenation is debated. Techniques used include timing pre-oxygenation against the clock, and measuring expired nitrogen or end-tidal oxygen. Again, there is little consensus regarding which circuit should be used for pre-oxygenation.

Induction of general anaesthesia is via a rapid sequence technique. Thiopental (5 mg kg$^{-1}$ lean body weight) and succinylcholine are currently the agents of choice. Propofol is associated with a poorer neonatal profile, shorter duration of amnesia (potentially leading to awareness), and longer time to recovery of spontaneous ventilation. Etomidate and ketamine have been used as alternatives. Cricoid pressure of 10 N should be applied before consciousness is lost. Ideally, the pressure should be applied on the cricoid cartilage towards the body of C6, remembering that the pressure should be directed at 90° to the tilted table. After induction, cricoid pressure is increased to 20–40 N and kept in place until confirmation of tracheal intubation with capnography and the cuff of the tracheal tube is inflated. Auscultating the chest helps exclude endobronchial intubation. At this point, surgery may commence.

The use of the depolarizing neuromuscular blocking agent succinylcholine (1.5 mg kg$^{-1}$ body weight) is standard in the UK, but a higher dose may be required due to increased volume of distribution and relative resistance. Failure to use the correct dose has been implicated in difficulties with intubation because of inadequate paralysis at intubation. A reduction of up to 35% in pseudocholinesterase concentrations may prolong the effects of succinylcholine; therefore, a return of spontaneous breathing should be observed before using non-depolarizing muscle blockers. Lively debate continues around the use of higher dose non-depolarizing neuromuscular blocking agents (e.g. rocuronium up to 2 mg kg$^{-1}$ body weight) as an alternative to succinylcholine. The prolonged actions of these agents limit their use. However, this may change with the introduction of sugammadex, a selective binding agent for rocuronium.

Opioids traditionally do not form part of the rapid induction technique due to fetal transfer leading to neonatal respiratory and neural effects. However, opioids such as alfentanil have a place in pregnancies complicated by severe cardiac disease or hypertensive disorders of pregnancy to obtund the hypertensive response to intubation. Other drugs noted for those purpose are magnesium sulphate and rapid-onset β-blockers, for example, labetalol.

**Perioperative care**

Monitoring should be carried out according to standard AAGBI guidelines. Improved monitoring in obstetric anaesthesia has contributed to the significant reduction in maternal mortality. The non-invasive arterial pressure equipment should be capable of measuring at 1 min interval. More advanced monitoring can be instituted as appropriate. BIS monitoring has rarely been used in the UK. Anaesthesia is generally maintained with inhalation agents. Nitrous oxide is preferred by some practitioners due to its rapid onset and intraoperative analgesia. End-tidal agent monitoring can be used to titrate the anaesthetic depth, with the knowledge that minimum alveolar concentration is decreased by up to 40% for pregnant patients. $F_{IO2}$ should be guided by pulse oximetry; any level above 0.33 may be used.

Five international units of the uterotonic oxytocin are administered slowly after the delivery of the baby with reversal of the lateral tilt of the table. An oxytocin infusion of 10 IU h$^{-1}$ may be used, as these patients are subject to increased blood loss. The first dose of prophylactic antibiotics is usually administered at this stage. Intraoperative opioid analgesia is generally withheld until clamping of the umbilical cord.

**Extubation and recovery**

Extubation should be carried out with the patient maintaining airway reflexes and in the left lateral position. Facemask oxygen
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The causes of failed intubations in Caesarean section are many: than in an obstetric population (1 in 300 compared with 1 in 3000). CEMACH reports is shown in Table 2.

For Caesarean section. The reduction in mortality since the start of (2000–2), three deaths were associated with general anaesthesia during a Caesarean section. However, in the previous report (1952–4) compared with six in the most recent CEMACH report (2003–5). None of these deaths was due to a general anaesthetic. Gastrointestinal contents inflame the alveolar membrane; and aspiration pneumonia. Treatment of aspiration involves maintenance of oxygenation and provision of supportive measures. The factors responsible for increased morbidity due to pulmonary aspiration should be countered by judicious use of antacids, anti-emetics, the head-up tilt, and rapid sequence induction.

A higher incidence of awareness has traditionally been associated with general anaesthesia for Caesarean section. A fear of oversedating the fetus and reducing the contractility of the uterus led to the deliberate use of low doses of anaesthetic agents. This concern has lessened with the availability of modern anaesthetic drugs and pharmacological agents to treat the causes of excess haemorrhage. The definition of awareness is not precise; consequently, its incidence varies. In its patient leaflet, the Royal College of Anaesthetists estimate that awareness occurs during 4 in every 1000 general anaesthetics for Caesarean section. The average blood loss during a Caesarean section under general anaesthesia is estimated to be 100–200 ml more than under regional anaesthesia.

It has been reported that postoperative nausea and vomiting is three times less common after general anaesthesia compared with epidural. This conclusion was made using data acquired before the widespread use of phenylephrine infusions. The incidence of shivering is markedly reduced after general anaesthesia compared with a regional anaesthetic.

should be prescribed as appropriate. After the operation, the patient should be kept in a monitored environment with exactly the same facilities and staffing as a standard recovery unit.

Postoperative analgesia

Postoperative analgesia involves the use of regular acetaminophen and, if appropriate, non-steroidal anti-inflammatory drugs. However, opioid analgesia is usually required, either as oral morphine (20 mg 4-hourly) or as a morphine-based patient-controlled analgesia.

In addition, local anaesthetic infiltration, rectus sheath blocks, and ilioinguinal blocks may be used for postoperative analgesia. More recently, the advent of ultrasound-guided blocks has re-invigorated the use of the transversus abdominis plane block, performed after cessation of surgery.

Thromboprophylaxis

Embolic phenomenon remains a significant cause of postoperative morbidity. After general anaesthesia, the benefits of regional blockade are not present, so intraoperative calf compression, graduated elasticated stockings [thrombo-embolus deterrent (TEDs)], and postoperative heparin should be considered. Owing to the lack of neuraxial blockade, heparin may be given sooner.

Complications

The current low rate of general anaesthesia for Caesarean section is a marked decrease from the rate of 76% in the early 1980s. This goes some way to explain the decline in mortality from anaesthetic causes detailed in the Triennial Maternal Mortality reports, particularly the avoidance of unrecognized oesophageal intubation and failed ventilation coupled with the reduction in aspiration of gastric contents. There were 49 deaths in the first triennial report (1952–4) compared with six in the most recent CEMACH report (2003–5). None of these deaths was due to a general anaesthetic during a Caesarean section. However, in the previous report (2000–2), three deaths were associated with general anaesthesia for Caesarean section. The reduction in mortality since the start of CEMACH reports is shown in Table 2.

Failed intubation is encountered almost 10 times more often than in an obstetric population (1 in 300 compared with 1 in 3000). The causes of failed intubations in Caesarean section are many: increased fatty tissue, complete dentition, increased pharyngeal and laryngeal oedema, drug dosage differences, large tongue, and large breasts. The rate of difficult intubation can be as high as 1 in 7 in the obese parturient. The incidence of obesity in the obstetric population is increasing; thus, these problems will become more common. Owing to the decrease in actual obstetric intubations and reduction in trainees’ hours, inexperience may also contribute to this rate. For these reasons, it is important that a fully equipped airway trolley is maintained in the delivery suite and that failed obstetric intubation drills are practised frequently. The essential requirement of the latter is to maintain oxygenation at all times.

The incidence of aspiration in Caesarean section under general anaesthesia is 1 in 400–600. Premedication, nil by mouth orders, and rapid sequence induction cannot guarantee that aspiration will not occur. Aspiration is associated with: impairment of laryngoscopic view; obstruction of the upper airway by solid matter potentially leading to asphyxiation; chemical pneumonitis (Mendelson’s syndrome) where volumes (≥25 ml) of acidic (pH ≤2.5) gastric contents inflame the alveolar membrane; and aspiration pneumonitis. The incidence of aspiration involves maintenance of oxygenation and provision of supportive measures. The factors responsible for increased morbidity due to pulmonary aspiration should be countered by judicious use of antacids, anti-emetics, the head-up tilt, and rapid sequence induction.

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<table>
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<tr>
<th>Triennium</th>
<th>Number of maternities</th>
<th>Number of Caesarean sections</th>
<th>Caesarean rate as percentage of maternities</th>
<th>Number of direct deaths due to anaesthesia</th>
<th>Number of direct deaths due to anaesthesia for Caesarean section</th>
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References

10. Afolabi BB, Lesi FEA, Merah NA. Regional versus general anaesthesia for caesarean section. Cochrane Database Syst Rev 2006; 4

Please see multiple choice questions 9–12