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REVIEW

Anaesthesia for emergency caesarean section

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SUMMARY

Globally, the emergency caesarean section rate has been rising. The majority of caesarean sections are done using regional techniques rather than general anaesthesia. For general anaesthesia, the use of supraglottic airway devices can be considered and an obstetric difficult airway algorithm is vital in the management of the difficult airway. Regional anaesthesia can be done through various techniques, including single shot spinal, epidural and combined spinal epidural anaesthesia, as well as less commonly used methods, such as rapid sequence spinal and continuous spinal anaesthesia. This article discusses the indication for different methods of anaesthesia and their advantages and risks. There are also some updates regarding decision-to-delivery time, prophylactic antibiotic administration and pre-oxygenation duration based on recent guidelines and studies.

1. Introduction

The indications for an emergency caesarean section vary from compromised foetal status to less urgent situations such as cephalopelvic disproportion or failure of labour to progress. Both the health of the mother and unborn baby are important considerations when providing anaesthesia for emergency caesarean sections. In an emergency setting, a multidisciplinary team approach is vital to ensure best maternal and foetal outcome and a safe and pleasant experience for the parturient.

The proportion of deliveries done by caesarean section varies greatly from country to country. Studies have estimated that the proportion of caesarean births in developed countries is 21.1% whereas in less developed countries, it is much lower with only 2% of deliveries being done by caesarean section.[1] In the United States, the rate of caesarean section has increased from 5.8% in 1970 to 32.3% in 2008.[2] There are multiple factors contributing to this overall rise. An increase in urgent caesarean sections has been attributed to more advanced intrapartum foetal monitoring, hence, allowing obstetricians to diagnose intrapartum foetal compromise earlier and more effectively.[3] Furthermore, a lower threshold for surgical intervention can also account for this increase in the caesarean section rate.[4] Blanchette suggested that vaginal birth should be encouraged since the increase in caesarean delivery rate has not led to significant improvements in neonatal morbidity and mortality or improvements in maternal health. Patients with one previous low transverse caesarean delivery should also be encouraged to undergo a trial of labour.[2] However, it has been noted that the rate of increase appears to be slowing down in most industrialized countries, comparing trends of caesarean delivery from 1998–2002 to 2003–2007.[5]

Since the mid 1980s, there has been a move towards more caesarean sections being done under regional anaesthesia compared to general anaesthesia.[6] New techniques for regional anaesthesia, such as the combined spinal epidural anaesthesia and continuous spinal anaesthesia, offer specific advantages. There has also been recent interest in the use of supraglottic airway devices to protect the airway under general anaesthesia, especially when an unanticipated difficult airway is encountered in the emergency setting. For emergency caesarean section, when choosing the method of anaesthesia, communication between obstetricians and anaesthetists is important to ensure the best outcome is achieved for both mother and baby. In addition, timing of the caesarean section is an issue, especially when foetal or maternal status is compromised. Therefore, it is important to have a classification system for the urgency of the caesarean section.

2. Classification of the urgency of caesarean section

A classification of caesarean section, taking account of the urgency, is useful for both obstetricians and anaesthetists. This allows health care professionals to make informed decisions in resource allocation with the aim of prioritising the most urgent cases and improving foetal and maternal outcome. A number of classification systems have been developed and used in practice. An international

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standardised classification system would be useful as it would enable auditing and comparing caesarean section rates all over the world.[7]

An example of a classification system is shown below[8]:

Grade 1 (Emergency) – Immediate threat to life of woman or foetus

Grade 2 (Urgent) – Maternal or foetal compromise, not immediately life threatening

Grade 3 (Scheduled) – Needing early delivery but no maternal or foetal compromise

Grade 4 (Elective) – At a time to suit the woman and maternity team

3. Decision-to-delivery time

A decision-to-delivery time (DDI) of 30 min has been widely used as an audit standard for emergency caesarean sections. There are some controversies about this. Some have reported that this standard is unrealistic, especially in morbidly obese women, with institutions in first world countries achieving this target in only 71% of emergency caesarean sections.[9] There is also a lack of firm evidence supporting a better outcome comparing a DDI within 30 min with one which is greater than 30 min.[10] For grade 1 cases, the National Institute for Health and Clinical Excellence (NICE) clinical guideline has advised a DDI, which is as short as possible, to maximize maternal and/or foetal outcome.[11] For grade 2 cases, studies have shown poorer neonate outcome when DDI is greater than 75 min.[12]

With a properly organized, well-trained and cooperative multidisciplinary team, DDI can be optimized. An institution, which has implemented a protocol for extremely urgent caesarean sections, managed to achieve a mean decision-to-delivery interval of 7.7 min with 100% of deliveries made within 17 min.[13]

4. Antibiotic prophylaxis

A recent systematic review looking at the timing of administration of prophylactic antibiotics for caesarean section, showed significantly reduced rate of endometritis in women who received antibiotics before skin incision compared to those who received antibiotics intraoperatively.[14] Giving the limited power of the study, no significant difference in terms of neonatal outcome was shown. This is consistent with the latest NICE clinical guideline 132, which recommends administration of antibiotics before skin incision. An exception to this rule is when co-amoxiclav is used,[15] where it is discouraged to administer co-amoxiclav before skin incision. ORACLE studies have demonstrated that foetal exposure to co-amoxiclav increased the risk of necrotising enterocolitis in the neonate.[16,17] The principle is to use antibiotics that are effective against endometritis, urinary tract and wound infections. These prophylactic antibiotics should be administered before skin incision.

5. General versus regional anaesthesia for caesarean section

The method of anaesthesia for caesarean section depends on a multitude of factors including the urgency and indication of the operation, coexisting medical problems as well as maternal preference. Therefore, proper communication between anaesthetists, midwives and obstetricians is crucial in choosing the most appropriate method of anaesthesia. A poorly coordinated team could lead to unnecessarily high general anaesthesia rates.

The Centre for Maternal and Child Enquiries (CMACE, formerly CEMACH) publishes a report on maternal deaths every 3 years. These reports have had a great impact on maternal and newborn health over the last 50 years. The number of direct deaths attributable to anaesthesia has dropped significantly since the mid 1980s. This could be attributed to the increase in regional anaesthesia for caesarean delivery, improved safety of regional technique, increased clinical and educational efforts in managing difficult airways, as well as evolving airway devices to improve safety of general anaesthesia.[18] In the latest report which covers maternal deaths from the triennium 2006–08,[19] only 7 direct deaths were attributable to anaesthesia, with 2 direct deaths attributed to failure to ventilate the lungs. However, in the last three reports, there were a disproportionately greater number of direct deaths associated with general anaesthesia, often related to difficult airway management.[19,20] The risk of maternal death has been estimated to be up to 17 times higher for general anaesthesia compared to regional anaesthesia.[21]

5.1. General anaesthesia

Indications for general anaesthesia include maternal request, contraindications to regional anaesthesia and emergency situations with potential life threatening foetal compromise.[22] As it can be administered rapidly, general anaesthesia is almost always recommended in emergency situations where there is on-going maternal antepartum haemorrhage, cord prolapse or abruptio placentae with the hope of improving neonatal survival without ischaemic hypoxic injury.[23] However, careful assessment, most importantly of the airway, must be carried out in every patient before choosing the method of anaesthesia.

General anaesthesia used to be the technique of choice for caesarean deliveries. However, recent data has shown a declining trend of general anaesthesia used in caesarean deliveries. For example in the United States, general anaesthesia is used in less than 5% of elective caesarean deliveries and 15–30% of emergency deliveries.[6] The experience with general anaesthesia is also reported to be decreasing, especially amongst trainee anaesthetists.[24] Nowadays, the first experience carrying out general anaesthesia for a caesarean section for trainees might be in an emergency situation.

It is important for anaesthetists to understand the physiological changes during pregnancy to allow safe and effective anaesthesia to be delivered. Airway management could be more difficult due to maternal airway changes, upper airway oedema, breast enlargement and excessive weight gain during pregnancy.[25] The incidence of failed tracheal intubation in an obstetric population has been reported to be almost 10 times as high as that compared to a non-obstetric population.[21] It is therefore necessary to ensure that there is a well thought out difficult obstetric airway algorithm, with availability of airway adjuncts, to deal with airway emergencies during difficult or failed intubation. Increasingly, the newer difficult obstetric airway algorithms are incorporating video laryngoscopes into the algorithm.[26] Once the haemoglobin saturation decreases below 90%, cyanosis develops or after two failed intubation attempts, oxygenation and ventilation take priority over intubation. Repeated attempts at intubation may result in progressive difficulty in ventilation that ultimately leads to complete airway obstruction.[27] The CMACE report from 2006 to 08 has recommended that the effective management of failed tracheal intubation is a core anaesthetic skill that should be rehearsed and assessed regularly.[19] In an emergency setting, an unanticipated difficult airway can be stressful for an obstetric anaesthetist, who may perceive a failed intubation as a failure in performance. In these situations, it is vital for all anaesthetists involved to follow the accepted difficult airway drill fully and to maintain maternal oxygenation.

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Obstetric patients have increased oxygen consumption and decreased oxygen reserve due maternal respiratory changes. This places women at risk of rapid desaturation during periods of apnoea. Therefore, preoxygenation with 100% oxygen is critical for increasing the margin of safety prior to the induction of general anaesthesia.[28] However, an evaluation of preoxygenation quality for emergency caesarean section cases carried out in a UK hospital has shown that 19% of patients received inadequate preoxygenation. Porter et al. suggested that the duration of preoxygenation should be tailored to the needs of individual patients by using targeted expired fractional concentrations of oxygen instead of a set time or number of respirations for all patients.[29]

Besides maternal airway and respiratory changes, maternal gastrointestinal changes should be taken into consideration for women undergoing general anaesthesia. Those changes include increased intra-abdominal pressure due to the gravid uterus and relaxation of the lower oesophageal sphincter due to hormonal changes. In addition, gastric emptying is decreased during labour, increasing the risk of aspiration with induction of general anaesthesia in a patient who has been labouring.[28] It is therefore important for anaesthetists to take precautions against aspiration. A Cochrane review article suggests that the combination of antacids with H_2 antagonists is more effective than antacids alone in preventing low gastric pH. However the quality of evidence is poor, with no studies assessing adverse effects of such medication or clinical outcome.[30] The latest CMACE article has also recommended that if general anaesthesia is chosen for an inadequately fasted parturient, anaesthetists must ensure that the patient is fully awake and able to protect her airway before extubation. Gentle 'in and out' insertion of an orogastric tube should be considered prior to extubation in these situations.[19]

In general anaesthesia for caesarean section, the use of rapid sequence induction with thiopental and succinylcholine with cricoid pressure has remained standard and largely unchanged for the last four to five decades.[8] However, one prospective observational study carried out in an African setting showed that cricoid pressure has no effect in preventing regurgitation or reducing mortality. Arguably, this study was not randomized thus possibly introducing bias.[31] Recently, sugammadex, a selective relaxant binding agent, has been developed. It antagonises the effects of rocuronium on muscle tissue and quickly reverses neuromuscular blockade. This development may replace succinylcholine with a high dose rocuronium–sugammadex combination in the near future.[32,33] Therefore, in situations when a fast onset and short duration of muscle relaxant is required, rocuronium has a reasonably rapid onset and can now be reversed with sugammadex.

5.1.1. The use of supraglottic airway devices for general anaesthesia in obstetric patients

If intubation of the trachea in an unanticipated difficult airway is unsuccessful, emergency caesarean delivery may proceed only when the anaesthetist can reliably ventilate the patient with either a facemask or laryngeal mask airway (LMA). Although the Laryngeal Mask Airway (LMA) and the LMA Proseal™ have been used extensively in elective non-obstetric surgery, its use in emergency obstetric surgery has been limited. The LMA Proseal™ incorporates a second tube intended to permit continuity with the gastrointestinal tract and isolation from the airway, minimising gastric insufflations during positive pressure ventilation.[34] Several reports have shown that LMA Proseal™ has also been used successfully as a rescue device during failed rapid sequence induction in obstetric patients.[35,36] While the LMA has also been incorporated into the obstetric difficult airway algorithm, the routine use in elective caesarean deliveries is debatable.

In a large prospective cohort study involving 1067 obstetric patients, LMA was used for elective caesarean deliveries without any incidents of hypoxia or aspiration.[37] An anaesthetist with proficient regular use of LMA is a prerequisite. To ensure safety using a supraglottic airway, patient selection is paramount. Only non-obese patients with an easy airway, who are adequately fasted, should be considered. Effective airway was obtained in 99% of the parturients and only seven parturients required intubation.

5.2. Regional anaesthesia

Regional anaesthesia is now used for most cases of caesarean section. Compared to general anaesthesia, regional anaesthesia has several advantages, including avoidance of managing a difficult airway,[3,6] avoidance of multiple drugs required for general anaesthesia and allowing the parturient to be awake to participate and enjoy the birthing experience. Moreover, analgesics used during regional anaesthesia can help with post-operative pain control. Furthermore, safer local anaesthetics such as ropivacaine and levobupivacaine are now being used.

Currently single shot spinal anaesthesia, epidural anaesthesia and combined spinal epidural anaesthesia are the main types of regional techniques used for caesarean delivery. There are also case reports of continuous spinal anaesthesia used for caesarean delivery, but this is far less common.

Guidelines now explicitly recommend that the majority of caesarean sections should be done under regional techniques. For example, the Royal College of Anaesthetists in the United Kingdom has proposed that more than 95% of elective caesarean deliveries and more than 85% of emergency caesarean deliveries should be done using regional anaesthetic techniques.[38]

5.2.1. Single shot spinal anaesthesia

This is by far the most common method of anaesthesia for emergency caesarean sections.[6] It can be as fast as general anaesthesia in skilled anaesthetists. Single shot spinal anaesthesia has several advantages. Firstly, it is more cost effective compared to epidural anaesthesia. This is due to the lower complication rate in spinal anaesthesia and the significantly shorter total operating room times to establish spinal anaesthesia.[39] Secondly, analgesics such as opioids can be co-administered, which can help with post-operative analgesia. Thirdly, the time interval from the start of the anaesthetic to the start of the operation is shorter in patients receiving spinal anaesthetic, which is important in emergency caesarean sections.[40] Lastly, there is minimal risk of systemic toxicity because only low doses of local anaesthetics are required to perform spinal anaesthesia.[41]

Spinal anaesthesia is not without its shortcomings, including an increased need for treatment of hypotension compared to epidural anaesthesia,[40] and the inability to extend the block if the original block height is inadequate or if the surgery takes a longer period of time than predicted. Therefore, it is crucial to ensure an adequate block before commencing surgery, to avoid patient discomfort, the need of conversion to general anaesthesia and possible medico-legal implications.

5.2.2. 'Rapid sequence spinal' anaesthesia

In cases where the foetal state is compromised and delivery of the foetus must be expedited, rapidity of spinal anaesthesia could be useful. In the United Kingdom, a case series of 25 patients has described the use of spinal anaesthesia in category-1 caesarean section. It is reported that anaesthesia can successfully be established in suitable parturients in 6–8 min with 'rapid sequence spinal' anaesthesia. The components of 'rapid sequence spinal' anaesthesia includes the 'no touch' technique of donning gloves, the omission

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of spinal opioids while increasing the dose of hyperbaric bupivacaine 0.5% (up to 3 ml) and limiting the number of attempts. Furthermore, one must be prepared to convert to general anaesthesia if the level is inadequate or if other complications arise.[42] However, there are concerns that this technique could result in a traumatic experience for the parturient.[43] Careful explanation and informed consent should be taken at all times.

5.2.3. Epidural anaesthesia

Epidural neuraxial anaesthesia is a catheter-based technique used to provide continuous analgesia. The in-situ epidural catheter allows the anaesthetist to convert labour epidural analgesia to surgical anaesthesia for caesarean section by giving a "top-up" dose of local anaesthetics. Studies have shown that a "top-up" can be as fast as a general anaesthetic in a well functioning epidural.[4,13] Thus, parturients with indwelling catheters must be continuously assessed to ensure proper functioning of the epidural should a "top-up" be necessary.[23] Before augmenting an epidural block, it is vital to ensure that the epidural is functioning well during labour and that no blood or cerebral spinal fluid is aspirated from the catheter prior to giving boluses of local anaesthetics.

The location where the epidural "top-up" is commenced is controversial. While initiating the "top-up" in the labour ward will help to expedite the establishment of an adequate block height, it brings about the dangers of inadequate monitoring of a parturient when the risk of a high block or toxicity is greatest. Initiating the "top-up" in the operating theatre might not allow sufficient time for anaesthesia thus increasing the risk of converting to general anaesthesia. One recommendation is to give a small dose in the delivery room while completing the rest of the "top-up" en route to the operating theatre, continuously assessing the patient for any adverse effects.[23]

The local anaesthetic should be safe and rapid in onset. A meta-analysis has shown that lidocaine 2% with epinephrine + fentanyl gives the fastest onset and should be the drug of choice if the speed of onset is important. If the quality of epidural block is paramount, 0.75% ropivacaine is suggested.[44] Levobupivacaine, which is an S enantiomer of bupivacaine, may play a greater role in the future.

A systematic review, comparing epidural with spinal technique, has shown that there is no significant difference between the two techniques with respect to failure rate, the need for additional intraoperative analgesia, the need for conversion to general anaesthesia, the need for post-operative pain relief, neonatal outcome or maternal satisfaction.[40]

5.2.4. Combined spinal epidural (CSE)

CSE combines the advantages of spinal and epidural anaesthesia. It is able to produce a fast and dense block while allowing additional doses of local anaesthetics to be administered via the epidural catheter should the need arise. The epidural catheter can also be used for post-operative analgesia.

This method is especially useful in patients with certain medical conditions such as high-risk cardiac patients where it is necessary to titrate the block height carefully. It is also useful in the situation where an epidural "top-up" has failed to produce adequate anaesthesia. In this situation, a single shot spinal might produce an unpredictable block height. A combined spinal epidural with a lower spinal dose can easily be augmented with titrated boluses of epidural local anaesthetics.[23]

A teaching maternity unit in the United Kingdom did an audit including 3519 elective caesarean sections using the CSE technique over a ten-year period. The result showed a need for conversion to general anaesthesia for only 0.23%.[45] This is lower than previous reports of single shot spinal anaesthesia which has a general anaesthesia conversion rate of 1.2–1.4%.[46,47]

5.2.5. Continuous spinal anaesthesia (CSA)

CSA can provide excellent labour analgesia and surgical anaesthesia. However, it is infrequently used mainly due to the fear of postdural puncture headache (PDPH), neurological complications and technical difficulties. Nowadays, with the use of newer spinal catheters that have smaller gauges, the interest in this controversial form of regional technique has increased. This technique has the benefits of spinal anaesthesia with the possibility of block extension with very small doses of local anaesthetics. However, a recent cohort study showed that continuous spinal anaesthesia may be associated with increased failure rate and postdural puncture headache.[48] The apparent high risk of post dural puncture headache had led to the development of microcatheters which were unfortunately associated with kinking and breakage.[49,50] In the early 1990s, FDA made the decision to withdraw approval of all catheters 24 g and smaller due to its possible association with cauda equina syndrome.[51] Regrettably, due to its unacceptable high risk of PDPH and lack of availability of suitable catheters, CSA will probably continue to be an infrequently used option in the obstetric population in the foreseeable future.[52] The relative risk of this treatable side effect should be weighed against the many advantages of the technique, specifically in patients with previous spinal surgery, significant cardiac disease or morbid obesity, or in situations when there is difficulty in epidural catheter placement.

6. Conclusion

With advances in technology, the obstetric anaesthetist needs to face new techniques and challenges. Recent guidelines and studies have some updates regarding DDI and prophylactic antibiotic. Regional anaesthesia may be regarded as preferable to general anaesthesia for most cases where caesarean section is required. This has resulted in regional anaesthesia being performed for even more urgent cases. The LMA and the LMA Proseal™ can be considered as a useful airway device in the management of the difficult airway and could see a greater role in an obstetric difficult airway algorithm. It would be interesting to see the future development of new medications (sugammadex, levobupivacaine) and newer techniques (continuous spinal anaesthesia, ultrasound guided epidural placement). Obstetric anaesthetists continue to play an important role in optimising the care of the parturient during caesarean delivery.

Conflicts of interest

None.

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