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Review Article

Complications in obstetric anaesthesia

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Summary

'Obstetric anaesthesia is a litigious area of medical practice – patient expectations are high, and many of the interventions undertaken by anaesthetists are performed urgently or emergently, frequently out of hours. The complications that occur during obstetric practice are not unique to this area of anaesthesia, but some of the physiological and anatomical changes that take place during pregnancy can affect the frequency with which these happen. In this narrative review, we hope to cover a few of the more common complications in obstetric anaesthesia, as well as some of the more severe, yet less frequently occurring problems.

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Post-dural puncture headache

Headaches affect up to 40% of women in the postnatal period [1]. These headaches can be due to a variety of causes, including the following conditions: post-dural puncture headache; pre-eclampsia; migraines; subdural haematoma; meningitis; cerebral venous sinus thrombosis; and subarachnoid haemorrhage [2]. Accidental dural puncture occurs in around 1:100 epidurals sited during labour, the majority of whom will go on to develop post-dural puncture headache (PDPH) [3]. The incidence following spinal anaesthesia depends on the size and design of the needle tip, but with modern fine needles, it is around 1:500 in the obstetric population [4].

Post-dural puncture headache is identified by its postural nature, which can be severe enough to render the patient bedridden. The cause of the headache is thought to be due to loss in cerebrospinal fluid (CSF) volume, resulting in cerebral hypotension, adenosine activation and subsequent dilatation of cerebral vessels to increase cerebral blood flow, thus resulting in a headache [5, 6]. The leak of CSF is greater when the patient is standing or sitting, and as such, the symptoms may be relieved by lying down. These headaches normally develop within the first 72 h, but can be delayed for up to 14 days after the dural breach, or may rarely occur immediately. A patient with PDPH may also complain of neck stiffness, photophobia, hearing loss and tinnitus. Loss of CSF volume can cause downward traction on the cranial nerves, and this can result in a sixth nerve palsy. Post-dural puncture headaches can be classified as mild, moderate and severe. Treatment depends on which category the patient falls into.

1 Mild PDPH: no restriction on daily activities; no associated symptoms and responds well to non-opioid analgesia.
2 Moderate PDPH: bedridden for most of the day; may have associated symptoms, requires opiate analgesia.

3 Severe PDPH: completely bedridden; associated symptoms present and no response to conservative management.

Unintentional dural puncture may be witnessed at the time of insertion of an epidural. If this occurs, the majority of centres recommend immediately inserting a spinal catheter using the same Touhy needle. This is left in situ, clearly labelled as an intrathecal catheter, for 24 h. This technique has been shown to reduce the incidence of PDPH from 66% to 51% and reduce the need for epidural blood patch from 59% to 33% [4]. It is probable that the intrathecal catheter plugs the hole, thereby reducing CSF leak, and that the presence of a foreign body induces an inflammatory response which aids healing of the dural puncture.

Management of PDPH can be divided into conservative treatment, pharmacological management and an epidural blood patch. Conservative management involves hydration, bed rest and simple analgesics to allow the dural puncture to heal. Pharmacological methods used to control post-dural puncture symptoms have been shown to have limited efficacy in treatment of PDPH. Therapies include caffeine, 5-HT_3 agonists, adrenocorticotrophin hormone and epidural saline, but, currently, there is no evidence for their use.

An epidural blood patch is the gold standard for treatment of severe PDPH. An epidural blood patch is thought to seal the dural puncture site, preventing further CSF leakage, which allows intracranial pressure to rise, thus alleviating symptoms. The success rate of epidural blood patching after 24 h is between 70% and 90% [7]. Prophylactic patching in advance of a PDPH developing has not been shown to be beneficial [8]. Epidural blood patching is performed using full aseptic technique. An epidural puncture should be performed at or one space below the original site, and then 10–30 ml of the patient's own blood should be injected into the epidural space. Injection should stop if radicular pain occurs. Epidural blood patches have risks including: failure; backache; repeat dural tap; nerve damage; meningitis; abscess; and cranial nerve palsies. There are contra-indications to blood patches, which include: systemic fever and infection; local infection at the injection site; coagulopathy; and patient refusal.

Nerve injury

Nerve injuries are common in pregnant women – up to 1:100 women report some form of neurological injury in the postpartum period, the majority of which are due to pregnancy and labour rather than any anaesthetic cause [9]. However, central neuraxial blockade used either as analgesia during labour or as an anaesthetic to facilitate delivery carries a risk of causing nerve injury. These are most commonly transient, but the 3rd National Audit Project, a large multi-centre study into complications as a result of anaesthesia, quotes the risk of a permanent injury from an obstetric regional anaesthetic technique as 0.2-1.2:100,000 [10].

Nerve injuries due to regional anaesthetic techniques can be the result of any of three issues: direct trauma to the nerve; chemical injury; or a compressive injury.

Direct trauma to the nerve occurs at the time of insertion of the central neuraxial block, either due to needles, catheters or the fluid injected. This direct trauma causes a transient neuritis, which usually resolves within three months to one year. These injuries may present with paraesthesia, loss of sensation and weakness in muscles in the distribution of the affected nerve [11].

Compressive injuries that cause damage to the spinal cord and subsequent ischaemia are rare, but can be caused by spinal haematomas or epidural abscesses. The greatest risk factor for developing a haematoma is the presence of coagulopathy, either due to pathological processes or induced by medications such as low-molecular-weight heparins [12]. The use of such medications in modern obstetric practice is increasing, and anaesthetists must therefore be vigilant to ensure an adequate time interval between anticoagulant dose and undertaking regional anaesthetic techniques. Similar caution must also be paid to the timing of epidural catheter removal, as 50% of haematomas develop at this time [13]. Compressive injuries can be reversible, if identified early and treated by surgical decompression, but if diagnosis and subsequent management occurs late, there can be severe and irreversible nerve damage and this can lead to paralysis below the lesion. Any non-resolving motor block following an epidural or progressive block should initially be managed as a

compressive injury, and an urgent MRI scan arranged to confirm or exclude the diagnosis.

Chemical injuries such as adhesive arachnoiditis and septic meningitis are very rare, but highlight the need for fastidious attention to sterility and drug use. Arachnoiditis causes collagen to develop between the nerve roots and the pia-arachnoid, eventually resulting in ischaemia and atrophy [14]. A variety of chemicals have been implicated in causing adhesive arachnoiditis – the most recent accounts implicate chlorhexidine, once again showing the need for attention to detail during these techniques [15].

Nerve injury in obstetric patients is associated with a high rate of litigation, as these women often had no neurological deficit before becoming pregnant. It is important for anaesthetists to explain risks in terms that the women can understand and to clearly document any neurological symptoms present during the pregnancy, before initiating any form of epidural for spinal anaesthesia.

Inadequate block for caesarean section

Over 90% of caesarean sections are now carried out under regional anaesthesia, undoubtedly contributing to the dramatic improvement in anaesthetic-related maternal mortality over the last 30 years [16]. However, pain during caesarean section is now the most common successful negligence claim against anaesthetists [17]. It is recognised that some patients will feel pain during a caesarean section due to the need to block high thoracic dermatomes. Consequently, the Royal College of Anaesthetists has set an audit standard that fewer than 1% of patients undergoing an elective section should feel pain and fewer than 1% should require conversion to general anaesthesia. Due to the time constraints of a category-one caesarean section, the audit standards in this group are less stringent, with a standard that fewer than 20% of patients should feel pain, and fewer than 15% require conversion to general anaesthesia [18].

The need for supplemental intra-operative analgesia varies depending on the type of regional blockade performed. After a 'single-shot' spinal anaesthetic, the Obstetric Anaesthetists' Association (OAA) suggest a figure of 1:20, whereas for an epidural top-up, it is 1:7 patients. A more significant risk of an inadequate block is the need to convert from a regional anaesthetic to general anaesthesia. This occurs 1:50 times for spinals and 1:20 for epidurals. However, 1:10 epidurals sited in labour will not be working adequately to provide successful anaesthesia for caesarean section. In these cases, an alternative anaesthetic technique should be used before surgery. Spinal anaesthesia is most commonly used.

The assessment of block height and quality preoperatively is very subjective, and techniques can vary. Surveys of anaesthetists have shown a variation in modality of assessment and the height of the block aimed for [19] – the loss of cold or light touch sensation is most commonly used. The most frequently quoted block height that anaesthetists aim for before caesarean section is bilateral loss of cold sensation below T4, and/or bilateral block to light touch to T5 [20]. If this is not initially achieved, then more time may be needed for the block to spread. Positioning may allow the local anaesthetic to spread more cranially, so many anaesthetists will tilt the bed head down slightly. If this does not work or time does not allow, then alternative measures should be taken, potentially a general anaesthetic or a second regional technique.

Communication is key during obstetric procedures carried out under regional anaesthesia. The anaesthetic provided will not take away all sensation, and there are times during a caesarean where the sensations experienced may be uncomfortable. Often these points are predictable, such as the pull before uterine incision, the high abdominal push to deliver the baby and swabbing the peritoneal gutters before closing the abdomen. The anaesthetist should make the mother aware when these events are about to happen. However, if the mother feels genuine pain or is too uncomfortable to continue, then alternative analgesia should be offered, including nitrous oxide or a short-acting intravenous opioid such as alfentanil. If an opioid is administered pre-delivery, the neonatal team must be informed, as these drugs can cross the placenta and cause respiratory depression in the newborn.

Above all, it is important to believe women when they complain of pain during surgery. Supplements including general anaesthesia should be offered early, and the offer should be repeated if initially turned down. In particular, general anaesthesia should not be

denied for fear of sedating the neonate, no matter how close to delivery.

Accidental awareness under general anaesthesia

Accidental awareness under general anaesthesia occurs when a patient experiences a period of recalled consciousness at a time when they think they should be under the influence of general anaesthesia; it is nearly always associated with the use of neuromuscular blockers, preventing the patient from alerting those caring for them. The overall awareness rate for all types of surgery is 1:19,000 [21].

Awareness is more common in patients having obstetric procedures under a general anaesthetic. The 5th National Audit Project (NAP5) carried out by the Royal College of Anaesthetists over a period of one year found that the incidence of awareness in obstetric patients for all procedures was 1:1200, but for caesarean sections, it was 1:670 [21].

There are multiple factors that are considered to increase the risk of accidental awareness in this patient population. The physiological changes of pregnancy can mask signs of inadequate depth of anaesthesia. The increase in cardiac output associated with pregnancy means that intravenous induction agents have a shorter onset and offset time, but that volatile agents take longer to exert their effects. This means that the gap between offset of the intravenous induction agent and adequate depth of pure volatile anaesthesia, particularly if there has been a delay in tracheal intubation, is a potential time for awareness. Woman having obstetric procedures are likely to be very anxious but, because of concerns for the baby, receive no premedication, opioid analgesia or sedative agents before induction. Category-one caesarean sections require surgery to begin as soon after tracheal intubation as is safe for the mother – this may mean that there might not be enough time to build a sufficiently high effect-site volatile agent concentration to ensure unconsciousness. Obesity is a risk factor for awareness, and the obstetric population includes significant numbers of obese patients [22]. A single ampoule of suxamethonium is frequently used to provide neuromuscular blockade during rapid sequence induction but, because of patient size and the increased volume of distribution in pregnancy, this may often be inadequate, making tracheal intubation more difficult and time-consuming; this further increases the risk of awareness [23].

The majority of general anaesthetics in the pregnant population take place out of hours as an emergency, and the anaesthetist is likely to be junior. The stressful nature of the situation may affect performance and be a further factor in the incidence of awareness [24].

Accidental awareness under a general anaesthetic has greater and longer lasting implications for patients than previously thought. The 5th National Audit Project found that, in obstetric patients who had been subject to accidental awareness, at least 21% reported new psychological morbidity – most commonly a new anxiety state or nightmares [21].

Failed tracheal intubation

Many trainee anaesthetists would admit that one of their biggest fears is failed tracheal intubation in an obstetric patient. This is probably because the risks of a failed intubation rate in an obstetric patient is considerably higher than that of the general population, 1:300 vs. 1:1000–2000 [25]. The time pressures of obstetric procedures requiring general anaesthesia add to the stress levels, as does the fact that over recent years the use of general anaesthesia in obstetrics has become less and less common; as a result, junior anaesthetists may never have seen one before they have to carry out their first solo obstetric general anaesthetic.

The failed tracheal intubation rate may be higher in pregnant women for a number of reasons. In addition to the stress relating to the time-critical nature of the procedure, which may degrade performance [23], anatomical changes occur which can make tracheal intubation more challenging. The larynx can become oedematous, particularly in pre-eclampsia, and this can make it difficult to gain a view of the vocal cords or to pass a tracheal tube. Breast size increases during pregnancy, and this, when combined with cricoid pressure, can obstruct the laryngoscope handle during insertion into the mouth. Some anaesthetists choose to use a stubby handled laryngoscope or a polio blade for this reason. Physiological changes also increase the risks associated with failed intubation. In pregnancy,

functional residual capacity is reduced and cardiac output is increased, and this means that these women desaturate more quickly than non-pregnant patients [26]. The gravid uterus can press on the inferior vena cava, reducing venous return and dropping cardiac output when the mother lies supine. To prevent this, obstetric patients are anaesthetised with a left lateral tilt on the bed. This can alter the view at laryngoscopy but can also mean that cricoid pressure, if applied in a direction that does not take account of the tilt, can make intubation almost impossible.

The incidence of obesity in pregnancy is increasing. Obesity carries its own risks of difficult intubation, which are in addition to the ones relating to pregnancy [22]. These patients should be carefully positioned preoperatively to maximise the chances of successful tracheal intubation. There are specific positioning devices such as the Oxford Help Pillow to aid this [25].

In 2015, the Difficult Airway Society released new guidelines for failed tracheal intubation including, for the first time, guidance relating to the obstetric patient. These focus on careful pre-induction planning, including the role of waking the patient up if intubation fails. The use of modern airway adjuncts, including videolaryngoscopes and second-generation supraglottic airway devices, is also explored in these guidelines [26].

Aspiration

Aspiration of gastric contents by obstetric patients has been a recognised risk for many years. It was first described by Mendelson in 1946, when he reported on women having an operative delivery in New York with an anaesthetic of nitrous oxide and ether. These women did not have their tracheas intubated and 0.15% aspirated. Mendelson went on to describe the complications that these women suffered, including two who died from airway obstruction due to solid material. The women who aspirated fluid developed a triad of symptoms, dyspnoea, cyanosis and tachycardia, now known as Mendelson's syndrome [27]. Pregnant women are at increased risk of aspiration, due to both hormonal and physical changes that occur during pregnancy and labour. These include: increased intragastric pressure due to the gravid uterus; a reduction in the lower oesophageal sphincter tone as an effect of increased progesterone levels; and delayed gastric emptying during labour. The delay in gastric emptying may also be exacerbated by the use of opioid analgesia during labour.

Animal studies have shown that aspiration of as little as 25 ml of acid with a pH of 2.5 can cause severe pulmonary complications. Human gastric pH is often as low as pH 2, and in studies, up to 50% of fasted patients have a residual gastric volume of 25 ml. This suggests that unfasted obstetric patients will have a lower pH and greater volume, putting them at high risk of severe complications if aspiration does occur. Consideration must be given to prevention of aspiration, but also to altering the pH of gastric fluid, so that if aspiration does occur the subsequent complications will not be as severe. Rapid sequence induction of anaesthesia aims to reduce the risk of aspiration, and although it is a practice that is often debated, it is still recommended by the Difficult Airway Society for all obstetric procedures requiring general anaesthesia. Antacid prophylaxis, most commonly ranitidine, is given either orally or intravenously to increase the pH of the gastric contents. This aims to minimise pulmonary damage, should aspiration occur [28].

It is as important to consider the risk of aspiration at tracheal extubation as well as intubation. Patients' tracheas should be extubated when they are fully awake and airway reflexes have returned. The use of a nasogastric tube for aspiration of gastric contents should be considered. When waking from the procedure, women should be in a head-up or left lateral position to reduce the risk of regurgitated gastric contents being aspirated into the lungs [25].

Summary

This review discusses complications that may occur when performing anaesthesia for an obstetric patient. These complications span the spectrum from minor, transient problems through to permanent, life-altering injuries. The physiological changes of pregnancy, as well as increasing levels of obesity in pregnant women, make some of these complications more likely in this setting. We highlight the need for vigilance and fastidious attention to detail, both while undertaking anaesthesia and providing analgesia to parturients. Women should be believed when they describe either pain or

symptoms that may be consistent with a suspected iatrogenic injury. Early, appropriate steps need to be taken to ensure that complications are detected and treated.

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References

1. Goldszmidt E, Kern R, Chaput A, Macarthur A. The incidence and etiology of postpartum headaches: a prospective cohort study. *Canadian Journal of Anesthesia* 2005; **52**: 971–7.
2. Stella CL, Jodicke CD, How HY, Harkness UF, Sibai BM. Postpartum headache: is your work-up complete? *American Journal of Obstetrics and Gynecology* 2007; **196**: 318.
3. Choi PT, Galinski SE, Takeuchi L, Lucas S, Tamayo C, Jadad AR. PDPH is a common complication of neuraxial blockade in parturients: a meta-analysis of obstetrical studies. *Canadian Journal of Anesthesia* 2003; **50**: 460–9.
4. Van de Velde M, Schepers R, Berends N, Vandermeersch E, De Buck F. Ten years of experience with accidental dural puncture and post-dural puncture headache in a tertiary obstetric anaesthesia department. *International Journal of Obstetric Anesthesia* 2008; **17**: 329–35.
5. Turnbull DK, Shepherd DB. Post-dural puncture headache: pathogenesis, prevention and treatment. *British Journal of Anaesthesia* 2003; **91**: 718–29.
6. Grant R, Condon B, Hart I, Teasdale GM. Changes in intracranial CSF volume after lumbar puncture and their relationship to post-LP headache. *Journal of Neurology, Neurosurgery, and Psychiatry* 1991; **54**: 440–2.
7. Abouleish E, Vega S, Blendinger I, Tio TO. Long-term follow-up of epidural blood patch. *Anesthesia and Analgesia* 1975; **54**: 459–63.
8. Agerson AN, Scavone B. Prophylactic epidural blood patch after unintentional dural puncture for the prevention of postdural puncture headache in parturients. *Anesthesia and Analgesia* 2012; **115**: 133–6.
9. Loo CC, Dahlgren G, Irestedt L. Neurological complications in obstetric regional anaesthesia. *International Journal of Obstetric Anesthesia* 2000; **9**: 99–124.
10. Cook TM, Counsell D, Wildsmith Ja W, Royal College of Anaesthetists Third National Audit Project. Major complications of central neuraxial block: report on the Third National Audit Project of the Royal College of Anaesthetists. *British Journal of Anaesthesia* 2009; **102**: 179–90.
11. Wong CA. Neurologic deficits and labor analgesia. *Regional Anesthesia and Pain Medicine* 2004; **29**: 341–51.
12. Moen V, Dahlgren N, Irestedt L. Severe neurological complications after central neuraxial blockades in Sweden 1990-1999. *Anesthesiology* 2004; **101**: 950–9.
13. Boyce H, Plaat F. Post-natal neurological problems. *Continuing Education in Anaesthesia Critical Care and Pain* 2013; **13**: 63–6.
14. Burton CV. Lumbosacral arachnoiditis. *Spine* 1978; **3**: 24–30.
15. Association of Anaesthetists of Great Britain and Ireland, Obstetric Anaesthetists' Association null, Regional Anaesthesia UK, et al. Safety guideline: skin antisepsis for central neuraxial blockade. *Anaesthesia* 2014; **69**: 1279–86.
16. National Obstetric Database. Monitoring of adverse outcomes at caesarean section. http://www.oaa-anaes.ac.uk/assets/_managed/cms/files/NOAD%20REPORTS/National%20Obstetric%20Anaesthesia%20Data%20for%202012%20final.pdf (accessed 21/05/2017).
17. Bogod D. Pain during caesarean section. *British Journal of Obstetrics and Gynaecology* 2016; **123**: 753.
18. Royal College of Anaesthetists. Raising the Standard: a compendium of audit recipes, 3rd Edition. 2012. https://www.rcoa.ac.uk/system/files/CSQ-ARB2012-SEC8.pdf (accessed 21/05/2017).
19. Husain T, Liu YM, Fernando R, Nagaratnam V, Sodhi M, Tamilselvan P, Venkatesh S, England A, Columbe M. How UK obstetric anaesthetists assess neuraxial anaesthesia for caesarean delivery: National surveys of practice conducted in 2004 and 2010 *International Journal of Obstetric*. *Anaesthesia* 2013; **22**: 298302.
20. Hoyle J, Yentis SM. Assessing the height of block for caesarean section over the past three decades: trends from the literature. *Anaesthesia* 2015; **70**: 421–8.
21. Pandit JJ, Andrade J, Bogod DG, et al. 5th National Audit Project (NAP5) on accidental awareness during general anaesthesia: summary of main findings and risk factors. *British Journal of Anaesthesia* 2014; **113**: 549–59.
22. Helsehurst N, Ells LJ, Simpson H, Batterham A, Wilkinson J, Summerbell CD. Trends in maternity obesity incidence, rates, demographic predictors and health inequalities in 38,821 women over a 15 year period. *British Journal of Obstetrics and Gynaecology* 2007; **114**: 187–94.
23. Brien KO, Conlon C. Failed intubation in obstetrics. *Anaesthesia and Intensive Care Medicine* 2013; **14**: 315–9.
24. Paech MJ, Scott KL, Clavisi O, Chua S, McDonnell N, ANZCA Trials Group. A prospective study of awareness and recall associated with general anaesthesia for caesarean section. *International Journal of Obstetric Anesthesia* 2008; **17**: 298–303.
25. Rucklidge M, Hinton C. Difficult and failed intubation in obstetrics. *Continuing Education in Anaesthesia Critical Care and Pain* 2012; **12**: 86–91.
26. Guidelines for the management of difficult and failed tracheal intubation in obstetrics – 2015 Difficult Airway Society. 2015. https://www.das.uk.com/guidelines/obstetric_airway_guidelines_2015 (accessed 25/05/2017).
27. Mendelson CL. The aspiration of stomach contents into the lungs during obstetric anesthesia. *Anesthesiology* 1946; **7**: 694–5.
28. Rout CC, Rocke DA, Gouws E. Intravenous ranitidine reduces the risk of acid aspiration of gastric contents at emergency cesarean section. *Anesthesia and Analgesia* 1993; **76**: 156–61.