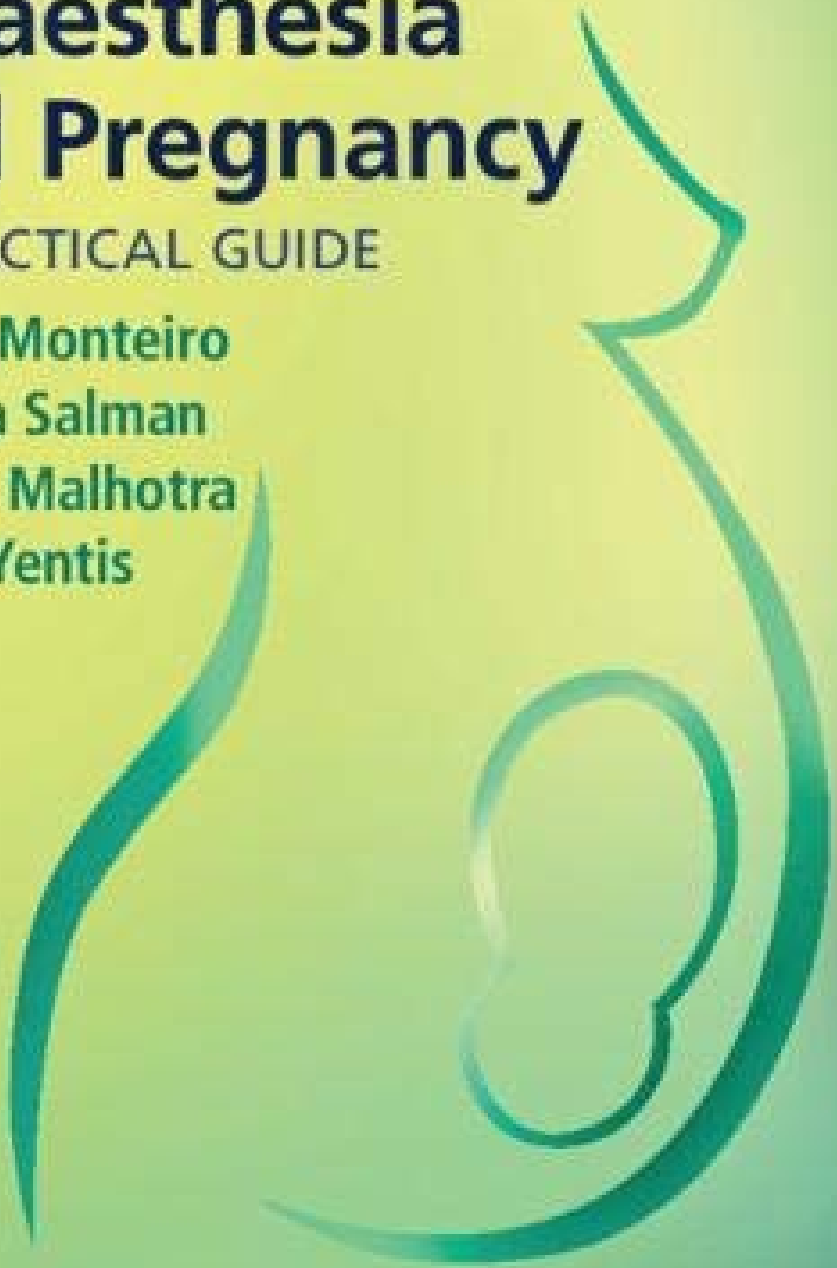
FOURTH EDITION

Analgesia, Anaesthesia and Pregnancy

A PRACTICAL GUIDE

Róisín Monteiro
Marwa Salman
Surbhi Malhotra
Steve Yentis



CAMBRIDGE Medicine

Analgesia, Anaesthesia and Pregnancy

A Practical Guide

Fourth Edition

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Róisín Monteiro
Consultant Anaesthetist at Brighton and Sussex University Hospitals NHS Trust, UK

Marwa Salman
Consultant Anaesthetist at Guy's and St Thomas' NHS Foundation Trust, UK

Surbhi Malhotra
Consultant Anaesthetist at Fiona Stanley Hospital, Perth, Australia

Steve Yentis
Consultant Anaesthetist at Chelsea and Westminster Hospital and Honorary Reader at Imperial College London, UK

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Preface

The first edition of this book was written in order to provide useful, practical information and advice to obstetric anaesthetists, in the form of a ready and easily accessible guide to obstetric anaesthesia and analgesia. The book was aimed primarily at trainees, both those starting in the maternity suite and their more experienced colleagues preparing for anaesthetic examinations. We also hoped the book would be of use to more senior anaesthetists and those of all levels involved in teaching obstetric anaesthesia, as well as non-anaesthetists working in the maternity suite. We are pleased that the book has been popular enough to warrant a fourth edition, and welcome two new authors to join the team.

In this fourth edition, we have reviewed and revised each section but kept to the original aims, structure and format, since we are convinced that the need for a short, practically based text still exists. In doing so, we have attempted to bridge the gaps between routine obstetric anaesthesia and analgesia and the care of women with coexisting medical conditions, and between anaesthetic care and advice before pregnancy and that during pregnancy itself.

As before, we have assumed basic anaesthetic knowledge and thus do not include topics such as anaesthetic equipment and drugs, etc., except where there are areas of specific obstetric relevance. We have tried to base the advice given on what we believe would be considered standard UK practice, supported by evidence wherever possible, although we have deliberately not included supporting references for each point made since this would, in our view, detract from the readability and ease of use of this book; readers wishing to obtain such reference lists are directed to the many larger, more comprehensive texts that are currently available.

We hope that the layout of the book is easy to follow. We have tried to provide a brief list of pertinent further reading where possible – though often this has meant that very large topics have been left relatively unreferenced, since there are few journal reviews broad enough in scope.

Finally, we gratefully acknowledge the contributions of Dr D. Bogod, Dr D. Brighouse and Dr C. Elton to the first edition, and Dr A. May to the first and second editions. For this fourth edition, we are also grateful to Dr Aisha Alzouebi for her contributions to the chapters on obstetric topics.

Chapter 1

Assisted conception

Infertility affects about one in seven couples, with a small increase in infertility and the number of couples seeking help over the past 10 years. The treatment of infertility has developed rapidly, and the anaesthetist may be involved in many aspects of the patient's treatment, which may be complex. The harvesting of oocytes needs to take place within a defined period of time, or ovulation may have occurred and oocytes will be lost. Couples presenting for infertility treatment are generally anxious, and women are often emotional at the time of oocyte retrieval. It is therefore particularly important for the anaesthetist to understand the couple's anxieties, and to be able to explain the effects of the anaesthetic technique that is to be used.

Problems and special considerations

All of the methods of assisted fertility techniques involve extraction of oocytes from the follicles, either laparoscopically or, with the development of transvaginal ultrasonography, via the transvaginal route (ultrasound-directed oocyte retrieval, UDOR). The techniques differ in the site of fertilisation and/or replacement of the gamete/zygote:

- **In-vitro fertilisation (IVF).** This term is often (incorrectly) used to encompass all aspects of infertility treatment. IVF involves either UDOR or laparoscopic oocyte retrieval, fertilisation in the laboratory and transfer of the developing embryo into the uterus via the cervix, 48 hours later. UDOR may be painful so may require analgesia, sedation or anaesthesia. Embryo transfer is performed with the patient awake, although there are occasions when the anaesthetist may be requested to provide sedation. The success rate is approximately 15–25%.
- **Gamete intrafallopian transfer (GIFT).** This involves retrieval of oocytes which are placed together with sperm into the fallopian tube It is performed laparoscopically in the majority of cases and has not been shown to have a higher success rate than IVF, so is used less commonly.
- **Zygote intrafallopian tube transfer (ZIFT) or pronuclear stage transfer.** This process involves oocyte retrieval and IVF, with the zygote then being placed in the fallopian tube as for GIFT. It has no significant difference in pregnancy rates to IVF, but has a trend towards increased ectopic pregnancy rates.
- **Intracytoplasmic sperm injection (ICSI).** Fertilisation occurs in the laboratory via injection of sperm into the oocytes, and the developing embryo is transferred into the uterus as for IVF. This technique is used for male infertility. The success rate is approximately 30%.

Management options

Most women who present for assisted conception techniques are healthy and in their thirties or forties. However, it is now recognised that some women may also have a number of comorbidities associated with increasing age. Therefore, a multidisciplinary approach is necessary. It would be logical to minimise drug use and use sedation or regional anaesthesia whenever possible, although this is not suited for laparoscopy (see Chapter 3, *Anaesthesia before confirmation of pregnancy*).

For UDOR, which has become the most common method used for oocyte retrieval, the main anaesthetic techniques are intravenous sedation and regional anaesthesia. It is important to remember that patients requiring UDOR are day cases, and the basic principles of day-case anaesthesia apply. There has been a considerable amount of work to date on the use of propofol with alfentanil, and this combination of drugs would appear to be the technique of choice for intravenous sedation. Propofol may be administered by intermittent boluses or by continuous infusion, with the patient breathing oxygen via a Hudson mask. Many anaesthetists find that they are using levels of sedation close to anaesthesia. There does not seem to be a difference in patient satisfaction or pregnancy rate if sedation or general anaesthesia is used. It is essential that the sedation is administered in a suitable environment with resuscitation facilities and anaesthetic monitoring. Often the assisted conception unit is some distance from the main theatre suite; therefore it may be difficult for the staff working in an isolated environment to maintain their skills in resuscitation.

The desire to minimise the drugs administered to women undergoing ultrasound-guided techniques has led to the use of regional anaesthesia, although there is limited evidence supporting its association with increased pregnancy rates. Careful administration is required to allow same-day discharge; the low-dose spinal that is used for labour analgesia or the short-acting agents used for cervical cerclage can give good operating conditions while satisfying the criteria needed for day-case anaesthesia.

The main considerations for laparoscopy are the type of anaesthesia, the pneumoperitoneum and the effects of the anaesthetic agents on fertilisation and cell cleavage. The length of exposure to the drugs is also important. The effects of nitrous oxide and volatile anaesthetic agents on fertilisation and cleavage rates have been extensively examined. It is generally recognised that all volatile agents and nitrous oxide have a deleterious effect, although opinion is divided as to the extent of the problem. It is also recognised that the carbon dioxide used for the pneumoperitoneum causes a similar effect, and it is difficult to separate the effects of the anaesthetic agents from those of the carbon dioxide.

Of the intravenous agents, the effect of propofol on fertilisation and cleavage appears to be minimal. Propofol accumulates in the follicular fluid, and the amount in the follicular fluid may become significant if there are a large number of oocytes to retrieve. Propofol decreases the fertilisation rates, but there is no significant effect on the cell division rates. This has led to the increased use of propofol as the main agent in total intravenous anaesthesia.

Analgesia following the procedure may be provided with a combination of codeine and paracetamol. Non-steroidal anti-inflammatory drugs such as diclofenac are considered less suitable, as these are thought to interfere with embryo implantation, owing to a disruption in prostaglandin levels. All assisted conception techniques carry the risk of ovarian

hyperstimulation (see Chapter 2, *Ovarian hyperstimulation syndrome*), and multiple or ectopic pregnancy.

Key points

- Oocyte retrieval may involve laparoscopy requiring general anaesthesia, although intravenous sedation and regional anaesthesia are suitable for transvaginal ultrasound-directed techniques.
- Couples are usually very anxious and require constant reassurance.

Further reading

Kwan I, Bhattacharya S, Knox F, McNeil A. Pain relief for women undergoing oocyte retrieval for assisted reproduction. *Cochrane Database Syst Rev* 2013; (1): CD004829.

Tsen L. Anesthesia for assisted reproductive technologies. *Int Anesthesiol Clin* 2007; **7**: 99–113.

Vlahos NF, Giannakikou I, Vlachos A, Vitoratos N. Analgesia and anesthesia for assisted reproductive technologies. *Int J Gynaecol Obstet* 2009; **105**: 201–5.

Chapter 2

Ovarian hyperstimulation syndrome

Ovarian hyperstimulation syndrome (OHSS) is a complication of ovarian induction that may be caused by any agent that stimulates the ovaries. Over the last 10 years, the incidence has risen due to the increased use and development of in-vitro fertilisation (IVF) treatments, where the ultimate goal is to produce enough oocytes and embryos. It is thought to be the most common complication of IVF treatment, though the true incidence is unknown, because mild to moderate cases are probably under-reported.

OHSS occurs 3–8 days after treatment with human chorionic gonadotrophin (hCG), and the effects continue throughout the luteal phase. A variety of cytokines and pro-inflammatory mediators such as vascular endothelial growth factor are secreted from the hyperstimulated ovaries, leading to increased vascular permeability and a prothrombotic effect. The condition may become severe enough to warrant intensive care admission.

Problems and special considerations

Clinical manifestations of the syndrome are:

- Enlargement of the ovaries
- Pleural effusion
- Ascites

Additional complications that may occur include:

- Hypovolaemic shock
- Renal failure
- Acute lung injury
- Thromboembolism
- Cerebrovascular disorders

Women undergoing ovarian stimulation who develop OHSS may be classified by the severity of their presenting symptoms and signs (Table 2.1).

Management options

Prophylactic plasma expanders such as human albumin solution may reduce the risk of severe OHSS in women at high risk; these include women with a large number of oocytes retrieved, high oestradiol levels or polycystic ovary syndrome.

Once suspected, the diagnosis of OHSS is made on clinical grounds as there are no specific diagnostic tests. However, the combination of elevated haematocrit with reduced

Table 2.1 Grading of ovarian hyperstimulation syndrome

Grade	Features
Mild	Abdominal distension and discomfort
Moderate	Abdominal pain, nausea, vomiting and diarrhoea Ultrasound evidence of ascites
Severe	Clinical ascites ± hydrothorax, oliguria, haematocrit > 0.45, hypo-osmolality, hyponatraemia, hyperkalaemia, hypoproteinaemia
Critical	Tense ascites/large hydrothorax, haematocrit > 0.55, white cell count > 25×10^9/l, oliguria/anuria, thromboembolism, acute respiratory distress syndrome

Adapted with permission from Royal College of Obstetricians and Gynaecologists. *The Management of Ovarian Hyperstimulation Syndrome*. Green-top Guideline 5. London: RCOG, 2016.

serum osmolality and sodium levels is highly suggestive. Pelvic ultrasound may demonstrate multiple ovarian follicles, enlarged ovaries or free fluid.

Mild to moderate forms of OHSS will be self-limiting and can be managed in the outpatient setting with analgesia, antiemetics and oral hydration, but those women with more severe pathology are likely to require hospitalisation for monitoring and intravenous fluids to correct the hypovolaemia and haemoconcentration.

Ultrasound-guided paracentesis should be considered for women with severe pain, abdominal distension, respiratory compromise or oliguria thought to be secondary to ascites. In women with impaired renal function, dopamine has been given to improve renal perfusion. Ultrafiltration and intravenous reinfusion of ascitic fluid has been used in severe cases. Thromboprophylaxis must be considered.

Monitoring is tailored to the severity of the syndrome, and the following progression is recommended:

- Urea and electrolytes
- Full blood count and packed cell volume
- Plasma/urine osmolality
- Clotting screen
- Chest radiography
- Invasive haemodynamic monitoring may be beneficial for those with a reduced urine output or persistently raised haematocrit despite large volumes of fluid replacement.

Clinicians should be aware that pregnancies complicated by OHSS have an increased risk of pre-eclampsia and preterm delivery.

Key points

- Hyperstimulation comprises ovarian enlargement, pleural effusion and ascites, which may be relentless.
- Severe protein loss may result in shock and renal failure.
- The most severe form occurs in 1–2% of cases treated with human chorionic gonadotrophin.

Further reading

Budev M, Arroliga A, Falcone T. Ovarian hyperstimulation syndrome. *Crit Care Med* 2005; **33**: S301–6.

Royal College of Obstetricians and Gynaecologists. *The Management of Ovarian Hyperstimulation Syndrome*. Green-top Guideline 5. London: RCOG, 2016. www.rcog.org.uk/en/guidelines-research-services/guidelines/gtg5 (accessed December 2018).

Sansone P, Aurilio C, Pace MC, *et al.* Intensive care treatment of ovarian hyperstimulation syndrome (OHSS). *Ann N Y Acad Sci* 2011; **1221**: 109–18.

Chapter 3

Anaesthesia before confirmation of pregnancy

Many women will require anaesthesia when they are pregnant, and some will be unaware that they are pregnant before attendance for surgery, especially in the first 2–3 months of their pregnancy. Studies have found incidences of up to 2.4% of unrecognised early pregnancy in preoperative testing.

Concerns with anaesthesia and surgery in early pregnancy are related to fetal loss and teratogenicity. A systematic review suggested that miscarriage rates may be slightly increased when surgery occurs in the first trimester; however, whether this is related to anaesthesia, surgery or the underlying pathological process necessitating surgery is difficult to say. A teratogen is a substance that causes structural or functional abnormality in a fetus exposed to that substance. The thalidomide catastrophe initiated the licensing arrangements for new drugs and their use in pregnancy; the current cautious stance of the pharmaceutical industry is reflected in the British National Formulary's statement that no drug is safe beyond all doubt in early pregnancy.

Current evidence suggests that there is no increase in congenital abnormalities in women undergoing surgery and anaesthesia. However, concern has been raised over prenatal anaesthetic exposure and subtle functional neurocognitive changes. The anaesthetist should have a clear knowledge of the time scale of the developing fetus in order to balance the risks and benefits of any drug given to the mother.

Problems and special considerations

The possible effect of a drug can be considered against the stage of the developing fetus:

- **Pre-embryonic phase (0–14 days post-conception).** The fertilised egg is transported down the fallopian tube and implantation occurs at around 7 days post-conception. The conceptus is a ball of undifferentiated dividing cells during this time and the effect of drugs on it appears to be an all-or-none phenomenon. Cell division may be slowed with no lasting effects or the conceptus will die, depending on the severity of the cell damage.
- **Embryonic phase (3–8 weeks post-conception).** Differentiation of cells into the organs and tissues occurs during this phase, and drugs administered to the mother may cause considerable harm. The type of abnormality that is produced depends on the exact stage of organ and tissue development when the drug is given.
- **Fetal phase (9 weeks to birth).** At this stage, most organs are fully formed, although the cerebral cortex, cerebellum and urogenital tract are still developing. Drugs administered during this time may affect the growth of the fetus or the functional development within specific organs, but structural changes are unlikely.

Management options

The anaesthetist should always consider the possibility of pregnancy in any woman of childbearing age who presents for surgery, whether elective or emergency, and should specifically enquire in such cases. If there is doubt, a pregnancy test should be offered; accepted practice is to delay elective surgery in pregnancy. If pregnancy is confirmed and surgery necessary, it would seem pragmatic to use systemic drugs after weighing up their necessity, benefits and risks while focusing on maintaining normal physiological parameters.

The use of nitrous oxide is now generally considered acceptable, despite its effects on methionine synthase and DNA metabolism, as there is little evidence that it is harmful clinically; however, it may be sensible to avoid as anaesthesia can be delivered safely without its use. Similarly, although the volatile agents have been implicated in impairing embryonic development, clinical evidence is lacking. Some drugs cross the placenta and exert their effect on the fetus – for example warfarin, which may cause bleeding in the fetus.

Key points

- The possibility of pregnancy should be considered in any woman of childbearing age.
- No drug is safe beyond all doubt in pregnancy.

Further reading

Allaert SE, Carlier SP, Weyne LP, *et al.* First trimester anesthesia exposure and fetal outcome: a review. *Acta Anaesthesiol Belg* 2007; **58**: 119–23.

Cohen-Kerem R, Railton C, Oren D, Lishner M, Koren G. Pregnancy outcome following non-obstetric surgical intervention. *Am J Surg* 2005; **190**: 467–73.

Perna RB, Loughan AR, Le JA, Hertza J. Prenatal and perinatal anesthesia and the long-term cognitive sequelae: a review. *Appl Neuropsychol Child* 2015; **4**: 65–71.

Chapter 4

Ectopic pregnancy

Ectopic pregnancies occur in approximately 11 per 1000 pregnancies, with nearly 12,000 women diagnosed with an ectopic in the UK each year. There are many risk factors, of which tubal pathology or surgery and the use of an intrauterine device are the most important. Other risk factors are infertility, younger or older maternal age and smoking. The incidence is thought to be increasing as a result of pelvic inflammatory disease.

Ectopic pregnancy accounted for almost 5% of deaths prior to 24 weeks' gestation in the Confidential Enquiries into Maternal Deaths and Morbidity report in 2016 (MBRRACE-UK). Most ectopic pregnancies occur in the fallopian tube, but up to 5% occur elsewhere within the genital tract or abdomen. Typically, the tube initially expands to accommodate the growing zygote, but when it is unable to do so any more, there may be bleeding from the site of implantation or even rupture of the tube.

Problems and special considerations

Diagnosis of ectopic pregnancy may be difficult. Most ectopic pregnancies present 6–8 weeks from the last menstrual period and thus many of the physiological changes of pregnancy are absent or mild – the patient may even be unaware that she is pregnant. Signs and symptoms of an ectopic pregnancy vary. The most commonly reported symptoms are abdominal pain, amenorrhoea and vaginal bleeding. Other symptoms include gastrointestinal upset and rectal pressure or shoulder-tip pain from intraperitoneal blood. Sudden decompensation may occur due to concealed haemorrhage, leading to haemodynamic collapse.

A common theme in deaths associated with ectopic pregnancy is the failure to consider the diagnosis before collapse; ectopic pregnancy was not considered as a diagnosis in five out of the nine women who died from ectopic pregnancy in the 2016 Confidential Enquiry report. Non-specific abdominal signs including diarrhoea or vomiting may be misinterpreted as other intra-abdominal conditions such as appendicitis or gastroenteritis. Haemodynamic collapse may be misinterpreted as signs of pulmonary embolism, and MBRRACE-UK reported that a third of women who died of ectopic pregnancy received thrombolysis. Ectopic pregnancy must be considered in all women of childbearing age who present with haemodynamic collapse, particularly if anaemic, and it is now recommended that a focused assessment with sonography in trauma (FAST) ultrasound scan should be performed before thrombolysis if pulmonary embolism is considered likely.

A urinary pregnancy test should be performed in all women of reproductive age in whom the diagnosis is unclear or any of the above symptoms or signs are present; the bladder should be catheterised if necessary to facilitate this. Abdominal ultrasound has low

specificity, and transvaginal ultrasound is the imaging modality of choice. If ultrasound is not convincing, then diagnosis may be aided by blood tests and laparoscopy. In a less acute situation, serum levels of human chorionic gonadotrophin (hCG) and progesterone are often measured, but these measurements often resemble those levels seen in a normal pregnancy. Previously, the gold standard for diagnosis of an ectopic pregnancy was a laparoscopy; however, its diagnostic accuracy has been questioned when the procedure is performed too early.

The implications for the current and future pregnancies pose a great psychological stress on the patient and her partner. There may be a previous history of ectopic pregnancy, since its occurrence is itself a risk factor for subsequent ectopics.

Management options

Initial management is directed at treating and preventing massive haemorrhage; thus the patient requires at least one large-bore intravenous cannula and careful observation, at least until the diagnosis has been excluded. Similarly, once the decision to operate has been made, surgery needs to occur as soon as possible, since the risk of tubal rupture is always present.

Operative management usually involves laparoscopy unless there is severe haemodynamic instability, in which case laparotomy may be performed. Traditionally, laparoscopy was performed purely for diagnostic purposes, but laparoscopic removal of the zygote with or without tubal resection has become routine in many units.

Anaesthetic management is as for any emergency surgery, given the above considerations. Haematological assistance and admission to the intensive care unit should be available if required. Point-of-care haematological testing may be a useful adjunct. In severe cases, anaesthesia must proceed as for a ruptured aortic aneurysm: full preoperative resuscitation may be impossible, and the patient is prepared and draped before induction of anaesthesia, which may be followed by profound hypotension.

Medical management may be considered in selected cases; thus systemic methotrexate may be offered to suitable women in whom the diagnosis of ectopic pregnancy is absolutely clear and the absence of a viable intrauterine pregnancy has been confirmed. The drug antagonises folic acid and prevents further growth of the trophoblast, which is especially vulnerable at this early stage. Similar outcomes to those following surgical management have been claimed. Local injection of hyperosmolar glucose or potassium chloride, with aspiration of the sac, is an option for clinically stable women with a heterotopic pregnancy. Finally, expectant management has been used in selected patients, although women whose pregnancies are self-limiting cannot yet be identified reliably.

Key points

- Ectopic pregnancy must be considered as a diagnosis in all women of reproductive age presenting with non-specific abdominal symptoms or haemodynamic collapse.
- Severe haemorrhage and/or cardiovascular collapse is always a risk.

Further reading

Elson CJ, Salim R, Potdar N, *et al.*; Royal College of Obstetricians and Gynaecologists. Diagnosis and management of ectopic pregnancy. Green-top Guideline 21. *BJOG* 2016; **123**: e15–55.

Jurkovic D, Wilkinson H. Diagnosis and management of ectopic pregnancy. *BMJ* 2011; **342**: d3397.

Knight M, Nair M, Tuffnell D, *et al.*; MBRRACE-UK. *Saving Lives, Improving Mothers' Care: Surveillance of maternal deaths in the UK 2012–14 and lessons learned to inform maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009–14*. Oxford: National Perinatal Epidemiology Unit, University of Oxford, 2016.

Chapter 5

Evacuation of retained products of conception

Evacuation of retained products of conception (ERPC) may be required at any stage of pregnancy, but it occurs most commonly in early pregnancy following incomplete miscarriage or early fetal demise. It is also required during the puerperium following retention of placental tissue (see Chapter 40, *Removal of retained placenta and perineal suturing*).

Problems and special considerations

ERPC following spontaneous abortion at 8 weeks' gestation may be a minor routine gynaecological emergency for the anaesthetist, but the mother may have lost a much-wanted baby.

The urgency of the procedure varies greatly. The majority of ERPCs are performed as scheduled emergencies in fit young women, and this may lull the inexperienced anaesthetist into a false sense of security. Death may occur from spontaneous abortion; blood loss may be heavy and is frequently underestimated.

The possibility of coexisting uterine or systemic sepsis must always be considered, especially in postpartum ERPC or in a repeat procedure following incomplete evacuation.

Management options

Diagnostic ultrasound scanning is frequently used to confirm a non-viable early pregnancy or the presence of retained placental tissue. Transabdominal and transvaginal ultrasonography are now considered to be complementary to each other, with most women requiring a transvaginal ultrasound. Most units now operate a policy of fully assessing mothers on the day of admission in an early pregnancy advisory unit (EPAU), allowing them home and re-admitting them the following day for planned ERPC. This facilitates planning of medical and nursing staffing levels, reduces prolonged periods of waiting and starvation for the mother, and can be economically advantageous.

Expectant management may be offered as a first-line management strategy, unless there are particular risks of haemorrhage or infection. Medical treatment is increasingly used, and this enables women to be allowed home after treatment with prostaglandin analogues to await events. Analgesia and antiemetics should be offered as required. Non-surgical methods are associated with longer and heavier bleeding, and 15–50% of these women will need surgical management if the products of conception are not fully expelled. If required, surgical management of miscarriage may occur under local, regional or general anaesthetic.

Preoperatively, a full assessment is required. Assessment of blood loss may be difficult; fit young women may lose a significant proportion of their blood volume without becoming

hypotensive. Tachycardia should alert the anaesthetist to possible hypovolaemia. Signs of sepsis should be sought, and prophylactic antibiotics may be considered.

General anaesthesia is most commonly used in the UK, although in the absence of uncorrected hypovolaemia or other contraindications, regional anaesthesia is entirely suitable. The puerperal mother in particular may wish to stay awake if offered a choice, and she should be advised to do so if she is at risk of regurgitation.

Rapid-sequence induction of general anaesthesia is indicated for the non-fasting mother requiring urgent surgery (uncommon) and for the mother who is at risk of regurgitation (see Chapter 59, *Aspiration of gastric contents*). Anaesthesia using a laryngeal mask airway or facemask using any standard day-case anaesthetic technique is appropriate for the majority of women needing ERPC. Sedative premedication is rarely needed. Intravenous anaesthesia, for example with propofol, or inhalational anaesthesia, are acceptable, though if the latter is used high concentrations of volatile anaesthetic agents (> 1 minimum alveolar concentration (MAC)) should be avoided because of the uterine relaxation that may ensue.

Oxytocic drugs may be requested by the surgeon, although there is little evidence for their efficacy at gestations of less than 15 weeks. A single intravenous bolus of 5 U oxytocin usually suffices. Ergometrine causes increased intracranial and systemic pressure, and nausea and vomiting, and should not be used routinely.

Spinal anaesthesia produces more rapid and dense anaesthesia than epidural anaesthesia, and an anaesthetic level of at least T8 is recommended. Clinical experience shows that the traditionally taught anaesthetic level of T10 is insufficient to prevent pain occurring when the uterine fundus is manipulated or curetted.

Postoperatively, the aim is rapid recovery and discharge home. Requirement for postoperative analgesia rarely exceeds simple non-opioid drugs. Non-steroidal anti-inflammatory agents may be beneficial in relieving uterine cramps. Routine administration of antiemetics should be considered, since these women are at risk of postoperative nausea and vomiting. Thromboprophylaxis may be indicated depending on risk factors.

Key points

- A sensitive and sympathetic approach to the mother is necessary.
- Prolonged preoperative waiting and starvation reflects poor communication and inefficiency.

Further reading

National Institute for Health and Care Excellence. *Ectopic Pregnancy and Miscarriage: Diagnosis and Initial Management*. Clinical Guideline 154. London: NICE, 2012. www.nice.org.uk/guidance/cg154 (accessed December 2018).

Chapter 6

Termination of pregnancy

Termination of pregnancy in the UK is undertaken under the terms of the Abortion Act 1967, with over 200,000 induced abortion procedures occurring each year. For the consideration of anaesthetic procedures and potential problems, patients presenting for a termination of pregnancy broadly fall into two groups:

1. The presence of a maternal problem, the most commonly stated reason being danger to the mental or physical health of the mother. This accounts for up to 98% of terminations and may occur up to 24 weeks' gestation, but usually before 15 weeks.
2. Severe fetal congenital abnormality or early fetal death, two-thirds of which occur before 20 weeks' gestation.

Problems and special considerations

When caring for women who are to undergo a termination of pregnancy, it is important to consider the physiological changes of pregnancy, the psychological state of the woman and the need for routine preoperative assessment of the patient.

Those women in the first group above are usually scheduled to have termination of pregnancy on a gynaecological operating list. Patients in the second group are often looked after in the maternity unit.

Some members of staff may express conscientious objection to performing or being involved in termination of pregnancy, and this must be respected. They cannot be made to participate in such procedures, although they do have a duty to find other staff who will, if that is the patient's wish.

Management options

Termination for maternal indications

Surgical termination of pregnancy is usually a day-case procedure. Assessment should be conducted sympathetically, as these women are often very distressed. Vacuum aspiration may be performed up to 15 weeks' gestation; patients and clinicians are more used to this being performed under general anaesthesia in the UK, although it can be performed with systemic analgesia, local anaesthesia or conscious sedation. After 15 weeks' gestation, dilatation and evacuation (D&E) is necessary, which is also usually performed under general anaesthesia.

As most terminations for maternal indications occur before 15 weeks, these women can usually be regarded as non-pregnant with respect to gastric emptying and acid aspiration unless they have symptoms of reflux.

An anaesthetic technique suitable for day-case anaesthesia should be employed, such as induction with propofol and maintenance with propofol or a volatile anaesthetic agent. There has been concern about concentrations of volatile anaesthetic agents greater than 1 MAC causing uterine relaxation unresponsive to oxytocics. For a termination of pregnancy at less than 15 weeks, standard concentrations of volatile anaesthetic agents do not appear to pose a risk and may be used to maintain anaesthesia. Analgesia may be provided by intravenous fentanyl or alfentanil, with rectal diclofenac (100 mg) at the end of the procedure.

The gynaecologist may request that 5–10 U oxytocin is administered to aid uterine contraction. There is no clear evidence that this is helpful at this stage of pregnancy, and it is not recommended by the Royal College of Obstetricians and Gynaecologists (RCOG).

Termination for fetal abnormality or death

Women who present for termination of pregnancy because of fetal abnormality or intrauterine death present a difficult clinical problem. A medical termination with vaginal delivery is often aimed for at later gestations, partly because this offers the opportunity for pathological examination of an intact fetus, but also because of limited access to D&E within the NHS. Induction of labour is usually required, and this may be a long and tedious process involving the use of prostaglandin pessaries and oxytocin infusion. The RCOG currently recommends feticide for terminations over 21^{+6} weeks. A discussion regarding analgesic options should be offered, including parenteral opioids and epidural analgesia (see Chapter 76, *Intrauterine death*). It must be remembered that as gestational age increases, the risks associated with termination, including complications such as haemorrhage, uterine perforation and infection, increase.

Termination of a pregnancy at less than 28 weeks is often associated with the retention of products of conception, for which surgical evacuation and anaesthesia are required (see Chapter 5, *Evacuation of retained products of conception*). Either regional or general anaesthesia may be offered to the woman, balancing the risks and benefits of each depending on the clinical condition and whether epidural analgesia is already in place. Rapid-sequence induction and tracheal intubation may be appropriate.

Key points

- Women may present for termination of pregnancy for maternal reasons or because of fetal abnormality or death.
- Such women are distressed and should be dealt with sympathetically.
- Early termination is usually performed as a day-case general anaesthetic procedure.
- Issues surrounding late terminations are as for intrauterine death.

Further reading

Royal College of Obstetricians and Gynaecologists. *Termination of Pregnancy for Fetal Abnormality in England, Scotland and Wales: Report of a Working Party*. London: RCOG, 2010. www.rcog.org.uk/en/guidelines-research-services/guidelines/termination-of-pregnancy-for-fetal-abnormality-in-england-scotland-and-wales (accessed December 2018).

Royal College of Obstetricians and Gynaecologists. *The Care of Women Requesting an Induced Abortion*. Evidence-Based Clinical Guideline 7. London: RCOG, 2011. www.rcog.org.uk/en/guidelines-research-services/guidelines/the-care-of-women-requesting-induced-abortion (accessed December 2018).

Chapter 7

Cervical suture (cerclage)

Cervical suture (Shirodkar or McDonald cerclage) is performed to reduce the incidence of spontaneous miscarriage when there is cervical incompetence. Although it can be done before conception or as an emergency during pregnancy, the procedure is usually performed electively in the second trimester. Indications include women with a history of cervical trauma, spontaneous preterm birth, preterm prelabour rupture of membranes (PPROM) or fetal loss between 16 and 34 weeks of pregnancy, and in whom transvaginal ultrasound scans at 16 and 24 weeks indicate a cervical length of less than 25 mm.

It generally takes 15–20 minutes and is performed transvaginally on a day-case basis. A non-absorbable stitch or tape is sutured in a purse-string around the cervical neck at the level of the internal os. This requires anaesthesia, since the procedure is at best uncomfortable, although the suture can often be removed without anaesthesia (usually at 36–37 weeks' gestation unless in preterm labour); spontaneous labour usually soon follows. In patients with a grossly disrupted cervix, for example following surgery, placement of the suture via an abdominal approach may be required. Delivery is usually by elective caesarean section in these cases.

Problems and special considerations

A woman undergoing cervical suturing may be especially anxious if a previous pregnancy has ended in miscarriage. Apart from the possibility of anxiety, anaesthesia is along standard lines, bearing in mind the risks of anaesthesia in the pregnant woman and the possible effects of drugs on the fetus (see Chapter 8, *Incidental surgery in the pregnant patient*). Cerclage may be difficult if the membranes are bulging; the head-down position and/or tocolysis may be required to counteract this.

Management options

Both regional and general anaesthesia are acceptable for the insertion of a cervical suture, with maintenance of normal haemodynamic parameters being paramount. Many authorities advocate spinal anaesthesia as the technique of choice, since only a small amount of drug is administered, although epidural anaesthesia is also acceptable. If spinal or epidural anaesthesia is chosen, standard techniques are used. The procedure itself requires a less extensive block than caesarean section (from T8–10 down to and including the sacral roots) and thus smaller doses are required; however, the reduction is offset by the greater requirements at this early stage of pregnancy compared with the term parturient. Thus the doses required for regional anaesthesia are in the order of 75% of those used for caesarean section. Low-dose techniques have also been used, as for caesarean section; the women have more

sensation (though painless) but have less motor block. Short-acting local anaesthetic agents such as prilocaine may be used to facilitate good anaesthesia for a short procedure while allowing faster discharge.

General anaesthesia may also be used; advantages include the relaxing effect of volatile agents on the uterus, and patient comfort if a steep Trendelenburg position is required. This involves administration of several drugs, and the effects on the fetus of many agents in current use are not clear (see Chapter 8, *Incidental surgery in the pregnant patient*). There may also be an increased risk of regurgitation and aspiration of gastric contents, depending on the gestation and severity of symptoms (see Chapter 59, *Aspiration of gastric contents*).

Paracervical and pudendal block and/or intravenous analgesia or sedation may also be used, but most authorities would recommend avoiding paracervical block because of potential adverse effects on uteroplacental perfusion.

Key points

- Cervical suture is usually performed in the second trimester.
- Patients may be especially anxious because of previous miscarriage.
- Standard techniques for the parturient are used; spinal anaesthesia may be preferable.

Further reading

National Institute for Health and Care Excellence. *Preterm Labour and Birth*. NICE Guideline NG 25. London: NICE, 2015. www.nice.org.uk/guidance/ng25 (accessed December 2018).

Chapter 8

Incidental surgery in the pregnant patient

Non-obstetric surgery may occur in 0.5–2% of pregnancies; pregnant women may present with the same surgical conditions as the non-pregnant population, or with problems related to their pregnancy. Most pregnant women are relatively young and fit, although there is an increasing number of women with systemic disease who are becoming pregnant because of advances in medical or surgical management of their condition. Points of particular relevance to anaesthetists are therefore any underlying condition in addition to the reason for surgery, the effects of pregnancy on its management and the effect upon the fetus.

Problems and special considerations

Surgical diagnosis of the acute abdomen may be difficult because of the physical presence of the gravid uterus. Non-specific signs such as white cell count may be unreliable (up to 15×10^9/l in normal pregnancy). The differential diagnosis may also include obstetric conditions such as placental abruption and HELLP (haemolysis, elevated liver enzymes and low platelet count) syndrome.

The risks of aortocaval compression, difficulties with airway management and aspiration of gastric contents are present as for any pregnant woman, and depend to a certain extent on the stage of pregnancy and the reason for surgery; most will treat such risks as clinically relevant during the second trimester (see Chapter 59, *Aspiration of gastric contents*).

Surgical technique may be hindered by the pregnancy, and the operation itself may be more difficult than in the non-pregnant patient. For example, laparoscopic procedures may be impossible. Surgery that normally requires the non-supine position, such as back surgery, may pose particular problems.

Since surgery is generally withheld during pregnancy unless absolutely necessary, patients who do present for surgery tend to be more severely affected; thus careful preoperative assessment and management are especially important. Problems of emergency surgery include inadequate preparation and investigation and an increased incidence of vomiting and dehydration.

The fetus is at risk from the primary effects of the mother's illness (e.g. dehydration, sepsis), the possible teratogenic effects of any drugs that are given to the mother, especially during the first trimester (see Chapter 3, *Anaesthesia before confirmation of pregnancy*), alterations in uteroplacental blood flow or oxygenation during anaesthesia and surgery, and possible premature onset of labour provoked by the illness, drugs or surgery itself.

Management options

In general, surgery is delayed until the second trimester if possible, because by then the major fetal organs will have already developed; in addition, the risk of premature labour is lower and the surgery easier than in the third trimester. Elective surgery should be postponed until after pregnancy. Once 24 weeks' gestation is reached, surgery should be undertaken at a location where emergency caesarean section is possible.

Perioperative management requires attendance by senior surgical and obstetric staff, with investigations and scans as required. The neonatal team should be informed once the fetus reaches 24 weeks' gestation. Anaesthetic management includes thorough preoperative assessment, taking into account the altered physiology of pregnancy (see Chapter 11, *Physiology of pregnancy*) when interpreting history, examination and investigations, and planning management. Particular attention should be paid to general assessment, as for emergency surgery in any patient. A sensitive discussion regarding risk to the pregnancy should be included in the preoperative assessment (see Chapter 3, *Anaesthesia before confirmation of pregnancy*). Current evidence suggests that miscarriage rates and premature delivery may be slightly increased, particularly when surgery occurs in the first and third trimester respectively. However, whether this is due to the anaesthetic, the surgery or the underlying pathological process is difficult to establish.

Depending on the stage of pregnancy, the airway may be more difficult, antacid administration should be considered, and the supine position should be avoided, although the efficacy of lateral tilt when the uterus is still small is uncertain. The disadvantages of regional anaesthesia (e.g. hypotension, increased peristalsis, problems with managing the block during difficult or prolonged surgery) must be weighed against those of general anaesthesia (airway problems, risk of awareness, less familiarity with general anaesthesia in the pregnant population etc.).

Although general anaesthesia involves the administration of more drugs with possible effects on the fetus, it also allows the use of volatile agents that relax the uterus. In general, drugs with good safety records during pregnancy should be used; most anaesthetic drugs do not have licences for use in pregnancy (mainly because of the costs involved in extending their licences), but newer drugs should probably be avoided until more is known about their actions. The only standard anaesthetic drug that has excited controversy in recent years is nitrous oxide, because of its effects on methionine synthase and DNA metabolism. Although there is a theoretical risk of its affecting the fetus, there is no evidence to support this clinically and many authorities, if not most, would now consider its use acceptable if needed.

General anaesthetic management would thus usually consist of rapid-sequence induction with standard agents, tracheal intubation and maintenance of anaesthesia with a volatile agent, as for any emergency general anaesthetic. Other drugs would be used as standard, but those that might increase uterine tone (e.g. ketamine, β-blockers) or vasoconstriction should be avoided if possible. Certain drugs given near to delivery may cross the placenta and affect the fetus (e.g. non-steroidal anti-inflammatory drugs, which can prevent the ductus arteriosus from closing). Prophylactic administration of tocolytic drugs has not been shown to be of any benefit, but uterine tone should be monitored perioperatively to allow administration of tocolytics if indicated. Traditional fears about the detrimental effects of high levels of maternal oxygen causing uteroplacental vasoconstriction are now known to be unfounded, and fetal arterial partial pressure of oxygen increases (up to

a maximum of about 8 kPa (60 mmHg)) as maternal arterial oxygen content increases, so long as maternal hypotension is avoided. Phenylephrine is considered the vasopressor of choice as it has the most evidence supporting its use; however, other α-agonists (e.g. metaraminol) may also be used. Maternal arterial partial pressure of carbon dioxide should be kept in the normal (pregnant) range during controlled ventilation, to avoid fetal acidosis with associated myocardial depression, and uterine artery vasoconstriction.

With regard to fetal monitoring, between 18 and 24 weeks' gestation, the fetal heart rate should be recorded pre- and post-procedure. From 24 weeks, cardiotocography monitoring with simultaneous electronic fetal heart rate and contraction monitoring should be performed before and after the procedure as a minimum. Intraoperative monitoring necessitates the presence of staff suitably trained to interpret preterm monitoring in the presence of anaesthesia and surgery, and abdominal surgery makes it more difficult to place the monitor. It may be difficult to arrange midwifery and surgical nursing care both before and after surgery, and the most appropriate area for the mother's postoperative care needs careful consideration.

Key points

- Surgical diagnosis and management may be difficult.
- Maternal risks are those of anaesthesia in the pregnant state.
- Fetal risks are related to the mother's condition and maternal drugs, and include the premature onset of labour.
- Anaesthetic management should focus on maintaining normal uteroplacental blood flow.

Further reading

American College of Obstetricians and Gynecologists. ACOG Committee Opinion No. 474: nonobstetric surgery during pregnancy. *Obstet Gynecol* 2011; **117**: 420–1.

Cheek TG, Baird E. Anesthesia for nonobstetric surgery: maternal and fetal considerations. *Clin Obstet Gynecol* 2009; **52**: 535–45.

Melnick DM, Wahl WL, Dalton VK. Management of general surgical problems in the pregnant patient. *Am J Surg* 2004; **187**: 170–80.

Reitman E, Flood P. Anaesthetic considerations for non-obstetric surgery during pregnancy. *Br J Anaesth* 2011; **107** (Suppl 1): i72–8.