Obstetrical Analgesia and Anaesthesia

19

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Learning Objectives

At the end of a careful reading of this chapter, the reader should be able to:

- Differentiate the obstetric patient from the other patients as being unique
- Identify the physiological changes in pregnancy and implications on the anaesthetic care
- Understand the mechanisms for the pain of labour and delivery
- Articulate the need for the relief of the pain of labour
- Critically evaluate the features of an ideal labour analgesic and the various methods for pain relief during labour and delivery
- Delineate the issues with epidural analgesia in labour and the accompanying consensus
- Explain the need for adequate preoperative preparation for caesarean section and effective communication between the obstetrician, midwife and anaesthetist
- Discuss the anaesthetic options for caesarean section and the associated complications
- Identify the best anaesthetic technique for the individualised care of the patient

19.1 Introduction

Obstetric anaesthesia is a subspecialty of anaesthesia dedicated to the care of women at childbirth. Traditionally, this care is often provided in the form of labour analgesia, anaesthesia for instrumental delivery or caesarean section and the care of the critically ill woman. However, some other aspects of care may be required in anaesthesia consult clinic for the obstetric patient while attending the antenatal clinic.

The practice of obstetric anaesthesia includes the care for the lives and well-being of at least two individuals particularly at caesarean section, instrumental delivery or in labour. This burden of care, sometimes, may be a reason for concern to the anaesthetist. This trepidation associated with obstetric anaesthesia and analgesia is further accentuated by the remarkable changes in the maternal anatomy and physiology. Furthermore, the pharmacokinetics and pharmacodynamics of anaesthetic and analgesic medications are altered by the changes in the mother. There is also the worry of the drugs administered to the mother getting to the unborn infant. These peculiarities of obstetric analgesia and anaesthesia occur on daily basis in most hospitals that offer care to the pregnant woman.

The challenges of obstetric anaesthesia notwithstanding, the maternal joy accompanying the delivery of an infant may be rewarding to the efforts of the obstetric anaesthetist. This satisfaction by the mother can also be perceived by the entire multidisciplinary team involved in the care. The care of the mother by the anaesthetist at caesarean section or in the delivery room demands a clear understanding of anatomy, physiology and pharmacology.

19.2 Physiological Changes in Pregnancy and Their Implications

Pregnancy is associated with a number of changes with significant implications on obstetric analgesia and anaesthesia. These changes affect different organs and systems. The physiological changes in pregnancy may mimic a disease state and it is important to differentiate the normal physiological changes from pathological processes. Multiple pregnancies often exaggerate the physiological changes in the mother. The current

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development in assisted reproduction may mean greater responsibility for the obstetric anaesthetist in the management of women with multiple gestations. Basically, changes in early pregnancy are hormonally mediated, e.g. progesterone, oestrogen, human chorionic gonadotropin and prostaglandins. As pregnancy progresses, the later changes are due to mechanical distortions resulting from the enlarging uterus.

19.3 Hormonal Changes

Progesterone remains the most important physiological change in the pregnant woman. Progesterone is secreted in the second half of the menstrual cycle in preparation for pregnancy. The corpus luteum maintains adequate secretion of progesterone until placental secretion becomes sufficient. The major function of progesterone is the capacity to induce smooth muscle relaxation and other physiological changes are dependent on this critical role.

Airway There is capillary engorgement in the entire respiratory tract including nose, pharynx larynx and trachea. Thus, the mucosa is friable and prone to easy bruising and bleeding with any airway manipulation. The bleeding may make airway control to be difficult by obscuring visibility of the larynx and increasing the risk of aspiration of the blood. All pregnant women are considered as potential difficult airway leading to difficult intubation/failed intubation/regurgitation/aspiration – a major cause of anaesthesia-related maternal morbidity and mortality worldwide.

19.4 Respiratory System

Oxygen consumption increases by 20% at rest and there is a 15% increase in metabolic rate resulting in significant increase in oxygen demand during normal pregnancy. This may increase further during painful contractions. The minute ventilation increases early in pregnancy with 30% increase by the 7th week and 50% increase at term (hyperventilation). These changes are mostly due to increase in tidal volume rather than any increase in respiratory rate. An altered sensitivity to carbon dioxide mediated by progesterone, and increased metabolic rate are thought to account for these changes in ventilation. The maternal hyperventilation increases the arterial pO_2 and the arterial carbon dioxide drops significantly with a compensatory fall in serum bicarbonate (compensatory metabolic alkalosis).

The enlarging uterus results in upward displacement of the diaphragm with a 15–20% decrease in functional residual capacity (FRC), commencing around 5 months. In the supine position, the closing volume (the volume during expiration at which airway closure begins to occur in dependent lung zones) may exceed FRC leading to hypoxaemia. The decreased FRC, increased airway closure and elevated oxygen consumption will result in early desaturation in the pregnant woman, especially during the induction of general anaesthesia.

19.5 Cardiovascular System

Blood volume increases from 65–70 to 80–85 mL/kg preferentially by the expansion of the plasma volume. Although the red blood volume increases linearly, it remains behind the relative increase in plasma volume. Consequently, the haematocrit decreases causing the physiological anaemia of pregnancy. This has implications for oxygen carriage under anaesthesia.

Cardiac output: 30–40% rise in cardiac output in the first trimester. Cardiac output continues to rise in the second trimester until it reaches a point 50% greater than the non-pregnant state. During labour, further changes due to increased stroke volume and heart rate include a 15%, 30% and 45% with latent phase contractions, active phase contractions and expulsive phase, respectively. Thus, labour could be a cardiac stress and women with pre-existing cardiac disease may decompensate in pregnancy and delivery.

Aortocaval compression: In the supine position, the gravid uterus can compress major vessel as from the 20th week. Compression of the inferior vena cava decreases venous return, decreases cardiac output and consequently causes symptomatic maternal hypotension. The compensatory mechanism for the aortocaval compression is through the sympathetic stimulation and collateral venous circulation via the azygos and the vertebral plexus. Spinal or epidural blocks may impair the compensatory mechanisms leading to exaggerated maternal hypotension. The effect of the aortocaval compression may vary from mild hypotension to cardiovascular collapse. Left uterine displacement is the major preventive measure against the symptomatic aortocaval compression. This can be accomplished by the placement of Crawford wedge under the right buttock, left lateral tilt of the operating table or manual displacement of the uterus in extreme situations.

Blood pressure: Generally, blood pressure changes occur with maternal age and parity. The nulliparous women have higher mean arterial blood pressure than parous women for a given age. However, the blood pressure increases with maternal age. The mean arterial pressure decreases by 15% during pregnancy, with 21% decrease in systemic vascular resistance and 35% reduction in pulmonary vascular resistance. The reduced systemic vascular resistance is thought to result from low resistance intervillous bed, and vasodilatation caused by prostacyclin, oestrogen and progesterone.

19.6 Gastrointestinal System

The enlarging uterus causes the stomach to assume more horizontal position. This mechanical displacement of the uterus decreases the effectiveness of the lower oesophageal sphincter, predisposing to reflux oesophagitis. Gastrin, elaborated by the placenta, increases the gastric acidity. Similarly, the gastric emptying time is increased, probably due to progesterone effect. During labour and delivery, the gastric emptying time is slowed further by the pain, anxiety and narcotic medications associated with labour. All pregnant women after 14 weeks of gestation must be treated as full stomach. This implies antacid prophylaxis and rapid sequence induction of anaesthesia.

19.7 Haematological Changes

There are major changes in the coagulation system in normal pregnancy. Plasma fibrinogen concentration increases and similar increases in all coagulation factors except V, IX and XIII. Thus, pregnancy induces a hypercoagulable state. The platelet count is moderately reduced but the function remains normal.

Fibrinolytic activity is low until an hour after placental delivery. At delivery, placental expulsion releases thromboplastic substances and this results in an increase in clotting activity. This increased clotting activity moderates the blood loss at vaginal delivery or by caesarean section. There is a return to normal coagulation and fibrinolysis to levels prior to pregnancy at about 3–4 weeks in the puerperal period.

19.8 Pain Pathway in Labour and Caesarean Section

The pain of labour can be characterised to include visceral and somatic components. The visceral component involves the cervix, lower uterine segment and the adnexa. During the first stage of labour, the presenting part stretches and distends the cervix and lower uterine segments. These noxious impulses are transmitted by sensory nerves that accompany sympathetic nerves terminating in the dorsal horn of the spinal cord. The afferent nerves pass through the paracervical region, the pelvis lumbar sympathetic chain and the white rami communicantes associated with the T10-L1 spinal nerves, and then pass through the posterior roots of these nerves to the dorsal horn.

The somatic pain results from the distention of the pelvic floor, vagina and perineum during the second stage of labour. The noxious impulses are transmitted through branches of the pudendal nerve (S2–4). The pudendal nerve innervates the posterior two-thirds of the labia majora, the vagina, vulva, perineum, and supplies motor fibres to various skeletal muscles of the pelvic floor and the perineum. It is important that central neuraxial block for caesarean section should cover sensory level to T_4.

19.9 Pain Relief in Labour

The nature of labour pain varies from one parturient to another. Characteristically, the pain of labour comprises three qualitatively distinct kinds of pain. These types of pain have been described in relation to the location of the pain: abdominal contraction pain, low-back contraction pain and continuous low-back pain.

The severity of pain experienced by parturients varies and may be affected by several factors including parity and the position of the foetus. Melzack and colleagues found that labour pain was more severe in nullipara than multipara (61% vs. 46%). In addition, none of the nulliparous women and only 6% of the parous women rated the pain of labour as minimal. Similarly, other maternal and fetal factors modify the mother's experience of pain at childbirth. The occipito-posterior position, maternal age and fetal weight are central to the nature and severity of labour pain experienced by parturients.

19.10 Why Pain Relief in Labour?

Pain and suffering wherever present should be relieved! The pain of labour, even without the specific aggravating factors, is comparatively severe, as it is only surpassed by amputation of the small digit. Besides the compassionate concerns, the pain of labour may result in physiological changes with maternal and fetal consequences. Most major systems in the body are affected by the pain of labour. The maternal and fetal consequences of the pain at parturition will be related to its severity. In labour, pain may result in maternal hyperventilation leading to marked hypocarbia. This results in uteroplacental and foetoplacental vasoconstriction, a leftward shift in oxyhaemoglobin dissociation curve and consequently fetal hypoxaemia. Maternal oxygen consumption is also increased. Pain, stress and anxiety induce elevated maternal plasma concentrations of catecholamines during labour. The pain of labour is also a major stress on the cardiovascular system. Labour results in progressive increase in maternal cardiac output from an increased stroke volume. These untoward effects of labour have been reversed with adequate pain control. In addition, severe and unrelieved labour pain has been associated with poor maternal satisfaction, postpartum depression and post-traumatic stress disorder.

19.11 Methods of Pain Relief in Labour

Several methods are available for the relief of the pain of labour. These methods are classified as pharmacological and non-pharmacological methods. The non-pharmacological methods include psychological preparation of the women, emotional support at delivery, transcutaneous electrical nerve stimulation (TENS), acupuncture and hydrotherapy. This discourse shall be limited to the pharmacological options as practiced by most anaesthetists. The utilisation of the various methods varies and requires a considerable level of training for the obstetric anaesthetist. Pethidine has long been licensed for use by midwives for the control of the pain of labour.

19.11.1 Parenteral Analgesia

Parenteral opioids are the most commonly administered alternative to epidural analgesia. This includes the use of pethidine, fentanyl, morphine, nalbuphine and remifentanil. None of these opioids meet the ideal analgesic for the management of labour pains (Box 19.1). The use of pethidine was initially limited to the intramuscular route of administration and has long been licensed for independent use by midwives in the United Kingdom. Pethidine stands out as a drug of choice for parenteral labour analgesia. It is highly lipid soluble and flexible for intramuscular or intravenous routes of administration. This may be of benefit in developing economies where the luxury of drug infusion pumps may for now, be unavailable. However, advancements in technology for drug administration have led to improved methods of the intravenous use of these agents.

Many other opioids have been used in patient-controlled analgesia (PCA) for labour. Remifentanil, because of its unique pharmacokinetics, is quite appropriate for patient-controlled labour analgesia. It has rapid onset and offset, short duration and esterase metabolised, thus independent of liver or renal functions. It crosses the placenta (mean uterine vein: maternal artery ratio = 0.88), rapidly metabolised by both mother and neonate, indicating lack of risk of prolonged respiratory depression at birth. Remifentanil provides superior analgesia when compared with intramuscular or intravenous patient-controlled pethidine as well as nitrous oxide. The potential benefits of remifentanil for obstetric analgesia may be achieved with a regime with a background infusion with rescue analgesia at peak of contraction.

Fentanyl, is equally lipid soluble, but not amenable to intramuscular administration. Like remifentanil, it is best used with facilities for intravenous patient-controlled analgesia. Morphine is used with caution due to its propensity for delayed maternal as well as fetal respiratory depression. Other opioids of interest in labour analgesia include nalbuphine, butorphanol and pentazocine. Pentazocine has both agonist and antagonist (weak) properties. Its prescription for labour analgesia may still be a feature in developing countries. Nevertheless, the problems of maternal drowsiness, nausea and vomiting as well as fetal respiratory depression with the use of the parenteral analgesics remain a major concern to the anaesthesiologist, obstetrician and neonatologist.

Parenteral analgesics for pain relief in labour appears to be limited to clinical states when lumbar epidural analgesia remains contraindicated such as the presence of coagulopathy, sepsis, previous spinal surgery, difficult back or patient's refusal of epidural analgesia (Box 19.1).

19.11.2 Inhaled Analgesia

Self-administered inhalational analgesia has been used for the relief of the pain of labour for years. The agent in common use is nitrous oxide (50%) premixed in oxygen (50%), entonox®. The administration of entonox relieves the pain of labour reasonably and could be safely used by unsupervised midwives. Several attempts have been made to improve the quality of analgesia provided to the parturient with entonox. Increasing the concentration of nitrous oxide resulted in higher number of mothers who lost consciousness during labour. Furthermore, inhalational anaesthetic vapour has been added to entonox to improve the quality of analgesic available to the parturient. Isoflurane has been most involved. The wide acceptance of entonox is probably related to its safe use even in the hands of midwives during self-administration by women in labour. Isoflurane/entonox may be safer than increasing the concentration of nitrous oxide beyond 50%, which has been shown to induce unconsciousness.

19.12 Regional Analgesia for Labour

Regional analgesia for labour can be provided in various ways. These include spinal analgesia, epidural analgesia and combined spinal epidural (CSE) analgesia and other local nerve blocks.

Box 19.1 The ideal labour analgesic

Features of the Ideal Labour Analgesic
• Rapid onset and short duration of action
• Minimal placental transfer
• Minimal effects on foetus and the newborn
• Minimal maternal central nervous system depression
• No tocolytic or oxytocic effects
• No adverse effects on uteroplacental circulation
• Maternal composure during 1st and 2nd stages of labour

The epidural technique is believed to be the most effective regional technique for pain relief in labour. However, some patients may not be good candidates for labour epidural analgesia because of contraindications to the technique, technical reasons, delayed onset of analgesia or increased pain intensity with advanced labour. The combined spinal epidural technique has gained widespread use in labour analgesia due to its rapid, reliable analgesia with minimal haemodynamic changes and motor block. The CSE is mainly employed for analgesia in late labour and some women have delivered with the spinal components only. This has led to the evolution of spinal analgesia in labour.

19.12.1 Spinal Analgesia

Spinal analgesia is an emerging and innovative technique in labour analgesia. It combines the injection of low dose bupivacaine with lipophilic opioids into the spinal space using pencil-point needle. The spinal space is usually accessed through any one of these intervertebral spaces L2/L3, L3/L4 or L4/L5 with a pencil-point spinal needle. Specifically, a combination of 1 mL of 0.25% bupivacaine with fentanyl 25 μg has been found to provide significant analgesia for 73% of multiparous women. It has rapid onset of action, provides good analgesia for the first and second stages of labour and is useful for the repair of episiotomy or perineal lacerations. Besides fentanyl, other adjuvants like clonidine, morphine have been used successfully to provide single shot spinal analgesia for labour. Maternal satisfaction with single shot spinal analgesia has been reported widely. In addition, single shot spinal analgesia does not cause impairment of maternal mobility and balance during labour.

The duration of analgesia provided by single shot spinal analgesia in labour appears to be a major limitation to its widespread application. Thus, this technique has been restricted largely to the multiparous women in whom labour is expected to be short. However, some practitioners have included the continuous spinal analgesia with a catheter in the subarachnoid space. Again, the cost of the specialised packs and catheter is a hindrance to the general application of this method. In addition, some practitioners have suggested that the single shot spinal analgesia could be repeated a number of times to accommodate the duration of labour. This is yet to become a widely accepted technique but offers a ray of hope particularly for nulliparous women with long duration of labour.

19.13 Labour Epidural Analgesia

Epidural analgesia is the most effective method of pain relief of labour in contemporary practice. It provides significant analgesia in majority of women in labour. The overall maternal experience of the birthing process was superior with epidural analgesia when compared with other pharmacological and non-pharmacological methods. Besides pain relief, epidural analgesia reduces maternal plasma concentration of catecholamine, improves uteroplacental perfusion, and blunts the hyperventilation/hypoventilation cycle associated with painful contractions. This method of pain relief in labour has undergone the most radical modification, evaluation and application.

The earliest application of lumbar epidural analgesia was as a single shot via the needle. The advent of the epidural catheter has given this technique the desired flexibility in the administration of the local anaesthetic agent. Dosing of the local anaesthetic agent could be done to achieve the desired dermatomal sensory analgesia on demand or at a determined interval. This section of the review would be restricted to the contemporary practice of Patient-Controlled Epidural Analgesia (PCEA), low dose epidural local anaesthetic and opioid administration and the combined spinal epidural analgesia.

19.14 Choice of Local Anaesthetic and Initiation of Labour Epidural Analgesia

The goal of epidural analgesia is adequate pain relief, not anaesthesia! An appreciation of this would result in better outcome with fewer side effects. During labour, the aim is to achieve rapid onset of effective analgesia, negligible motor blockade, minimal risk of materno-fetal toxicity, limited effect on uterine activity and an appreciable duration of action. There is no such ideal agent as at now.

Bupivacaine, an amide, is the most used local anaesthetic for labour epidural analgesia. Early studies with this agent indicate that the patient experiences some pain relief in 8–10 min and peak effect in 20 min. Current methods of administration of dilute solutions of bupivacaine with lipid soluble opioids have improved further the maternal experience and expectations.

Ropivacaine, a single-levorotatory isomer of bupivacaine, has emerged as a regular alternative in lumbar epidural analgesia. Studies have shown ropivacaine to be less cardiodepressant and arrhythmogenic than bupivacaine. It has also been speculated that ropivacaine has less propensity to block muscle fibres. The rather wider safety margin and minimal effect on motor blockade make it attractive to anaesthetists. In our experience, however, the motor sparing effect is not quite evident. This observation may be related to the use of dilute solutions of these agents and/or the addition of lipid soluble opioids as against the earlier administration of high concentrations of bupivacaine.

Other local anaesthetics of interest include lidocaine and 2-Chloroprocaine. These agents have limited usefulness for the initiation and maintenance of epidural analgesia for labour.

19.15 Other Adjuvants

Opioids have been used epidurally or intrathecally in combination with local anaesthetics for the relief of the pain of labour. This frequent use of epidural opioids is attributable to the synergistic interaction between opioids and local anaesthetics. The extremely lipid soluble opioids like fentanyl or sufentanil are more commonly employed as against alfentanil and meperidine. The addition of opioid allows the anaesthetist to use high volume and low concentration of local anaesthetics due to the bupivacaine sparing effect of epidural sufentanil or fentanyl. The dose-dependent decrease in epidural requirement offers a number of benefits including decreased risk of abnormally high blocks, decreased risk of local anaesthetic toxicity and minimal motor block.

Epinephrine is one of the adjuvant medications commonly added to local anaesthetic for epidural analgesia. The addition of epinephrine is thought to enhance the onset of epidural bupivacaine analgesia but may also be associated with increase in the intensity of motor block. The increased motor block is undesirable during labour and delivery. In addition, systemic absorption of epinephrine may induce maternal tachycardia and transient decrease in uterine activity as a result of stimulation of beta-adrenergic receptors. The onset of tachycardia may precipitate undue interventions by the unwary obstetrician. These factors have led to the cautious use of epidural epinephrine.

19.16 Maintenance of Lumbar Epidural Analgesia (Box 19.2)

Intermittent Bolus Injection

This is the traditional method of administration of epidural analgesia for labour. It involves administration of local anaesthetic solution at intervals. In our experience, it is best to give the local anaesthetic at specified intervals rather than on demand when patients have breakthrough pain. It is often difficult getting the patient to be as comfortable as desirable. The usual precautions of blood pressure check and the use of a titrated dose of the local anaesthetics is recommended.

Continuous Epidural Infusion

Continuous infusion of local anaesthetics involves the use of an infusion pump. The pump delivers a set volume of the local anaesthetic agent. It has been shown to result in fewer top-ups and improved maternal satisfaction. There are fears that continuous infusion may result in increased administration of greater doses of bupivacaine. However, busier centres have shifted to the use of patient-controlled analgesic devices.

Patient-Controlled Epidural Analgesia

This is largely dependent on technology. A galaxy of infusion regimens have been described for PCEA. The major advantage of this technique is that it offers a willing parturient the psychological benefit of a sense of autonomy and control. In addition, it provides the patient the opportunity of finding an acceptable threshold of comfort, which may vary from one parturient to another. The use of equipment does not preclude catheter migration. Thus, close monitoring of the patient remains vitally important.

The technique of PCEA has been refined to further improve analgesia, reduce motor block, increase maternal satisfaction and minimise intervention by the anaesthetist. One of such improvements has been the use of PCEA with continuous background infusion. The PCEA has a computer integrated continuous bolus doses. The background infusion should be about a third to half of the hourly doses.

Timed Intermittent Bolus Injection (Programmed Intermittent Epidural Bolus)

The evolution of the maintenance of labour epidural analgesia is currently on timed intermittent bolus injection or the Programmed Intermittent Epidural Bolus (PIEB). The automated systems are designed to deliver small dose of anaesthetics at programmed intervals. The programmed pump delivers about 5–10 mL of local anaesthetic at 30–60 min. The PIEB has been found to provide better analgesia, lower local anaesthetic consumption when compared with PCEA or Continuous Epidural Infusion (Box 19.2).

19.16.1 Combined Spinal Epidural Analgesia

The popularity of combined spinal epidural for pain relief in labour has soared in recent times. CSE technique has the flexibility of epidural analgesia and the rapidity and reliabil-

Box 19.2 Initiation and maintenance of labour epidural analgesia

Local anaesthetic	Concentration
Bupivacaine	0.0625–0.125%
Ropivacaine	0.08–0.2%
Levobupivacaine	0.0625–0.125%
Opioids	
Fentanyl	1.5–3 μg/mL
Sufentanil	0.2–0.33 μg/mL

ity of spinal analgesia with minimal local anaesthetic dosage. The needle through needle, single space technique is the widely used method of establishing CSE. This involves locating the lumbar epidural space and identification of the subarachnoid space with a spinal needle.

Combined spinal epidural analgesia for pain relief in labour can be achieved with short acting opioids such as fentanyl, sufentanil or pethidine. Spinal injection of fentanyl, sufentanil or pethidine provides effective analgesia for 2–3 h. If in early labour, the parturient may ambulate since there is no motor block. However, in late labour, the deposition of fentanyl/sufentanil with local anaesthetic provides immediate pain relief. Ambulation may not be advisable in such situation because of the possible motor effect of local anaesthetic agent, even if negligible. The time of activation of the epidural component of the technique is at the discretion of the attending anaesthetist. Some anaesthetists may be reluctant to dose an untested epidural catheter. It is, however, pertinent to be cautious with an untested catheter in the epidural space. The side effect profile of CSE is acceptable and includes pruritus, nausea, vomiting, hypotension, respiratory depression and postdural puncture headache. Sufentanil is more associated with fetal bradycardia than fentanyl.

19.17 Epidural Analgesia: Progress and Outcome of Labour

The very strong concerns with the effects of epidural analgesia on labour are well expressed and debated. It is important to note the current consensus opinion on these issues. Labour epidural analgesia does not increase caesarean section rate. It, however, prolongs the second stage of labour and is not associated with higher incidence of instrumental delivery. These observations have some far-reaching implications. First, more active monitoring is required especially in the second stage of labour. Second, experience and training in instrumental delivery will be emphasised for the current trainee obstetricians. This factor has actually been speculated as reason for the increased rate of instrumental delivery in the presence of epidural analgesia. Third, the principles of active management of labour should be encouraged, whenever, labour epidural analgesia is used. Furthermore, the epidural administration of dilute solutions of local anaesthetic may minimise these effects. It is salutary that labour epidural analgesia provides superior pain relief when compared to other methods of labour analgesia.

19.17.1 Anaesthesia for Caesarean Section

Caesarean section is an integral part of modern obstetrics. Therefore, anaesthesia becomes very necessary for the abdominal delivery of the newborn, forceps delivery, retained placenta or repair of trauma to the birth canal. Consequently, the anaesthetic options include general anaesthesia, regional anaesthesia or infiltration with local anaesthetics. The choice of anaesthesia is determined by the maternal health status, indication for the caesarean section, urgency of the surgical intervention and the desires of the mother. Whatever the choice of anaesthesia for the caesarean section, the clinical management begins with history taking, physical examination, relevant laboratory works and preoperative preparations and optimisation of any intercurrent medical condition.

Conduct of Anaesthesia

It is essential that all patients for caesarean section are visited by the anaesthetist to perform a preoperative assessment and develop an anaesthetic plan suitable to the parturient. The link between poor preoperative evaluation and morbidity underscores the relevance of preoperative care of the surgical patient. Beyond the establishment of rapport and gaining patient's trust, the preoperative history must inquire into the indication for caesarean section, previous exposure to anaesthesia, previous medical history, allergies, current medications, presence of dental prosthesis and the time of the last meal. A history of adverse outcomes with previous anaesthetic care would provoke the design of an anaesthetic plan to avoid such event in the planned surgery. The presence of intercurrent medical diseases means a good evaluation and control of the medical condition in other to enhance good postoperative outcome. The duration of illness, level of care, current medications for treatment and the presence or absence of related complications may provide insight into the control of the disease. It is important to identify the presence of loose tooth, dentures, false teeth and removable bridges/crowns. Failure to acknowledge these dental interventions may result in catastrophic outcome at airway control. Nevertheless, irrespective of the gestational age, the time of the last meal or drink should be documented.

The physical examination should be focused to identify the cardiorespiratory state and the ease of tracheal intubation. Good blood pressure control and absence of respiratory difficulty may indicate a stable cardiopulmonary status. However, the airway examination must be detailed enough to allow for good laryngoscopy and tracheal intubation. These predictive tests include mouth opening, neck movement, the thyromental distance and the pharyngeal view (Mallampati assessment). A combination of two or more of these tests is recommended.

The laboratory investigations include urinalysis, full blood count, electrolytes, urea and creatinine estimation. The blood group of the patient is determined and two units of donor blood cross-matched. The number of units of blood to

be screened depends on the local protocols and challenges. In developing countries without a central blood donation centre, ready access to banked blood may be difficult. It may be necessary therefore to keep screened blood in the bank for women scheduled for caesarean section. Other laboratory investigations would be dependent on the health status of the mother. Coagulation profile of the parturient becomes expedient in patients with preeclampsia.

There are specific preoperative preparations of the parturient for surgery due to the physiological changes attributable to pregnancy. The preparations are many but should adhere to institutional preoperative fasting guidelines, address the volume and acidity of residual gastric volume, prophylaxis against nausea and vomiting and others as may be necessary. Parturients are expected to remain nil per os for upward of 6 h and above since the pregnant woman has a full stomach! The fasting prevents further increases in the residual gastric volume. The acidity of the gastric content is best addressed with antacids. Sodium citrate 0.3 M (30 mL) just at the induction of general anaesthesia remains the preferred choice because of its non-particulate state. However, particulate solutions like magnesium trisilicate (30 mL) would be helpful especially when freshly prepared. Others have administered ranitidine, a H_2-reeceptor blocker, for the preparation of the parturient for caesarean section. Ranitidine stops further production of acids by the oxyntic cells in the gastric mucosa but does little to the acidity of the residual gastric contents. In order to achieve the reduction of the acidity of the gastric content, ranitidine 50 mg should be given the night before surgery and repeated on the day of surgery.

19.18 General Anaesthesia for Caesarean Section

In the days past, general anaesthesia was the technique of choice because of its quick induction more than the safety. At a point, concerns about the safety and efficacy of general anaesthesia outweighed the potential benefits of its speed. Specifically, general anaesthesia was one of the leading causes of maternal mortality in the UK. Difficulties with tracheal intubation, aspiration of stomach contents were the main anaesthesia-related factors in such maternal deaths. The conduct of anaesthesia with minimal doses of induction agents and inhalation agent so as to reduce the transplacental transfer culminated in the development of awareness under anaesthesia in the obstetric population more than the other surgical patients. A complication of general anaesthesia that provokes both patient and public concerns! The factors responsible for the loss of status of general anaesthesia for caesarean section are shown in Box 19.3:

The risks of general anaesthesia for caesarean section notwithstanding, there are clinical scenarios where regional anaesthesia is not an option. Whenever there is significant threat to foetus like fetal distress, general anaesthesia becomes the only option. Acute maternal hypovolaemia, significant coagulopathy, fixed cardiac output states, inadequate regional anaesthesia and maternal refusal of inadequate analgesia indicate general anaesthesia for the delivery of the foetus.

The induction of general anaesthesia poses a great risk to the mother and foetus. Appropriate position of the mother is key to smooth and effective induction. A small pillow should be placed beneath the occiput so as to allow for the eyes to look downward at the nipples. Rapid sequence induction with cricoid pressure is the standard of care. A predetermined dose of thiopentone (3–5 mg/kg) or propofol (1–2 mg/kg) is administered as a bolus while cricoid pressure is maintained. Laryngoscopy is facilitated with succinylcholine (1–1.5 mg/kg). A pre-selected cuffed endotracheal tube is gently passed into the tracheal through the glottis. Correct placement of the tube is confirmed by direct visualisation of the tube through the glottis, minimum of 6 traces of capnography and auscultation of adequate air entry to the lungs. The tracheal tube is then connected to the breathing system for mechanical ventilation. The sequence of events for general anaesthesia is shown in Box 19.4.

Box 19.3 Problems of general anaesthesia for caesarean section

- Risk of regurgitation and aspiration of gastric content
- Difficult laryngoscopy and tracheal intubation
- Hypoxaemia
- Supine hypotensive syndrome
- Haemorrhage
- Risk of postoperative deep vein thrombosis
- Awareness under general anaesthesia
- Death!

Box 19.4 General anaesthesia for caesarean section

- H2-receptor blocker iv/PPI/Metoclopramide
- Antacid: 0.3M sodium citrate/freshly prepared MMT
- LUD: Crawford wedge/left lateral tilt
- Baseline monitoring: HR, BP, SpO_2, ECG, $ETCO_2$, Temp
- Preoxygenation: 100% O_2 × 3–5 min/4 vital capacity breaths
- Cricoid pressure
- Rapid sequence Induction
- Laryngoscopy + Tracheal intubation
- Maintenance: 30–50% nitrous oxide in oxygen + 0.5MAC volatile agent
- Delivery: oxytocic for 3rd stage/ opioid + paracetamol ± NSAIDs
- Awake Extubation with good airway reflexes

General anaesthesia is maintained with 50% oxygen in nitrous oxide, an inhalation vapour like halothane, isoflurane or sevoflurane and neuromuscular block sustained with any of the non-depolarising neuromuscular blocker (rocuronium, atracurium, vecuronium, pancuronium etc.). Any of the inhalation vapour is useful provided that the concentration is not beyond 0.5MAC. Higher vaporiser setting may result in uterine relaxation and consequent haemorrhage. This complication is particularly dangerous and should be avoided. Specifically, the ventilation should achieve normocapnia. Following the delivery of the foetus, the nitrous oxide fraction may be increased and analgesia augmented with opioid or in its absence, infusion of paracetamol 1G over 15 min. Additional analgesics may include diclofenac suppository.

Monitoring: Standard monitoring to include heart rate, non-invasive blood pressure, electrocardiography, capnography, pulse oximetry and temperature

At the end of surgery, the airway is suctioned and the residual non-depolarising neuromuscular blocker is antagonised with neostigmine. An anticholinergic agent (atropine or glycopyrrolate) is given prior to or with the neostigmine to blunt the muscarinic side effects. The patient is allowed to continue to breathe 100% oxygen and the trachea is extubated when the patient responds well to verbal commands and the airway reflexes are active.

19.19 Regional Anaesthesia for Caesarean Section

There has been a shift from general anaesthesia to regional techniques. Indeed, regional anaesthesia precedes general anaesthesia in discussions on the anaesthetic options for caesarean section. This migration has favoured single shot spinal anaesthesia than epidural or combined spinal epidural technique. Epidural technique is not as appealing as spinal because of the slower onset and higher failure rate.

19.19.1 Spinal Anaesthesia

Single shot spinal anaesthesia is simple to conduct with rapid onset and predictable dense neural blockade. It is the preferred regional anaesthesia for elective caesarean section and some emergency cases (non-reassuring fetal heart tracing).

Technique: The conduct of spinal anaesthesia commences with antacid prophylaxis (Box 19.5). Intravenous ranitidine 50 mg diluted to 20 mL and metochlopramide10 mg is almost routine. A bolus intravenous fluid loading with 15–20 mL/kg of balanced salt solution (0.9% saline or Ringer's lactate) is mandatory. However, lack of time for preloading is no excuse for failure to offer spinal anaesthesia to the parturient. Intramuscular ephedrine 25–50 mg may suffice in such difficult moments. Supplemental oxygen is encouraged for all mothers particularly those parturients with compromised foetus.

The sitting position is preferred. The patient sits on the operating table with the feet resting on a stool such that the flexed knees are higher than the flexed hips and the head looking at the abdomen. After the aseptic preparation of the skin overlying the lumbar area, the lumbar puncture is done at the L3/4 or L2/3 interspace. The pencil-point needle, Whitacre needle, is passed gently until a loss-of-resistance is felt. Clear and free flow of cerebrospinal fluid indicates a correct identification of the subarachnoid space. Hyperbaric bupivacaine is the preferred drug for spinal anaesthesia. However, other local anaesthetic agents commonly utilised for spinal anaesthesia include lidocaine, tetracaine and procaine. The duration of action for lidocaine is short and may be useful for the very fast obstetrician. The duration and quality of anaesthesia may be improved further with the addition of adjuvants like epinephrine, morphine, diamorphine, pethidine or fentanyl.

Following the administration of the spinal medications, the needle is removed and patient is placed supine with left uterine displacement (LUD). The desired sensory level for caesarean section is T6 but T4 becomes mandatory for the obstetrician who exteriorises the uterus for repair.

Spinal induced maternal hypotension remains one of the main perioperative complications during caesarean section. It is imperative that vasopressors should be available to the anaesthetist involved in the care of women undergoing caesarean section under spinal anaesthesia. Ephedrine was considered the vasopressor of choice some decades ago. Phenylephrine has assumed the primal position. The consensus is to provide intravenous fluid preloading when feasible and maintain the systolic blood pressure above 100 mmHg. These measures could prevent the deleterious consequences of prolonged spinal induced maternal hypotension on the foetus (Box 19.5).

Box 19.5 Spinal anaesthesia for caesarean section

- H2-receptor blocker iv/PPI/Metochlopramide
- Antacid: 0.3M sodium citrate/freshly prepared MMT
- LUD: Crawford wedge/left lateral tilt
- Baseline monitoring: HR, BP, SpO_2, ECG, $ETCO_2$, Temp
- Preloading: 15–20 mL/kg 0.9% saline or Ringer Lactate
- Sitting Position: Lumbar puncture @ L2/3, L3/4
- 25G or 26G Whitacre needle
- Hyperbaric bupivacaine 10 mg + pethidine7.7–10 mg
  – Left Uterine Displacement (LUD)
- Prompt treatment of hypotension
  – Phenylephrine/ephedrine

19.20 Epidural Anaesthesia

Epidural anaesthesia is particularly popular because of the flexibility of its administration. The local anaesthetic agent can be given in incremental doses to achieve the desired sensory level. The use of the continuous technique enables the anaesthetist to maintain anaesthesia irrespective of the duration of surgery. Epidural anaesthesia as a primary technique for caesarean section should be for a reason. Quite often labour epidural analgesia is extended for surgical delivery. This is achieved by the administration of carbonated 2% lidocaine or the addition of 1 mEq of 8.4% sodium bicarbonate to each 10 mL of lidocaine. Details of the conduct and management of epidural is shown in Box 19.6.

19.21 Combined Spinal Epidural

This technique allows for the rapidity of spinal anaesthesia and the flexibility of epidural. CSE may be a preferred choice in major placental praevia, previous uterine surgeries with adhesions, possible difficult surgery and morbid obesity. In these situations, the epidural anaesthesia is activated if the caesarean section goes beyond the spinal component.

19.22 Local Anaesthesia

The use of local infiltration of anaesthesia appears to be of historical relevance in more developed countries. As a primary technique, local infiltration may be necessary when the anaesthetic personnel are unavailable. Furthermore, it may be necessary to do a local infiltration for the delivery of the foetus if the mother is severely compromised or grossly unstable. It is pertinent to understand the limitations inherent with this technique. The administration of the local anaesthetic is at different layers to the uterus. See Box 19.7 for details.

Box 19.6 Epidural anaesthesia for caesarean section

- H2-receptor blocker iv/PPI/Metochlopramide
- Antacid: 0.3M sodium citrate/freshly prepared MMT
- LUD: Crawford wedge/left lateral tilt
- Baseline monitoring: HR, BP, SpO_2, ECG, $ETCO_2$, Temp
- Preloading: 0.9% saline or Ringer Lactate
- Sitting Position: Epidural catheter @ L2/3, L3/4
- Left Uterine Displacement
- Test dose
- Epidural medications in aliquots of 3–5 mL
- 15–20 mL of 0.5% Bupivacaine ± fentanyl 50 mcg
- OR 10 mL 2% lignocaine + 5 mL 0.5% bupivacaine ± 50 mcg fentanyl
- Prompt treatment of hypotension
  - Phenylephrine/ephedrine

Box 19.7 Local infiltration for caesarean section

- Intracutaneous
- Subcutaneous injection
- Intrarectus
- Parietal peritoneal
- Visceral peritoneal
- Paracervical

19.23 Conclusion

Pain relief is indicated whenever pain exists! It is unacceptable to watch women go through labour and delivery without adequate control of the associated pain. The American College of Obstetricians and Gynaecologists and the American College of Anesthesiologists issued a joint statement on labour pain which included the following statement: "Labour results in severe pain for many women. There is no other circumstance where it is considered acceptable for a person to experience severe pain amenable to safe intervention, while under a physician's care." Most of the available methods are safe and should be offered to all parturients to make an informed choice. Anticipation, preparation and effective communication between the anaesthetist, obstetrician and midwife will lead to a better maternal experience of the birthing process.

19.24 Summary

The obstetric patient is a unique patient due to the physiological changes of pregnancy. These changes also have varying implications on the anaesthetic care. The obstetric patient is often admitted to the hospital for labour and delivery.

The labour may terminate in spontaneous vaginal delivery, assisted vaginal delivery or by caesarean section. Pain accompanies labour and delivery and the anaesthetist is often called upon to provide pain relief. The available methods could be classified as pharmacological and non-pharmacological. The pharmacological options include the use of parenteral analgesics, inhaled analgesic or regional analgesia. Epidural analgesia remains the most effective method of regional technique because of its flexibility. However, spinal analgesia is becoming a veritable option for labour analgesia due to the ease of insertion and cost-effectiveness. The duration of analgesia provided by single shot spinal analgesia in labour is a major limitation to its widespread application thus, restricting its use largely to the multiparous women in whom labour is expected to be short.

When labour terminates in caesarean section or abdominal delivery has been electively decided, the anaesthetist remains a member of the multidisciplinary care of the patient. The choice of anaesthesia is influenced by the maternal

health status, indication for the caesarean section, urgency of the surgical intervention and the desires of the mother. Spinal anaesthesia is the preferred technique to general anaesthesia for caesarean delivery in the absence of contraindication. Most of the available methods labour analgesia are safe and should be offered to all parturients to make an informed choice. Anticipation, preparation and effective communication between the anaesthetist, obstetrician and midwife will lead to a better maternal experience at parturition.