

GP Review Article**General Anaesthesia for Caesarean Section****PART I. A REVIEW OF THE SPECIAL PROBLEMS CONFRONTING
THE OBSTETRIC ANAESTHETIST**

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SUMMARY

The special problems confronting the obstetric anaesthetist are emphasised.

The anaesthetic sequence currently used in over 2 000 Caesarean sections performed yearly at King Edward VIII Hospital, Durban, is described.

The importance of lateral tilt, the length of induction to delivery (I-D interval), and the time taken from uterine incision to delivery of the fetus (U-D interval) are discussed. The various manoeuvres employed to protect the mother from the hazards of pulmonary aspiration of acid gastric contents, are reviewed. The problem of maternal awareness during surgery, and its avoidance by the use of various supplementary anaesthetic agents, is considered.

Drug-induced neonatal depression associated with anaesthesia should be avoided, and induction agents which adversely affect the maternal haemodynamics should not be used in the patient suffering from hypovolaemic or septic shock. The rare occurrence of laryngeal oedema in the obstetric patient and its management, is discussed in relation to the anaesthetic technique advocated.

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Certain aspects of obstetric anaesthesia merit special emphasis: firstly, the gravid uterus in the supine subject may compress the major abdominal blood vessels, and by reduction of venous return to the heart, decrease maternal cardiac output, thus jeopardising both mother and fetus. Secondly, pulmonary aspiration of acid gastric contents (Mendelsohn's syndrome) continues to be a prominent cause of maternal morbidity and mortality. Thirdly, the commendable desire to administer the minimum amount of anaesthetic agents, thus avoiding drug-induced neo-

natal depression, is marred by a relatively high incidence of maternal awareness during surgery. Finally, both intravenous and inhalational anaesthetics cross the placental barrier, and therefore may adversely influence the response of the newborn infant at birth.

A number of general anaesthetic techniques, which acknowledge the special problems posed by the obstetric patient, have been advocated. In this review we describe the anaesthetic sequence currently adopted at King Edward VIII Hospital, Durban, where over 2 500 Caesarean sections are performed annually. Consideration is given to the difficulties associated with obstetric anaesthesia, and the appropriate management is discussed.

ANAESTHETIC METHOD

The mother receives 15 ml magnesium trisilicate (BPC) by mouth 30 minutes before surgery. While awaiting operation, the patient is placed on her side. No premedicant drugs are prescribed before anaesthesia. On transfer to the operating table, a foam rubber wedge is positioned under the mother's hip, tilting the pelvis approximately 15° laterally. The direction of tilt depends on the surgeon's preference; most subjects, therefore, are tilted to the right. Sudden hypotension, or marked maternal tachycardia in this position, is remedied by reversing the direction of tilt. In the absence of a suitable rubber wedge, a simple 10° table tilt will suffice.

An intravenous infusion of Ringer's lactate is commenced, using a 16-gauge Argyle Medican cannula. Atropine 0.6 mg and alloferin 2.5 mg are given intravenously. The mother inhales oxygen through a non-rebreathing circuit for 5 minutes; anaesthesia is then induced by injection of a thiopentone/suxamethonium mixture, which must be freshly prepared to avoid hydrolysis of the muscle-relaxant drug. Dosages of thiopentone range from 200 - 300 mg (3 - 4 mg/kg), suxamethonium from 100 - 150 mg (2 mg/kg). As consciousness is lost, an assistant applies manual pressure to the cricoid cartilage (Sellick's manoeuvre) and a cuffed endotracheal tube is rapidly placed and inflated. This induction sequence has been suggested as a means of reducing the incidence of regurgitation and aspiration of gastric contents during induction of anaesthesia. A small dose of non-depolarising muscle relaxant, injected before the mixture, mitigates against unpleasant awareness of muscle fasciculations,

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and may prevent the rise in intragastric pressure associated with suxamethonium. The dosage of suxamethonium should be increased by about 70-100% of the usual intubating dose to compensate for the antagonistic action of the non-depolarising relaxant.

Ventilation of the lungs is mechanically controlled with a Manley respirator, delivering 8-10 litres/minute of nitrous oxide (65%) and oxygen (35%). Further muscle relaxation is obtained by giving alloferin 10-15 mg intravenously. After delivery of the fetus, anaesthesia is supplemented with 0.5% halothane vapour and 50 mg pethidine injected intravenously.

After birth, the infant is transferred to a Meco neonatal resuscitation unit. Pharyngeal suction is performed under direct vision, using an infant laryngoscope. Should the infant fail to breathe adequately, or have a heart rate of less than 100/minute within two minutes of birth, the trachea is intubated and respiration controlled with oxygen. Sodium bicarbonate (2-3 mEq/kg) and 8-10 ml 50% dextrose is given via a cannula introduced into the umbilical vein, if the Apgar score is less than 5/10 at two minutes. The newborn infant is then rapidly transferred to an incubator to avoid heat loss and drop in temperature.

At the termination of surgery, the residual effects of alloferin are reversed by the injection of atropine 1.2 mg and neostigmine 3.5 mg. After pharyngeal suction under direct vision, the mother is turned on her side. A simulated cough is induced by filling the lungs to capacity with oxygen just before deflation of the cuff and removal of the endotracheal tube, in order to clear the upper air passages of secretions or regurgitated matter.

DISCUSSION

The 'supine hypotensive syndrome', due to obstruction of the inferior vena cava and abdominal aorta by the gravid uterus, is an overt circulatory emergency characterised by hypotension, tachycardia, pallor and sweating. An insidious variety of inferior vena caval occlusion, which escapes clinical detection, has been postulated, based on radiographical evidence and fetal blood gas/acid-base studies in mothers undergoing Caesarean section in the supine position. Blood pressure in the latter group is presumably maintained by peripheral vasoconstriction and diversion of blood via collateral venous channels, which tends to partially compensate for the reduced venous return associated with inferior vena caval occlusion.

The terms 'revealed vena caval occlusion' and 'concealed vena caval occlusion' have been proposed to differentiate the two conditions, and the view expressed that obstruction to the vena cava may occur whenever the pregnant patient at term is placed in the supine position. The resultant decrease in the maternal cardiac output may endanger the mother, if her compensatory mechanisms are, for example, obtunded by a bolus injection of thiopentone during induction of anaesthesia, causing severe maternal hypotension and even cardiac arrest. In addition, the consequent reduction in placental perfusion and, therefore fetoplacental metabolic blood gas interchange,

poses a threat to the fetus, resulting in a significant degree of fetal acidemia which is directly related to the time taken from induction of anaesthesia to delivery of the fetus. These problems can be largely obviated by lateral uterine displacement, by operating in the lateral position, by tilting the patient with a wedge, or simply by tilting the operating table 10° laterally.

Prolongation of the time taken from uterine incision to delivery of the fetus (U-D interval), may also significantly contribute to biochemical asphyxia in the newborn. Placental blood flow may be compromised by the over-vigorous application of fundal pressure by the surgical assistant endeavouring to facilitate delivery. In addition, the umbilical cord may be inadvertently compressed between the fetal head and the operator's hand or obstetric forceps, thus seriously disrupting fetoplacental exchange. The obstetrician should not only be aware of the importance of lateral tilt at Caesarean section, but should also be encouraged to expedite delivery gently and rapidly once the uterus has been incised.

Aspiration of acid gastric contents by the mother during general anaesthesia for obstetric manoeuvres, is an important avoidable cause of maternal morbidity and mortality. Severe bronchoconstriction, pulmonary oedema, and chemical pneumonitis may follow the inhalation of acid stomach contents. The occurrence of the 'acid aspiration' or 'Mendelsohn's syndrome' may apparently be obviated by prior administration of an antacid. The use of magnesium trisilicate BPC (containing magnesium trisilicate, magnesium carbonate and sodium carbonate), which appears to be more effective than plain magnesium trisilicate in reducing gastric acidity, has been advocated. If the pH of the gastric aspirate is greater than 2.5, Mendelsohn's syndrome rarely occurs.

Alkalinisation of the stomach contents does not, however, preclude mechanical obstruction to the airway by the aspirate. All mothers presenting for emergency general anaesthesia in our obstetric unit, therefore, have a large bore stomach tube passed before the induction of anaesthesia, unless obstetric contra-indications (e.g. prolapsed cord or bleeding placenta praevia) exist. Low residue diet for patients in labour with careful attention to fluid intake, will also lessen the hazard of aspiration.

Cricoid pressure (Sellick's manoeuvre) will apparently control passive regurgitation of gastric material. The induction of anaesthesia using a thiopentone/suxamethonium mixture, coupled with application of manual pressure to the cricoid cartilage, allows rapid passage and inflation of a cuffed endotracheal tube within 20-30 seconds of injection, further decreasing the risk to the mother.

Maternal awareness during surgery is a frequent problem encountered in obstetric anaesthetic practice, especially when conducted at the reduced atmospheric pressure of high altitudes, where it is difficult to achieve anaesthetic tensions of nitrous oxide.

The use of adjuvants in the form of volatile agents such as halothane, methoxyflurane and ethrane during anaesthesia for Caesarean section, reduces the incidence of factual recall, but may result in some degree of drug-induced neonatal depression. Intravenous anaesthesia for Caesarean section has been advocated, and ketamine may

be the drug of choice with this technique. However, supplementation with diazepam or droperidol appears necessary to avoid the serious psychic sequelae associated with ketamine anaesthesia.

In a study conducted at sea level, on 50 mothers undergoing elective Caesarean section and using the anaesthetic technique described, 2 cases of awareness were encountered. Both involved auditory recall, and neither patient experienced pain or discomfort during surgery. This low incidence (4%) of awareness may be attributed to the use of an adequate induction dose of thiopentone, and effective denitrogenation by oxygen breathing before anaesthesia commenced. The latter manoeuvre allows rapid equilibration with narcotic tensions of nitrous oxide between alveoli, blood and brain, thus assuring anaesthesia in the majority of mothers anaesthetised at sea level (barometric pressure about 760 torr). Anaesthetists practising away from the coast would be well advised to consider the use of either a volatile inhalational agent, or intravenous supplementation before delivery of the fetus during obstetric anaesthesia, if maternal awareness is to be avoided.

Drug-induced neonatal depression may follow induction of anaesthesia with barbiturates, or maintenance of anaesthesia with volatile or gaseous anaesthetic agents. Thiopentone dosage should be limited to 4 mg/kg or less, while inspired concentration of 0,5% halothane, 0,1% methoxyflurane or ethrane 0,5 - 1%, do not appear to depress the infant unduly. Greater concentrations of the inhalational agents may not only depress the baby, but also reduce uterine muscle tone, leading to excessive maternal bleeding.

The technique of anaesthesia described in this article does not appear to be associated with significant clinical depression of the infant, while fetoplacental exchange, as assessed by fetal blood gas analysis and maternal to fetal blood gas gradients, is well maintained regardless of the

length of the I - D interval. The latter may be attributed to the introduction of lateral tilt to obviate the undesirable effects of aortocaval occlusion. The hazard of regurgitation and aspiration of acid gastric contents is reduced to a minimum, and maternal awareness does not seem to be a serious problem.

Rapid induction of anaesthesia with thiopentone is, however, contra-indicated in the presence of either hypovolaemia following severe haemorrhage, associated with placenta praevia, abruptio placentae and rupture of the uterus, or endotoxic shock due to intra-uterine sepsis. Under these circumstances, ketamine, cyclopropane or nitrous oxide induction of anaesthesia may be more safely employed.

A further contra-indication to the use of thiopentone/suxamethonium mixture, is inexperience in the art of endotracheal intubation. In our view, obstetric anaesthesia, general and regional, should only be undertaken by persons capable of intubating the trachea when required. Therefore a selection of endotracheal tubes, a functional laryngoscope (adult and infant blades), and suitable apparatus for inflation of the lungs is requisite equipment in obstetric practice.

Additional care should be taken in the pre-operative assessment of oedematous patients, who can occasionally present at laryngoscopy with unsuspected laryngeal oedema. The immediate availability of endotracheal tubes, ranging in size from 4,5 - 8 mm, not only obviates the danger posed by this hazard to mother and fetus, but also avoids embarrassment to the anaesthetist.

In conclusion, we have advocated an anaesthetic method which has become routine in the majority of over 2 500 Caesarean sections performed annually in our obstetric unit, including diabetic and toxemic patients. The obstetric anaesthetist, responsible to both mother and fetus, should be aware of the special problems confronting him, and their appropriate management.