

ANAESTHESIA FOR CAESAREAN SECTION

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Caesarean section (LSCS) is one of the commonest operations performed in the developing world and is often carried out in difficult circumstances. As with any operation, the anaesthetist should first think about all the problems that may occur as it is always better to be prepared for trouble than to be taken by surprise.

The problems concern 5 areas:

1. The patients
2. The surgery (and the surgeon!)
3. The drugs (both anaesthetic drugs and any taken by the patient)
4. Equipment
5. The anaesthetist

1. Problems with the patients

Caesarean section is often said to be the unique situation where the anaesthetist has to deal with 2 patients under the same anaesthetic. The health of the baby has to be considered as well as that of the mother.

Risks to the mother. Changes in maternal physiology are described elsewhere in this journal, as are problems associated with hypertensive disease of pregnancy. Any other significant concurrent disease, such as maternal diabetes or sickle cell disease, will have to be handled in the usual way. The important changes affecting anaesthesia are:

Pregnant women are at risk of hypoxia. They are more difficult to oxygenate than non-pregnant patients due to changes in their respiratory mechanics and they use the oxygen more quickly because of a higher metabolic rate. This situation can be made worse by other factors. Obesity makes control of the airway more difficult and interstitial fluid retention may make the larynx harder to visualise for successful intubation.

Although fluid retention is a feature of pregnancy, a more common problem is the risk of hypovolaemia

either due to obstetric complications causing significant antepartum haemorrhage or, very commonly, prolonged labour leading to exhaustion and dehydration. This is particularly noticeable in the hot season.

The pregnant mother is at greater risk of pulmonary acid aspiration, as regurgitation of acidic stomach contents is more likely than in non-pregnant patients. This can lead to catastrophic aspiration pneumonitis.

The patient with hypertensive disease of pregnancy may have abnormal clotting function and multiple other complications of this disease.

Risks to the fetus include hypoxia and acidosis if placental blood flow is reduced. Since maternal blood pressure is maintained at the expense (if necessary) of placental perfusion, by the time a significant drop in maternal blood pressure has been measured the fetus has already suffered from reduced placental perfusion. The general condition of the fetus should be considered.

What is the state of the fetus preoperatively? How significant is any "fetal distress"? Is there an obstetric complication, such as cord prolapse, that puts the fetus at imminent risk and requires the quickest possible intervention? Are there more than one fetus?

Risks to mother and fetus. Both need to be protected from the "supine hypotensive syndrome" (aorto-caval compression). This occurs when the maternal inferior vena cava and, to a lesser extent, the aorta are compressed by the gravid uterus if the mother is allowed to lie on her back.

2. Problems with the surgery

Ask yourself the following questions:

Who is the surgeon, how experienced, how long does he expect to take and what incision is planned? Are blood and other intravenous fluids available? Is there a surgical complication such as placenta praevia that could cause serious intra-operative haemorrhage ?

Does your surgeon lift the uterus right out of the abdominal cavity after delivery in order to suture it? (Under regional anaesthesia this is very uncomfortable and is rarely necessary.)

3. Problems with drugs

As with any patient, the pregnant woman may be taking drugs for concurrent diseases which have to be considered, e.g. steroids, anti diabetic medication. They may also be taking drugs that can react with anaesthetic drugs, e.g. antidepressant medication.

With all drugs, beware of the weight of the patient and try and weigh her if possible. Do not believe average doses quoted in textbooks but give drugs as mg/kg. This is particularly important in Asia where, in the authors' experience, fully grown women at term may only weigh 35 to 40kg.

There is a moderate reduction in pseudocholinesterase in pregnant women compared with the non-pregnant population (at least in Caucasians). This is more notable immediately post-partum. Although the initial dose of suxamethonium is the same, its effect may be prolonged. If suxamethonium has not been correctly stored it may not be fully effective.

Ketamine causes a rise in blood pressure. It should not be given to mothers with hypertension but is well worth considering if a mother is being resuscitated from hypovolaemia. Ergometrine, given to encourage uterine contraction immediately after delivery, frequently causes nausea and vomiting. It is better to use oxytocin in the awake patient having a regional or local anaesthetic.

Are all general anaesthesia including emergency drugs available?

Drugs used for the anaesthetic may affect the fetus. Anaesthetic drugs cross the placenta and therefore a "deep" anaesthetic will sedate the baby and risk birth apnoea. Narcotics and sedatives should not be given to the mother prior to delivery. Gallamine crosses the placenta and will affect the fetus. Other neuromuscular blocking agents are safe.

4. Problems with equipment

What anaesthetic equipment is available? Is there adequate oxygen, either in cylinders or as a functioning oxygen concentrator? Is the power supply reliable?

Does the sucker work and is there a back up manually operated sucker?

Does the table tilt and is there a suitable wedge available?

Is there a range of equipment for difficult intubation: introducers, a range of laryngoscope blades and handles and endotracheal tubes?

Is there resuscitation equipment ready for the patient having a regional anaesthetic? What resuscitation equipment is ready for the baby?

What sterile needles are available for spinal anaesthesia?

Is there any monitoring equipment available?

5. Problems with the anaesthetist

Finally, you should consider how experienced you are with any particular technique and how long you expect to take. *Can you obtain the help of another anaesthetist?* This is a good policy if you are expecting a difficult intubation or other problems. Lastly, and probably as important as anything else, *do you have a trained assistant? Do they know how to do cricoid pressure correctly? Are they strong enough to turn the patient on to her side if you get into trouble?*

Having considered all the potential difficulties, make a plan for your anaesthetic.

Plan for Anaesthesia

Preoperative preparation

Peroperative	induction
	maintenance
	recovery

Postoperative care

PREOPERATIVE PREPARATION

Visit the patient, take a history and examine them. Consider the state of the maternal cardiovascular system, whether or not you expect a difficult intubation and also the state of the fetus. Give antacid as described in the table 1. If ranitidine is not available, give antacid pre-operatively.

Explain the type of anaesthetic that you plan to use and what the patient can expect to happen before, during and after surgery. Try to gain the patient's, and her family's agreement for what you plan to do. If the patient is at high risk then this should be explained to the family concerned.

Table 1

Elective case	Ranitidine 150 mg orally the night before and 90 minutes pre op
	Sodium Citrate 30 mls orally immediately pre op
Emergency	Ranitidine 50 mg IV immediately decision made to operate
	Sodium Citrate 30 mls orally immediately pre op
High risk labour	Ranitidine 150 mg orally 6 hrly (e.g. Diabetic)
	Sodium Citrate 30 mls orally if proceeds to Caesarean section

Premedication should not be given because it will depress the baby's respiration and conscious level at birth. If naloxone is available for the baby (or nalbuphine as a second-best alternative), then pethidine may be given to the mother during labour. A good alternative to pethidine in labour is to use inhalational analgesia, either with a 50/50 mixture of nitrous oxide and oxygen (Entonox), or with trichloroethylene (Trilene) in air. Trilene is easy to use, cheap and effective. It can be used for analgesia in labour and other situations, e.g. change of burns dressings, setting of simple fractures. The simplest system for delivery is a draw over vapouriser (e.g. OMV) with some tubing, a face-mask and a one-way valve at the patient end. Note that it must never be used in the presence of soda lime. Provided about 1% Trilene is used (half way between max and min on a Cyprane inhaler scale) and the mother holds the mask herself, it is safe. If she begins to move from analgesia to anaesthesia then she will drop the mask and become fully conscious again.

ANAESTHESIA

Three anaesthetic techniques are possible:

1. Local infiltration anaesthesia with or without supplementation.
2. Regional anaesthetic
3. General anaesthetic

Before starting anaesthesia check the following:

- Antacids, sucker, availability of blood, oxygen and an assistant who can do cricoid pressure.
- Establish good IV access with a reliable large bore cannula and start an IV infusion of Normal Saline or Ringer's Lactate (Hartmann's solution).
- Place a wedge on the operating table, under the right side of the patient so that she is tilted to the left by 15 to 20 degrees.
- Always have at hand the drugs and equipment necessary to perform an urgent general anaesthetic or resuscitation of mother or child. Whatever technique you start with, you may end up giving a general anaesthetic.

1. Local Anaesthetic (LA)

The local anaesthetic infiltration is normally carried out by the surgeon. Work out the maximum safe dose of the drug being used and add adrenaline at the rate of 5 micrograms per ml of LA. This is a 1 in 200,000 solution of adrenaline (easily made by adding 0.1ml of adrenaline 1:1000 to each 20mls of LA).

If available give oxygen to the mother until delivery.

Using a 100mm needle two long bands of skin are infiltrated either side of the proposed incision. Keep the needle parallel to the skin and beware that the abdominal wall is very thin at term. Do not stick the needle into the uterus. After incising the skin, the rectus sheath is infiltrated. In order to anaesthetise the parietal peritoneum, a further 10mls of solution is injected under the linea alba, once it is reached and, lastly, 5mls is injected into the loose visceral peritoneum of the uterus at the point of the incision in the lower segment.

Reassure the patient and explain that after the local anaesthetic has been given, she will still feel certain sensations of touch. She may experience discomfort if the head is well engaged in the pelvis. However, the anaesthetic will prevent her feeling significant pain.

Supplementation is a problem because of the effects on the fetus and the first choice is to give nothing until the cord is clamped, after which small doses of narcotic or sedative may be used. Probably the safest supplementation is nitrous oxide in oxygen or Trilene in air (+/- oxygen), as described above.

Ketamine should be used cautiously, in as low a dose as possible, and only intravenously. In analgesic doses of 0.25mg/kg, it has little effect on the baby and, although it crosses the placenta easily, doses up to a total of 1mg/kg can be used. Full anaesthetic doses of 2mg/kg will sedate the baby and may cause chest wall rigidity which complicates resuscitation. If ketamine is used then diazepam or promethazine should be given to reduce the problems of hallucinations on emergence. These should only be given after the cord has been cut. Ketamine also causes contraction of the uterus and should probably be avoided in cases of significant fetal distress. Atropine may be needed in some adults with ketamine because of excess salivary secretions.

Other points with local and regional anaesthesia:

Atropine is also useful in combating the discomfort and nausea that some patients feel on surgical traction on the peritoneum.

If ergometrine is used to contract the uterus after delivery it will cause vomiting which may be awkward to manage in the supine position during surgery. If it is the only drug available give it very slowly intravenously, preferably with the infusion running. Oxytocin is better, either in a drip at 10-20 units in 1000mls running at 2 to 3mls/minute or a 5 to 10 units IV bolus slowly intravenously.

NB. if these drugs are mistakenly given prior to delivery, constriction of the uterus can be a catastrophe for the baby. There is no need to draw up the oxytocin until it is needed after delivery of the baby and on checking with the surgeon.

The main advantages of local anaesthesia infiltration are:

- It is safe, especially for mothers in poor condition and those who are hypotensive.
- There is a reduction in bleeding because of the adrenaline.
- It is a suitable technique for the single operator / anaesthetist although any supplementation is best avoided.
- It is inexpensive, requiring minimal resources.

The disadvantages are:

- It is not always a perfect technique and the

mother may experience considerable discomfort.

- It takes time to establish and gives less surgical exposure.
- It requires experience on the part of the surgeon.

It is probably most suitable when a reasonably experienced surgeon has limited anaesthetic backup.

2. Regional anaesthetic blockade

Either epidural (extradural) or spinal (subarachnoid) blocks may be used. A combined spinal + epidural technique is commonly practised in UK which has the advantages of a dense subarachnoid block, with the potential for topping up the anaesthetic via the epidural if necessary. In addition the epidural may be used for postoperative analgesia. This combined technique is rarely done in the developing world and will not be further discussed.

Epidural anaesthesia is commonly used in developed countries for analgesia during labour and can therefore easily be used to produce anaesthesia for Caesarean sections with larger doses of local anaesthetic. However, epidurals are technically more difficult to perform than spinal anaesthesia and require more specialised equipment, which is often not available in the developing world. There are significant and potentially fatal complications and they require experienced anaesthetists and midwives for their safe use.

The main advantage of epidurals is that they are suitable for prolonged use e.g., in labour and for post Caesarean section pain relief. Another indication for the experienced anaesthetist is as a choice in patients in poor condition since surgical analgesia can be established slowly with small repeated doses of local anaesthetic, thereby minimising cardiovascular instability. However, since equipment to perform epidurals is often not available, they are not always a practical technique for routine anaesthesia for Caesarean section. Anaesthesia takes longer to develop compared with subarachnoid block and is induced by using increments of either 2% lignocaine with 1:200,000 adrenaline or 0.5% bupivacaine. Note that 0.75% bupivacaine is not recommended for anaesthesia for LSCS. Since epidural anaesthesia is not routinely used in many places it will not be further dealt with here.

Spinal anaesthesia has many advantages for anaesthesia for LSCS. The patient is awake and therefore her airway is safe. The baby is not sedated and is usually born in good condition providing hypotension is avoided. If the baby is born with a low Apgar score the anaesthetist is free to resuscitate the baby (unless he is also the surgeon!). With a little experience the technique is as quick as giving a general anaesthetic and provides good operating conditions with some reduction in surgical haemorrhage. It has the advantage of giving good pain relief for several hours after surgery and is straightforward to learn and teach. It is inexpensive and appropriate for virtually all cases except those with unresuscitated preoperative hypovolaemia and those with the specific contraindications of a bleeding disorder, sepsis at the site of injection or allergy to local anaesthetic. It should be avoided in a patient who is suspected of having raised intracranial pressure and patients with hypertensive disease of pregnancy should have clotting function checked. (See also Update in Anaesthesia No. 3)

Explain the technique and its advantages to the patient. There are widely varying views on spinal anaesthesia among different patient populations (and also between surgeons!). Ensure that the patient understands that pain sensation will be abolished but she should expect some pulling and pressure sensation during surgery which may be unpleasant but will be short-lived.

The preparations described above are necessary. i.e. antacids, IV access, wedge, sucker, assistant who can give cricoid pressure, full GA and resuscitation drugs and equipment for mother and child, oxygen until the baby is delivered and blood for transfusion. A sterile surface should be prepared for the procedure with all equipment for spinal anaesthesia available.

Technique:

- Measure a baseline blood pressure
- Pre-load the mother with one litre of normal saline or Ringer's lactate solution (Hartmann's) prior to performing the block.
- Have a vasopressor drawn up and diluted, ready for injection.
- The block can be performed either with the mother sitting up with her feet on a stool and her body bent forward over a pillow on her lap; or lying on her side. The spine should be well flexed. The

injection should be at the level L2/3 or L3/4.

- **The injection should be performed with full sterile precautions.** The skin must be prepared with an alcoholic or iodine based skin preparation. The anaesthetist should be wearing sterile gloves and a face mask. A sterile drape should be placed over the patient if they are in the lateral position.

- Explain what will happen to the patient as this will help them to stay still.

- Inject local anaesthetic to the skin.

- While waiting for the local anaesthetic to take effect, draw up the correct dose of the spinal injection which you plan to use and leave it ready beside you on the sterile surface. Ensure that your drawing up needle touches only the inside of the ampoule that you are using. Check the name, concentration and expiry date of the spinal anaesthetic on two occasions. Almost all serious neurological complications of spinal blocks have been due to the wrong drug being injected into the subarachnoid space due to lack of vigilance. Record the batch number and date of expiry of the drug on your anaesthetic chart.

- For the mid-line approach, place a spinal needle introducer between the lumbar spines to a depth of 2 or 3 cms until it is firmly held by the interspinous ligament. If the proper introducer is not available, a size 19 gauge hypodermic needle can be used. Insert the spinal needle with the *stilette* through the introducer and advance steadily and carefully feeling for the slight extra resistance of the *ligamentum flavum* followed by the easing of resistance which occurs when the subarachnoid space is entered. This normally lies at a depth of about 4 - 6cms and you can check your progress from time to time by withdrawing the *stilette* and seeing if CSF flows back.

- On entering the subarachnoid space, hold the the hub of the needle firmly in place by resting the back of the left hand (for a right handed person) on the patient's back and holding the hub between thumb and forefinger. Carefully attach the syringe of spinal anaesthetic solution and withdraw gently on the plunger. CSF should flow back steadily and can be seen as "oily" streaks if a heavy solution is used. If all is well, steadily inject the anaesthetic solution and withdraw the needle and introducer. Apply a small dressing or sticking plaster over the puncture wound.

An alternative approach in difficult cases, or by choice, is the paramedian approach. In this case the local anaesthetic is infiltrated one finger's breadth lateral to the L3 or L4 spinous process. Place the introducer at right angles to the skin, followed by the spinal needle which is advanced straight in until it hits the lamina of the vertebra. Then angle it slightly medially and cephalad (towards the head) and "walk" it off the lamina aiming for the gap between it and the lamina above in the midline. Advance the needle until CSF is found then proceed to inject the local anaesthetic as described above.

Difficulties. If the patient experiences pain the introducer is probably not in the midline but is contacting the periosteum of an adjacent vertebra or in the muscle on one or other side of the ligament. The patient can tell you which side you are on, which will help you to redirect your needle. Withdraw the introducer and reposition it - it should be held firmly by the interspinous ligament. If it moves around freely, it is probably lying to one side of the midline and is not in the ligament. If the subarachnoid space is not found try re-positioning the patient and get your assistant to help flex the patient's back more (that's why they need to be strong!). Alternatively try a different space or the paramedian approach. If blood flows back when you remove the stillette it is probably due to minimal trauma to the small veins in the epidural space. Wait until clear CSF flows and then inject the spinal solution. If it doesn't clear reposition the needle slightly further in or try flushing with sterile saline. If blood continues to flow you must NOT inject the spinal anaesthetic but withdraw the needle and try again in a different space.

After injecting the local anaesthetic, lie the patient down on her right side for 2 or 3 mins then place her tilted to the left on a wedge ready for surgery. This helps ensure that the block spreads to both sides of the abdomen.

The height of the block can be assessed by testing for loss of temperature sensation using ice or cotton wool soaked with ether. Alternatively test gently for loss of pinprick sensation using a sterile needle. The block should be above the umbilicus and preferably towards the xyphisternum. The block works almost immediately, and you can allow the surgeon to proceed after 5 minutes.

Needles. One problem with spinals that has limited their use in the past is the occurrence of significant headache for 2 or 3 days following the procedure. This is due to leakage of CSF through the hole made by the needle and it is more common in pregnant women because the raised CSF pressure, due to dilated epidural veins, causes a bigger leak. The rate of post dural puncture headache is related to the size and design of the needle. Use the smallest gauge needle you have available, preferably 25 or even 26 gauge. If you have to use a 22 gauge spinal needle then you may find that the incidence of headache is unacceptable. When placing the spinal needle try to align the bevel of the needle along the body. This parts the fibres of the dura rather than cuts them and reduces the incidence of headache.

In recent years a new design of needle has been used which has an atraumatic "pencil-point" tip, instead of the standard cutting needle design. These reduce the rate of post puncture headache to less than 1% and are worth considering.

Some spinal needles can be reused, providing they are properly sterilised after each use. The best way of doing this is to use needles with metal hubs that can be re-autoclaved. Some plastic hubs stand up to autoclaving.

Drugs, ampoules and doses. You will have to use whatever drugs are available. A hyperbaric agent (local anaesthetic mixed with glucose) is most useful as it has a quick and predictable onset and usually produces a dense block. If you want to keep the level low and do a saddle block you will need the heavy solution. Solutions injected into the subarachnoid (or extradural) space should always be preservative free and taken from a single dose vial not a multi dose container. Where possible the ampoules should be sterile to make drawing up the solution easier. This can be achieved by buying sterile wrapped ampoules or by autoclaving glass ampoules of local anaesthetic. Never soak ampoules in sterilising solutions. If the ampoules are not sterile on the outside, draw up the drug carefully ensuring complete sterility.

Bupivacaine lasts longer and should be used if prolonged surgery is expected e.g. Caesarean section followed by hysterectomy.

The volume to use is controversial and has been discussed in this journal and elsewhere.

Table 2. Local anaesthetics suitable for spinal anaesthesia

Drug	Volume	Approximate length of action
Bupivacaine (Marcain) 0.5%. hyperbaric or plain	2-2.5 mls	2 - 3 hours
Lignocaine 5% hyperbaric +/- adrenaline 0.2ml of 1:1000	1.2 - 1.6 mls	45 - 90 minutes (with adrenaline)
Lignocaine 2% plain + adrenaline 0.2 ml of 1:1000	2 - 2.5 mls	60 - 120 minutes

Engorgement of epidural veins in pregnancy reduces the volume of CSF and hence a given volume of local anaesthetic will have a wider spread in the pregnant than in the non-pregnant female. The height of the block also depends on the size of the woman. Beware of the small stature of Asian women. At the same time, ethnic groups who are tall will require significantly higher volumes.

In the authors' experience, the following regimes have been effective, giving a block to T5 or T6.

1.2 to 1.4mls of heavy 5% Lignocaine in Nepali women (depending on height)

2.0 to 2.5mls of heavy 0.5% Bupivacaine in Caucasian women (less than 5 ft. to greater than 5ft 6 ins.)

Low spinal blockade. Some authors prefer a low block (T10 - around the height of the umbilicus) which is performed with the patient in the sitting position with a low dose of local anaesthetic (see letters Update in Anaesthesia no 6 & 7).

If the height of this or any block proves inadequate then it may be supplemented with an opioid after delivery. Ketamine, always starting with a low analgesic dose, or inhalational analgesia with air/Trilene or nitrous oxide and oxygen are alternatives. Great care must be taken to avoid loss of consciousness and inadequate protection of the airway.

Management of hypotension. Sympathetic blockade occurs due to the action of the local anaesthetic on the sympathetic nerves which are easily blocked, often for several segments higher than the dermatomal action. Nearly all patients will have some fall in systolic BP (which is one of the signs of a successful block) and, furthermore,

placental blood flow is reduced before maternal systolic BP falls. It is important to take preventative measures to minimise the fall in BP and to act quickly to treat it.

Preload the patient with IV fluid as described and measure the BP before the block and at least 5 minute intervals thereafter.

Make sure the left sided tilt is adequate.

If the systolic BP falls more than 20mmHg from the baseline then speed up the drip and give oxygen. If this does not reverse the hypotension then give a dose of vasoconstrictor (See table 3). These should be diluted and given in small bolus doses every few minutes until the hypotension is treated. Do not tilt the patient head down as this will potentially increase the height of the block. A feeling of nausea is often the first symptom of hypotension.

A good way to give the vasoconstrictor is to dilute it in a drip and start running it slowly as soon as the block is performed unless the patient is hypertensive. (e.g. Ephedrine 60mg in 500ml N Saline). However this is more expensive than giving bolus doses. Although these drugs cause vasoconstriction they increase blood flow to the placenta by raising the cardiac output and improving the placental perfusion pressure.

In a number of patients, the block will be high enough to cover the mid-thoracic sympathetic outflow to the heart (T4-T6) even when the correct dose is used. This prevents a compensatory increase in heart rate and may even cause a significant bradycardia. Severe falls in BP are sometimes seen and should be treated immediately. Give atropine (0.5mg) for bradycardia.

Table 3. Recommended vasopressors

Drug	Action	Initial/Follow-up dose
Ephedrine (best drug)	Vasoconstrictor and increases heart rate with some inotropic action	6-12/3-6mg
Methoxamine (Vasoxine)	Vasoconstrictor only (may see reflex bradycardia)	2-4/2mg
Phenylephrine	Vasoconstrictor only	200/100 micrograms
Adrenaline (use only if other drugs are unavailable)	Vasoconstrictor and increases heart rate ++ and inotropic action	0.5-1ml of 1:10,000 - make by diluting 1ml of 1:1000 to 10mls total with saline

High spinal blocks If the block is high then the patient may complain of tingling or even weakness of the upper limbs. Even though some of the intercostal muscles will be paralysed, the diaphragm is unaffected and these patients should be managed with a slight head-up tilt (to prevent a hyperbaric agent spreading higher), oxygen and reassurance. With these high blocks many patients will complain of an unpleasant feeling of not being able to take a full breath, however, they will be able to speak normally. If the patient gets difficulty in speaking with associated tingling in the arms this is indicative of a very high block which is beginning to affect the diaphragm. These patients are likely to need intubation and ventilation. Remember that a long acting muscle relaxant will not be required.

Total Spinal Very rarely, if too big a dose of local anaesthetic is given, there may be a "total spinal" with paralysis of all respiratory muscles and a respiratory arrest. There will be an associated loss of consciousness and severe hypotension and bradycardia. (This should really only be seen as a complication of epidural anaesthesia when a relatively large dose of local anaesthetic is injected into the subarachnoid space in error).

Immediate resuscitation along the normal lines of Airway, Breathing, Circulation; together with rapid intravenous fluids and large doses of vasoconstrictors will rescue the situation. This is one reason why full resuscitation drugs, equipment and skilled personnel must always be immediately

available whenever a regional anaesthetic is given.

Nausea Apart from hypotension, this may be caused by traction on the peritoneum in which case a small dose of atropine may be helpful. Ergometrine will also cause nausea and is best avoided in the awake patient.

Sedation As previously discussed, none should be given prior to delivery, unless it is known that the baby is dead.

Caudal anaesthesia For completeness it should be mentioned that epidural anaesthesia via the sacral hiatus has been used to establish regional anaesthesia for LSCS. However, it gives an unpredictable spread of anaesthesia, slower onset and is not recommended.

3. General Anaesthesia (GA)

General anaesthesia will be necessary if there are contraindications to spinal anaesthesia or if you cannot encourage either the mother or the surgeon to do the operation with the patient awake. The main risk associated with general anaesthesia is that of airway control. There is a significant risk of aspiration of stomach contents and only 30mls of acid aspiration can cause a fatal acid pneumonitis (Mendelson's syndrome). General precautions previously mentioned must be observed.

Ensure good IV access, antacids and left lateral tilt. If it is an emergency with a significant risk of a full stomach then it is safest to pass a large bore nasogastric tube to drain the stomach. Remove the

tube before inducing anaesthesia. Check that the suction is working.

Always use a rapid sequence induction with pre-oxygenation and drugs given by bolus injection according to the patient's weight. Cricoid pressure is maintained until the anaesthetist is satisfied that the airway is secure and both lungs are being ventilated.

If a draw-over circuit is being used then preoxygenate the patient from a reservoir bag filled from an oxygen cylinder or an oxygen concentrator (see page 48)

Monitor closely throughout. Measure the blood pressure at least every 5 minutes and the pulse continuously.

Common Problems Intubation is often more difficult than in the non-pregnant patient, especially if the mother is obese. Since oxygen consumption is high you cannot afford to take too long. Assess the difficulty of intubation beforehand and if you anticipate difficulties consider whether spinal anaesthesia should be your first choice or try and get an experienced colleague to help you.

Ensure there is a reliable, trained assistant. Prepare your different introducers, laryngoscopes and Magills forceps.

If there is not enough room for the laryngoscope handle because of a short neck or large breasts (or both!), try a child's laryngoscope handle with an adult blade or when using an adult handle, take off the handle, insert the blade and then re-attach the handle afterwards.

During maintenance of anaesthesia most anaesthetists continue the muscle relaxation using either a non-depolarising muscle relaxant or sometimes intermittent suxamethonium. This allows a light inhalational anaesthetic to be given. A standard anaesthetic should not be given before delivery as it will anaesthetise the baby. If you are using N₂O/O₂, give 50% N₂O only and add 0.5% halothane or 1 - 1.5% ether or 1% Trilene (Do NOT use Trilene with soda lime). If you are using air/oxygen give 50% oxygen if possible together with twice the percentage of volatile agent recommended above.

If you are not using a relaxant technique after intubation then ether breathed spontaneously has a

good safety record provided that the baby is delivered quickly. Indeed, ether breathed spontaneously without intubation is a traditional technique which has a better than expected safety record. It is probably safer than having inexperienced practitioners attempting occasional intubations. In a series of 420 patients using open drop ether anaesthesia, there was no evidence of aspiration of gastric contents [1]. Light ether anaesthesia does not cause too much relaxation of the uterus.

After the baby is born you can revert to a standard anaesthetic and give narcotic analgesics. Avoid high concentrations of halothane (ideally no more than 0.5%) as it can increase the blood loss during surgery by relaxing the uterus.

Recovery Because of the risk of aspiration, the mother should always be extubated on her side, when she is awake and in full control of her airway.

Particular complications A failed intubation plan must be available and discussed regularly. Your colleagues should know what to do and it should be printed on a card and attached to the anaesthetic machine. The priorities are:

- Ensure full oxygenation of the mother at all times.
- Give only the initial dose of suxamethonium and do not attempt intubation too many times.
- If you have no success with introducers and other intubation aids then accept that you will not be able to intubate and ventilate the mother with a face mask until spontaneous respiration returns.
- Maintain cricoid pressure at all times.
- The safest thing to do is usually to allow the patient to wake up and perform the operation under a spinal anaesthetic.

If the airway is easy to maintain and the operation is urgent it may be necessary to consider proceeding under general anaesthesia (ether 4-6% or halothane 1-1.5%) without an endotracheal tube. An alternative is ketamine though this does not provide such good relaxation for the surgeon. In all cases maintain cricoid pressure until the operation is finished and the patient can be turned into the left lateral and head down position.

Remember that the baby will be sedated, and will probably require resuscitation, so get help.

Whatever happens, do not let your patient die or suffer brain damage just because you cannot intubate. If the airway is completely obstructed and mask ventilation impossible do an immediate cricothyroidotomy with a large IV cannula (see Update 7). This should be converted to a formal tracheostomy or the mother allowed to wake up and regain control of her own airway.

Acid aspiration If the patient vomits or regurgitates during induction of anaesthesia, the airway should be suctioned and the patient immediately placed in the left lateral head down position to prevent aspiration. Depending on the situation the patient may then be intubated or woken up.

Vomiting and regurgitation can also occur during recovery and it is imperative that patients are not left on their backs during this phase. Solid food causes immediate airway obstruction resulting in hypoxia, whilst liquid gastric contents cause an acid pneumonitis (inflammation of lung tissue). If aspiration occurs at induction then intubate the patient and clear the airways with suction. Consider bronchoscopy (if available) to remove solid food. Lavage of the airways is ineffective and not recommended. Ensure adequate oxygenation using added oxygen if available.

The diagnosis can usually be confirmed by listening with a stethoscope to the mid zone of the lungs at the tips of the scapulae 30 minutes after the event. Fine crepitations heard in this area is an early sign of aspiration pneumonia and, if the aspiration is significant, signs of hypoxia will develop. Within a few hours the chest Xray will show signs of aspiration pneumonitis. The patient will require supportive treatment with oxygen, chest physiotherapy and observation, particularly of respiration, for 24-48 hours. If respiratory function deteriorates then aggressive supportive treatment will be needed including high flow oxygen and, if necessary, intubation and ventilation. When there is no obvious deterioration, if the patient is well after 6 hours, clinically significant aspiration is most unlikely to have occurred.

In making the diagnosis, consider other causes of hypoxia and respiratory failure in late pregnancy, e.g. pulmonary oedema (fluid overload, cardiac failure, pre eclampsia / eclampsia), amniotic fluid embolism and pneumonia.

Some authorities recommend giving steroids immediately but opinion is divided on whether or not to give antibiotics since acid pneumonitis is initially a sterile condition without bacterial infection. Give broad spectrum antibiotics if solid matter has been inhaled or if signs of a secondary bacterial pneumonia develop after a day or two.

Intra-operative haemorrhage Good surgical technique should prevent the need for transfusion in most patients unless they are previously significantly anaemic and/or have been haemorrhaging in labour. Catastrophic haemorrhage can occur with certain placental problems (placenta praevia or abruption) or abnormalities (placenta accretia). All patients presenting for LSCS should be crossmatched for 2 units of blood before theatre. If haemorrhage is anticipated more blood should be crossmatched. Most theatres in UK store two units of group O negative blood (universal donor blood) for cases of severe unexpected haemorrhage.

A useful technique is normovolaemic haemodilution autotransfusion. Patients with a haemoglobin of at least 10gm% can have 2 units drawn off into transfusion bags just before surgery. These are replaced by 2 litres of normal saline or Hartmann's. The blood is kept nearby, labelled and is re-transfused at the end of surgery. Since it is fresh the clotting factors still function, unlike the situation with stored blood. All risks of stored blood are avoided. The technique has been well described [2].

Special circumstances - the operator anaesthetist.

At some small hospitals the surgeon conducts the anaesthetic as well as performing the operation. This is a difficult situation, but is commonplace in many parts of the world. Techniques of anaesthesia used in this situation include local infiltration, spinal anaesthesia, epidural anaesthesia and ketamine. Whatever method of anaesthesia is used, expertise will develop with experience. A trained assistant must care for the patient throughout the operation to look after the airway and monitor the patient's vital signs. Regional techniques, during which the patient remains awake, are probably safer.

Summary

In most circumstances LSCS is a straightforward common operation, which requires little alteration to our normal anaesthetic practice. Preparation

should be thorough and problems anticipated before they occur. Plans should be prepared for emergencies such as a failed intubation or unexpected severe haemorrhage. Both general anaesthesia and regional anaesthesia may be associated with unnecessary mortality if they are not carried out carefully. In all cases keep reminding yourself of the 4 cornerstones which are easily

forgotten: suction, cricoid pressure, left lateral tilt and close observation.

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