

Cesarean Section – a review for African surgeons

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1.0 Introduction

Surgeons in the developing world are often called upon to perform cesarean section, whether or not they might have extensive obstetrical training. The indications are often left up to the midwives and many surgeons see these procedures as simply a technical

exercise. However, a thorough understanding of the indications, techniques and postoperative care of cesarean section patients will ensure their best management, especially as maternal mortality is a major cause of premature death in women in the developing world. Over half a million women and 5.7 million newborns die each year from complications relating to pregnancy and childbirth. Many of these are preventable and timely access to safe and competent obstetrical care, including cesarean section, is lifesaving for both mother and child. This Review will concentrate on the major indications for cesarean section, the technical aspects and common post-operative problems. Subsequent Reviews will deal in more detail with the major antepartum complications of pregnancy.

2.0 Antepartum and Intrapartum Conditions Requiring Surgical Management

2.1 Rates of Cesarean Birth

There has been considerable debate over the years as to what represent reasonable rates of cesarean section. The World Health Organization (WHO) published guidelines in 1985 suggesting that cesarean rates should not exceed 15%, but revised these in 1994, suggesting that rates should be between 5-15% (1). Debate around these numbers has centered on implications that rates under 5% suggest that perhaps the population does not have sufficient access to life-saving health care. Alternatively, it could be argued that trying to maintain cesarean rates at too low a rate (potentially even as low as 15%) may put pregnant women and their infants in peril. To date, there is no consensus worldwide as to what is an appropriate rate of cesarean section (2).

Data has shown increases in rates of childbirth taking place in a medical context. Between 1990 and 2000, delivery in the presence of a skilled attendant increased from 41% to 57% in developing countries. All areas of the developing world demonstrated increases with the exception of sub-Saharan Africa (3). Recent current estimates of cesarean birth rates indicate an overall cesarean rate of 12.4% in the developing world (2). Sub-Saharan Africa remains the only region in the developing world not to have reached the WHO's suggested minimum cesarean rate of 5%.

Socioeconomic status is also an important indicator of access to obstetrical care and this too can be evidenced in rates of cesarean section. Studies from developing countries have shown that in some populations, cesarean section rates amongst the poorest 20% of the population are under 1%, clearly indicating insufficient access to life-saving care (4). Given the lack of decrease in the maternal mortality statistics through the last part of the 20th century, however, it is clear that cesarean rates alone are far from the only indicator of access to adequate obstetrical care (2).

2.2 Indications for Cesarean Section

One of the most common indications for cesarean section is prior cesarean section. This will be discussed in the section on Vaginal Birth After Cesarean Section (VBAC) (see below).

2.21 Maternal/Fetal Indications: Dystocia

The most common indication for cesarean section in primiparous women, accounting for 68% of cesarean sections in one series, is failure to progress in labour or dystocia (5). Dystocia, literally meaning “difficult labour”, refers to a disproportion between the fetal presenting part and the maternal pelvis. Dystocia is typically accompanied by slower than usual progress in labour (dilation at less than 1cm/hour in a primiparous patient) or crossing of lines on the partogram, indicating slow progress in labour. Dystocia can be caused by poor forces of expulsion - either poor contraction forces (in the first or second stages of labour) or insufficient maternal expulsive effort (in the second stage of labour). It can also be caused by fetal malpresentation or malposition, such as transverse, posterior presentations of the fetal occiput, breech or transverse position, by fetal macrosomia or abnormality (such as hydrocephalus) or by inadequate size of the maternal pelvis, due to either bony contracture or soft tissue abnormalities (5). Typically, dystocia is described by a problem with one of the “Three P’s”: the *Power* - the contractions, the *Passenger* - the fetus or the *Passage* - the maternal pelvis (5).

Causes of poor contractions include epidural analgesia, chorioamnionitis and perhaps recumbent positioning during labour (5). While contractions of the pelvic size can cause dystocia (and are also felt to increase the incidence of malpresentation), X-ray pelvimetry to predict dystocia has not been shown to be useful; CT pelvimetry is felt to expose the fetus to undue amounts of radiation and MRI pelvimetry is experimental to date (5). Fetal size is a definite cause of dystocia, although there is no absolute weight above which dystocia can be anticipated, as most cases of dystocia involve fetuses well within the normal range of weight. Attempts to predict dystocia on the basis of fetal head size, as determined by imaging, have not proven useful (5). Therefore, the most important means of assessing dystocia is through the attendance during labour of a skilled professional who assesses progress via a partogram.

2.211 Malpresentation can be a common cause of dystocia. Accurate vaginal assessment of the presenting part is required in order to make a diagnosis of malpresentation; consultation between the consultant physician and midwives is recommended. Although face presentation is rare (0.17%), it should be remembered that mentum anterior presentations can deliver vaginally, although mentum posterior cannot. Mentum posterior presentations can, however, convert to anterior even late in labour. Manual attempts to convert a face presentation can be dangerous and are not indicated. Cesarean delivery may often be indicated as pelvic contraction may be the cause for the face presentation (5). Brow presentation is the rarest of presentations; it may spontaneously convert to mentum or vertex, but so long as a brow presentation persists, vaginal delivery is not possible and cesarean section is indicated (5).

A transverse lie is also an indication for cesarean section, as there is no direct presenting part expressing force on the maternal cervix. In the presence of active labour, it is not anticipated that a transverse lie will convert to any other sort of presentation. In addition, the risk of cord prolapse is significant. Transverse lie is most commonly encountered in cases of high parity, where there is significant laxity of the abdominal wall, a preterm infant, placenta previa, abnormal uterine anatomy, polyhydramnios or a contracted pelvis (5).

A compound presentation (a limb accompanying the fetal head, usually an arm) will usually resolve spontaneously prior to delivery. The arm can also be gently pushed away. Compound presentation is not usually a barrier to delivery, although increased rates of

neonatal injury and death are reported and the situation can be more commonly associated with cord prolapse as well (5). Therefore, cesarean section should be considered for persistent compound presentation.

Persistent occiput posterior presentation is the most common malpresentation causing dystocia and was found as the cause of 12% of cesarean deliveries for dystocia in one series (5). When the presentation is persistent and there is either arrest of the first stage of labour or vaginal delivery (either spontaneous or operative) cannot easily and safely be achieved, a cesarean section is indicated.

2.212 Breech Presentation

At term approximately 3-4% of infants are in the breech presentation. A breech presentation has been associated with a higher incidence of morbidity for both the mother and the fetus. In general, complete or footling breech presentation is considered an indication for cesarean section, due to the increased risk of cord prolapse. Similarly, a “stargazing” fetus, with a hyperextended neck, is also considered an indication for cesarean section due to the risk of cervical spinal injury. Significant injury to the fetus can also occur in a breech delivery in a mother with an even slightly contracted pelvis due to the size and lack of molding of the aftercoming head (5). Many centres would not advocate induction of labour or even oxytocin augmentation in the case of a breech presentation and would rather proceed to cesarean section (5).

A large, multicentre randomized controlled trial of planned vaginal delivery or planned cesarean section for breech delivery published in 2000 concluded better fetal outcome for cesarean section, with no difference in maternal outcome (6). While this may not be practical in all regions of the world, many centres certainly now consider breech presentation at term alone to be indication for cesarean section unless delivery is imminent and this is the stance of the American College of Obstetricians and Gynecologists (ACOG) as well (5). Similarly, breech presentation of the first twin would also be considered an indication for cesarean section.

There are no studies of preterm infants to indicate the preferred mode of delivery with a breech presentation (5).

2.213 Failure to progress

In order to properly diagnose failure to progress, the mother should be in active labour, that is, at least 3-4cm dilated. Prior to that, it is not possible to make a diagnosis of dystocia as the active first stage of labour has not begun and there has not been an adequate trial of labour (5).

Prior to a diagnosis of dystocia in the first stage of labour, so long as the fetal heart is reassuring, contractions can be optimized by use of oxytocin. As per the American College of Obstetricians and Gynecologists, a contraction pattern of at least 200 Montevideo units in ten minutes should be present (approximated by the presence of 3 moderate to strong contraction in ten minutes) for at least 2 hours in order to diagnose failure to progress in the first stage of labour (5).

In the past, there have been arbitrary cutoffs as to the appropriate length of the second stage of labour. Increasingly, data is showing no poorer neonatal outcome with a prolonged second stage and the increased use of epidural analgesia in the developed world is certainly correlated with longer second stages (5). That said, adequate fetal monitoring to ensure a reassuring fetal heart rate pattern, or auscultation of the fetal heart rate every 5 to 10 minutes, is required throughout the second stage. In addition, the

longer the second stage, the more likely the need for operative vaginal or cesarean delivery such that by the time a second stage has reached 5 hours, only a 10-15% chance of spontaneous vaginal delivery remains (5). Consequences of extremely prolonged labours and, in particular, second stages, can of course include maternal and fetal infection, uterine rupture, maternal nerve injury, fistula formation and other injuries to the maternal pelvic floor and therefore mothers must be carefully monitored in a prolonged labour (5). If spontaneous or operative vaginal delivery cannot safely and easily be accomplished, or if attempted operative vaginal delivery fails, a cesarean section is indicated.

2.22 Fetal Indications: Fetal Distress

The heart rate should be monitored through labour, either intermittently or continuously. Despite initial optimism about continuous monitoring, it has not to date shown improved outcomes over intermittent auscultation (5). Normal baseline fetal heart rate is between 110 and 160 beats per minute; above 160bpm is considered tachycardic and below 110 bpm is considered bradycardic. Nonreassuring fetal heart rates include late decelerations, repetitive prolonged variable decelerations (to less than 60bpm or for more than 60 seconds), sinusoidal patterns, tachycardia, prolonged bradycardia (greater than 4-6 minutes) and, where possible to determine, a nonreactive fetal heart rate accompanied by a scalp pH of less than 7.20. Timing to cesarean section will be discussed in an upcoming section.

2.23 Placental Indications

In placenta previa, the placenta lies over the cervix and below the fetus. This would lead to detachment of the placenta and maternal hemorrhage in labour as the cervix opens. Placenta previa must therefore be delivered by cesarean section (5). Profuse, painless bleeding and a high presenting part in labour would be clinical findings associated with placenta previa. Where possible, ultrasound is used to confirm the diagnosis. In the case of an anterior placenta previa with prior cesarean section, one should be aware of a 50% chance of placenta accreta, which is a placenta which abnormally invades the underlying endometrium. In such cases hemorrhage should be anticipated and adequate preparations made.

A low-lying placenta, less than 2.5 cm from the internal os, can also be associated with hemorrhage and require delivery by cesarean section (5).

2.24 Other Indications

Additional indications for cesarean section include, but are not limited to, major antepartum hemorrhage such as with significant abruption, severe Pregnancy Induced Hypertension (PIH) remote from term, high order multiple gestations (triplets or higher), twins with twin A in a noncephalic presentation, cervical cancer and active herpes infections (5). In addition, certain fetal abnormalities such as severe hydrocephalus or large sacrococcygeal teratoma, may require cesarean section unless a destructive procedure is performed vaginally. Without the use of ultrasound, such diagnoses may present with failure to progress due to inability of the fetus to descend in the pelvis.

2.3 Reasonable Time to Cesarean Section

Once the decision to perform a cesarean section has been made, there is debate as to what is a reasonable time to proceed to the procedure itself. Some national guidelines, including ACOG and the Society of Obstetricians and Gynecologists of Canada (SOGC) recommend 30 minutes to the time of the procedure from the time of decision to perform cesarean section (7). Other studies have examined actual time from decision to performance of cesarean section, indicating 42.9 minutes for emergency cesarean section and 27.4 minutes for “crash” cesarean section and times over 90 and 120 minutes for cesareans for maternal indications and fetal reasons (non urgent indications) (8). In this study, fewer than 40% of deliveries were achieved within the recommended 30 minutes and yet there was no indication of any detriment to the fetus from the longer wait to delivery for all circumstances other than “crash” cesarean section (8). General anaesthesia was associated with a 50% shorter time to delivery from decision than regional anaesthesia (8). Certainly, the 30 minute standard seems to be a standard worth striving to achieve, but it may not actually incur significant benefit to either the mother or the fetus.

2.4 Vaginal Birth after Caesarean Section (VBAC)

In general, women with no contraindications and 1 prior lower segment cesarean section are considered candidates for a trial of labour after appropriate understanding of the potential risks to the mother and the fetus (9). Success rates for vaginal delivery vary in different series but, in general, are between 50-85%. Risks of uterine rupture and fetal morbidity are higher in the trial of labour population, but other risks, including placental previa, placental abruption and maternal febrile morbidity have been shown to be higher in the repeat cesarean group (9). To date, there are no randomized controlled trials on VBAC and therefore no recommendations that can be endorsed by the Cochrane Collaboration (10).

Contraindications to a trial of labour, and thus indications for repeat cesarean section include: previous classical or “T”-shaped uterine incision, previous hysterotomy or myomectomy entering the uterine cavity, history of uterine rupture, contraindications to labour (eg placenta previa) and patient refusal of trial of labour (9). Greater than 1 previous transverse cesarean section is also generally considered a contraindication to a trial of labour.

In order to proceed with trial of labour, there must be appropriately trained staff and ideally a hospital policy in place for the management of attempted VBAC. Continuous fetal monitoring should be considered and the facility should have the means to proceed with a cesarean section in a timely fashion, namely within 30 minutes according to guidelines. Additionally, there should be intravenous access and the facility should have the capacity to proceed with blood transfusion if indicated (9). Otherwise repeat cesarean section should be considered.

Women in developing countries, however, are often culturally conditioned that in order to preserve their womanhood, they must deliver vaginally and they are willing to do so even if it means placing their lives in jeopardy (11). Studies have determined VBAC to be safe in a developing country context (11).

2.5 Perimortem Cesarean Section

Occasionally, a cesarean section is indicated in a perimortem and postmortem situation. In fact, cesarean section has been recommended performed in the context of maternal cardiac arrest since 1986 (12). This recommendation is due to the expectation that cardiac compressions in the third trimester would be ineffective due to aortocaval compression from the gravid uterus. Emptying the uterus improves the cardiac output during resuscitation by 60-80% (13). The recommendation was therefore made in order to optimize the maternal resuscitation (12). Data to date indeed support this recommendation, although there is an insufficient collection of cases to conclusively prove its benefit.

In circumstances of perimortem cesarean section, classical cesarean section, through vertical incisions of the skin and uterus, should be considered for the speed of the procedure (13). CPR should also be maintained throughout delivery. The neurological outcome of the infant is, not surprisingly, correlated to the speed with which it is delivered relative to the time of maternal collapse. In cases where maternal collapse may be anticipated, maintaining cesarean section equipment and neonatal resuscitation equipment near the maternal bedside is appropriate (13).

3.0 Surgical Technique for Cesarean Section

3.1 Types of Abdominal Skin Incisions

3.11 Vertical skin incisions

The advantage of the midline vertical incision is that entry into the abdominal cavity is quicker and repeat abdominal incisions through this route are easier. (5)

The vertical incision should start below the umbilicus and should be of sufficient length to allow the delivery of the infant without difficulty. Sharp dissection should be carried to the level of the anterior rectus sheath, and a strip of fascia should be exposed which is about 2 cm wide. A small opening can be made in the sheath with a scalpel and the incision can be extended with scissors. Some surgeons prefer to incise the sheath in its entire length with the scalpel. The rectus and the pyramidalis muscles are separated in the midline by sharp or blunt dissection. This exposes the transversalis fascia and peritoneum. (5)

The peritoneum may be opened either bluntly, or by elevating it with two hemostats about 2 cm apart, and incising between the hemostats. Before incising the peritoneum, the area between the clamps is inspected to ensure that no omentum, bowel, or bladder is immediately adjacent. The peritoneum is opened superiorly and inferiorly to expose the uterus. (5)

3.12 Transverse skin incisions

The modified Pfannenstiel incision involves making a transverse, slightly curvilinear incision at the level of the pubic hairline and extending it somewhat beyond the lateral borders of the rectus muscles. The subcutaneous tissue is separated from the underlying fascia for about 1 cm, and then the fascia is incised transversely the whole length of the incision. The superior and then the inferior edges of the fascia are grasped with suitable clamps and the fascia is undermined from the underlying rectus muscles either bluntly or sharply. Hemostasis is maintained by clamping, cutting, and ligating vessels or by electrocautery. The rectus muscles are then separated in the midline to expose the

underlying peritoneum. The peritoneum is opened in the same fashion as described above. (5)

The definite cosmetic advantage of the modified Pfannenstiel cannot be denied. However, some disadvantages of this incision include less operative exposure in some women, and more difficulty and time consumed in performing repeated cesarean section. (5)

The Joel-Cohen incision is another type of transverse skin approach. The incision is placed 2 to 3 cm higher than the Pfannenstiel incision. The anterior rectus sheath is not dissected off the underlying muscle before the rectus muscles are separated in the midline by traction. This technique involves minimal tissue handling and reduction in operative time, but the cosmetic effect is less satisfactory. (14) A recent Cochrane review cited that the advantages of the Joel-Cohen incision compared to the Pfannenstiel incision include less fever, pain and analgesic requirements; less blood loss; shorter duration of surgery and hospital stay. The review did not provide information on severe or long-term morbidity and mortality. (15)

3.2 Types of Uterine Incisions

The most common type of uterine incision used today is the transverse which runs from side to side transversely in the lower uterine segment. This incision takes advantage of the fact that the lower uterine segment is less vascular than the body of the uterus. This type of incision is also easier to repair because the lower segment in labour is thinner than the body of the uterus. Advantages of this type of incision include less blood loss, less operative time, and a lower incidence of uterine dehiscence or rupture in subsequent pregnancies. (5)

A vertical incision in the lower uterine segment can also be made and has been recommended in certain clinical situations. The most common reason for a low vertical incision is for the delivery of a preterm infant when the lower uterine segment is not well developed. (5)

A vertical cut in the upper body of the uterus is called a 'classical' uterine incision. It is rarely used because of increased risk of blood loss and more difficulty to repair. Some of the indications for a classical incision include a baby in transverse lie in the uterus, a premature baby, or a placenta praevia that lies in the lower segment and on the anterior wall of the uterus. (5)

At times, after a low transverse uterine incision has been made, the operator finds difficulty in delivering the infant. There are two possibilities to extend the incision to facilitate the delivery of the infant. The incision may be extended vertically in the midline making an upside-down T-shape, or the incision can be extended vertically upwards from either side. (5)

3.3 Technique for Transverse Cesarean Incision

Before proceeding to begin opening the uterus itself to deliver the infant, it is important to observe if the uterus is centered in the abdomen or if it is rotated on its long axis. Often the uterus is slightly rotated to the mother's right side (dextro-rotated), bringing the left round ligament more anterior and closer to the mother's midline than the right. Knowing the position of the round ligaments will help the operator make a well-centered uterine incision.

To prevent injury to the bladder, a bladder flap is created by grasping the loose reflection of the peritoneum of the uterus and incising it transversely with a scalpel or scissors. In creating the bladder flap, the tips of the scissors are directed somewhat more cephalad as the margins on each side are approached. This will direct the incision upwards and away from the area of the uterine arteries entering the uterus at this level. The bladder flap is made by gently separating the peritoneal layer from the underlying myometrium.

The uterine incision itself can be made by a variety of techniques. A scalpel should be used to incise the exposed lower uterine segment for 1 to 2 cm in the midline working carefully to avoid injury to the fetus. Once the uterus is opened the incision can be extended laterally either by cutting with scissors or by spreading the incision, using lateral and upward pressure applied with each index finger. Rodriguez and associates reported that blunt and sharp techniques were equivalent in terms of safety and postoperative complications. (16) However, Magann and colleagues reported that sharp dissection increased the amount of blood loss and the need for transfusion. (17)

No matter how the uterine incision is made, it is important to make the incision large enough to allow delivery of the head and trunk of the fetus without causing tearing laterally where the uterine arteries and veins are located. (5)

3.4 Delivery of the Infant

To deliver the head of the infant in a cephalic presentation, the surgeon's hand is slipped into the uterine cavity between the symphysis and fetal head. Then this hand is drawn upwards to gently elevate the head towards the uterine incision. (5)

Prolonged labour with an impacted head of the fetus in the pelvis is a common occurrence in Africa. There are two methods that can be used to dislodge the fetal head, the "push" method and the "pull" method. The "push" method involves an assistant who, under sterile conditions, introduces his finger into the vagina and then pushes the head up from below to disimpact it. The "pull" method involves the surgeon introducing his hand towards the upper uterine segment and searching for a fetal leg. He then applies gentle traction until the second leg appears. He then gently pulls the fetus up and out of the uterus through the uterine incision as he holds the two fetal legs together. With this "pull" method the fetal shoulders and head are delivered last. (18)

A randomized comparative study of 108 patients in Nigeria showed that patients delivered by the "push" method had statistically significant higher rates of maternal morbidity than those delivered by the "pull" method. This included longer operating time, more blood loss, extension of the uterine incision, endometritis, longer hospital stay and higher hospital bills. (18)

After the head is delivered through the incision, the shoulders of the fetus and the rest of the body should be delivered. The cord should be clamped and the baby will be handed off to an assistant who will conduct resuscitative efforts as needed. (5)

The uterine incision should be observed for any bleeding. Bleeding points can be clamped with ring forceps or Pennington clamps. The placenta can be delivered by controlled cord traction or by manual removal. Using manual removal increases the risk of postpartum endometritis. (5)

3.5 Repair of the Uterus

The uterus may be repaired either by exteriorizing it through the abdominal wall or by closing the incision while the uterus remains in the abdominal cavity. Some of the advantages of exteriorizing the uterus include: (a) easy recognition of an atonic uterus and ease of manual massage of the uterus, easier visualization of any bleeding points, easier access to placing of sutures, and better adnexal exposure. (5) The principal disadvantage is discomfort and vomiting caused by traction on the uterus. A recent Cochrane review found that there was no evidence to make a definitive conclusion about which method of uterine closure, exteriorizing or not exteriorizing, offers greater advantages. (19)

There are two methods for delivery of the placenta after the baby is delivered. Gentle traction may be applied to the umbilical cord until the placenta separates spontaneously from the decidua basalis. Or, the surgeon may introduce his dominant hand into the uterine cavity and create a cleavage plane between the placenta and the decidua basalis. The placenta is then held in the palm of the hand, grasped, and removed.

Manual removal was associated with significantly more blood loss and a decrease in postoperative hemoglobin levels than waiting for placental separation. There was shorter operative time with manual removal. There was no difference in the incidence of endometritis, wound infection, or the need for blood transfusion. (20)

After delivery and inspection of the placenta, the uterine cavity should be inspected and either suctioned or wiped with a gauze pack to remove all membranes, clots, vernix, or other debris. Brisk bleeding from large vessels should be clamped and individually ligated at this time to reduce blood loss. (5)

Traditionally, the transverse lower segment uterine incision has been closed in two layers. (21) Those who favor double layer closure cite as advantages improved haemostasis and wound healing, and possibly a reduced risk of uterine rupture in a subsequent pregnancy. Single layer closure of the uterine incision involves less operative time, less tissue disruption, and less suture material left as a foreign body in the uterine wound. (21)

Hauth and colleagues (22) randomized 906 women to either one or two layer closure of the uterus using 1-0 chromic gut. In this study a continuous locking one-layer closure was used, requiring less operative time and fewer additional hemostatic sutures. Follow up of 164 women in subsequent pregnancies revealed that the type of closure, either single layer or double layer did not significantly affect several maternal and fetal complications. (23) However, a recent observational study from Canada has suggested that single layer closure of the lower uterine segment is associated with a four-fold increase in the risk of uterine rupture in a subsequent pregnancy. (24)

The first suture is placed just beyond the angle of the uterine incision. Usually, a running, locking suture is carried out, with each suture penetrating the full thickness of the myometrium. Often a single layer is enough to adequately close the incision, especially then the lower segment is thin. If the approximation is not satisfactory, or there is bleeding, then more sutures should be placed to stop bleeding and adequately close the uterus. Individual bleeding sites can be secured with figure-of-eight or mattress sutures. (5)

If the surgeon decides to use a double layer closure technique, usually the stitches for the second layer are placed in a manner to imbricate the first layer. To do this the stitches for the second layer can be placed either perpendicular to the first suture line or at right

angles to the line. Either way when the continuous second layer is cinched up, the first layer is imbricated.

Serosal edges overlying the uterus and bladder have been approximated with a continuous 2-0 chromic catgut suture in the past. (5) A Cochrane review published in July, 2003, states that there is no evidence at present to justify suturing any peritoneal layers at cesarean section. (25)

Before abdominal closure, all packs should be removed and blood and amniotic fluid should be suctioned from the paracolic gutters and cul-de-sac. The rectus muscles are allowed to fall into place. If there is a significant separation of the muscles one or two figure-of-eight sutures of 0 or number 1 chromic may be placed to approximate the muscles. The rectus fascia is usually closed with continuous, nonlocking suture of a long-lasting absorbable or permanent type. The sutures are placed about 1 cm lateral to the fascial edges and no more than 1 cm apart. (5)

Closure of the subcutaneous tissue is not necessary if it is less than 2 cm in thickness. Chelmow and colleagues concluded that suturing the subcutaneous tissue at cesarean delivery decreases the risk of wound disruption by 34 percent in women with a fat thickness greater than 2 cm. (26)

The skin layer can be repaired in a variety of different ways including subcuticular stitches immediately below the skin layer, an interrupted stitch going through the skin, or with skin staples. A recent Cochrane review concluded that the best way of closing the mother's skin layer after caesarean section is not known. (27)

3.6 Technique for Classical Cesarean Incision

A classical incision on the uterus is a vertical incision made in the body of the uterus. Some of the conditions for performing a classical incision include: (a) difficulty in exposing the lower uterine segment due to dense adhesions over the bladder, a myoma occupying the lower uterine segment, or invasive cervical cancer; (b) transverse lie of a large fetus; (c) placenta previa with anterior implantation; (e) certain cases when the fetus is very small and the lower uterine segment is very thick and small; (f) massive maternal obesity making access to the lower uterine segment very difficult. (5)

The vertical classical incision is begun as low as possible in the uterus and extended upwards. Bandage scissors can be used to cut the thick uterine wall. The incision must be made long enough to allow safe delivery of the fetus. The myometrium at this level often has large vessels that bleed profusely. (5)

The classical incision is usually closed in two layers with 0 or 1 chromic. The first layer unites the deeper halves of the incision. The second layer unites the upper halves. It is helpful to have an assistant compress the uterus on each side of the wound toward the midline as each suture is placed and tied. The rest of the operation is then completed as described earlier. (5)

3.7 Antibiotic Prophylaxis for Cesarean Section

Use of prophylactic antibiotics in women undergoing cesarean section has been shown to substantially reduce episodes of fever, endometritis, wound infection, urinary tract infection and serious infection after the surgery. (28) In women undergoing either elective or non-elective cesarean section with no signs of infection before the operation,

the use of prophylactic antibiotics has been shown to reduce the risk of endometritis by two thirds to three quarters. (28)

Both ampicillin and first generation cephalosporins have shown similar efficacy in reducing postoperative endometritis. No added benefit has been shown by using a more broad spectrum agent or a multiple dose regimen. (38)

Intra-amniotic infection refers to infection within the amniotic cavity present before delivery, either operative or non-operative delivery. Signs of amniotic infection or amnionitis include maternal fever and tachycardia, uterine tenderness, fetal tachycardia, and a foul-smelling amniotic fluid. Amnionitis is associated with maternal morbidity and neonatal sepsis, pneumonia and death. Current consensus based on a meta-analysis of a small number of studies is for the intra-partum administration of antibiotics when the diagnosis of intra-amniotic infection is made. In such women with intra-amniotic infection the antibiotic regimen is not a prophylactic, but a treatment regimen, for both the mother and the baby. (29) It is continued after delivery. The meta-analysis cited that there was a trend towards a decrease in the incidence of post-partum endometritis in women who received treatment with ampicillin, gentamicin and clindamycin compared with ampicillin and gentamicin alone, but this did not reach statistical significance. (29)

3.8 Uterine Rupture

Rupture of the labouring uterus should be suspected in a setting of prolonged obstructed labour and failure to progress. In one study in Nigeria uterine rupture was more common in women who were para 5 and above. The most important obstetric factor associated with rupture was cephalopelvic disproportion. The commonest clinical features at presentation were abdominal tenderness (46.3%), vaginal bleeding (31.7%), and pallor (31.7%). Rupture can occur in a scarred and an unscarred uterus. (30)

In a four-year study of uterine ruptures in 52 women in eastern Nepal, 92.3% of the women had no antenatal care. Two of the women were nulliparous and 38.4% of them were para four or above. Most patients required blood transfusion (88.5%). In this study maternal death occurred in 13% and fetal death occurred in 94%. (31)

The uterine rupture may be partial or complete. Usually there is discharge of the intrauterine contents into either the peritoneal cavity or retroperitoneal tissues. Due to intraperitoneal hemorrhage, hypovolemic shock is usually present. Additional neurogenic shock from the infected uterine contents released outside the uterus is also possible. Careful attention must be paid to fluid resuscitation before taking the patient to theatre. The diagnosis of suspected uterine rupture demands surgical laparotomy after insertion of an indwelling urethral catheter. The fetus may be completely or partially extruded from the uterus. After the fetus has been removed, the uterus should be delivered from the abdominal incision and examined to assess its condition. A difficult situation occurs when there has been massive hemorrhage into the broad ligament with hematoma distorting the anatomy and making bleeding points difficult to identify. The bladder may have been injured during the rupture. (32)

When the uterus is severely damaged by the rupture, a hysterectomy may be necessary. Generally, the ovaries can be conserved as they are not involved in the rupture. As in any situation in late labour, the cervix is well dilated and no longer a discrete and circumscribed solid structure that is easy to delineate. For this reason, and due to the patient's critical condition, removal of the distal cervix if it is not bleeding is not

necessary. At times, simple repair of the uterine rupture may be preferable to hysterectomy. (32)

In a follow-up of repair of ruptured uterus in women admitted to a rural hospital in Ethiopia from 1991 to 1995, the uterus was conserved in 238 of 245 women. The patients were followed for intervals from 6 years and 3 months to one year and 11 months. One hundred and eleven mothers had given birth to 117 healthy babies, and all these mothers did well with elective cesarean sections. Repair of ruptured uteri was considered safe as long as women understood well that they would need to spend the latter months of pregnancy in the maternity waiting area and would need to have a cesarean section with a subsequent pregnancy. (39)

3.9 Fetal Destructive Operations

When the cervix is fully dilated and the baby has died during labour, there are several surgical alternatives to performing a cesarean section for a dead baby. A fetal destructive operation and removal of the fetus per vagina would avoid the risk of a life-threatening intra-peritoneal infection after cesarean section. Maternal mortality from cesarean section in infected cases can be as high as 70%. (33)

Since most women with prolonged, obstructed labour are extremely ill, careful attention must be paid to resuscitation of the women before proceeding to surgery. Hypovolemic shock will require infusion of crystalloids or colloids as well as blood transfusion. Broad-spectrum antibiotics to avoid septicemic shock must be given as infection must be assumed to be present. The abdomen must be examined for signs of uterine rupture or impending rupture. If uterine rupture is suspected, a laparotomy must be done even if the fetus is dead. (33)

Fetal destructive operations are usually only done in cases where the cervix is fully dilated. An experienced operator may sometimes do this operation when the cervix is 7 cm or more dilated. (33)

Post-partum hemorrhage from an atonic uterus should be avoided by infusing 20-40 units of oxytocin in one liter of normal saline or lactated ringers immediately after the delivery of the baby. A self-retaining retractor should be left in the bladder for at least 48 hours after the procedure. If there is danger of fistula formation the catheter should be left in the bladder for 10-14 days. (33)

The most commonly performed operation for delivery of a dead fetus in the cephalic presentation is craniotomy, or perforation of the fetal skull. The perforation can be done with a Simpson's perforator, if available. The Simpson's perforator is passed into the fetal skull up to the shoulders of the blades and opened widely. It is then closed and rotated through 90 degrees and opened again to produce a cruciate opening in the vault. Extraction of the fetal head is then accomplished by traction on the edges of the cranium by application of vulsell, Kocher's foreps, Morris's craniotomy forceps or Maingot clamps. (33)

A sturdy pair of Mayo scissors can also be used to penetrate the fetal skull. The scissors are opened widely within the skull to allow extrusion of fetal brain tissue. As the volume of the fetal skull decreases, traction with the above mentioned instruments can be used to deliver the baby. (33)

Decapitation of the fetus is the procedure of choice in cases of transverse lie with prolapsed arm or shoulder presentation. The 43 cm long Gigli-type Blond-Heidler saw is

the safest instrument to use for decapitating the fetus. This wire saw has the central portion bare and the two ends protected by rubber tubing. After the head has been severed by a sawing motion, traction on the arm will deliver the trunk and the rest of the body. The aftercoming head is manipulated in the uterus to enable the operator to grasp the stump of the neck with a volsellum. The head can then be delivered like the aftercoming head of a breech with the operator's finger in its mouth. (33)

Cleidotomy, or division of one or both fetal clavicles, can be done to reduce the diameter of the shoulders of a dead fetus in cases of impacted shoulders. The clavicle can be cut at its midpoint using either scissors or a scalpel. (33)

4.0 Postpartum Issues in Cesarean Section

4.1 Postoperative Analgesia

Pain relief postoperatively is particularly important in the circumstances of cesarean section, as the postpartum mother is at particularly increased risk of a thrombotic event, which is, of course, decreased by good mobility. Further, good postoperative analgesia, permitting good mobility, also allows the new mother to optimally breastfeed and care for her new infant (34,35). Systemically administered analgesics have been used over a long period of time and have proven utility and safety in the post-cesarean section population although require staff administration, which can be problematic if there are limited staff at the institution (34). Systemic narcotics have particular utility after general anaesthesia for cesarean section. (35) At typical doses, no significant increase in vigilance to vital signs should be required (34). Where available, Patient Controlled Analgesia (PCA) by intravenous allows the patient to administer her own medications and diminishes the peaks and valleys in medication concentrations in the blood. Despite patients using overall less opioid than when dosed by the physicians, satisfaction rates in the literature are consistently higher, likely due to the autonomy the patients feels in their own care (34). Obviously, the hospital must have PCA devices and the patient must understand how to properly use them.

Addition of opioids to epidural and spinal anaesthesia has proven an extremely effective mechanism of providing prolonged postoperative analgesia, lasting up to 24 hours postpartum, when regional anaesthesia is used for the cesarean section (34).

While nonsteroidal anti-inflammatory drugs (NSAIDs) are usually insufficient alone for pain control postoperatively, they are extremely effective when used in combination with other analgesics. NSAIDs can be given orally, intramuscularly or intravenously (34).

Prolonged use of NSAIDs can be associated with gastrointestinal concerns and one must also be aware of potential platelet dysfunction resulting from NSAID use. In general, NSAIDs are considered safe in a breastfeeding population although ketorolac specifically is cautioned against in labouring or breastfeeding mothers (34,35).

Ideally, a multimodal approach to postoperative analgesia is employed in order to best control the patient's pain synergistically. In this manner, ideally, less of each individual drug is required to control pain. NSAIDs have been shown to potentiate the effects of opioids. Adding acetaminophen also potentiates the effects of the other medications with very little additional adverse risk (35). Wound infiltration with local anaesthetic may further assist with postoperative analgesia and certainly carries minimal risk, although studies of benefit are conflicting to date (35).

4.2 Postoperative Feeding

Despite traditional practices that patients should not be fed until a fixed duration after surgery, or until the passage of flatus, the evidence is in favor of early feeding. The Cochrane Review found that early fluid feeding was associated with reduced time to full diet, a trend towards reduced distention postoperatively, and reduced length of stay (36). There is no reason to restrict fluid diet postoperatively and patients can thereafter be advanced to full diet as tolerated.

4.3 Postpartum Hemorrhage after Cesarean Section

Postpartum hemorrhage (PPH) is a major cause of maternal mortality and nowhere is this reality more apparent than in developing countries, where it accounts for 28% of maternal deaths (37). PPH is traditionally defined as blood loss in excess of 500mL from a vaginal delivery or 1000mL at cesarean section. PPH hemorrhage can result from uterine atony, retained placental tissue including that from abnormal placentation, maternal genital tract trauma and coagulopathies (5).

The main mechanism by which the bleeding under the placental site subsides is retraction of the vessels feeding the placenta. If blood clots or retained pieces of placenta are adherent to the placental implantation site, the vessels will not retract. It is therefore crucial to ensure that the uterus is evacuated of all placenta and clot in order to prevent this common cause of PPH (5).

Uterine atony is a common cause of PPH. Risk factors relevant to operative delivery for atony include uterine incisions (ie. including cesarean section itself), previous PPH, delivery after a prolonged labour, desultatory labour or precipitous labour, abruption placenta chorioamnionitis, a large infant, polyhydramnios and multiple gestation (all of which exert additional stretch on the uterus) (5).

Bleeding due to atony can be managed with bimanual massage as well as with medical therapy. Medical therapies for atony include oxytocin, ergometrine, hemabate (PGF) and misoprostol suppositories (PGE₂). All of these therapies can be used up to their maximum dosages (5).

Of course, once uterine atony and PPH do not seem to be responsive to initial medical therapies, other aspects of hemorrhage management need to be initiated. Excellent vascular access, ideally with 2 large-bore IVs, should be ensured and fluid resuscitation with crystalloids should be initiated. Fluid status should be monitored by insertion of a foley catheter and measurement of urine output. Help from available colleagues should be requested and the patient's vital signs should be frequently and carefully monitored. Blood products, if available, should be called for and transfusion initiated as appropriate. Other causes of PPH such as genital tract lacerations and retained placental tissue should also be excluded (5).

If PPH remains refractory to medical and conservative measures, lifesaving surgical measures will need to be considered. These include uterine artery ligation, internal iliac artery ligation, uterine artery embolization (where available) and ultimately hysterectomy, if other measures fail (5).

In the specific circumstance of refractory uterine atony, uterine compression sutures can be employed as a method to prevent the need for hysterectomy. The B-Lynch suture was first described in 1997 and other similar techniques, such as the Cho Square Suture and

the Hayman modification to the B-Lynch suture, have since been described as well (37). This is a suspender-type suture proceeding over top of the uterus and creating extreme compression. (see B-Lynch) In multiple reports of these sutures used for uterine atony, they have been found extremely effective (successful in 45 of 46 reported cases). In addition, in comparison to other surgical treatments for PPH, the B-Lynch suture is easy to perform, requires less advanced surgical skill, avoids major anatomically dangerous landmarks such as pelvic vessels and ureters and also gives the opportunity to preserve fertility. As the tensile strength of the suture declines after 48 hours (as the uterus contracts), there is not a permanent alteration to the uterine cavity, as has been evidenced from postoperative imaging studies (37)

5.0 Recommendations

- 1. In general, as per the World Health Organization, centres should anticipate a rate of cesarean section between 5-15%**
- 2. Cesarean section for failure to progress is indicated if the patient is at least 3-4 cm dilated, experiencing 3 moderate to strong contractions in 10 minutes and fails to progress over the span of 2 hours.**
- 3. Breech presentation other than frank breech should be considered an indication for cesarean section, as should a breech presenting twin. Many centres in developed countries would advocate cesarean delivery of all breech fetuses.**
- 4. Unresolving fetal malpresentation, causing failure to progress, is an indication for cesarean section.**
- 5. Fetal distress of a fetus who cannot immediately be delivered vaginally is an indication for cesarean section.**
- 6. Placenta previa is an indication for cesarean section.**
- 7. Major antepartum hemorrhage may be an indication for cesarean section.**
- 8. Higher order multiples (triplets or greater) is an indication for cesarean section.**
- 9. Advanced cervical cancer is an indication for cesarean section.**
- 10. In a mother receiving cardiac resuscitation, cesarean section should be performed as rapidly as possible to improve maternal outcome.**
- 11. It is reasonable to have a trial of labour for a woman with a single previous transverse cesarean section.**
- 12. The preferred type of uterine incision is a lower uterine segment transverse incision because of less blood loss, less operative time, and less risk of uterine dehiscence or rupture in subsequent pregnancies.**
- 13. In cases of an impacted fetal head deep in the pelvis, the best method of extracting the fetus safely is by first locating one fetal leg and then the other, pulling up on the legs to dislodge the head upwards, and delivering the baby from the uterus.**
- 14. There is insufficient evidence to recommend either exteriorizing or not exteriorizing the uterus from the abdominal cavity before closing the uterine incision.**

15. **Manual removal of the placenta from the uterus is associated with more blood loss for the mother, but there is no difference in rates of endometritis, wound infection, or the need for blood transfusion.**
16. **All women undergoing cesarean section, whether elective or non-elective, should receive prophylactic antibiotics.**
17. **All women with signs of uterine infection before cesarean section should receive therapeutic doses of antibiotics for five to seven days after surgery.**
18. **Uterine rupture should be suspected in a setting of prolonged obstructed labour in a woman who presents in hypovolemic shock with a dead baby.**
19. **Performing a fetal destructive operation to deliver a dead baby vaginally is preferable to doing a cesarean section for a dead baby.**
20. **Combination analgesia, using local anaesthetic to the wound, acetaminophen, NSAIDs and narcotics where necessary, should be used in recovery from cesarean section.**
21. **Early refeeding post cesarean section is recommended and associated with a more favourable outcome.**
22. **Medical and surgical methods of PPH control are also appropriate post cesarean section. The B-Lynch suture should be considered to conserve the uterus when PPH is caused by uterine atony.**

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