Chapter

Caesarean Section

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Abstract

Caesarean section is a procedure performed to save the life of the fetus and sometime to save the life of the woman. Although risks are low, affected women suffer from severe complications. The first caesarean section performed has a bearing on management of subsequent pregnancies. It is crucial that the procedure is performed when necessary. The evolution of caesarean section has shown marked improvement in maternal outcome especially after the introduction of antibiotics. The resistance of bacteria to antibiotics may lead to rethinking about the procedure performed long ago to try and minimised complications related to sepsis. Complications of caesarean sections are common in patients who have had a previous caesarean section. Training in previous caesarean sections will be vital in preventing these complications.

Keywords: ruptured membranes, preterm, prelabour

1. Introduction

Caesarean section is a procedure to deliver the baby though the incision made on the uterus. Ideally this is to deliver a viable fetus which is of 22 weeks or fetal weight of 500 g. Contrary to repeated use of caesarean section referring to the laparotomy to have access to perform a hysterotomy. The objective of caesarean section is to save the life of the mother and fetus. The origin of caesarean is section is somehow not clear as it was believed that Julius Caesar was born following this procedure but the Latin word "caedare" refers to cut.

2. Epidemiology

Caesarean section is the most common surgical procedure. The rapid increase in caesarean deliveries without clear evidence of concomitant decreases in maternal or neonatal morbidity and mortality is a significant concern that the procedure may be overused [1]. Caesarean section rate is defined as the number of caesarean deliveries over the total number of live births and is expressed as a percentage. This is obviously the definition used which does not follow the statistical guideline, as the number the denominator should pregnancy that have reached 22 weeks and not live births as some would have had stillborns but are not included in this definition. Majority of caesarean sections are emergencies compared to elective caesarean sections. In South Africa emergency caesarean sections accounted for 80.9% of total caesarean sections [2] while in the United States of America 63% were emergencies [3].

3. Classification of caesarean sections

Classification relates to the degree of urgency to save the mother's life or the fetus and the mother's life should be always a priority over the fetal life, accept in a situation that the mother's life cannot be modified by the surgical procedure. The word emergency may comprise of many components within which the extent of urgency differs. Once the decision to deliver has been taken, delivery should be carried out with the urgency appropriate to the risk to the baby and the safety of the mother. The objective should be to shorten the decision to delivery time in such circumstances [4] (**Table 1**).

Category	Description
1	Immediate threat to the life of the mother or fetus
2	No immediate threat to the life of the mother or the fetus, has maternal or fetal compromise
3	No maternal or fetal compromise but require early delivery
4	Elective –delivery at a time that suit maternity services and the mother

Table 1.
Classification of caesarean sections.

4. Indications for caesarean sections

See **Table 2** indications for caesarean sections [5].

Urgent caesarean	Elective caesarean
1. Poor progress of labour	1. 2 Previous caesarean section
2. Cephalopelvic disproportion	2. Macrosomia
3. Fetal compromise	3. Transverse lie/unstable lie
4. Abuptio placentae	4. Placenta previa
5. Placenta previa with hemodynamic instability or placenta previa major	5. Previous major shoulder dystocia
6. Cord prolapse with live fetus	6. Active genital Herpes infection
7. Transverse lie in labour	7. Cardiomyopathy with EF < 45%
8. Footling breech in labour	8. Breech presentation at term
9. Uterine rupture	9. Multiple pregnancy with leading twin no-vertex
10. 2 Previous caesarean in labour	10. Previous pelvic fracture
11. Prolonged second stage	11. Previous 3rd/4th degree perineal tear
12. Failed assisted delivery, etc	12. High HIV viral load
	13. Transverse lie not in labour
	14. Preterm rupture of memebranes in a previous caesarean
	15. Pelvic tumour obstructing pelvic inlet
	16. Intrauterine growth restriction
	17. Decreased fetal movements
	18. Contracted pelvis
	19. Recurrent intrauterine fetal death late in third trimester
	20. Previous repair of vesico vaginal fistula,etc

Table 2.
Indications for caesarean sections.

5. Preoperative management

Preoperative discussion should take place to assess the disciplines involved [6, 7].

5.1 Objectives

1. To identify medical and obstetric comorbidities that may increase anaesthetic and surgical risks

2. To establish the urgency of the caesarean section

3. To obtain anaesthetic and surgical informed consent

4. To enable patient preparation

The above objectives may require multidisciplinary team management in certain cases like, cardiac disease, respiratory diseases, concurrent surgical conditions, endocrine conditions and others. It is important that the patient has a full understanding of the procedure and its anticipated complications. In case of emergencies the discussion with the patient should be carried out in a best shortest time not to jeopardise the objective of the procedure. Blood products should be organised if deemed necessary.

The person performing the surgical procedure is responsible for checking that the written consent has been signed and explain the need for the operation again. Risks and complications should be clearly communicated with the patient and care must be taken when explaining the frequency of the complications and those that are less likely.

5.2 Preoperative procedure principles

There is evidence abdominal shave if done should be performed in the operating room just before applying the antiseptic preparation and not a night before. Prolonged shave to operating time increases the bacterial count on the abdomen. The abdomen is scrubbed with alcohol containing solution or nonorganic iodide solution.

Nonparticulate antacid should be given orally before transferring patient to operating table. In some instances, long acting antacid could be given a night before like Ranitidine 150 mg orally. Metoclopramide is given to increase the tone of lower oesophageal sphincter, preferably after oxygenation [6, 7].

Patient should be placed in the 15 degree left lateral tilt position to minimise uterine compression of inferior vena cava [8]. Urinary catheter should be placed to allow the bladder to drain during the operation keeping the operative field clear.

The principle should be to have adequate exposure but not excessive. Gentle handling of tissues with attention to haemostasis.

5.3 Different abdominal incisions

5.3.1 Transverse abdominal incisions

The full thickness abdominal wall incision should be adequate to allow easy delivery of the fetus. At least a minimum incision of 15 cm to allow bladder retractor with ease.

1. Pfannensteil incision is made transversely on the suprapubic area approximately 2-3 cm above the symphysis pubis and should be curvilinear, with the lateral apices of the incision curved slightly up toward the anterior superior iliac spines. The incision is performed sharply to the level of the rectus fascia. The fascia is incised with the scalpel in the transverse manner to expose the muscles. The incision in the anterior rectus fascia may be extended laterally

using the scalpel or dissecting scissors. Watch out for the superficial epigastric and superficial circumflex iliac veins. It is important to minimise the risk of haematoma. After the is incised, the anterior rectus sheath is then dissected from the underlying rectus muscle both in the cephalic and caudal direction using blunt and sharp dissection. Care must be taken to identify perforating vessels between the rectus muscles and the anterior fascia. Peritoneum should be exposed staying in the midline and avoid hooking fingers under the rectus muscles which can damage the underlying vessels. The entry through the peritoneum should be made high in the operative field to avoid injury to the bladder. The peritoneum should be elevated using artery forceps and palpate the intended entry point to exclude small bowel that may be trapped.

2. Joel-Cohen incision is performed in a transverse manner above the location of a Pfannesteil incision and is linear. Once the fascia is incised the rest of the dissection is performed bluntly. There are no maternal or fetal advantages over Pfannensteil incision, but may be quicker.

3. Misdav Ladach incision is based on Joel Cohen incision introduced for hysterectomy. This is a straight transverse incision somewhat higher than the Pfannesteil. The subcutaneous tissue is left undisturbed apart from the midline. The rectus sheath is separated, and the muscles are separated by pulling [9].

5.3.2 Vertical abdominal incisions

Midline vertical incision was the preferred incision for caesarean section because is faster and ease of entry into the peritoneal cavity with minimal dissection required (**Figure 1**). The incision is useful in situation where high peritoneal access is needed. The incision is made vertically just below the umbilicus to at least 1 cm above the symphysis pubis. The advantage is that it can be extended above the umbilicus if necessary if exposure in the upper part of the abdomen is required. The procedure is undertaken by sharp dissection to the level of the rectus sheath (**Figure 2**).

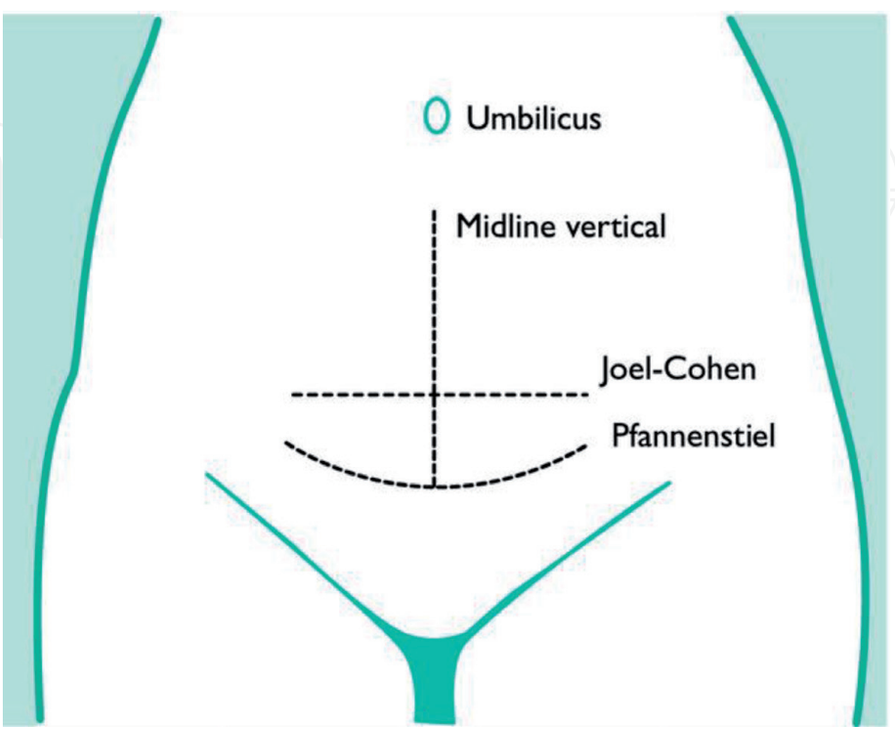

Figure 1.
Abdominal wall incisions.

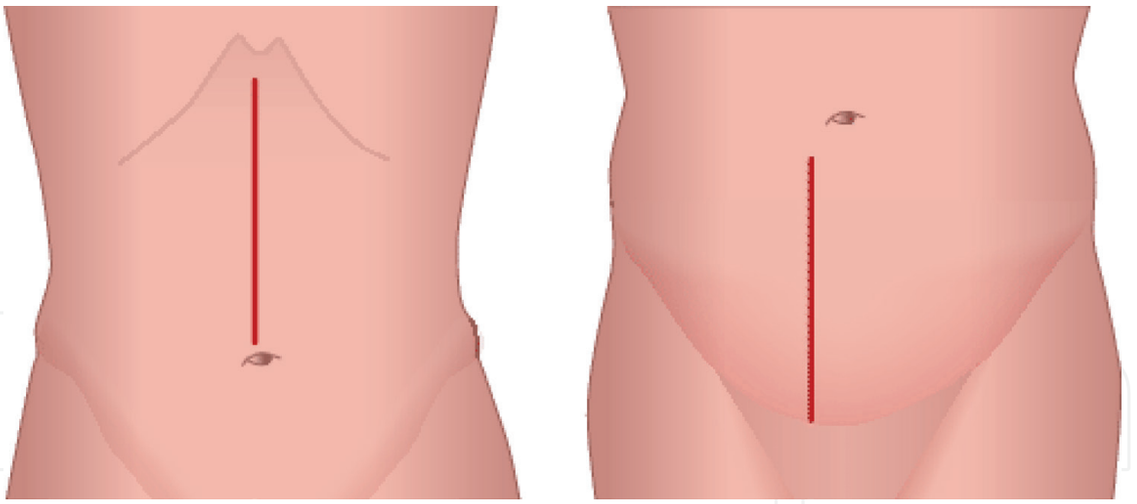

Figure 2.
Midline subumbilical incision (left) and paramedian subumbilical incision (right).

Paramedian incisions are made to serve the purpose of the procedure. For caesarean sections paramedian incisions are made 2-5 cm lateral to the midline over the median aspect of bulging convexity of rectus muscles. Closure is theoretically more secure because rectus muscle can act as buttress between the re-approximated posterior and anterior fascial planes (**Figure 2**).

In obese patients the challenges are anaesthetic with difficult intubation [10], extensive subcutaneous tissue leading to prolonged entry time, obscured vision, difficult delivery, increased bleeding, etc. whether a transverse or midline incision is superior for the obese patient remains controversial, but a larger incision is advisable. Retractors should be used to aid with exposure (**Figure 3**).

Bladder flap reflection is not universally as the creation of the flap was not associated with any increase of complications like bladder injury, increased blood loss or prolonged hospital stay [10]. Non flap reflection was associated with reduced operation time [11]. Situation when bladder flap may be advisable is when the fetal head is impacted and in previous caesarean section. The location of the bladder is best delineated by palpating the bladder catheter (**Figure 4**).

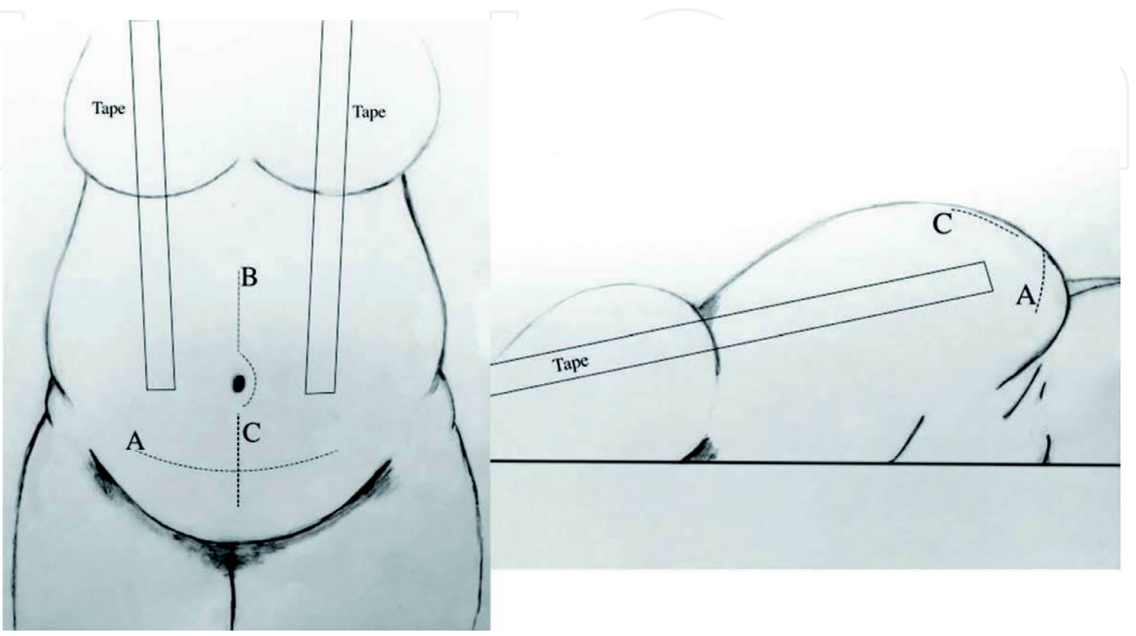

Figure 3.
A = Transverse subumbilical incision; B = Midline incision extending above the umbilicus; C = Midline subumbilical incision.

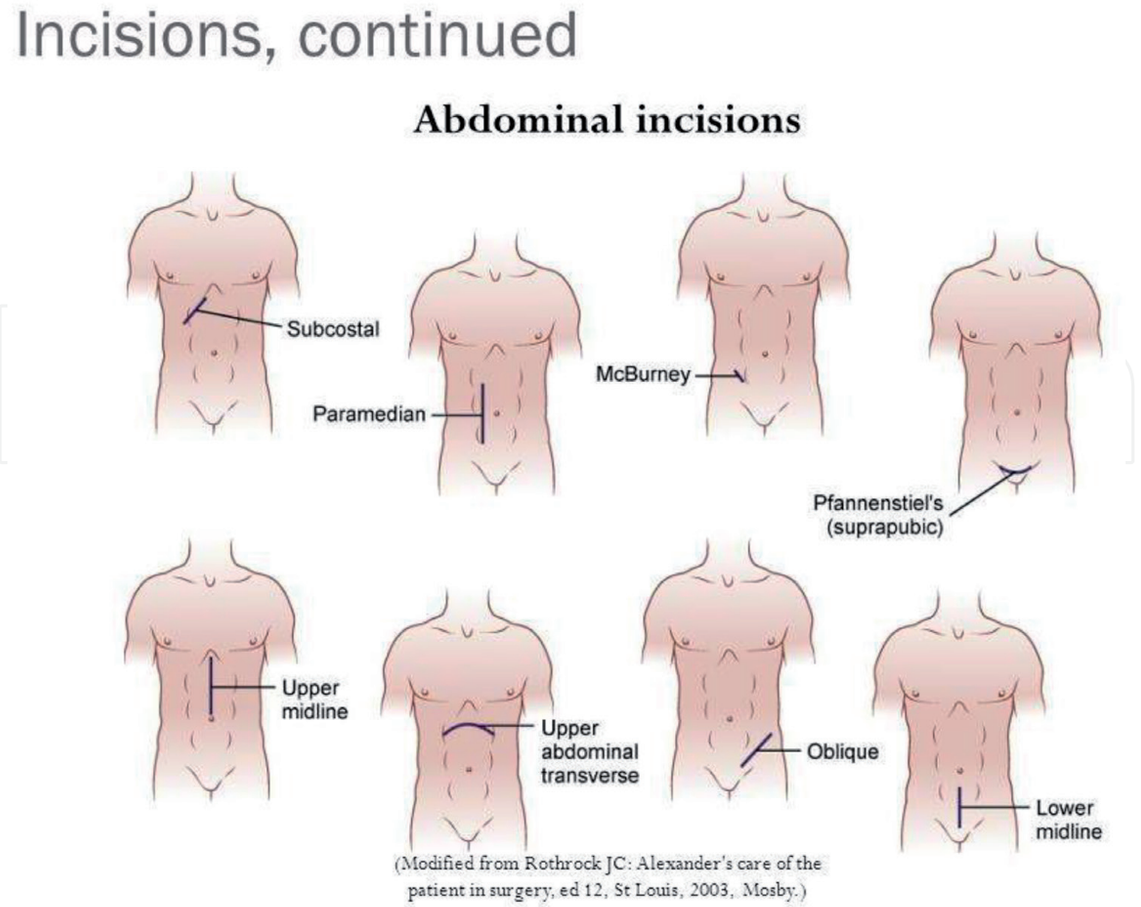

Figure 4.
Different abdominal wall incisions.

5.4 Uterine incisions

The uterine incision is usually transverse but may be vertical. The incision should be large enough to allow atraumatic delivery of the fetus. Factors to consider before a uterine incision is made are

1. Position of the uterus
2. Size of the uterus
3. Location of the placenta
4. Presence of uterine tumours
5. Accessible and developed lower segment
6. Future pregnancy plans

5.4.1 Transverse uterine incision

This is the incision recommended for most patients unless there is a contraindication. For the term pregnancies the incision is made 2-3 cm below the upper edge of the uterovesical fold of the peritoneum [12, 13].

Advantages of lower segment incision:

1. Less blood loss because it is less vascular

2. Less risks of uterine rupture

3. Less subsequent adhesions to the bowel and omentum

4. Reduced risk of ileus and peritonitis

5. Rapid healing

There are different types of incisions on the uterus to deliver the fetus [14], but Kerr incision is the one performed commonly in uncomplicated cases.

1. Kerr incision

2. Kronig incision

3. Sanger high classical incision

4. Delee lower segment vertical incision

5. Kerr transverse lower uterine segment incision

If there is a need to extend the incision this should be done with blunt dissection as sharply extending the uterine incision significantly increases intraoperative blood loss and the need for blood transfusion [12].

The incision to delivery intervals does not significantly contribute to Apgar scores and cord blood gases, but the maternal status prior to caesarean section and optimal anaesthetic management are the most important factors for good neonatal outcome [13, 15].

Lower vertical uterine incision are of 2 types which is either on the lower segment or on the upper segment. The lower segment vertical incision is as strong as the lower segment transverse incision. The major disadvantage of the low vertical incision is likelihood of extension cephalad into the uterine fundus or caudally into the bladder, cervix or vagina.

The classical incision is rarely performed at or near term because of its likelihood to rupture spontaneously antenatally or early in labour. It also associated with increased maternal morbidity [16] (**Figures 5–8**).

Indications for vertical uterine incision are [17]:

1. Poorly developed lower segment like in preterm pregnancies

2. Anterior morbidly adherent placenta

3. Anterior lower segment uterine tumours

4. Dense lower segment adhesions involving the bladder adhesions

5. Delivery of a marked macrosomia

6. Transverse lie

7. Gross congenital anomaly to minimise uterine incision extension and trauma to the fetus

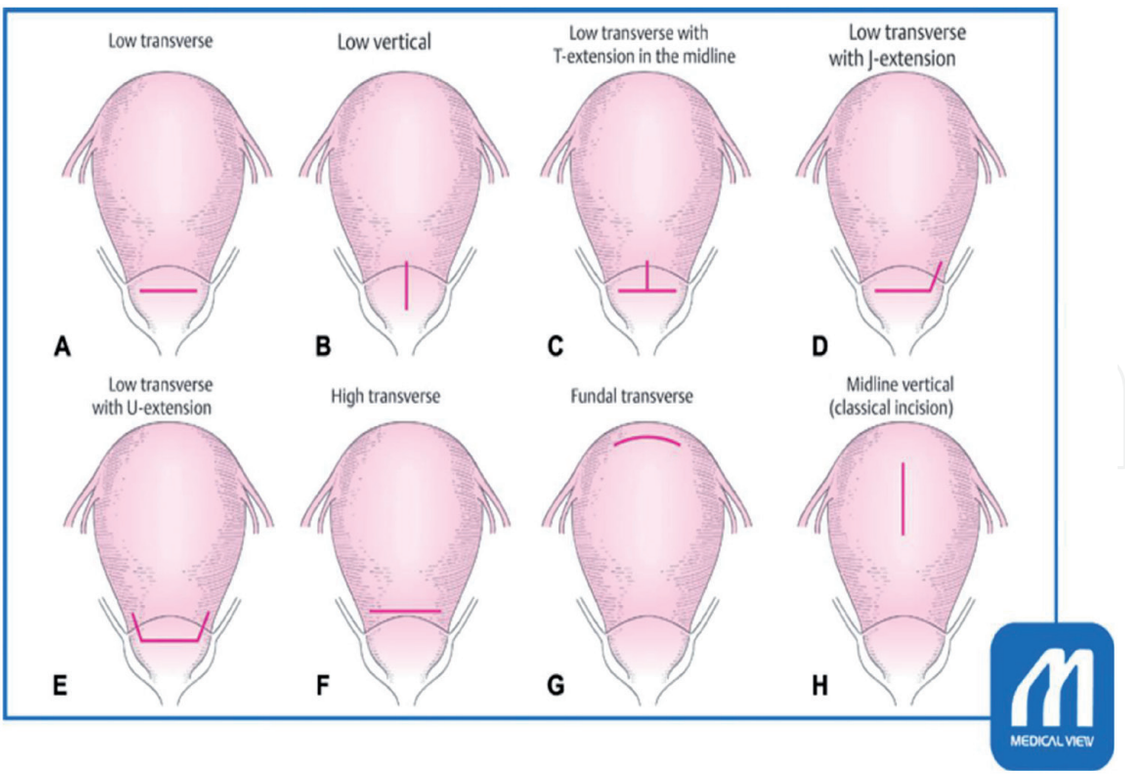

Figure 5.
Different types of uterine incisions.

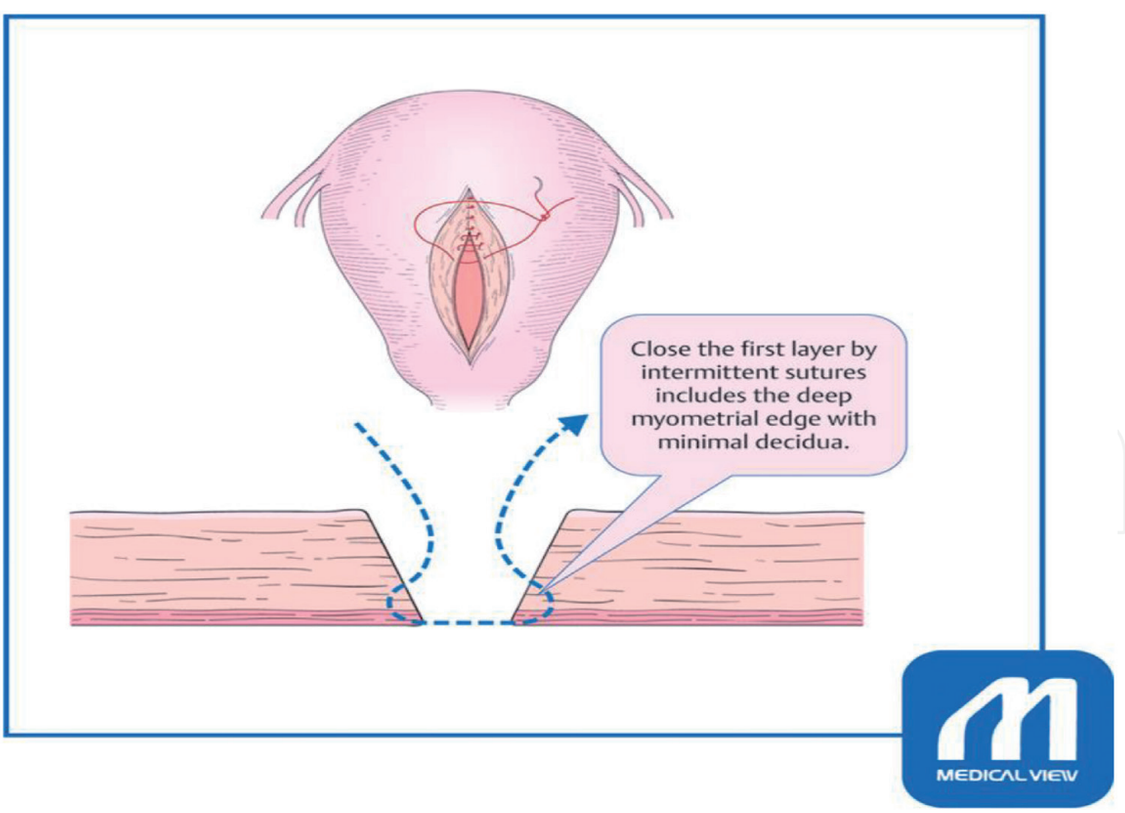

Figure 6.
First layer for uterine closure.

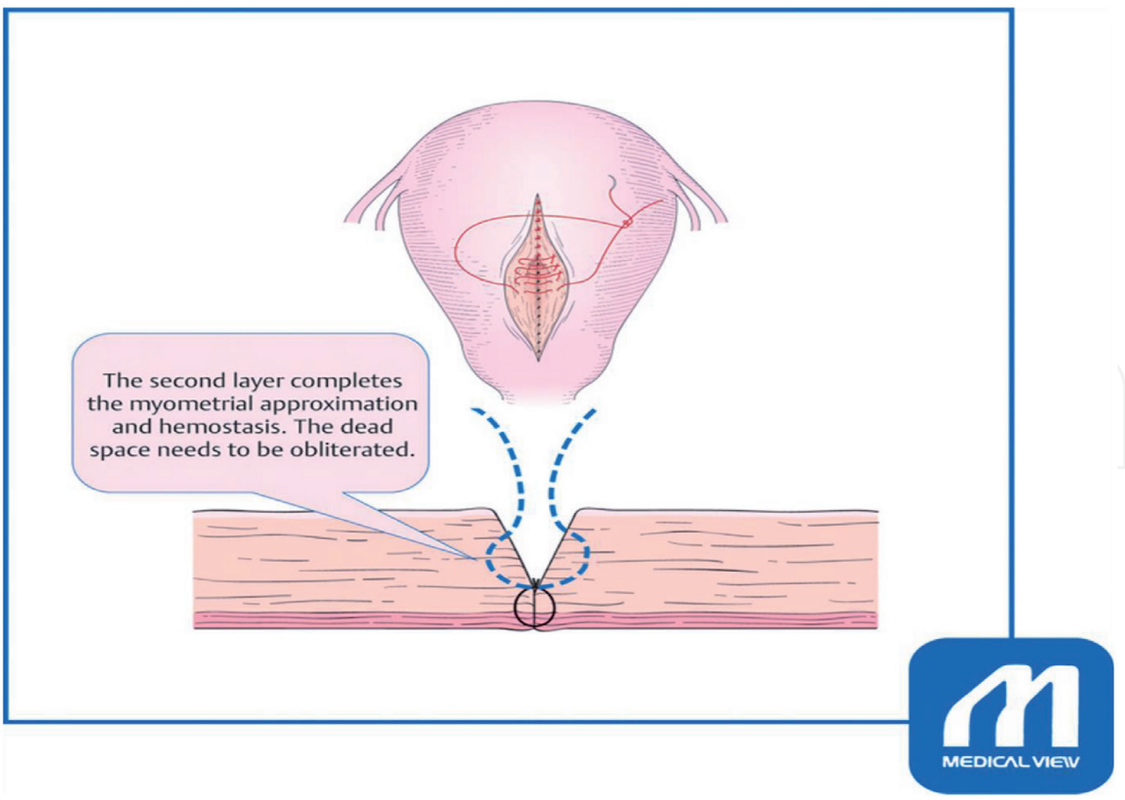

Figure 7.
Second layer closure technique.

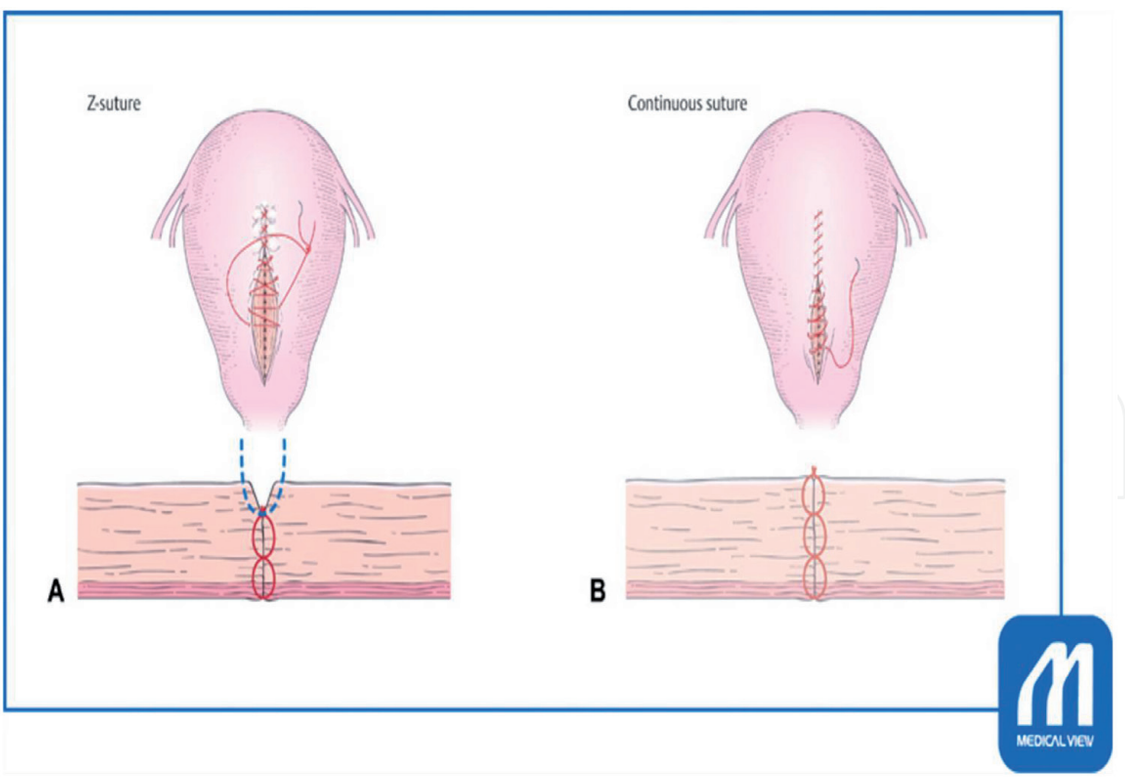

Figure 8.
Abdominal closure techniques.

8. Breech
9. Cervical malignancy
10. Conjoined twins
11. Uterine anomaly

5.5 Extraction of the fetus

The fetus should be extracted expeditiously and in a non-traumatic way. The delay in delivery after a uterine incision with contractions following leads to decreased uteroplacental blood flow and compromise the fetus [15]. Fingers are put around the curvature of the fetal head for leverage, lifting without overly flexing the wrist not using the lower segment and symphysis pubis as a fulcrum, to avoid extensions of the incision. The head is gently elevated and flexed to bring the occiput into incision, with the aid of modest fundal pressure. The shoulders are then delivered transversely along the largest diameter of the incision. Of note that there are conditions that may make this process difficult like impacted head and abnormal lie [16, 17]. Instrumental delivery has been suggested to assist delivery of the fetal head when is found to be difficult and forceps are preferred. The objective should be to carry out an atraumatic fetal delivery as possible.

5.6 Cord clamping

For newborns who do not require resuscitation delayed cord clamping for 30-60 seconds is recommended. Clamping should be done following onset of respiration.

Delivery of the placenta should be by cord traction as this has many benefits compared to manual removal and the use of oxytocin [18].

Advantages are:

1. Less blood loss
2. Less endometritis
3. Shorter hospital stay
4. Slightly shorter duration of surgery

5.7 Closure of uterine incision

After the delivery of the placenta is exteriorized onto the abdominal wall although this kinks the uterine vessels and may seem like there is no bleeding which may occur when replaced back in the pelvis. It is therefore advisable that when replaced haemostasis is verified by checking with systolic blood pressure of 100 mmHg or more. Non exteriorization is challenging but reassures for the achievement of haemostasis. The benefits of exteriorization found was only shorter surgical time [19, 20].

Uterine incision closure technique is the most important factor for good healing to minimise complications later. The assistant should compress the uterus to assist in approximation of the wound edges. Dead spaces need to be obliterated to achieve haemostasis. The angles of the incision should be secured and a full thickness needle bite 1 cm away from the margin of the incision and coming out at the junction of the

myometrium and decidua using polyglactin, poliglecaprone or catgut 1 sutures to avoid endometrial inversion at the scar site as this may delay healing. The type of a suture is largely based on personal preference with no statistical difference in maternal outcome [21, 22]. Double uterine incision closure with continuous locked or unlocked suture [23]. Two layer rather than a single layer is preferred but in a patient performing tubal ligation single layer can be done as there is no concern of subsequent uterine rupture.

Closure of the classical incision has no consensus as interrupted or continuous sutures have been used but the important objective is to obliterate all dead spaces. Approximation of the edges is important to minimise the tension when sutures are placed. The thick myometrium should have a separate layer of suture.

Abdominal irrigation with the use of prophylactic antibiotics seems not to reduce the maternal morbidity but also has not been found to be harmful.

Peritoneal closure has been found to be associated with adhesion formation, but personal experience is different. This may be due to marked tissue handling rather than washing. Re-operating on the patients self-operated before can clarify this issue. The lesser the tissue handling the lesser the adhesion formation.

There is no need for rectus muscle re-approximation unless in cases if rectus diasthesis to minimise visceral injury in subsequent abdominal surgical procedures. It is recommended that subcutaneous tissue with a depth of 2 cm or more should be closed to obliterate dead spaces using interrupted suture.

Skin closure can done with fine sutures like rapidly absorbable continuous or interrupted sutures unless in septic cases where interrupted non absorbable suture closure is mandatory. Absorbable suture give the best aesthetic outcome especially post caesarean section [24].

The challenge for performing caesarean section is when there is prolonged rupture of membranes as this may be associated with severe infections. Before the era of effective antibiotics extra-peritoneal caesarean section was advised. The skill to perform such a procedure has disappeared as effective antibiotics became available. Though the procedure had advantages like less postoperative pyrexia, less hospital stay, less incidence of pelvic abscesses and septic shock, less wound sepsis, lower incidence of secondary post-partum haemorrhage and need for further surgery, it had a prolonged anaesthetic time to delivery [25]. This was a way of minimising complications associated with caesarean section in the presence of infection.

5.8 Complications of caesarean section

In comparison with vaginal delivery caesarean section delivery is associated with increased morbidity and mortality [26].

5.8.1 Operative

1. Anaesthetic complications which related failure to intubate with associated aspiration leading to Mendelson syndrome

2. Extension of uterine incision laterally to involve the uterine vessels and inferiorly to the bladder and vagina

3. Massive intraoperative haemorrhage leading to hypovolaemic shock with associated coagulopathy. Uterine atony is common in caesarean delivery compared to vaginal delivery

4. Bowel injuries especially in patients who had previous laparotomy

5. Urological injuries in patients in prolonged second stage of labour and previous caesarean section

6. Fetal injuries In emergencies to salvage the fetal life

5.8.2 Post operative

1. Paralytic ileus and vomiting

2. Respiratory infections especially following general anaesthesia. This has been reduced to a minimal by the frequent utilisation of regional anaesthesia

3. Puerperal pelvic sepsis

4. Wound infection

5. Thromboembolism, this is even increased in the HIV era as antiretroviral drugs have effect on the functionality of the liver. This also increase the occurrence of pulmonary embolism

6. Fistulae formation in cases where bladder or ureter were injured

7. Rupture of the scar in subsequent pregnancies

8. Incisional hernia which is common in midline incisions compared to transverse incisions

5.9 Counselling for caesarean delivery

Caesarean delivery is the most common abdominal surgical procedure on women of reproductive age. Majority of patients present in a healthy physical state, so the outcome of pregnancy is expected to be a joyful one. Most nulliparous women have a strong preference for vaginal delivery. Women should be encouraged to attend child birth classes to prepare them for the labour and delivery experience. Interventions that decrease the chance of especially the first caesarean delivery include avoidance of non-medical indication for induction of labour. The woman experiences pain after caesarean delivery which limit the welcoming experience of the newborn. The techniques to improve the outcome of caesarean delivery should be developed and minimise the complications following this procedure. The procedure, intraoperative and post-operative complications should be discussed in detail. The unexpected outcome should be emphasised.

6. Conclusion

Caesarean section is the most common surgical procedure in women of reproductive age. Though it seems like a safe procedure it may have devastating consequences for the mother and the fetus. Pregnancy is a results of normal physiology and not a disease as most patients present with no complaints, but coming ambulating. The common complications occur when the labour is prolonged which presents with difficulty in delivery resulting in serious morbidity and/or death. Maternal death rate is high in underdeveloped countries as a result of inadequate facilities and equipment to look after pregnant patients and monitor labour.

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