AFRICAN JOURNAL OF FETOMATERNAL MEDICINE

Review Article

Current Concepts Review on Caesarean Section and Guidelines for Safe Surgical Techniques

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Abstract

Caesarean Section (CS), also known as Caesarean Delivery (CD) or C-section is the surgical procedure by which one or more babies are delivered through an incision in the mother's abdomen and uterus often performed because vaginal delivery would put the baby and or the mother at risk. CS has been part of human culture since ancient times and there are tales in both western and non-western cultures of this procedure. The rise in the rates of CS partly as a result of better surgical techniques and availability of blood transfusion and antibiotics and partly because of social factors such as fear of litigation should there be any fetal or maternal morbidity and woman aspiration to have a healthy baby. CS is the ultimate method of successful delivery of infants under various circumstances and is an indispensable operation in obstetrics. However, the degree of difficulty varies greatly depending on the gestational age of pregnancy, number of foetuses, number of previous CS, presence of uterine myomas, maternal obesity and other factors. In addition, emergency CS is a battle against time and prompt surgery is required. Caesarean section rates have increased globally and bleeding associated with CS is the most common cause of haemorrhage related maternal death. There are global efforts to reduce maternal morbidity and mortality. As with most surgical procedures, there is no standard technique for CS. In view of the importance of this life saving surgical procedures, we carried out a narrative review on the historical perspective, epidemiology, classification, types, indications, surgical techniques, complications and safety measures to reduce complications during CD.

Keywords: Caesarean Section, epidemiology, indications, surgical techniques, complications, safety measures, review.

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Historical Perspective

Caesarean section has been part of human culture since ancient times and there are tales in both western and non-western cultures of this procedure. According to Greek mythology Apollo removed Asclepius, founder of the famous cult of religious medicine, from his mother's abdomen at a time the procedure was performed only when the mother was dead or dying as an attempt to save the child for a state wishing to increase its population. The possible Latin origin of CS include the verb Caesarean meaning "to cut" and the term "Caesarean" that was applied to infants born by post-mortem operation; thus, numerous references to CS appear in ancient Hindus, Egyptian, Grecian, Roman, and Chinese literature[1]. Yet the early history of CS remains shrouded in myth and in dubious accuracy. Even the origin of CS has apparently been distorted over time. It is commonly believed to derived from surgical birth of Julius Caesarean; however, this seems unlikely since his mother Aurelia was reported to have lived to hear of her son's invasion of Britain; however, Roman law under Caesar decreed that all women who were so fated by child birth must be cut open, hence Caesarean[2].

Ultimately, though we cannot be sure of where or when the term Caesarean was derived, until the sixteen and seventeenth centuries the procedure was

known as Caesarean operation and this began to change following the publication in 1598 of Jacques Gullimeaus book on midwife in which he introduced the term “section,” increasingly thereafter “section” replaced “operation”[3]. During its evolution, CS has meant different things to different people at different times. The indications for it have also changed drastically from ancient dead or dying mother with live child to modern times live mother and child with other reasons[4]. Despite the rare references to the operation on living women, the initial purpose was essentially to retrieve the infant from a dead or dying mother, this was conducted either in the rather or vain hope of saving the baby's life or as commonly required by religious edicts, so that infant might be buried separately from the mother[4]. Above all it was not intended to preserve the mother's life. It took up to the nineteenth century era of modern advances in surgical practices to grasp the tenet of safe CS for both mother and child[3].

Though, there were sporadic early reports of heroic efforts to save lives, while the middle age has been largely viewed as a period of stagnation in science and medicine, some of the stories of CS actually helped to develop and sustain hopes that the operations could ultimately be accomplished. Perhaps the first written record available of a mother and baby surviving a CS came from Switzerland in year 1500 where Sow Gelder, Jacob Nufer, performed the operation on his wife after days of labour and help from thirteen midwives, the woman was unable to deliver her baby. Her desperate husband eventually gained permission from local authorities to attempt a caesarean. The woman lived and subsequently gave birth normally to five children, including twins[5, 6]. The caesarean baby lived to be 77 years old. Since the story was not recorded until 82 years later, historians question the accuracy[5]. Similar scepticism might be applied to other early reports of abdominal delivery and those performed by women on themselves and births resulting from attacks by home livestock, during which the peritoneal cavity was ripped open. The history of CS can be understood best in the broader context of the history of childbirth and general medicine and histories that also have been characterised by dramatic changes. Many of the earliest successful CS took place in remote rural areas lacking in medical facilities and operations could be carried out without professional consultation. This meant that caesarean could be undertaken at an earlier stage in failing labour when the mother was not near death and the fetus was less distressed[3]. Under this circumstance, the chances of one or both surviving were greater. These operations were performed on kitchen tables and beds, without access to hospital facilities, and this was probably an advantage until the late nineteenth century when surgeries in hospitals were bewilder by infections passed between patients, often by the unclean hands of medical attendants.

Definitions

Caesarean Section, also known as Caesarean Delivery or C-section is the surgical procedure by which one or more babies are delivered through an incision in the mothers’ abdomen and uterus often performed because vaginal delivery would put the baby and or the mother at risk[7].

Epidemiology

The rise in the rates of CS partly as a result of better surgical techniques and availability of blood transfusion and antibiotics, and partly because of social factors such as fear of litigation should there be any fetal or maternal morbidity and woman aspiration to have a healthy baby. A very small proportion of the increase is due to maternal request for non-medical reasons or due to monetary incentives[8,9]. The incidence of CS varies between 10% and 25% in most developed countries. There is global rise of CS in Italy at 35%, USA at 30% and Europe at 15%[9]. The overall CS rate in Nigeria is low. Recent studies show CS prevalence of approximately 2.1% to 2.7% of births, which is well below the global average for sub-Saharan Africa of 4.9% and much lower than 15% recommended by WHO[10-12]. The lower CS rate indicates a substantial unmet need for obstetric care in Nigeria. Though the overall national CS prevalence is 2.7%, there are disparities between regions (higher in the south 4.7% versus lower in the north 0.7%) and varies between settings (5.2% urban versus 1.2% rural)[11, 12]. The low CS rate in Nigeria contributes to poor maternal-fetal health outcome, which has high rates of maternal and infant mortality. The current CS rate in Nigerian tertiary health facilities varies from one health institution to the other but generally ranges between 13.6% to 45.7% as reported by different authors. A report of 30.8% in Enugu (2015), 40.1% in Lagos (2014), 45.7% in Elele (2025), 13.6% in Sokoto (2024), 34.8% Abakiliki (2020), 35.5% in Osogbo (2013), and 23% in Lokoja (2023)[10 - 13]. Addressing the inequitable access to CS, especially for high-risk pregnancies, is crucial for improving health outcomes.

Classification

Caesarean sections have been classified in various ways by different perspectives[14]. One way to discuss all classification systems is to group them by their focus either on the urgency of the procedure or characteristics of the mother and the fetus. Conventionally, CS are classified as being either an elective surgery or an emergency operation[15]. Classification is used to help communication between the Obstetrician, midwife and anaesthetic team for discussion of the most appropriate method of anaesthesia. The decision whether to perform general anaesthesia or regional anaesthesia (spinal or epidural) is important and is based on many indications, including how urgent the delivery needs to be as well as the medical and obstetric history of the woman[15]. Regional anaesthesia is almost always safer for the woman and the baby but sometimes general anaesthesia is safer for one or both of them and the

classification of urgency of the delivery is an important issue affecting this decision.

A planned CS arranged ahead of time is most commonly due to medical indications which have developed before or during the pregnancy and ideally after 39 weeks of gestation. In UK, this is classified as a "grade 4 section" (delivery time to suit the mother or hospital staff). Emergency CS are performed in pregnancies in which a vaginal delivery was planned initially, but an indication for CS has since developed. In the UK, they are further classified as grade 2 (delivery required within 90 minutes of the decision but no immediate threat to the life of the mother or the fetus) or grade 1 (delivery required within 30 minutes of the decision with immediate threat to the life of the mother or the baby or both[16].

Elective CS may be performed on the basis of an obstetric or medical indication, or because of a medically non-indicated maternal request. Among women in the United Kingdom, Sweden and Australia, about 7% preferred CS as a method of delivery. In cases without medical indications, the America Congress of Obstetricians and Gynaecologists recommend a planned vaginal delivery[17]. The National Institute for Health and Care Excellence (NICE) recommends that if after a woman has been provided information on the risk of a planned CS and she still insists on the procedure it should be provided[18]. If provided this should be done at 39 weeks of gestation or later[17]. There is no evidence that emergency CS can reduce mother-to child hepatitis B and hepatitis C virus transmission[19].

Caesarean delivery on maternal request (CDMR) is medically unnecessary CS, where the conduct of a child birth via a CS is requested by the pregnant patient even though there is no medical indication to have the surgery. Systematic reviews have found no strong evidence about the counselling to identify the reasons for the the request[17]. Recommendations encourage counselling to identify the reasons for the request, addressing anxieties and information and encouraging vaginal birth[17]. Elective CS at 38 weeks in some studies showed increased health complications in the new born. For this reason, ACOG and NICE recommend that elective CS should not be scheduled before 39 weeks of gestation unless there is a medical reason. Mothers who have previously had a CS are more likely to have a CS for future pregnancies than mothers who have never had a CS.

Vaginal birth after CS (VBAC) is the practice of birthing a baby vaginally after a previous baby delivered by CS. According to the ACOG, successful VBAC is associated with decreased maternal morbidity and a decreased risk of complications in future pregnancies[20]. According to the American Pregnancy Association, 90% of women who have undergone CS are candidates for VBAC. Approximately 60-80% of women opting for VBAC will successfully give birth vaginally, which is comparable to the overall vaginal delivery rate in the United States in 2010[21].

Types

There are several types of CS. An important distinction lies in the type of incision made on the uterus, apart from the incision on the skin, the majority of skin incisions are transverse suprapubic approach known as a Pfannenstiel incision but there is no way of knowing from the skin scar which way the uterine incision was conducted:

Classical Caesarean Section: The classical CS involves a longitudinal midline incision on the uterus which allows a larger space to deliver the baby. It is performed at a very early gestations where the lower segment of the uterus is not formed as it is safer in this situation for the baby but it is rarely performed other than at this early gestation, as the operation is more prone to complications than a low transverse uterine incision. Other indications for classical CS are grade four placenta praevia, lower segment uterine myoma and post-mortem CS to salvage life baby. Any woman who has had a classical section will be recommended to have an elective repeat section in subsequent pregnancies as the vertical incision is much more likely to rupture in labour than the transverse incision.

Lower uterine segment section: The lower uterine segment section is the procedure used today as it involves a transverse cut just above the edge of the bladder. It results in less blood loss and less few early and late complications for the mother, as well as allowing her to consider a vaginal birth in the next pregnancy.

Caesarean hysterectomy: A caesarean hysterectomy consists of CS followed by the removal of the uterus. This may be done in cases of intractable bleeding or when the placenta cannot be separated from the uterus.

Indications for Caesarean Section

Indications for CS could be due to maternal or fetal factors. A planned elective CS is performed for a variety of indications. The following are common indications but not an exclusive list such as breech presentation, unstable lie at term, twin gestation, fetal distress, placenta praevia, previous 3rd or 4th degree perineal tear, maternal diabetes with associated fetal macrosomia or maternal request.

Procedures

A CS typically takes 45 minutes to an hour [22]. It may be done with spinal block where the woman is awake, or under general anaesthesia. An incision of about 15cm is then typically made through the mother's abdomen. The uterus is then opened with a second incision of about 10 cm and the baby delivered. The placenta is also delivered. The incisions are then closed in layers. A woman can begin breastfeeding as soon as she is out of the

operating room and awake. Often, several days are required in the hospital to recover sufficiently to return home[23, 24].

Safe Surgical Techniques During CS

The WHO surgical safety checklist and FIGO guidelines for CS must be adhered to while preparing for CS [25]. The attending Paediatrician should be informed about general anaesthesia and fetal state. Prior to CS the surgeon must perform an abdominal examination before anaesthesia to check fetal lie and presentation as the findings may influence incision and assistance during CS. Premedication should include antibiotic prophylaxis using first generation cephalosporin intravenously 60 minutes before surgery. Oral antacid 30 minutes before surgery and intravenous antiemetic given 60 minutes before surgery. Vagina irrigation immediately before CS reduces the risk of postoperative endometritis and surgical site infections. A urinary catheter is used to drain the bladder and the skin of the abdomen is then cleaned with an antiseptic. The surgical site should be draped with non-adhesive drapes as adhesive drapes are associated with an increased risk of surgical site infections[25].

For the skin incision, transverse or vertical incision can be used. A transverse incision has a better outcome. Vertical incisions generally allow faster abdominal entry, less bleeding and nerve injury and can be easily extended in a cephalad direction.The minimal length of the incision should be 15cm (that is the size of Allis clamp) to allow for atraumatic and expeditious delivery of the term fetus, this can be manually stretched to ensure an adequate size opening and avoid additional sharp dissection. The common transverse incisions for CS are the Pfannenstiel and Joel-Cohen (Misgav Ladach) incisions[25-27]. The Pfannenstiel skin incision is curved, 3cm above the symphysis pubis. The Joel-Cohen incision is straight, 3cm below the line that joins the anterior superior iliac spine, and more cephalad than the Pfannenstiel incision[25]. The Pfannenstiel incision is preferred by many surgeons because of perceived better cosmetic appearance, lower in the abdomen. However, vertical skin incision must be used when a vertical incision on the uterus may be required for transverse lie, preterm deliveries, or when the lower segment of the uterus is not yet developed. There is no superiority in outcome of between scalpel or electrosurgical skin incision. Individual surgeon preference is reasonable. There is no difference between the use of one scalpel versus two scalpel technique. The dissection of the subcutaneous tissue layer could be sharp or blunt. The Joel-Cohen technique recommends blunt dissection. For the fascial and rectus layers, blunt separation is recommended in most cases. Transection of the muscles (Mallard incision) should be avoided. For the opening of the peritoneum, the Joel-Cohen approach recommends that fingers are used to bluntly open the peritoneum to minimize the risk of inadvertent injury to bowel and bladder. Maylard incision or extraperitoneal approach may be used in patient with dense adhesion between the lower uterine segment and the peritoneum but is very rarely needed. During the intra-abdominal procedures wide metal or O-ring retractors are needed. Bladder flap may be done for difficult deliveries with the fetal head deep in the pelvis, previous CS or patients who are not in labour. However, developing a bladder flap in an emergency lower segment CS in term labour is not recommended[25].

For hysterotomy, vertical or transverse incisions could be used. The incision must be large enough to allow atraumatic delivery of the fetus. The type of incision is depended on the lie, position and size of the fetus; location of the placenta; presence and location of fibroids; characteristics of the lower uterine segment; and future pregnancy. Transverse uterine incisions made along the lower uterine segment (Monro Kerr or Kerr incision) are associated with less blood loss; less need for bladder dissection; easier approximation; and lower risk of rupture in subsequent pregnancies. Transverse incision in the lower uterine segment is the best incision for patients who are planning another pregnancy and may attempt a trial of labour in that pregnancy. A "J" or inverted "T" extension may be required. Low vertical and classical incisions are two types of vertical incisions. The low vertical incision is performed in the lower uterine segment (noncontratile myometrium) and appears to be as strong as the low transverse incision.

However, it's limit is difficult to determine both cephalad and caudad. The classical uterine incision is a vertical incision that extends into the upper uterine segment (Contractile myometrium). It extends to the level or near the level of the round ligament insertion. It can safely be extended into the upper segment if needed and are preferred to "J" or "T" incisions. It is rarely performed these days at or near term. It is associated with higher frequency of uterine rupture in subsequent pregnancies and more maternal morbidity. Its accepted indications include: extremely adherent bladder; pathology of the lower uterine segment such as fibroids, anterior placenta previa or accreta; very large fetus as in fetal anomaly, extreme macrosomia; extreme preterm breech presentation or back down transverse lie. As regarding blunt or sharp extension of the uterine incision, blunt extension with surgeon's fingers is faster, has fewer risks of inadvertent trauma to the uterus and has maternal benefits. The Sharp extension of the uterus has high risk of postpartum haemorrhage with need for blood transfusion. The cephalad-caudad blunt extension reduced the risk of intended incision extension and uterine vessel injury. In general, the uterine incision should be more than or equal to 10cm. The mean biparietal and suboccipito-bregmatic diameters at term are about 9.5cm - to avoid a difficult delivery and uncontrolled extension. Avoid attempts to deliver the fetus through a uterine opening that is too small[23 - 27].

The goal of fetal extraction should be to extract the fetus expeditiously and atraumaticaly. For fetuses in cephalic presentation, the key points are : the surgeon dominant hand is inserted through the hysterotomy incision and the fingers are placed around the curvature of the head for leverage and lifting; using the fingers and

the palm, the head is gently elevated into horizontal plane and flexed to bring the occiput into the open hysterotomy and then extended and guided through the incision to deliver the fetus with assisted trans-abdominal fundal pressure as needed: the shoulders are delivered using gentle traction one after the other followed by the rest of the body with ease; the newborn is placed on the legs of the patient and cord clamping is delayed for 30-60 seconds, the major benefit is for newborn haematological parameters. Delayed cord clamping is recommended unless immediate resuscitation of the newborn is required[25].

Placental removal could be manual extraction or spontaneous expulsion of the placenta. Manual extraction compared with spontaneous expulsion of the placenta results in a higher rates of blood loss and lower postpartum haemorrhage. It is not clear if the changing of gloves after placental delivery or wiping the endometrial cavity or mechanical dilation of the cervix influence postoperative morbidity. Attempt to prevent postpartum hemorrhage should start as soon as the placenta is delivered, the uterus is massaged to promote contraction; a bolus of oxytocin is administered intravenously to promote uterine contractions as well as involution and continued as an infusion in the postpartum period[25-27].

Uterine closure is done either by exteriorization or in situ repair. Exteriorization of the uterus may improve exposure and facilitate closure of the hysterotomy. The endometrial layer may be closed including or excluding endometrium layer. The difference is Niche formation and risk of adverse gynaecologic and reproductive outcomes such as dysmenorrhea and placenta accreta spectrum. Considering the use of needles such as blunt (rounded tip) versus sharp (tapered point) needles, blunt needles are preferred and safer for surgeons in terms of needle stick injury and glove perforation. The choice of suture material is the surgeon preference. However, delayed absorbable synthetic polyglactin monofilament or braided (Monocryl, vicryl) suture is preferred. In terms of continuous (locked or unlocked) versus interrupted sutures, the unlocked is preferred. The decision may depend on whether a single- or double-layer closure is being performed. For single versus double layer closure of the lower uterine segment incision: in terms of single layer closure for permanent contraception, a continuous unlocked technique is the best. For thick myometrium, a double or triple layer is preferred as in classical incisions. For the closure of classical incisions, interrupted figure of 8 in the first layer and second layer of continuous sutures suffice[25].

For abdominal wall closure, the surgeon should ensure adequate control of haemostasis, enlargement or bulging of the broad ligament are signs of retroperitoneal haemorrhage. Closure of the visceral and parietal peritoneum are not recommended. For closure of the fascia, approximation is the goal, no tension, unlocked continuous technique 1cm apart, using nonabsorbable 0 or 1 braided (polyglactin) or monofilament (polydioxanone) in a single layered closure. The subcutaneous tissue is closed with interrupted delayed absorbable sutures if the layer is more than 2cm thick. The skin closure is done either with staples or sutures which are removed 3-4 days postoperative period. Monofilament (poliglecaprone) or braided (polyglactin) 2/0 are preferred interrupted or subcorticular sutures. Dressing versus no dressing is the surgeon preference. Gauze dressing is the norm. The use of drain and approximation of the rectus muscle are not necessary. Surgeons should be mindful of bleeding at CS and be prepared for standard of care[25]. Following delivery of placenta there may be arterial bleeding from one or more uterine tears and bleeding from atonic uterus.

Complications of Caesarean Section

Caesarean sections, while generally safe carry potential risks for both mother and the baby. Maternal complications can include: postpartum haemorrhage, infection, reactions to anaesthetic agents, injuries to organs like bladder or bowel. In rare cases, hysterectomy may be needed. For future pregnancies, there is a higher risk of placenta previa and placenta abruption and or the uterus may rupture during vaginal birth attempt. The baby might also experience breathing difficulties especially if born before 39 weeks of gestation[26, 27].

Conclusions

In conclusion, CS is the ultimate method of successful delivery of infants under various circumstances and is an indispensable operation in Obstetrics. However, the degree of difficulty varies greatly depending on the gestational age of pregnancy, number of foetuses, number of previous CS, presence of uterine myomas, maternal obesity and other factors. In addition, emergency CS is a battle against time and prompt surgery is required. The evolution of practice of CS as a method of operative delivery is fascinating with remarkable advances in techniques and mastery.

During training in CS, surgeons must master the basic techniques in cases involving complications such as malpresentation, preterm birth, placenta previa and other conditions. There are several indications and classification of CS. The incidence of CS varies from one continent to the other and within the same continent; CS rate varies from one region to the other. The rise in rate of CS is partly as a result of better surgical techniques and availability of blood transfusion and antibiotics. Understanding the best practice principles of safe surgical techniques during CS is crucial in improving the maternal and infant health in the perioperative period.

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