REVIEW ARTICLE

Developments in Caesarean Section Techniques: A Review.

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ABSTRACT

Background: *Caesarean section is the most common surgical procedure Performed on women world- wide. It is recommended when vaginal delivery might pose a risk to the mother or baby. This review examines the history and developments in caesarean section techniques over the years as well as the difficulties that may be encountered in each stage in our environment.*

Method: *A review of relevant literature was conducted using Pubmed and e-medicine websites for computer search. The following keywords were used: history, development, techniques and caesarean section. Relevant review articles, Cochrane database and chapters in text books were also used to extract information.*

Results: *Though practiced since ancient times, the history of caesarean section remains shrouded in myths as no document describing its indication and techniques is still available. Ancient medical writers like Galen, Hippocrates and Soranus made no mention of the procedure. However, the evidence that it was performed arose from legal texts. The development in its technique was gradual over many years.*

Conclusion: *The development of caesarean section technique occurred with the withdrawal of surgeries from the stronghold of religion in Renaissance time. Operative techniques vary and this has continued to improve through many years of trial and error.*

KEY WORDS: *Caesarean section, history, development, techniques.*

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INTRODUCTION

Caesarean section(C/S) is defined as the delivery (birth) of a fetus(es) alive or dead through a surgical incision made on the mother's anterior abdominal and uterine wall (technically a laparotomy followed by hysterotomy) [1-3]. The definition excludes removal of a fetus from the abdominal cavity in the case of ruptured uterus or abdominal pregnancy. Caesarean section (delivery) remains the most common major operations performed on women world wide and the rate is increasing [2, 4 - 6]. This literature review was undertaken to highlight the history and gradual development in caesarean section techniques over the years as well as difficulties that may be encountered at each stage in our environment.

History Of Caesarean Section

Caesarean section has been practiced since ancient times and is referred to in myths and folklore of some ancient nations [7 10]. Though no ancient medical documents describing the technique or exact indication for caesarean section (C/S) are still in existence, the evidence that C/S was carried out arose from legal texts[11]. For instance, a cuneiform tablet dealing with adoption of a small boy during the 23rd year of the famous king Hammurabi of Babylon (1795-1770 BCE)[12] Lex Regia (the law of the kings) proclaimed by Numa Pompillus, an ancient Roman King (716 -673 BCE) mandated a post mortem operative delivery so that both mother and baby could be buried separately (the specific law was called Rex Cesare); and Mishna, the collection of ancient Jewish laws(2nd century BCE to 6th century CE) [9,12,13].

The exact origin of the term caesarean is unclear, controversial and apparently distorted over time. It may have arisen from the middle ages from Latin verb caedere meaning to cut or caedones, a term for the children born post-mortem [14]. The common belief that Julius Caesar was born through this operation seems untrue as his mother, Aurelia is reputed to have lived to hear of her son's invasion of Britain. It is doubtful that a woman in Roman times would survive laparotomy [15]. Any how, the procedure was performed only when the mother was dead or dying as an attempt to save the child. According to Greek mythology, Apollo removed Aesculapius, the founder of the famous cult of religious medicine from his mother's abdomen. Bacchus was also believed to have been delivered abdominally with Jupiter's assistance [16].

The indication for caesarean section in the ancient world's of Mesopotamia, India, Egypt, Israel and Rome was mainly post-mortem delivery of the dead or live babies [9, 10,] .Midwives or clergy performed this procedure purely on religious grounds [9]. The withdrawal of surgery from religious authority during the Renaissance led to the emergence of caesarean births as a medical procedure [9].

The earliest authenticated report of a child who survived caesarean birth is a document describing the birth of Gorgias in Sicily about 508BC [9]. There is no other accurate description of the performance of caesarean section or the immediate outcome of the mother or neonate until 1610 [1].

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In 1500, Jacob Nufer, a sow gelder, from Switzerland was reported to have performed a successful "modern" caesarean section on his wife with the survival of both mother and child. There may be doubt in the authenticity of the report since it was not documented 82 years after the operation was performed. In his book, Treatise on caesarean section published in 1581, Roussett advised that caesarean section be performed on a living woman, so he was the first physician to do so[9]. Trautman in 1610, performed a well documented caesarean section in Wittenburg but the patient died from infection on the 25th post-operation day. The first successful caesarean delivery in the British Empire was performed between 1815 and 1821[17].

The first major surgical advance in the technique of caesarean delivery was introduced by Porro in 1876, the modern era of caesarean section[17]. His operation consisted of a laparotomy followed by supravaginal hysterectomy and bilateral salpingo-oophorectomy [1, 9]. The cervical stump was marsupialized to the anterior abdominal wall. His technique was influenced by the prevailing concept of none suturing of uterine incisions principally out of fear of uterine infection and haemorrhage. The Porro procedure resulted in a dramatic decline in maternal mortality but sterility and premature menopause were the side effects[18]. Prior to 1876, a series of 22 caesarean deliveries performed in Paris demonstrated a 100 percent maternal mortality, mostly due to haemorrhage and infection [19].

The era of modern caesarean section began in 1882 when Max Sanger from Leipzig described the value of suturing the uterine wall with silver wire (developed by 19th century gynaecologist, J. Marion Sims) and silk in 2 step closure following hysterotomy [20,21]. His operation was less radical and conserved fertility.

Operative techniques have continued to improve through innovations over many centuries of trial and error. There are many possible ways of carrying out caesarean section and operative techniques vary [2].

Abdominal Incision

Various abdominal incisions have been used for caesarean delivery and almost any abdominal area was suggested[1,2]. Initially the incision was made on either side of the linea alba usually the right [1]. The scar is stronger than the midline but has no cosmetic advantage. There was also a report of an oblique incision[1]. Levret originated the midline vertical incision through the linea alba[1]. Traditionally, midline incisions are used for caesarean delivery [22]. It has the advantage of reduced bleeding because the area is avascular, speed of abdominal entry, good healing and can be extended upwards if more space is required [2,12]. It is also advised if local anaesthesia Is to be used [23]. The disadvantages are the risk of injury to the urinary bladder, post-operative wound dehiscence and later development of incisional hernia [2,12]. The next innovation was by Pfannenstiel in 1900[24, 25]. His incision is a transverse slightly cephalad curved incision made at the level of the pubic hair or two finger breaths above the pubic symphysis. It extends slightly beyond the lateral borders of the rectus muscles and carried to the fascia which is incised bilaterally for the full length of the incision. The underlying rectus muscles are separated from the fascia both superiorly and inferiorly by blunt and sharp dissection. The rectus muscles are separated in the midline and access is gained into the peritoneal cavity. Its major contribution is the incision of the rectus fascia transversely. The advantages are better cosmetic appearance, minimal risk of incisional hernia, less post-operative pain and excellent visualization of the pelvis. The disadvantages are more blood loss since it involves more dissection, requirement of surgical skills and the incision is difficult to make under local anaesthesia [12,25].

Alfred Maylard modified the transverse incision for more exposure and space in 1907[26]. The procedure entails the division of the rectus abdominis muscles and anterior rectus sheath transversely and bilaterally. For most caesarean deliveries, the medial two thirds of each rectus muscles need to be divided.

The Mouchel incision (1981) is similar to that of Maylard. The transverse incision runs at the upper limit of the pubic hair and is lower than Maylard incision. The muscles are divided above the openings of the inguinal canal [27].

The Pelosi technique for caesarean delivery involves low cutting of the skin transversely with a knife while the subcutaneous tissue and fascia are incised with electrocautery. The upper aspect of the fascia is elevated and the median raphe is dissected upwards 2-3cm using electrocautery. The rectus muscles are separated bluntly with fingers to identify peritoneum which is entered by inserting the index finger inwards and upwards. The muscles and peritoneum are stretched to the full extent of the skin. No bladder flap is created before hysterotomy [28].

Recently in 1972, Joel Cohen described a transverse skin incision situated about 2cm below the line joining the anterior superior iliac spines which is higher than the traditional Pfannenstiel incision [29, 30]. The technique involves cutting the skin and the subcutaneous tissue. The rectus sheath is cut a few centimeters in the midline. The rectus sheath is extended laterally by blunt finger dissection or by pushing laterally with slightly scissor tips deep into the subcutaneous tissues [29, 31].

Finger traction is used to separate the rectus muscles [2]. If exceptional speed is necessary in the transverse entry, fascia may be incised in the midline and both the fascia and subcutaneous tissue are rapidly divided by blunt finger dissection [29]. This incision was used by Stark together with single layer closure of the exteriorized uterus and non-closure of the peritoneum. At the Misgav-Ladach hospital in Jerusalem, this package of surgical techniques has been popularized by Stark and others [32]. The advantages include shorter operating time, less use of suture materials, reduced intra-operative blood loss, reduced pain and less wound infection [2,31,33-35]. .

Historically, the midline vertical incision has been the preferred technique because of its speed and ease of entry into the peritoneal cavity. Currently the Pfannenstiel incision is the most commonly used [7]. Yet, for most obstetricians the choice of abdominal incision for caesarean section is dictated by our comfort and habit [36].

The incisions commonly used in our environment are the vertical midline and the suprapubic transverse (Pfannenstiel) .They all have their merits and demerits as shown in the text. However, difficulties should be anticipated when performing any of the abdominal incisions as adhesions resulting from sepsis is common. Wound infection is also common among our post-operative patients. When midline incision is used, the bladder, bowel, and omentum may be incised in an attempt to gain entry into the peritoneal cavity. Occasionally, the uterus is plastered to the anterior abdominal wall and the inexperienced may cut into it without realizing until liquor surprisingly exudes. These problems can be avoided by first anticipating them. It is advised that entry into the abdominal cavity in a repeat caesarean section should be by cutting above the old scar where there is normal tissue and then downwards. Entry into the abdominal cavity should be cautious without unnecessary haste. Undue slowness, however, may be disadvantageous especially when the indication for the surgery is fetal distress. Pfannenstiel incision may also present some difficulties when a repeat operation becomes necessary in our patients. Entry into the peritoneal cavity is difficult because the scar tissues are more difficult to dissect than in primary surgery. If extensive adhesions are present as happens occasionally a midline incision may be made on the already made transverse incision in order to access the peritoneal cavity. This will result in a inverted T incision with much blood loss. Also, when a tumour like fibroid occupies the lower uterine segment, a median incision should be preferred as access in Pfannenstiel incision is limited to the lower segment of the uterus. This incision, though cosmetically appealing, patient's selection should guide its use in primary caesarean section as subsequent surgeries may present problem of adhesions from post-operative infection. Effective post-operative antibiotic therapy should be instituted in any primary Pfannenstiel incision to avoid or minimize infection. Furthermore, it should be avoided in our native rural women as they may not present to the skilled surgeon for a repeat surgery should the need arises in

Future. It should as much as possible be avoided in emergency situations especially in unbooked patients who present late in labour requiring operative delivery as access to the uterus and baby takes longer time.

Uterine Incision

It was Max Sanger who introduced the classical caesarean section in 1882 and this held sway for the next century [18.] Majority of the early surgeons used classical (vertical) incisions. The median vertical incision on the uterus allows sufficient room for the delivery of the baby while avoiding the uterine vessels laterally [37]. Severe haemorrhage, downward extension to the bladder and vagina and risk of rupture in subsequent pregnancies are its limitations. It is rarely performed today unless for exceptional indications such as post-mortem, inaccessibility to the lower uterine segment due to severe adhesion or a mass, transverse lie and when sterilization is to be carried out[1,34]. In 1982, Kehrer introduced a transverse incision at the level of the internal os, believing the natural tendency of the uterus to anteflexy would reduce morbidity[38]. Fritsh suggested a fundal transverse incision. The suggestions by Kehrer and Fritsh were unpopular. Munro Kerr introduced a downward curving transverse incision on the lower uterine segment and this was modified by Pfaneul in 1931 to the present day upward curving low transverse incision [39]. The advantages of the transverse lower segment incision are reduced bleeding and decreased incidence of uterine rupture in subsequent vaginal delivery. Another development in transverse lower segment uterine incision is bilateral 'J' shape or inverted T when more space is needed [40,41]. Whatever incision that is indicated must allow enough room for easy delivery of the baby without injury to the uterine arteries.

Extreme caution should always be taken when incising and undermining the visceral peritoneum in the commonly used transverse lower segment incision especially in a previous caesarean section as the procedure may have resulted in scarring of the bladder flap. The bladder may be inadvertently injured in the process. Carefulness and directing the tip of the dissecting forefinger towards the lower uterine segment while undermining the lower peritoneal flap rather than the posterior surface of the bladder will

avoid inadvertent cystotomy.

Repair of Uterine Incision

Initially, the thinking was that the uterine wound at caesarean section did not require any treatment but cleansing [7]. Uterine sutures were thought to be ineffective because of uterine contractions accompanied by relaxation[9]. In 1769, Lebas suggested the use of sutures to close uterine incision[37]. It was Max Sanger as mentioned earlier who used silver wire in 1882 to close the uterine incision. Robert Harris, an American surgeon had suggested uterine sutures 4 years before Max Sanger in selected cases[40]. Extraperitoneal caesarean technique was introduced by Frank in 1906. This consisted of suturing the cut edges of the parietal and visceral peritoneum before uterine incision [36]. In 1923, Portes carried out a two stage surgery. The first was the delivery of the baby and the closure of the abdominal incision around the exteriorized uterus at the cervical level. The uterus was left out side the abdomen. If infection occurred, hysterectomy was performed. Otherwise, the uterus was returned to the abdomen in the second stage of the operation [42].

In recent times, repair of uterine incision is performed in single or double layer closure with chromic catgut or vicryl suture. A single layer has been shown to be safe and effective as a two-layer closure and associated with decreased operation time, fewer haemostatic sutures and no increased risk of adverse maternal outcome with subsequent pregnancy[43-46]. The technique of single layer closure involves the inclusion of the incised myometrium in a running-lock suture while avoiding the decidua and serosa. Traditionally chromic catgut suture is used, but the use of synthetic absorbable sutures such as polyglycolic acid or polyglactin has several advantages over catgut. While catgut suture is absorbed by phagocytosis resulting in more inflammation, polyglycolic acid sutures are by hydrolysis[47]. There is decreased inflammation and increased time interval to the loss of suture strength with the use of polyglycolic acid. However, Zuidema and colleagues found a 4-fold subsequent scar separation with the use of vicryl compared to chromic catgut suture (4.6 versus 1.2 percent) [48]. Also blunt expansion of the uterine incision rather than cutting through with scalpel has been shown to be associated with better protection of uterine vessels and reduced blood loss [49]. Again, non-closure of the visceral peritoneum has been shown to be associated with fewer post-operative complications, less pain, reduced operation time and analgesia [50, 51]. Peritoneum after disruption heals spontaneously by transformation of the mesothelial cells. When repaired with suture, the peritoneum undergoes more inflammation (foreign body reaction), ischaemia,necrosis and scarring in animal models [52-55].

Though single layer closure may seem attractive, the traditional double layer closure is advised in our environment as no local studies have been carried out to substantiate its application in our women. Apart from maintaining haemostasis, the double layer (Lemberts suture) buries the first layer thereby giving the surgeon a sense of security. The polyglycolic acid suture materials are increasingly being used now due to its superiority over catgut sutures but its draw back in our public health sector is that of cost and availability.

Abdominal Closure

The initial technique of abdominal wound closure is layer by layer. The parietal peritoneum, rectus sheath, the subcutaneous tissue and the skin were separately closed. Recently, the closure of the peritoneum and subcutaneous tissue (< 2 cm) has been found to be of no benefit [47, 56 58]. Skin closure may be accomplished with subcuticular stitch, staples, interrupted mattress or simple sutures. Interrupted mattress sutures on the skin are highly recommended in our environment as it is associated with good wound apposition, less infection and early discharge from hospital.

CONCLUSION

The development of caesarean section technique occurred with the withdrawal of surgeries from the stronghold of religion in Renaissance time[8]. Operative techniques in caesarean section vary and this has continued to improve through many years of trial and error.

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