

Review Article**Evolution of Cesarean Section**

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Phone no- 9978909950, Email: [rinkyagrawal1@gmail.com](mailto:rinkyagrawal1@gmail.com)**Abstract**

*Prior to 1500, postmortem Caesarean Section (CS) was advocated and occasionally carried out as an effort to save the child. Caesarean section on the living woman was first advocated during the 16<sup>th</sup> and 17<sup>th</sup> centuries but was opposed by the leading authorities of the day. During the 18<sup>th</sup> century and the first half of the 19<sup>th</sup>, understanding of the mechanism of labor improved. Caesarean section was advocated when a woman could not be delivered by any other means. However, many opposed Caesarean section because of the maternal mortality associated with this procedure. Important developments during the last half of the 19<sup>th</sup> century included anaesthesia, improved surgical techniques, and the introduction of asepsis and antiseptic procedures. A gradual reduction in maternal mortality followed, with a striking decrease throughout the 20<sup>th</sup> century. The safety of CS saw the uprising of its incidence, inclusion of new indications including even the patient's request or demand.*

**Introduction**

One of the oldest surgical procedures practiced by man, the "caesarean section" holds an almost mythical, certainly mysterious status in both human and medical history. Caesarean section has been performed for many centuries and there are references to caesarean section date back to ancient Hindu, Egyptian, Roman and Grecian folklore.<sup>[1]</sup>

"Surprising though it may seem, this operation is one of the oldest in the history of medicine, and without doubt the greatest; the oldest in that the

history of its origin is lost in the mists of antiquity, and the greatest in that it is the only operation in which two lives are concerned"— J H. Young in The History of the Caesarean Section 1944<sup>[3]</sup>.

**Etymology {Controversies on the term "Caesarean"}**

Caesarean section involves the delivery of the baby through an abdominal cut. Initially, "caesarean section" was referred to as "caesarean

operation". There is rampant debate over how the name "caesarean operation" came to be. Many theorize that the name came from Julius Caesar, who supposedly was born by this method.<sup>[3]</sup>

This, however, is unlikely because it is known that Caesar's mother, Aurelia, was still alive when he invaded Britain, and it is unlikely that she could have survived such a surgery given the crude technique and amount of knowledge of the female anatomy and physiology known at that time<sup>[4]</sup>.

Aurelia outlived her son to bury him 55 years later. The fact that she lived and gave birth successfully, rule out the possibility that Caesar was born in this way. Also, it is believed that at the time of his existence, the surgery was mostly done on dead or dying women. A possibility as to why his name is associated is that during his reign he ordered the use of this procedure to procure the child from a dying mother.<sup>[5]</sup>

Some say caesarean section derives from the Roman legal code, the "Lex Caesare". This law had its origins by King of Rome, Numa Pompilius, who codified Law in 715 B.C and prescribed that a baby should be cut from its mother's womb if she dies before giving birth. Similar terminology is evident in other languages. For example, the modern German, Norwegian, Danish, Dutch, Swedish, Turkish and Hungarian terms are respectively kaiserschnitt, keisersnitt, kejsersnit, keizersnede, kejsarsnitt, sezeryan, and csaszarmetszes [literally: "Emperor's cut"]<sup>[8,17]</sup>.

Some believe derivation of caesar and caesarean is from the Latin verb caedere 'to cut'. Children born by post-mortem operations were referred to as caesones<sup>[8]</sup>. According to "Shahnameh" ancient Persian book, the hero Rostam was the first person who was born with this method and term *rostamineh* corresponded to Caesarean.

Finally, the Roman praenomen [given name] Caeso was said to be given to children who were born via C-section. While this was probably just folk etymology made popular by Pliny the Elder, it was well known by the time the term came into common use.

History of Caesarean Section from Ancient world to the Modern Era

### **Ancient and Medieval History (C.S. on Cadaver to C.S. on Living)**

There is ample evidence to suggest that knowledge and practice of this type of procedure were present in ancient Greece and ancient Rome. It is these early practices, from this part of the world, which are thought to have formed the foundations for what is known today in modern Western medicine as the "caesarean section". Therefore it is paramount to explore the practices of this nature in the early Greek and Roman societies in more detail<sup>[2]</sup>.

Firstly, it is known that the ancient Greek societies had knowledge of a caesarean section like operation as it is incorporated into Greek mythology. Both Dionysus [the Greek god of Wine] and Asclepius [the Greek god of Medicine] were said to have been born via abdominal incisions into their mother's body. It is alleged that Zeus [father of Dionysus] removed Dionysus prematurely from his mother, and implanted him into his own loin until he could be removed again at full term.<sup>[6]</sup>

The story of Asclepius tells of the death of his mother Coronis by the arrows of Artemis. This is said to have come after Apollo [father of Asclepius] discovered that Coronis had been unfaithful; whereby he ordered that she be killed. While Coronis' body lay on the funeral pyre Apollo is then said to have extracted his son from her abdomen. Thus performing, in essence, what we today would describe as a post-mortem caesarean section<sup>[2]</sup>.

It seems there was a superhuman connotation attached to being born via caesarean section in the minds of these ancient people; thus explaining the presence of the caesarean section in these stories about the birth of their divinities. This superhuman component may have stemmed from the well-known knowledge that the mortality rates for the fetus were very high in situations where the mother passed away during child birth<sup>[7]</sup>, even if a post-mortem caesarean section was attempted

to save the infant's life. Therefore it appears that in antiquity, any individual that survived a birth of this extra-ordinary nature was said to be destined for great things in life. The attitude was that the Gods had intended for them to live, therefore they were saved from an early grave against all the odds. This attitude may have been extended in some cases to embellish the stories of the birth of an individual, in retrospect. It is possible that this was a means to glorify their birth in order to glorify their life.<sup>[2]</sup>

There is evidence that Cesarean sections were performed as early as 500 BCE, and quite possibly even earlier than that. Jewish forbade burying a pregnant woman without first removing the fetus in a last ditch effort to save the baby and avoid the slight chance of burying a live child. There has been much debate over whether Cesarean sections were forbidden for Muslims. There have been claims by historians that if a child is born in this manner, he or she must beslain.

#### **Historical Figures born by Caesarean Section**

However, there are a few extant records detailing these exceptional occurrences from the ancient Greek and Roman societies. There are records of a Gorgias of Sicily, a well-renown orator, being born via caesarean section. Scipio Africanus, the Roman general who defeated the Hannibal, is also said to have been born by a post-mortem caesarean section.

There are sporadic reports of historical figures born by caesarean section. Raymond Nonnatus [1204–1240], the Catalan saint, was given his surname from the Latin *non-natus* (not born) because he was born in this manner. His mother died in child birth<sup>[15]</sup>.

In 1316, Robert II of Scotland was born by caesarean section and his mother Marjorie Bruce died. This event may have been the inspiration for Macduff in Shakespeare's *Macbeth*. In the play, Macbeth hears a prophecy that 'none of woman born shall harm Macbeth', which is at first reassuring but then he discovers that Macduff was 'from his mother's womb untimely ripped', the product of caesarean section reminiscent of the

birth of Robert II of Scotland. Since Macduff was not 'born' in the sense of the word, he could kill Macbeth<sup>[5, 8]</sup>.

The mother of Bindusara (born c. 320 BCE, ruled 298 –c.272 BCE), the second Mauryan Samrat (emperor) of India, accidentally consumed poison and died when she was close to delivering him. Chanakya, the Chandragupta's teacher and adviser, made up his mind that the baby should survive. He cut open the belly of the queen and took out the baby, thus saving the baby's life<sup>[7]</sup>.

#### **First Successful CS with Survival of both Mother and Baby**

The first recorded case of a mother and a baby surviving caesarean section was in 1500 in Siegersausen, Switzerland, where Jacob Nufer, a pig gelder, reportedly performed the operation on his wife after a prolonged labor. His wife Elizabeth spent several days in labor and had assistance from 13 midwives but was still unable to deliver her baby. Her husband received permission from the religious authorities to perform a caesarean section and did with the tools of his trade. Miraculously, the mother lived and subsequently gave birth to five other children by vaginal deliveries including twins. The baby lived to the age of 77 years.

Historians question the accuracy of the story considering it was not reported until 82 years after the event. It is also possible that this was an extra-uterine abdominal delivery, as it seems unlikely that even if a woman had escaped death from haemorrhage or infection to survive caesarean section in those days, it is inconceivable that she could have had so many subsequent vaginal deliveries without uterine rupture<sup>[16]</sup>.

Because of all these controversies the first documented case was not accepted. First generally *accepted* and authenticated CS was performed by Trautmann in the presence of two midwives in Wittenberg, Germany in 1610. The patient died 25 days after the procedure and the uterine wall was found to have already healed<sup>[5]</sup>.

### Unique CS due to Cattle Horn Laceration

Some caesarean sections happened to occur under interesting and unique circumstances. For example, pregnant women were gored by the horns of animals such as bulls or cows, resulting in the birth of the child. Earliest case documented was in 1647 Holland, where the wife of a farmer in Zaandam was tossed by a bull in the ninth month of pregnancy and sustained an incision into the abdominal wall, which stretched from one ischium to the other, and through the pubic bone in the shape of a crescent. She had another wound through skin and peritoneum into the uterus, twelve finger breadths in length, from which the child issued." The woman died 36 hours later, and the child escaped unscathed<sup>[18]</sup>.

### Early Modern Era

During this period Caesarean section to save the mother and the child was first proposed in discussions stimulated by anecdotal accounts. Francis Rous set is credited as the first writer, in 1581, to advocate the performance of Caesarean section in living women. He outlined the indications and risks associated with this clinical problem. For this reason, he was acknowledged as the father of the CS<sup>[3,4]</sup>.

However, the leading authorities of this era, including Ambrose Pare in 1579 in his surgical text and the celebrated obstetrician Jacques Guillemeau in 1598, opposed Caesarean section in the living woman. Jacques Guillemeau's book on midwifery was published in 1598, in which he used the term '*la section Caesarienne*', since then cesarean operation gradually became known as caesarean section.<sup>[9,10]</sup>

### Knowledge of female pelvic anatomy: Book "De Corporis Humani Fabrica"

One of the first steps in performing any operation is an understanding the organs & tissues involved, knowledge that was scarcely obtainable until the modern era. During the sixteenth & seventeenth centuries with the blossoming of the Renaissance, numerous works illustrated human anatomy in detail. Andreas Vesalius's monumental general anatomical text "*De Corporis Humani Fabrica*",

for example, published in 1543, depicts normal female genital and abdominal structures. As well, medical education would be revolutionized by the removal of barriers to cadaveric dissection, which would increase not only anatomical knowledge but improved a surgeon's understanding of the relevant anatomy & better prepared them to undertake operations through practical experience. This provided the theoretical foundation for operative obstetrics, which emerged in the eighteenth & nineteenth centuries<sup>[1]</sup>.

### Man-midwife' or Obstetrician [Accoucheur]

For a variety of reasons, medical education in the mid- to late 1800s was available only to men and increasingly from the seventeenth century women were relegated to attendants at childbirth. From the seventeenth and eighteenth century, male practitioners such as the Chamberlen after invention of obstetric forceps in London established themselves in the profession of 'man-midwife' or obstetrician and men's claims of authority over such instruments, male dominance of the field persisted throughout the century<sup>[29]</sup>.

However, in an ironic twist, the first recorded, successful caesarean performed in the British Empire was conducted by a woman. Sometime between 1815 and 1821, James "Miranda" Stuart Barry performed the operation while masquerading as a man and serving as a physician to the British army in South Africa. The secret of her that born as a woman and living as a man to be able to serve as a physician was revealed only after her death<sup>[1]</sup>.

### Introduction of asepsis

Major advances in asepsis began with the introduction of hand-washing by Semmelweis in 1847 at the Vienna Maternity Hospital. He considered that puerperal fever was carried by medical students who were performing post-mortems in the basement of the hospital. His conclusions about the origins of infection were at first vigorously opposed<sup>[8]</sup>.

Lister's introduction of antiseptics in the 1870s, based on the germ theory of Pasteur, was an important step forward in the prevention and

limitation of infection. He introduced carbolic spray in 1867. The spray in the operating room kept the atmosphere above the wound free of bacteria and away from the open cavities<sup>[11]</sup>.

These principles became key to the rapid expansion of surgery and operative intervention in obstetric practice. Maternal mortality by 1895 was reported to be 10% with scrupulous antisepsis. By the end of the 19th century, Caesarean section was becoming an alternative to craniotomy in the presence of absolute and relative pelvic disproportion<sup>[10]</sup>.

### Evolution of anesthesia

The value of anaesthesia in surgery was first demonstrated in Boston in 1847. Thereafter there was a gradual introduction of anaesthesia in obstetrics. The discovery of diethyl ether in 1846 was a groundbreaking discovery for surgery. However this anesthesia had a large opposition due moral or religious reasons that women must feel pain in childbirth. But reservations largely resolved after Queen Victoria used chloroform during the birth of Prince Leopoldo in 1853 and Beatrice in 1857. Chloroform became popular for pain relief in the upper classes and became a practical means of anaesthesia in cases of caesarean section.<sup>[8,10]</sup>

The use of anesthetics gave surgeons the time to operate with precision, clean the peritoneal cavity properly, record the details of their procedures, and learn from their experiences. Women were spared from feeling the cuts made, and were less susceptible to shock, which was becoming a leading cause of post-operative mortality and morbidity<sup>[19]</sup>.

### Accouchement force

Accouchement force— the term for violent delivery whatever the risk. These interventions such as forceful dilatation of the cervix, symphysiotomy or pubiotomy increased maternal mortality from haemorrhage and sepsis. Towards the end of the nineteenth century, these procedures waned, as caesarean section became more viable<sup>[8]</sup>.

### Modern Era

#### Use of Blood Transfusion & Oxytocics

From the early twentieth century, blood transfusions became more widely available. Ergot alkaloids for uterine contraction and reduction in haemorrhage have been utilized since the early nineteenth century. Oliver Prescott in Massachusetts in 1813 described its use for uterine haemorrhage with extracts of Ergot given by mouth as ‘labor tea’.

Chassar Moir at University College Hospital performed the isolation of Ergotamine from three alkaloids of crude Ergot in London 1932. Subsequently, administration by the intramuscular route proved successful in reducing post-partum haemorrhage. Oxytocin was first synthesised at Cornell in 1951 and its application for reducing post-partum haemorrhage has increased since that time<sup>[8, 30]</sup>.

#### Antibiotics

In the 1930s and 1940s, the introduction of sulphonamides, penicillin, and subsequent antibacterials provided specific agents to treat intrauterine infection and postpartum puerperal fever thus substantially reduced the risk of poor outcomes from sepsis. As valuable as these are, they do not negate the importance of aseptic and antiseptic procedures in Caesarean section<sup>[10]</sup>.

#### “Porro’s Operation” (Universal Caesarean Hysterectomy)

The Porro’s operation, or the ‘radical caesarean section’, is defined as a surgery where the uterus is completely removed [hysterectomy]. This left the woman unable to have any more children, which in itself had profound effects on emotional well being of the woman. Dr Joseph Cavallini had suggested this surgery as early as 1768, but attempts to perform this surgery then had been unsuccessful<sup>[20]</sup>.

In 1876, Eduardo Porro, Professor of Obstetrics at Pavia and later Milan, procedure contributed to improved maternal mortality, but at the cost of the woman’s future fertility. Prior to Porro, no one in Pavia had survived a caesarean. His first case was a woman, Julia Cavillini, a dwarf primigravidae of

25 years with a pelvic configuration incapable of permitting a vaginal birth. The procedure, undertaken with chloroform anaesthesia, involved a vertical incision in the uterus and resulted in widespread bleeding. The uterus was amputated above a constrictor and after a turbulent postoperative course, the mother and son survived. The technique was published in Milan the same year and attracted worldwide interest. Harris in 1881 reviewed the world literature and found 50 cases delivered by the Porro method showing a maternal mortality of 58% and a fetal survival of 86%, a major improvement<sup>[21]</sup>.

### Evolution of Techniques of C- Section

#### C- Section with & without sutures

In 1870s. it was generally believed that suturing the uterine wall was not necessary. Fleetwood Churchill, a British obstetrician, recorded in 1872 'no sutures are required in the uterus; as it contracts, the wound will be reduced to 1–2 inches and the lips will come into opposition, if it be healthy'<sup>[12]</sup>.

In 1882, two German obstetricians, Adolf Kehrer and Max Sanger, independently developed methods for closing the uterine wound using sutures made of silver wire. These sutures were a new material developed in the USA by J. Marion Sims. Sims had advocated the sutures to treat vaginal tears or fistulas from traumatic childbirth. Previously, sutures had to be removed as it was considered impossible to remove them once the abdomen was closed. Sanger maintained that suturing was essential and the silver material produced little tissue reaction.<sup>[8]</sup>

In 1882, Sanger described a technique using two layers of deep and superficial sutures and closure of the peritoneum with a mattress suture. This provided good hemostasis and was gradually practiced widely<sup>[13]</sup>.

#### Skin incision

Almost any abdominal area was suggested for abdominal incision for cesarean section. At first, the incision was made on the right or on the left side along the linea alba. An oblique incision was also reported. The next improvement was a

midline incision through the linea alba, which was originated by Levret, Solayres, Platner, or Guenin. The apparent advantages of midline incision were reduced bleeding and good healing, whereas the disadvantage was the risk of injury to the bladder. James Blundell [1790-1878] suggested a high longitudinal incision to minimize the risk of bladder injury and adhesion formation, once the uterus contracted away from abdominal wall<sup>[20]</sup>.

Blundell's suggestion was not accepted, perhaps because of heavier bleeding and poorer healing. Pfannenstiel introduced the next improvement in 1900. At the turn of the 19th century, gynecologists began to incise the skin transversely but Still had suggested this approach in the 18th and early 19<sup>th</sup> centuries, but it did not become popular until its introduction by Kerr. The apparent advantages are less bleeding and reduced risk of uterine ruptures during subsequent trials of vaginal delivery. Pfannenstiel's crucial contribution was to incise the fascia transversely. The transverse abdominal incision was modified by Alfred Maylard in 1907 and by Joel-Cohen in 1972<sup>[24-27]</sup>.

#### Uterine incision

As confidence in the outcome of CS increased, doctors turned their attention to where to incise the uterus. Various styles [longitudinal, oblique, etc.] were debated for a century [1770- 1880]. In the first decade of the twentieth century, Kronig began operating transperitoneally and retrovesically using a longitudinal incision in an operation he named '*der cervikale Kaiserschnitt*'. Kronig's techniques were gradually accepted in Europe and the USA<sup>[5]</sup>.

In 1880-1925, Obstetricians experimented with transverse incisions in the lower segment of the uterus. The first person to suggest this type of incision was Robert Wallace Johnson (1786) in his book "*A New System*"<sup>[3]</sup>. He suggested this because of low bleeding that occurred with such a cut. Kehrer in 1881 successfully performed this type of Incision that gradually replaced the classical incision<sup>[22]</sup>.

Several surgeons including Kehrer had utilized the transverse incision in the nineteenth century, but it had not become widespread until the introduction by Kerr. In 1926, James Munro Kerr, Professor of Obstetrics at Glasgow, advocated the re-introduction of the transverse incision (the Kerr technique), which became preferred to the longitudinal incision (the Krönig technique)<sup>[23]</sup>.

#### **Extra peritoneal CS**

A major advance in technique occurred with Frank's description in 1907 of the extra peritoneal operation. This allowed the peritoneal cavity to be sealed before the uterus was opened with a vertical incision. Frank was a strong proponent of the lower-segment incision because of improved healing. Subsequently, Sellheim in 1908 and Latzko in 1909 modified the procedure to avoid peritoneal entry, thereby preventing peritoneal contamination and risk of sepsis<sup>[28]</sup>.

#### **Vaginal Cesarean section**

In 1911 a further modification vaginal cesarean section or vaginal hysterotomy came, in which the incision of the pregnant uterus through the vagina, is indicated in eclampsia when, in the presence of a rigid cervix, the uterus has to be rapidly emptied. It helped avoid peritonitis in patients who were already suffering from certain infections. However, with the discovery of penicillin in 1928 by Alexander Fleming, this method was eventually eliminated from practice<sup>[19]</sup>.

#### **Self Cesarean Section**

On March 5, 2000, in Mexico, Because of a lack of medical assistance and a history of fetal death in utero, a 40-year-old multiparous woman unable to deliver herself alone vaginally sliced her abdomen and uterus and delivered her child. Ines Ramirez performed a Cesarean section on her and survived, as did her son, Orlando Ruiz Ramirez. She is believed to be the only woman to have performed a successful cesarean section on self<sup>[14]</sup>.

#### **Changing Concepts of Post Cesarean Delivery**

Craigin's famous dictum 'once a caesarean, always a caesarean' first appeared in his paper in a

New York medical journal in 1916. His presentation before the Eastern Medical Society of the City of New York reflected the conservative view that the only indication for caesarean section was a contracted rachitic pelvis. Craigin's paper came at a time when the operation was still hazardous and performed through classical uterine incisions. Despite the contrary rationale, it has influenced obstetric practice for generations<sup>[31]</sup>.

In 1982 American College of Obstetricians and Gynecologists as a standard of care, recommended a trial of labor in selected cases of prior cesarean section. In 1988, the guidelines were expanded to include more women with previous cesarean births. Consequently, there was a steady increase in vaginal births after cesarean in the late 1980's. In the 1980s, vaginal birth after cesarean grew in popularity and the pendulum began to swing away from routine repeat cesarean delivery<sup>[32]</sup>.

#### **Conclusion**

Caesarean section has enjoyed a very long history and has been continuously refined by society. At one time such a procedure was only used on deathbeds. But now it is heavily being considered as elective or first line when it comes to delivery of a child. Before where the child's health and well being was put first, now the mother's health and cosmetic outlook is considered just as seriously. The art and style of caesarean section has developed despite many problems, and has grown with civilization as human nature has throughout these centuries.

An operation, which began as a vain rescue attempt for a fetus or for cultural or religious reasons, is now undertaken for the paramount safety of mother and child, but it also considers the mother's wishes and preferences. It seems ironic to comment on the antiquity of this operation and still refer to it as the greatest.

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