Caesarean section has been performed for many centuries and is considered to be one of the oldest operations in the history of medicine. References to cesarean section date back to ancient Hindu, Egyptian, Roman and Grecian folklore. For example, in Greek mythology, Apollo removed Asclepius, originator of religious medicine, from his dying mother's abdomen. Even the socio-economic structure of Jewish society accommodated such surgery. According to the Mishnah (140 B.C.), twins born by this method could not receive the right for primogeniture (obtain office or inherit property). Up until (and including) the 15th century, cases documented suggest that caesarean sections were performed only when the mother was dying or dead, in an attempt to save the unborn child or bury it separately (as was the religious custom). It was not meant to save the mother’s life. It was not until the 19th century that steps to improve the chances of survival of the mother were successfully made. This included the usage of anesthesia (allowed surgeons to take the time to operate with precision), surgical asepsis (carbolic acid introduced by Joseph Lister) better equipment (low obstetrical forceps reduced number of craniotomies performed and vaginal tears) and uterine sutures (used to treat the vaginal tears/fistulas resulting from traumatic childbirth). Following these changes, surgeons were able to focus on improving incisions made to the uterus. Advocated by British obstetrician Munro Kerr, between 1880 and 1925, transverse incisions of the lower aspect of the uterus were found to reduce infections and uterine ruptures in pregnancy, increasing survival rates. This still remains as the most common method today. This is in contrast to the vertical incisions made classically.

Origins of the name: Caesarean operation to caesarean section
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. 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. 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.

Romans described caesarean birth until the last century B.C as “a caeso matris utero”, which means, “to cut an infant of its mother’s womb”. Another possible source is from the King of Rome, Numa Pomphilius, who codified Roman Law in 715 B.C. Lex Regia, which later became known as Lex Caesarea (under the rule of the Caesars) made it mandatory to remove the child from its dying mother, even if there was no chance of its own survival. This was done in part to ensure separate burial for both mother and child. Also, the state was interested in raising its population size, and did not wish to loose any person unnecessarily.

Pliny (28-70 AD) in Book VII of ‘Natural History’ suggested that the term might come from the Latin verb ‘caedare’ which means ‘to cut’, implying delivery by cutting. Children born by this method were called ‘caesones’, which is another possible origin.

As for the change from caesarean operation to section, the first person to use the now common phrase was Jacques Guillimeau, who in 1598 used ‘section’ in his book of midwifery.

Historical references
The oldest authentic record of a living child is that of Gorgias, a famous orator of Sicily, 508 B.C. References to caesarean section appear in ancient Egyptian, Hindu, Grecian and Roman folklore. Religious laws of Egypt in 3000 BC and of India in 1500 BC required abdominal
delivery of the child from its dead mother.\textsuperscript{6} Greek and Roman mythology have tales of this surgery, and it is believed that Asclepius, the god of medicine, was removed by a cut from his dying mother’s (Coronis’) womb by Apollo (Figure 1).\textsuperscript{7} Bacchus, the god of wine, was also delivered this way, with Jupiter taking on the role of Apollo.\textsuperscript{1}

![Figure 1: The extraction of Asclepius from the abdomen of his mother, Coronis, by his father, Apollo. Woodcut from the 1549 edition of Alessandro Beneditti’s De Re Medica.\textsuperscript{3}](image)

Ancient Chinese texts portray this as being done on living women.\textsuperscript{3} The story of King Sol’s wife, as recounted by Machnezie (1927) also suggested that she delivered a son by this method and survived.\textsuperscript{1} These references to women surviving is odd considering that many of the operations (done in the earlier part of its history) were carried out after the woman had died, or it was late in the pregnancy/labor and done when the health of the child was at risk.\textsuperscript{6} Perhaps this operation was successfully done on living subjects a lot earlier than is actually documented.\textsuperscript{2}

Caesarean section was an integral part of life and accommodations were made within religious, literary and societal texts. The Jewish book of Law, the Talmud (400AD) states that women do not need to observe the usual days of purification following this type of delivery. In Mishnah (Jewish text from 140 BC), twins born by this method had restrictions placed on their birthright:

“... in the case of twins, neither the first child which shall be brought into the world by the cut in the abdomen, nor the second, can receive the right of primogeniture, either as regards the office of priest or succession to property”\textsuperscript{6}

Many great works of literature also refer to this operation. In Shakespeare’s ‘Macbeth’ for example, Macbeth is horrified to realize that Macduff was ‘from his mother’s womb untimely ripped’, therefore making him susceptible to death by Macduff’s hands (Macbeth could not be killed by “one of woman born”. Since Macduff was not ‘born’ in the sense of the word, he could kill Macbeth). Shakespeare also refers to caesarean sections in “Cymbeline”\textsuperscript{5}.

Religious influence
Islam before 1500 was against the procedure and stated that any child born by this method was an offspring of the devil and therefore should be killed immediately.\textsuperscript{2} Now of course such is not the case.

On the other hand, Christianity was positive towards this operation, being more concerned
with saving souls. Specifically, in the Middle Ages, the Roman Catholic Church encouraged the use of caesarean section to save the child and wanted to offer their souls a chance of salvation through baptism. The mother, on the other hand, was not a concern since the church prohibited usage of abortion, fetal dismemberment and craniotomy to save the mother. Other church councils did not decree anything positive for the mother either, but allowed for operating on a dead pregnant woman to save the child and allow baptism. In 1280, the church councils of Cologne made it mandatory to do this surgery. The Republic of Venice in 1608 actually laid down severe penalties for any doctor that failed to make an attempt to save a child in this way. The need to baptize and therefore save the soul of the child was so prevalent and important, especially in France, that Peu in his “Practiques des Accouchements” states that:

“... immediate opening of the abdomen as soon as the mother is assuredly dead and within the space of time taken to say one "Ave maria", and as soon as the child is visible, pouring water over it and adding to the usual words of baptism, "si tu as vie".

Similarly, in the United States, during the Franciscan mission period (1769-1833), it became the responsibility of the missionary priest to do the operation on dying women. They were actually taught pertinent maternal anatomy, the actual procedure and given instruments to aid in their task.

Earliest documented cases

Even though references in ancient texts indicate this surgery was performed on live subjects, it was during the 1500’s that debates issued over the possibility of doing this on live women. Francois Roussett in 1582, was the first physician to endorse the operation on living women. In fact, he was the one to record Jacob Nufer’s story (below), and use it as proof that such surgery should be considered for live women. Except for the Trautmann case (below), even though the authors were not the ones that performed those surgeries, many were penned down and used for debating purposes.

Trautmann performed the first generally accepted and authenticated case 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.

Jacob Nufer, in 1500, performed the first documented, successful operation on a living woman. He was not a doctor, but rather a Swiss sow-gelder. The story goes that the wife was pregnant for the first time, and was having severe labor pains. The skills of the 13 midwives involved were not leading to the subsequent delivery of the child. There did not seem to be much hope and so the husband wanted to perform caesarean section. She was willing, unfortunately, the municipal authorities were not willing to allow it. Only after the second request did the mayor consent, and then Jacob “...laid his wife on a table, incised the abdominal wall (with a razor), then the uterus and after which he quickly extracted the child. Several sutures were placed in the abdominal wall”. The wound healed and she lived to bear several children, even twins, vaginally, with no complications. This documentation suggests that this is the first successful vaginal delivery after a caesarean birth. The cesarean baby lived to be 77. However, some historians do not accept the validity of this case because it was not reported until 1582, 82 years after the procedure was done. This delay suggests publication of this case was based on hearsay. Adding to that, had this been really done, it is expected that such news would have spread far and wide long before 82 years.

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 Zaanadam 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.\(^9\)

**Refrinements in the medical profession and caesarean sections**

Improvements in many aspects that helped to enhance the medical profession had an impact on the mortality and precision of caesarean sections. According to Boley\(^5\), three major reasons can be attributed to the death of these women: using the surgery only when the woman was close to dying, high rates of infection (lack of sanitation) and lack of uterine sutures. Many improvements with instruments (high vs. low forceps) and procedures employed (including other than caesarean sections) to remove the baby all further enhanced and strengthened arguments for using caesarean sections, and eventually lead to the current style of surgery.

**Anesthesia**

In 1846, at Massachusetts General Hospital, dentist William T.G. Morton used diethyl ether to desensitize the face to remove a tumor. However, there was opposition to its use in obstetrics because of biblical injunction that women should suffer while giving birth in compensation for Eve's sin.\(^3\) This argument was weakened when Queen Victoria, the head of the Church of England, had chloroform administered for the births of two of her children (Leopold in 1853 and Beatrice in 1857). Subsequently, anesthesia in childbirth became accepted and practical in cases of cesarean section.\(^3\)

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.\(^3\)

**Procedures other than caesarean sections**

Using anesthesia shifted the argument for caesarean section versus relying on craniotomy. Craniotomy had been practiced for hundreds, perhaps even thousands, of years.\(^3\) It has been performed on both live and dead fetuses. This procedure involved the destruction of the fetal skull (by instruments such as the crotchet) and the extraction of the entire fetus vaginally. Figure 2 shows how this was done. Unlike caesarean section, it entailed lower risks to the mother.\(^3\) Another reason craniotomy was popular was because it was believed that the fetus felt no pain during this procedure.\(^2\) Closer to 1855 Sir James Y. Simpson showed otherwise and this seemed to have an effect on the number of such procedures done.\(^2\)

![Figure 2: Craniotomy](image)

Another method to deliver the baby involved forceps (figure 3). Initially, high forceps were used, which reduced the number of deaths that would have occurred via craniotomy. However, it ended up creating severe tears (fistulas) in the...
vaginal wall and perineum of the mother, affecting maternal morbidity and mortality. The fetus could also be injured if the forceps used to pull the baby were pressed too tightly. Harold Williams (1879) of Boston researched the number of cases and mortality with these forceps, and he concluded they were more lethal than caesarean sections. An improvement with this method was the use of low forceps, which did not cause as many vaginal tears. These forceps are still used today.

Neither craniotomy nor obstetrical forceps were of any help when severe pelvic distortion or contraction existed, and that is when caesarean sections were especially useful. One of the first men to suggest factors when caesarean sections should and should not be used was William Smellie (1752). He was a British physician who suggested that women should not be operated on when they were weak and in poor condition. If they were in such a situation then it was best that the operation was delayed until she died, after which it should be immediately performed to save the child. He suggested that it should only be done in:

“... laborious and preternatural labors, on account of the narrowness or distortion of the pelvis into which it is sometimes impossible to introduce the hand; or from large excrences and glandular swellings that fill up the vagina and cannot be removed... or adhesions in that part and at the os uteri that cannot be separated, ...in such emergencies, if the woman is strong and of good habit of body, caesarean operation is certainly advisable and ought to be performed; because the mother and child have no other chance to be saved, and it is better to have recourse to an operation which has sometimes succeeded than leave them both to inevitable death...”

Uterine sutures
In the 16th century, obstetricians opposed performing surgery on live patients because maternal mortality was incredibly high. As well, during most of the 19th century (1787 to 1876), no successful caesarean operation had been performed in Paris. This was attributed to the wrong belief that the natural rhythmic contraction and relaxation of the uterus prevented the use of sutures. Therefore, after the baby was removed, incisions in the uterus were left open. Due to this, women died from hemorrhage and infection. As well, in those days, sutures had to be removed, and it was impossible to remove them from the uterine wall after the abdomen had been closed. The first man to close a uterine incision with sutures was Lebas, a French surgeon in 1769. However, the usage of sutures did not become popular until the Sanger method (below) resulted in reduced mortality rates.

Antiseptic
It is interesting to note that the early documented cases with successful births took place under unusual circumstances, and far away from hospitals (Bull horn goring and Jacob Nufer). Most of the surgeries in remote areas lacked medical staff and facilities. As well, because they lacked a medical community, time was not wasted on professional consultations. Instead it was being used to take action earlier. This meant that surgery was being performed earlier, when the fetus was not under much distress and the mother was not close to dying. Treating both parties at an earlier time increased their survival rates. Since operations got performed on kitchen...
tables, beds and any other facilities but the hospitals, infection rates were low (sanitation was not practiced in hospitals) and survival rates were higher.

Hospitals during those times were notorious for being ‘infection beds’, especially because the surgeons came in wearing street clothes and did not clean their hands in between patients. As a matter of fact, it was estimated that if a woman performed surgery on herself or was gored by a bull, she had a 50% chance of survival, compared with 10% survival rate if she were being taken care of by a New York surgeon.10 In the mid-1860s, the British surgeon Joseph Lister introduced an antisepctic method using carbolic acid.3 Introducing this method however helped reduce the number of deaths due to infection (seen as being the most common cause for women mortality), and allowed physicians to focus on their technique and style of operating.

Time of intervention
As cesarean section became safer, obstetricians increasingly argued against delaying surgery. Rather than waiting for hours of unsuccessful labor, physicians like Franz von Winckel in Germany, Thomas Radford in England and Robert Harris in the United States opted for early intervention.3 Higher rate of survival were likely with early intervention. Such arguments eventually led to greater numbers of operations occurring earlier, and the data collected showed lower mortality.3

Porro Operation
The Porro 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.2 In 1876, Eduardo Porro successfully performed this surgery. With the widespread usage of this surgery, presence of antisepctic protocols, and intervening earlier, mortality rates showed a marked decrease.2

Sanger operation
In 1882, Max Sanger used uterine sutures (silver and silk wire) to sew up the cuts made in the peritoneum. This was just as successful in reducing mortality rates as the Porro operation, and it did not involve removal of the uterus. Development of the silver wire stitches to treat vaginal tears (fistulas that resulted from traumatic delivery) was done by 19th century American gynecologist J. Marion Sims.3 Sanger operation was just as effective as the Porro method, and thus a lot of physicians moved to using this, for the woman’s benefit.

Where to incise?
As confidence in the outcome of their procedures increased, doctors turned their attention to where to incise the uterus. Various styles (longitudinal, oblique, etc.) were debated for a century (1770-1880). Between 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 Systems of Midwifery”.1 He suggested this because of low bleeding that occurred with such a cut. Kehrer in 1881 successfully performed this type of incision.6

Munro Kerr, a British obstetrician, highly advocated the Kehrer method during the 1920’s.2 He believed that such an incision had low bleeding, low infection rate and low uterine rupture from subsequent pregnancies (because the scar would make the region stronger).6 A further modification -- vaginal cesarean section -- helped avoid peritonitis in patients who were already suffering from certain infections.3 However, with the discovery of penicillin in 1928 by Alexander Fleming, this method was eventually eliminated from practice.3

Most incisions today either involve transverse incision of lower segment (Kerr technique) or classical/vertical incision, which is a cut made through the abdomen and front wall of uterus. The latter has high blood loss and increased incidence of infection.6 However, if it
is an emergency C-section, a pre-term fetus, or a tumor that obscures the lower segment, then vertical incision is used.  

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 (especially in South American countries like Brazil). 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.

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All pictures obtained for this paper were accessed from the Collection of the National Library of Medicine's History of Medicine Division on March 25, 2004 (http://www.nlm.nih.gov/exhibition/cesarean/cesarean_1.html).