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Correspondence

Sulochana Dhakal-Rai,
Bournemouth University,
Bournemouth BH8 8GP, UK
Email:
sdhakalrai@bournemouth.ac.uk

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Patan Academy of Health
Sciences, Lalitpur, Nepal

Prof. Dr. Nabees MS Pradhan,
Patan Academy of Health
Sciences, Lalitpur, Nepal

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A brief history and indications for cesarean section

Sulochana Dhakal-Rai¹  , Edwin van Teijlingen² , Pramod R. Regmi³ , Juliet Wood⁴ , Ganesh Dangal⁵ , Keshar Bahadur Dhakal⁶ 

¹PhD Student, ²Prof., ^{3,4}Senior Lecturer, Faculty of Health and Social Science, Bournemouth University UK; ⁵Senior Consultant, Kathmandu Model Hospital, Kathmandu, Nepal; ⁶Chief Consultant, Karnali Province Hospital, Surkhet, Nepal

Abstract

Cesarean section (CS) is one of the oldest surgical operations. Originally, this surgery was performed post-mortem by cutting open the woman's abdomen to remove a dead or alive fetus. It was therefore not intended for saving the mother in ancient times. Roman law and religious rituals shaped the procedure until the Middle Ages. At that time, the indication of CS was only post-mortem. Although CS became a medical procedure in the Renaissance, maternal mortality was extremely high, mainly due to hemorrhage and puerperal infection. The reason for performing CS was to rescue the mother and fetus from protracted labor as a last resort. Since the late 19th century, with the introduction of chloroform and the developments of surgical techniques, and the availability of blood transfusion in the early twentieth century, CS became a relatively safe procedure, further helped by the introduction of antibiotics after World War II. Then, CS was increasingly an intervention to preserve the health and safety of both mother and fetus. During the 21st century, CS has been performed even without medical indication, such as maternal choice. Advancement of obstetric practice technologically and professionally during the period as well as changing attitudes of both obstetricians and childbearing women meant indications for CS are no longer limited to medical/obstetric indications. CS is perceived as a safer mode of childbirth. Therefore, the indications of CS have been changed drastically from ancient times (rescuing a baby from dying or dead mother) to the 21st century (maternal choice/reproductive rights).

Keywords: Cesarean section, indication, history

Introduction

Cesarean section (CS) is a surgical procedure to remove a fetus from the uterus of a mother through an incision made in the abdominal wall and uterus. CS has been around for millennia. CS is perhaps one of the oldest surgical operations, which originated as a post-mortem procedure to separate dead mother and child in ancient India and Egypt.^{1,2} The early history of CS remains covered in myths with doubtful accuracy in folklores of ancient societies in Europe, Asia, and the Middle East. CS was performed either to rescue a live baby from the womb of a dead or dying mother or to bury the dead mother and dead infant separately.²

Apart from myths, there is little evidence of maternal survival from a CS before 1500 A.D.³ The purpose of performing the CS was gradually changed towards saving the lives of both mother and child in the modern age. The indications of CS have been changed accordingly from ancient to modern times. Since middle of 19th century, both maternal and foetal outcomes of CS has been significantly increased due to the development in surgical techniques and aseptic environment such as antibiotic, anaesthesia, blood transfusion.⁴ In the twentieth century, the advancement of CS both technically and professionally widened the boundaries of indications for CS beyond its medical limits. Hence, performing a CS has become a sophisticated and frequently performed childbirth procedure. The reasons for performing CS are not only concerned with saving the lives of the mother and the child but also related to preferences/choice of the mother and the child's rights.⁴

The review was conducted aiming to explore insight on the brief CS history and changing indications for performing CS from ancient times to the twenty-first century. We strongly believe it is important for practitioners of any discipline to understand its history, and in this case the history of its obstetrical procedures, to help improve maternity care in the future and avoid the mistakes made in the past.

Therefore, our research question is: How has the CS developed over time as an obstetric intervention and what indications have been accepted for performing a CS from ancient times till the twenty-first century? The review has briefly explored the history and changing indications for CS since ancient to present-day.

Method

A scoping review⁵ was conducted related to the history of CS from ancient till 2019 using several bibliographic electronic databases such as PubMed, MEDLINE, EMBASE, SCOPUS, CINAHL, and Web of Science as well as Open Access journals such as NepJol, BanglaJol. Articles on CS history were searched from ancient era to contemporary era using Medical Subject Headings (MeSH) heading such as cesarean (both UK and USA spelling), c-section was combined with the specific keywords such as ancient or middle age or medieval age or renaissance age or modern age. Additional articles were searched from the reference list of the selected articles. Articles highlighting the issues around the history were included and a simple content analysis⁶ was conducted. Studies highlighting history and indications of CS and written in English published from 1961 to 2020 were search and included in this review. All selected articles were assessed for inclusion eligibility by first author (SD). Titles and abstracts of the identified articles were initially scanned. Then, full text of each article was analyzed individually, and relevant data were extracted. Extracted data were checked for accuracy by other authors (EvT, JW, PR, GD, KBD). Any discrepancies/disagreement over eligibility or quality of studies were discussed with reviewers and resolved based on consensus. The narrative synthesis of history and indications for CS was categorized (ancient, medieval, renaissance, modern period and twentieth century and beyond) using content analysis.⁶

Results

Origin of the term "Cesarean Section"

The origin of the term “cesarean section” has seemingly been debatable in its accuracy over time. The origin of the term cesarean section is still clearly not known.⁷ The term “cesarean”, commonly misperceived that it is derived from the surgical birth of Roman Emperor Julius Caesar (100-44 BC).^{1,2} It is very unlikely that he was born by CS. The surgical procedure was performed during that time only when the mother was dead or dying to save the unborn child whereas Julius Caesar’s mother, Aurelia, was alive until when he was an adult.^{1,2} There are also no documents from Caesar’s time referring to his birth by abdominal incision.⁸ The Dutch term for CS keizersnede hints in the direction of this origin as it translates as emperor’s cut.

Another theory refers to the Roman law Lex Regia. The Rome king, Numa Pompilius (715-673 BC),^{1,2,4} declared in his Royal Law (Lex Regia), that to comply with Roman ritual and religious custom it was forbidden to bury a pregnant woman before her fetus has been cut out of the womb.² This Lex Regia became Lex Caesarea later on in the Roman Empire.^{1,2} Therefore, the term cesarean might be derived from this Roman law Lex Caesarea, not from the birth of Julius Caesar.⁹

A third explanation is that the word “Cesarean” originated from the Latin verb “caedere,” meaning ‘to cut’. The term “caesones” was applied to the infants delivered by post-mortem CS.² Until the sixteenth century the procedure was known as “cesarean operation”. The term “cesarean birth” was first used in medical literature by François Rousset in 1581.¹⁰ Jacques Guillimeau introduced first the term “operation” in his 1598 book on midwifery.² The term “operation” was gradually replaced by “section” and the term “cesarean section” was widely used in the 20th century.⁷

The mythology of the cesarean section

Mythology and legends of CS not only highlight the importance of being ‘superhuman,’⁹ but also, a reflection of the reality of contemporary medical practice.¹¹ The fetal outcome of CS was very poor in ancient societies, therefore, if

a newborn baby survived by CS, then, it was believed that the Gods must have intended for this person an outstanding future.⁴ In Greek mythology, a live child born by CS is symbolized as the glorification of God. For example, Asclepius, the god of medicine, was born by a post-mortem CS. His father (Apollo), the God of light and the sun rescued him from the funeral pyre of his dead mother, Coronis.¹¹

In Roman writings, there are many heroes born by a CS such as Scipio Africanus, the Roman general who defeated Hannibal, who was born by a post-mortem CS in 237 BC.^{8,9} Similar stories appear in Persian mythology such as Rustam, the most famous superhero of the great Persian epic of the kings, was born by a CS.⁸ In Irish mythology a royal child was born alive by CS in 200 BC, the boy was called Furbaidh from the Gaelic word urbaidh meaning to cut.¹² In religious myth, CS has been portrayed as a “clean delivery”, to avoid the passage through the dark birth canal. Buddha, Prince Siddhartha Gautama (563-486 BC), was born pure and clean from the right flank of his mother Maya.^{8,9,13} Brahma was believed to be born through the umbilicus of his mother.¹³ The myths of CS maybe not only the way of expression of glorification of superheroes but also the reflection of existing normal medical practice in ancient societies.

Cesarean Section in Ancient Times

The CS appears to be one of the oldest surgeries in the history of medicine. Post-mortem CS was widely practised in ancient societies in Europe, the Middle East, and Asia.² It was a mysterious and ambiguous operation that comprised of mutilation of the body of a dead woman to rescue a living fetus.³ If a woman died during labor, then her abdomen was cut by a knife to open it, and the child was extracted. In ancient Indian societies, post-mortem CS was conducted to purify a woman’s corpse before incineration by removing an impure neonate from her body.⁸ Sage Sushruta, one of the founders of ancient Hindu medicine, described post-mortem CS delivery in his medical treatise “Susruta Samhita”.¹³ Lord Krishna, the Hindu God, was also born by CS and CS was performed by sage Susruta.¹³

The first living child born by a post-mortem CS in the ancient world was Gorgias (483-376 BC), a Greek sophist and rhetorician, who was born in Syracuse.^{1,2} The successful outcome of CS in living women is also described in ancient Jewish writings such as the Mishnah and Talmud.^{3,14} Unfortunately, none of the ancient medical documents are stating the exact indications for CSs.¹⁵ The possible justification could be that during the period, post-mortem CS was performed by priests, not by doctors.⁴

Cesarean Section in Medieval Period

During the period, the indication of CS was only post-mortem; to rescue live fetus from dead or dying mother or to bury dead infant separately from the mother as commonly required by religious edicts.² Robert II, king of Scotland was also born in 1316 in this fashion.¹⁶ CS was usually performed by midwives in the early Middle Age after the mother had died or was dying and if she wished that her neonate should be cut off her womb.¹⁵ Bernard of Gordon, a Montpellier physician first mentioned post-mortem CS in 1305.⁴ Muslim physicians were also familiar with the CS, but it was carried out only when the mother had died or dying and there was a chance to rescue a live fetus.¹⁷

The Roman Catholic Church had a great influence in post-mortem CS during the Middle Age, especially in Europe. For example, in 1280, the church councils across the Holy Roman Empire made it mandatory to do this operation to save the child and to offer their souls for salvation through baptism.^{2,9,18} However, there is no evidence CS performed on live women. Therefore, CS in the medieval period seemed to be just a cultural-religious event rather than a medical procedure.⁴

Cesarean Section in Renaissance and Modern Period

The first recorded successful CS was performed in a living woman in Switzerland in 1500 and both the mother and the baby survived. Jacob Nufer, a pig gelder performed the CS on his wife, who was suffering from prolonging labor. Nufer cut the abdomen and uterus wall with a

knife, pulled out the baby, and sutured the abdominal wall. The mother lived and gave birth vaginally to five other children.^{1,2} However, the success story was not recorded until eight decades later. CS was the last resort and not aimed to save the mother's life.² The main indication for CS was protracted labor, typically for several days possibly with intrauterine fetal death.¹⁵

In 1581, Francois Rousset, a French physician, first suggested performing CS on living women and published a revolutionary work on CS including its indications such as excessive fetal size, malformed fetus, dead fetus, twins, malpresentation, extremely young or old mother, too narrow maternal pelvis, or not elastic enough.¹⁹ This helped change the CS from a post-mortem operation to a more medical procedure. Increasing awareness of human anatomy and the establishment of medical education since the 16th century enhanced and enriched the development of CS as a medical procedure.²

The first successful CS was performed by a surgeon on a living woman was in Germany by Jeremias Trautman in 1610. The reason for CS was a huge abdominal hernia through which the uterus protruded, and a spontaneous delivery was impossible.¹ The first successful CS on a living woman in the British Empire was conducted by James Barry in South Africa between 1815 to 1821, the indication was unknown.²⁰ The earliest published successful CS in the USA (United States of America) was by John Richmond in 1827 on a patient woman who suffered from eclampsia with convulsion after 30-hour labor.¹

Maternal and perinatal mortality of CS was extremely high, almost 100%, during this period until the 19th century due to septic infection (septicemia/ peritonitis), hemorrhage, and exhaustion (protracted labor).^{1,2,9} Obstetricians were reluctant to perform CS on live patients. Not a single woman survived CS in Paris between 1787 and 1876. In the middle of the 19th century, maternal mortality was still high (up to 85%). The main reasons for the high maternal

mortality were lack of infection control precautions/aseptic techniques in hospital practice, leaving uterine incision open, and performing CS only when women were close to death.^{1,2,9}

During the last quarter of the 19th century, CS was transformed both technically and professionally as modern surgery. In 1876, Eduardo Porro, promoted suprapubic hysterectomy during CS to control uterine hemorrhage and prevent peritonitis but it left the woman unable to have any more children.^{1,21} An important advancement in CS was the introduction of effectively suturing the uterine incision by Max Sanger in 1882. The suturing technique was equally successful in reducing mortality rates as the Porro operation.^{1,2} Similarly, the introduction of the handwashing technique by Semmelweis in 1847, carbolic spray in 1867 by Joseph Lister, and chloroform (anesthesia) by James Young Simpson in 1847 improved the efficacy and safety of the operation. Then, obstetricians gradually moved forwards to preserve the health and safety of both mother and fetus performing CS on time rather than waiting.²

Cesarean Section in Twenty and Twenty-first Century

At the beginning of twenty century, rickets and pelvic deformity were highly prevalent even in industrialized countries and the only indication for CS was contracted pelvis/pelvic deformity.²² CS operation was still crude and hazardous. CS was performed mainly through a classical uterine incision. The famous dictum of Craigin 'once a cesarean, always a cesarean' appeared in 1916.²³ This statement symbolized the belief that once a woman had undergone a CS, she would require the surgery for all subsequent deliveries.²³ This notion had influenced on obstetric practice mostly in high-income countries and the trend of CS has steadily accelerated since 1940 especially in high-income countries. The rate of CS was about 5% in 1970 but it was risen to 24.7% by 1988 in the USA.² Thus, WHO (World Health Organization) recommended a CS rate of 10-15% in 1985.²⁴ In 1988, the guidelines of trial

for Vaginal Birth After Cesarean section (VBAC) were developed.²

The most effective transverse lower uterine segment incision in CS was promoted in the 1920s by a British obstetrician, John Munro Kerr.²⁵ The incision technique had advantages in subsequent pregnancies/births such as low bleeding, low infection rate, and low uterine rupture.^{16,26} The procedure is still popular today. The scope and rise of CS were influenced during the twenty century by many factors such as rapid urbanization, the continued growth in the number of hospitals, advancement of technologies, development of medical research, improvement in patient care, and numerous other factors.² Advancement of anesthesia and aseptic technique had boosted CS as a safer procedure. Blood transfusion was widely available in the early twentieth century. Availability of antibiotics such as sulphonamides (1935)²⁷ and penicillin (1940)² significantly reduced maternal mortality from sepsis.^{2,27} Likewise, medical research flourished and promoted evidence-based practice. Additionally, the introduction of electronic fetal monitoring (the 1970s), scalp pH monitoring, and ultrasound (late 1940s) not only increased the ability to detect fetal warning signs on time but also extended its indications such as fetal distress, abnormal fetal growth, etc.^{2,27} During the 20th-century indications of CS gradually extended such as breech/malpresentation, obstructed labor, pre-eclampsia, placenta previa, eclampsia, dystocia, elderly primiparous, medical conditions complicating pregnancy, etc.²² The main indications for performing CS during the twentieth century are classified roughly as protracted labor, non-reassuring fetal heart rate, fetal distress, malpresentation of the fetus, previous CS, placental abnormalities with heavy bleeding, and maternal reasons.^{4,28} CS provides a safe obstetric surgical intervention for women who experienced complications during pregnancy, labor, and delivery.²

The CS rate has been rising over the past four decades globally. The latest estimation

showed that the CS rate increased worldwide from 12.1% in 2000 to 21.1% in 2015 (from 7.2% in 2000 to 18.1% in 2015 in South Asia).²⁹ Similarly, hospital-based studies reported that the CS rate is rising unexpectedly high in urban Nepal³⁰ and cities in South Asian countries.³¹ Thus, the WHO recommended CS rate of 10-15% in 1985²⁴ has been controversial in the 21st century and there is a question on optimal rate of CS.³² The WHO Statement on Cesarean Section Rates has emphasized that "Every effort should be made to provide cesarean sections to women in need, rather than striving to achieve a specific rate".³³ Evidence showed that CS rate of more than 10% at the population level is not associated decrease in maternal and neonatal mortality rate although this operation is effective to preserve mother and fetus lives.³⁴ The main concern is the reduction of unnecessary CS and improvement of optimal use of CS. Robson classification can be the best tool to monitor the CS. Robson classification, a standardized internationally accepted classification system, was proposed in 2001 to monitor and compare CS rates in a consistent and action-oriented manner within and between the health facilities.³⁵

The CS has been a frequently performed surgical procedure for childbirth in obstetric practice in the 21st century.³⁶ The number of medical indications for CS grew as did the non-medical indications such as maternal choice.³⁷⁻⁴⁹ WHO emphasizes to perform CS only for medical indication³³ because CS is associated with severe maternal outcome.³⁴ However, CS performed on maternal request without medical indications is rising due to perceiving medical benefits as well as many other cultural and psychological factors as maternal fear of childbirth or maternal request.³⁷⁻⁴⁰ A global survey reported that CS conducted without medical indication was 1.0% of total birth.³⁷ A systematic review showed that the rate of CS on maternal requests ranging from 0.2% to 24.7%.⁵⁰ A hospital-based study mirrored the changing indications for an elective CS, which reported that the indications for CS were a fetal lie or a uterine factor in 1992, but in 2005 psychosocial indications such as maternal fear

of childbirth/maternal request without any medical indication.⁴⁰ Maternal requests as an indication for performing CS are evident also in South Asian countries like Nepal⁴¹⁻⁴³ Bangladesh⁴⁴⁻⁴⁶, India⁴⁷, and Pakistan^{48,49}.

Fear of childbirth, fear of labor pain, fear of health of their baby and themselves or perception of safer option, previous negative childbirth experience, maintain pelvic floor integrity, convenient and preserve sexual function are reported the main reasons of requesting CS by women.⁵¹ Chang et al. (2015) reported that CS was associated with increased prevalence of depression at 3 mo and higher pain level up to 6 mo postpartum, but no difference in sexual function between vaginal birth and CS after 6 weeks.⁵² However, Qian et al. (2016) reported that CS can have higher adverse effects on postpartum sexual function.⁵³ The increased risk for developing anal incontinence after CS is lower than the risk after vaginal delivery.⁵⁴ Additionally, the availability of ultrasound examination during pregnancy and lack of pain relief medication and social support during labor can encourage women to choose a CS as a safer mode of childbirth.⁵⁰ Higher educational achievement, use of assisted reproductive technology, history of previous operative childbirth, and miscarriages are found to be significantly associated with the CS on maternal request.⁵⁵

The guidelines for counseling and treatment regarding maternal requests suggest that the request for a CS is appropriate to consider if a woman persists in her request after counseling with enough serious reasons.⁵⁶ In the hospital situation, the medical expertise and authority of doctors can influence a woman to choose a CS.⁵⁷ The main reason of decision-making and willingness to perform a CS by care providers on maternal request is reported to be defensive practice for avoiding litigation or lawsuit if something goes wrong^{58,59} and financial incentives (especially in the private health sector).⁶⁰

Performing a CS on maternal choice has been a hotly debated topic both legally and ethically in recent obstetric practice.^{38,39,61,62} CS on maternal choice is a complex issue and beyond

the women's autonomy.⁶¹ Firstly, women may not have sufficient knowledge on the mode of childbirth or indications, risks, and benefits of CS.⁶³ Secondly, women may request CS due to reasons related to fetal well-being or cosmetic or sexual factors. In this situation, women would not be empowered and self-determined to make a voluntary choice of CS.^{50,63} Patient to be well informed about risks and benefits of CS for the promotion of informed choice (voluntary informed consent) based on the relevant information.^{39,61,62} Obstetricians are legally accountable to inform and counsel women by providing clear, concise, unbiased, truthful, and evidence-based information with all alternatives to allow the patient to have an informed choice.^{38, 39,61,62} However, evidence shows that women are not well informed on the process of receiving voluntary informed consent, and the request for a CS made by women often misled by poor knowledge.⁶³

Great emphasis has to be given to the assessment of the risk and benefits of the procedure. Decision-making on CS by obstetricians on maternal request without medical indications be focused on maximizing the empowerment of women to consider reproductive rights by ensuring voluntary informed choice.⁶¹ Most importantly, the provision of CS to those women who need it the most should not be affected by performing CS on non-medical reasons – maternal request.⁶² Obstetricians must identify the reasons for the maternal request for CS at first, provide unbiased evidence-based information about CS, and then, provide individual modifications to the management of labor to reconsider preference of CS and promote informed choice.^{39,61,62}

Conclusion

The indications for performing CS have been shaped mainly by religion, culture, and technology. The indications for CS have varied and changed tremendously throughout history from ancient times to the twenty-first century. The post-mortem CS was used until the Middle Ages and the operation was developed into a medical procedure during the Renaissance period. After around the middle of the 20th

century, CS became a relatively safe procedure due to the development of antibiotics, technology, and patient care. Changing the attitude of obstetricians and women, CS is performed also for non-medical indications like maternal requests.

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Conflict of Interest

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Author Contribution

All authors have contributed to the design/plan, quality assessment of the studies, analysis of data, and interpretation in this review. SD searched articles through the electronic data-based and scanned articles' titles and abstract and wrote the first draft. EvT, PR, JW, GD, and KBD edited the draft. All authors have read, revised, and approved the manuscript.

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