

Caesarean section: a journey not always smooth: complications of caesarean section

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ABSTRACT

Caesarean section (CS) is one of the most commonly performed obstetric procedures worldwide, with rates rising significantly over the past decades. While lifesaving, CS is associated with a spectrum of maternal and neonatal complications. Maternal risks include hemorrhage, uterocervical lacerations, urinary tract injury, postpartum infections, venous thromboembolism (VTE), chronic pelvic pain, uterine rupture, placenta previa, placenta accreta spectrum, caesarean scar ectopic pregnancy, caesarean scar niche, endometriosis, secondary infertility, and acquired uterine arteriovenous malformations (AVMs). Neonatal complications include superficial injuries, cephalhematoma, fractures, nerve injuries, lower Apgar scores, respiratory distress, increased NICU admissions, and long-term risks of asthma, obesity, and immune-related disorders. The increasing prevalence of CS underscores the importance of understanding its short-and long-term impacts on maternal and child health, emphasizing the need for careful risk assessment, preventive strategies, and informed clinical management.

Keywords: Caesarean section, Obstetric haemorrhage, Placenta previa, Uterine rupture, Bladder injury, Maternal mortality, Uterine arteriovenous malformation

INTRODUCTION

The term caesarean is often linked to Julius Caesar; however, historical evidence suggests his mother survived his birth, making this unlikely. The word is more accurately derived from the Latin “caedere” meaning “to cut.” The CS is one of the oldest obstetric operations, with origins in ancient civilizations. CS has been embedded in human culture since antiquity, with narratives from both Western and non-Western traditions describing the survival of both mother and child following the procedure. In Greek mythology, Apollo is said to have delivered Asclepius-the legendary founder of religious medicine-by surgically removing him from his mother’s womb. References to caesarean delivery are also found in ancient Hindu, Egyptian, Greek, Roman, and other European folklore.¹ A major milestone in the evolution of caesarean section occurred in 1882, when Max Säger introduced

uterine suturing. Previously, the uterine incision was left unsutured, resulting in fatal hemorrhage. Säger’s innovation rapidly became standard practice and led to a dramatic reduction in maternal mortality.² In 1926, James Munro Kerr reintroduced the lower-segment transverse uterine incision, later known as the Kerr technique, which replaced the longitudinal (Krönig) incision as the preferred approach. The technique offered key advantages, notably reduced intraoperative hemorrhage and a lower risk of uterine rupture in subsequent trials of vaginal birth.³

Analysis of 2010-2018 data from 154 countries, covering 94.5% of global live births, shows that 21.1% of women worldwide delivered by caesarean section, with wide regional variation-from 5% in sub-Saharan Africa to 42.8% in Latin America and the Caribbean. Caesarean rates have increased in all regions since 1990, with the largest rises in Eastern Asia, Western Asia, and Northern

Africa, and the smallest increases in sub-Saharan Africa and North America. Projections indicate that by 2030, 28.5% of global births will occur by caesarean section, amounting to 38 million procedures annually, most of them in low- and middle-income countries.⁴ Recent studies from India show the overall prevalence of caesarean was 21.50%, representing an increase from 16.72% in 1998-1999.⁵

REVIEW OF LITERATURE

Maternal complications of CS

Hemorrhage

Postpartum haemorrhage is a leading complication of childbirth, responsible for nearly one-fifth of global maternal deaths and the primary cause of maternal mortality in many low-income countries. Traditionally, postpartum hemorrhage has been defined as blood loss exceeding 500 mL after vaginal delivery or 1000 mL following CS. In 2017, the American College of Obstetricians and Gynecologists revised this definition to include a cumulative blood loss greater than 1000 mL accompanied by clinical signs of hypovolemia within 24 hours of birth, irrespective of the mode of delivery.⁶ Obstetric haemorrhage was more common in caesarean delivery compared to vaginal delivery. Also, these patients are more likely to require a blood transfusion compared to vaginal delivery. Most cases of haemorrhage are due to uterine atony followed by surgical bleeding.⁷

Uterocervical lacerations

Cervical lacerations can occur during caesarean delivery, particularly when the procedure is performed in the second stage of labor for arrest or fetal indications. It has been suggested that a low or caudally extended caesarean hysterotomy may unintentionally injure the cervix, potentially increasing the risk of cervical insufficiency and spontaneous preterm birth in subsequent pregnancies.⁸

Bladder injury

Urinary tract injury during CS is an uncommon but serious complication that can contribute substantially to maternal morbidity, given the high rate of caesarean deliveries. A study done by Safrai et al shows bladder injuries and ureteral injuries, corresponding to incidences of 0.08% and 0.06%, respectively. Bladder injuries predominantly occurred in women with a prior CS and dense adhesions, while ureteral injuries were more common in emergency caesarean deliveries during the second stage of labor and were often associated with extension of the uterine incision.⁹

Postpartum infection

Surgical site infections complicate approximately 2-7% of caesarean deliveries and may involve incisional or deep

organ infections, including endomyometritis, infected hematomas, and pelvic abscesses. Incisional infections present with erythema, purulent discharge, and sometimes systemic symptoms, and are caused by genitourinary or skin flora, with prior CS increasing risk due to poor scar vascularity. Rarely, necrotizing fasciitis may occur, particularly in women with comorbidities such as diabetes, and can be caused by polymicrobial organisms or group A streptococcus, requiring prompt recognition and management. All postpartum infections can progress to bacteremia, sepsis, shock, and death if not treated appropriately.¹⁰

VTE

VTE is a serious and potentially life-threatening complication following CS. The risk of VTE is approximately four times higher after CS than after vaginal delivery, appears to be independent of other VTE risk factors, and is higher following emergency compared with elective CS. Overall, about 3 per 1,000 women develop VTE after caesarean delivery.¹¹

Maternal mortality

According to the study done by Riches et al women undergoing CS had a fivefold higher risk of maternal death compared with vaginal delivery. Postpartum hemorrhage, eclampsia, and infection were the leading causes, with infection-related deaths occurring more frequently after CS. Health system delays, inadequate monitoring, delayed treatment, and lack of blood transfusion were more commonly associated with deaths following caesarean delivery.¹²

Breastfeeding

Compared with vaginal birth, CS is associated with a delayed initiation of breastfeeding and a shorter duration of exclusive breastfeeding. This may be related to postoperative pain, effects of anesthesia, delayed mother-infant contact, and early neonatal separation, all of which can interfere with the establishment and continuation of optimal breastfeeding practices.¹³ Incisional hernia-Although incidence data is low but incisional hernia can occur after lower segment CS in approximately 0.37% of cases.¹⁴ Chronic pelvic pain affects about 4% of women of reproductive age and is defined as persistent pelvic pain with significant physical, emotional, and behavioral impact, including both cyclic and non-cyclic pain. While diagnosis is primarily clinical, prior abdominal surgery-especially Pfannenstiel incisions used in CS s-is a key risk factor. Given that CS is the most common abdominal surgery worldwide, it represents an important contributor to chronic pelvic pain.¹⁵ Uterine rupture is an uncommon yet life-threatening peripartum complication. Can result in severe maternal hemorrhage, hysterectomy, fetal demise, and maternal death. Previous CS -related uterine scarring and labor induction with prostaglandins are the most frequently reported risk factors. As per the study done by

Savukyne et al the incidence of complete and incomplete uterine rupture is 6.8 per 10,000 deliveries, rising to more than 44 per 10,000 births among women with a uterine scar from a prior CS. The strongest risk factors include a previous uterine scar and the use of labor augmentation or epidural anesthesia in women with prior caesarean delivery. Acute abdominal pain during labor is the most common presenting symptom of uterine rupture.¹⁶ Placenta accreta spectrum is defined by partial or complete absence of the decidua, allowing abnormal placental invasion into the myometrium.¹⁷ It is a major cause of peripartum hysterectomy and is associated with significant maternal morbidity and mortality worldwide. The risk varied according to the number of previous caesarean deliveries and placental location, ranging from 5% in women with one prior caesarean and a posterior low-lying placenta to 63% in those with three or more prior caesareans and placenta previa.¹⁸ Caesarean scar ectopic pregnancy occurs when implantation takes place within the scar of a previous CS. With caesarean delivery rates rising by nearly 50% over the past decade, the incidence of CSEP has increased correspondingly. Given its association with severe complications-including massive hemorrhage, uterine rupture, placenta accreta spectrum, hysterectomy, and maternal death-early diagnosis and timely, appropriate management are crucial.¹⁹ The actual incidence of caesarean scar ectopic pregnancy remains uncertain, as the condition is likely underrecognized and underreported. Single-center studies estimate its occurrence to range from approximately one in 1,800 to one in the 2,656 pregnancies.²⁰

Endometriosis refers to the presence of endometrial glands and stroma outside the uterine cavity, with caesarean scar site endometriosis (CSSE) occurring in 0.2-0.95% of women after caesarean delivery. Diagnosis is confirmed histologically by identifying at least two of the following: endometrial glands, endometrial stroma, or hemosiderin-laden macrophages. Clinically, CSSE commonly presents as a palpable, often painful mass at or near the caesarean scar, with pain that is frequently cyclical and occasionally non-cyclical, and dysmenorrhea reported in a subset of patients.²¹ A caesarean scar niche is a myometrial defect at a previous caesarean incision site, first described in 1961 and also known as isthmocele or caesarean scar defect. It is associated with gynecological symptoms such as abnormal uterine bleeding, dysmenorrhea, and subfertility, as well as adverse obstetric outcomes including caesarean scar pregnancy, uterine rupture, and placenta accreta spectrum disorders. Although a standardized definition was established in 2019 as an indentation ≥ 2 mm at the scar site, reported prevalence varies widely (≈ 19 -100%) depending on diagnostic criteria and imaging modality, with studies showing niche formation in up to two-thirds of women within months after their first CS.²² A Study done by Hinterleitne et al. shows that CS is linked to a lower likelihood of subsequent pregnancy and live birth. Following a CS, several post-surgical complications may adversely affect future fertility. These include intra-abdominal adhesions, fallopian tube impairment, and

uterine abnormalities at the caesarean scar, all of which can contribute to potential reproductive dysfunction.²³ AVMs are rare vascular anomalies, primarily affecting the central nervous system but occasionally occurring in the uterus. Uterine AVMs (UAVMs) are clinically significant due to their risk of severe genital bleeding, accounting for 1-2% of intraperitoneal and genital hemorrhage. Their true incidence is unclear, as they are often asymptomatic or resolve spontaneously. UAVMs are high-flow, low-resistance lesions with abnormal connections between arteries and veins, with acquired forms often presenting as arteriovenous fistulas, while congenital forms have more complex vascular structures.²⁴ Acquired uterine arteriovenous malformation (AVM) is a rare but may develop after a CS and should be suspected in women with ongoing postpartum bleeding.

NEONATAL COMPLICATIONS OF CS

Neonatal lesions occur in approximately 1.1% of caesarean deliveries, most commonly as superficial scalpel injuries (0.7%), followed by cephalhematoma (0.2%), and rarely, fractures, peripheral nerve injuries, brachial plexus lesions (0.02%), or facial nerve palsy (0.03%). Infants born by CS may have lower Apgar scores, largely related to anesthesia, and may experience early respiratory difficulties. As caesarean delivery bypasses the birth canal, it can be associated with neonatal stress and shock. Inaccurate gestational age assessment may also result in the delivery of immature infants by CS.²⁵

Caesarean delivery performed without labor carries a persistent risk of neonatal respiratory complications across near-term and early-term gestations.²⁶ Studies indicate that children born by CS have higher rates of respiratory tract infections, obesity, and asthma compared with those delivered vaginally.²⁷ Infants delivered by CS have higher rates of NICU admission compared with those born vaginally.²⁸ According to some authors children born by caesarean delivery have a significantly higher risk of developing asthma, systemic connective tissue disorders, juvenile arthritis, inflammatory bowel disease, immune deficiencies, and leukemia.²⁹

DISCUSSION

CS is a critical obstetric procedure with a long history, evolving from high-risk interventions to safer, standardized techniques such as the lower-segment transverse incision. Despite its life-saving potential, CS is associated with significant maternal and neonatal complications. Maternal risks include hemorrhage, uterocervical and urinary tract injuries, postpartum infections, VTE, chronic pelvic pain, uterine rupture, placenta previa, placenta accreta spectrum, caesarean scar ectopic pregnancy, caesarean scar niche, endometriosis, secondary infertility, and acquired uterine AVMs. These complications can result from surgical technique, emergency indications, prior caesarean history, and underlying comorbidities.

Neonatal outcomes are also affected, with higher incidences of respiratory distress, NICU admission, lower Apgar scores, and long-term risks such as asthma, obesity, and immune-related disorders compared to vaginal deliveries. The physiological stress of bypassing the birth canal, anesthesia effects, and timing of delivery contribute to these risks.

The rising global rates of caesarean deliveries, particularly in low-and middle-income countries, underscore the need for judicious clinical decision-making. Awareness of maternal and neonatal complications, careful surgical technique, and appropriate postpartum monitoring are essential to mitigate risks. Additionally, strategies to optimize maternal and neonatal outcomes, including infection prevention, thromboprophylaxis, and early breastfeeding support, should be integral to CS management. The long-term reproductive and health consequences highlight the importance of counseling women on potential risks and planning for future pregnancies.

CONCLUSION

CS is a life-saving obstetric procedure with a long history and widespread global use. However, it is associated with a range of maternal complications, including hemorrhage, infections, urinary and uterine injuries, chronic pelvic pain, uterine rupture, placenta accreta spectrum, cesarean scar disorders, secondary infertility, and rare vascular anomalies. Neonatal risks include respiratory complications, NICU admission, and long-term health issues such as asthma and immune disorders. Given the rising global cesarean rates, careful patient selection, skilled surgical technique, and vigilant perioperative care are essential to minimize maternal and neonatal morbidity while ensuring optimal outcomes.

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