

Caesarean section

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Caesarean section, also known as **C-section**, is the use of surgery to deliver one or more babies.^[2] A Caesarean section is often performed when a vaginal delivery would put the baby or mother at risk.^[2] This may include obstructed labour, twin pregnancy, high blood pressure in the mother, breech birth, problems with the placenta, umbilical cord or shape of the pelvis, and previous C-section.^[2]^[3] A trial of vaginal birth in some of these situations, including after C-section, may be possible. Some C-sections are also performed upon request.^[2] The World Health Organization recommends that they should be done based on medical need and in many cases they are lifesaving for the mother and baby.^[3]^[4]

A C-section typically takes 45 minutes to an hour. It may be done with a spinal block such that the woman is awake or under general anesthesia. A urinary catheter is used to drain the bladder and the skin of the abdomen is then sterilized. An incision of about 15 cm (6

inches) is then typically made through the mother's lower abdomen. The uterus is then opened with a second incision and the baby delivered. The incisions are then stitched closed.^[2] A woman can typically begin breastfeeding as soon as she is awake and out of the operating room.^[5] Often a number of days are required in hospital to recover sufficiently to return home.^[2]

Caesarean section

Intervention



A team performing a Caesarean section^[1]

ICD-10-PCS 10D00Z0

ICD-9-CM 74 (<http://icd9cm.chrisendres.com/index.php?srctype=procs&srctext=74&Submit=Search&action=search>)

MeSH D002585

MedlinePlus 002911

C-sections result in a small overall increase in poor outcomes in low risk pregnancies.^[3] They also typically take longer to heal from, about six weeks, than vaginal birth.^[2] The increased risks include breathing problems in the baby and amniotic fluid embolism and postpartum bleeding in the mother.^[3] Established guidelines recommend that caesarean sections not be used before 39 weeks of pregnancy without a medical reason.^[6] The method of delivery does not appear to have an effect on subsequent sexual function.^[7]

In 2012, about 23 million C-sections were done globally.^[8] The international healthcare community has previously considered the rate of 10% and 15% to be ideal for caesarean sections.^[4] Some evidence finds a higher rate of 19% may result in better outcomes.^[8] More than 45 countries globally have C-section rates less than 7.5% while more than 50 have rates greater than 27%. There are efforts to both improve access to and reduce the use of C-section.^[8] In the United States about 33% of deliveries are by C-section.^{[2][3]} The surgery has been performed at least as far back as 715 BC following the death of the mother with the occasional baby surviving. Descriptions of mothers surviving date back to the 1500s. With the introduction of antiseptics and anesthetics in the 1800s survival of both the mother and baby became common.^[9]

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Uses

Caesarean section is recommended when vaginal delivery might pose a risk to the mother or baby. C-sections are also carried out for personal and social reasons. Systematic reviews have found no strong evidence about the impact of caesareans for non-medical reasons.^{[10][11]} Recommendations encourage counseling to identify the reasons for the request, addressing anxieties and information, and encouraging vaginal birth.^{[10][12]} Elective caesareans at 38 weeks showed increased health complications in the newborn.^[13] For this reason, planned caesarean sections (also known as elective caesarean sections) should not be scheduled before 39 weeks gestation unless there is medical reason to do so.

Medical uses

Complications of labour and factors increasing the risk associated with vaginal delivery, such as:

- abnormal presentation (breech or transverse positions)
- prolonged labour or a failure to progress (dystocia)
- fetal distress
- cord prolapse
- uterine rupture or an elevated risk thereof
- hypertension in the mother or baby after amniotic rupture (the waters breaking)
- tachycardia in the mother or baby after amniotic rupture (the waters breaking)
- placenta problems (placenta praevia, placental abruption or placenta accreta)
- failed labour induction
- failed instrumental delivery (by forceps or ventouse (Sometimes a trial of forceps/ventouse delivery is attempted, and if unsuccessful, the baby will need to be born by caesarean section.))
- large baby weighing >4,000 g (macrosomia)
- umbilical cord abnormalities (vasa previa, multilobate including bilobate and succenturiate-lobed placentas, velamentous insertion)

Other complications of pregnancy, pre-existing conditions and concomitant disease, such as:

- pre-eclampsia^[14]
- previous (high risk) fetus
- HIV infection of the mother with a high viral load (HIV with a low maternal viral load is not necessarily an indication for caesarean section)
- Sexually transmitted diseases, such as a first outbreak of genital herpes very recently before the onset of labor (which can cause infection in the baby if the baby is born vaginally)
- previous classical (longitudinal) Caesarean section
- previous uterine rupture



A 7-week old Caesarean section scar and linea nigra visible on a 31-year-old mother.

- prior problems with the healing of the perineum (from previous childbirth or Crohn's disease)
- Bicornuate uterus
- Rare cases of posthumous birth after the death of the mother

Other

- Decreasing experience of accoucheurs with management of the breech presentation — since the publication of the Term Breech Trial it is clear that planned caesarean section in women presenting at term in their first pregnancy with a breech presentation has a lower risk of infant death than planned vaginal breech delivery.^[15] Although obstetricians and midwives are extensively trained in proper procedures for such deliveries using simulation mannequins, there is decreasing experience with actual vaginal breech delivery which may increase the risk further.)^[16]

Prevention

It is generally agreed that the prevalence of caesarean section is higher than needed in many countries and physicians are encouraged to actively lower the rate, as a caesarean rate higher than 10-15% is not associated with reductions in maternal or infant mortality rates.^[4] Some evidence supports a higher rate of 19% may result in better outcomes.^[8]

Some of these efforts are: emphasizing a long latent phase of labor is not abnormal and not a justification for C-section; a new definition of the start of active labor from a cervical dilatation of 4 cm to a dilatation of 6 cm; and allowing at least 2 hours of pushing for women who have previously given birth and 3 hours of pushing for women who have not previously given birth before labor arrest is considered.^[3] Physical exercise during pregnancy also decreases the risk.^[17]

Risks

Adverse outcomes in low risk pregnancies occur in 8.6% of vaginal deliveries and 9.2% of caesarean section deliveries.^[3]

Mother

In those who are low risk, the risk of death for caesarean sections is 13 per 100,000 and for vaginal birth 3.5 per 100,000 in the developed world.^[3] The United Kingdom National Health Service gives the risk of death for the mother as three times that of a vaginal birth^[18] but it is important to remember the actual risk of death in either situation is extremely small in resource-rich settings.

In Canada the difference in serious morbidity or mortality for the mother (e.g. cardiac arrest, wound hematoma, or hysterectomy) was 1.8 additional cases per 100 or three times the risk.^[19]

A caesarean section is associated with risks of postoperative adhesions, incisional hernias (which may require surgical correction) and wound infections.^[20] If a caesarean is performed in an emergency, the risk of the surgery may be increased due to a number of factors. The patient's stomach may not be empty, increasing the risk of anaesthesia.^[21] Other risks include severe blood loss (which may require a blood transfusion) and postdural-puncture spinal headaches.^[20]

Women who had caesarean sections are more likely to have problems with later pregnancies, and it is recommended that women who want larger families should not seek an elective caesarean unless there are medical indications to do so. The risk of placenta accreta, a potentially life-threatening condition which is more likely to develop where a woman has had a previous caesarean section, is 0.13% after two caesarean sections, but increases to 2.13% after four and then to 6.74% after six or more. Along with this is a similar rise in the risk of emergency hysterectomies at delivery.^[22]

Mothers can experience increased incidence of postnatal depression, and can experience significant psychological trauma and ongoing birth-related post-traumatic stress disorder after obstetric intervention during the birthing process.^[23] Factors like pain in first stage of labor, feelings of powerlessness, intrusive emergency obstetric intervention are important in the subsequent development of psychological issues related to labour and delivery.^[23]

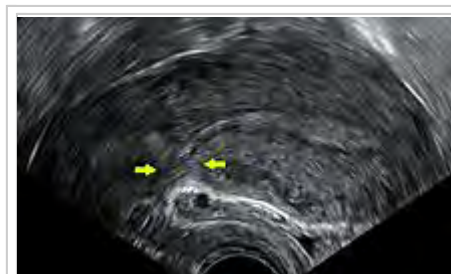
Subsequent pregnancies

Women who have had a caesarean for any reason are somewhat less likely to become pregnant again as compared to women who have previously delivered only vaginally, but the effect is small.^[24]

Women who had just one previous caesarean section are more likely to have problems with their second birth.^[3] Delivery after previous Caesarean section is by either of two main options:

- Vaginal birth after Caesarean section (VBAC)
- Elective repeat Caesarean section (ERCS)

Both have higher risks than a vaginal birth with no previous caesarean section. There are many issues which must be taken into account when planning the mode of delivery for every pregnancy, not just those complicated by a previous caesarean section and there is a list of some of these issues in the list of indications for section in the first part of this article. A vaginal birth after caesarean section (VBAC) confers a higher risk of uterine rupture (5 per 1,000), blood transfusion or endometritis (10 per 1,000), and perinatal death of the child (0.25 per 1,000).^[25] Furthermore, 20% to 40% of planned VBAC attempts end in caesarean section being needed, with greater risks of complications in an emergency



Transvaginal ultrasonography of a uterus years after a caesarean section, showing the characteristic scar formation in its anterior part.

repeat caesarean section than in an elective repeat caesarean section.^{[26][27]} On the other hand, VBAC confers less maternal morbidity and a decreased risk of complications in future pregnancies than elective repeat caesarean section.^[28]

Adhesions

There are number of steps that can be taken during abdominal or pelvic surgery to minimize postoperative complications, such as the formation of adhesions. Such techniques and principles may include:

- Handling all tissue with absolute care
- Using powder-free surgical gloves
- Controlling bleeding
- Choosing sutures and implants carefully
- Keeping tissue moist
- Preventing infection with antibiotics given intravenously to the mother before skin incision

However, despite these proactive measures, adhesion formation is a recognized complication of any abdominal or pelvic surgery. To prevent adhesions from forming after caesarean section, adhesion barrier can be put during surgery to minimize the risk of adhesions between the uterus and ovaries, the small bowel, and almost any tissue in the abdomen or pelvis. This is not current UK practice though as there is no compelling evidence to support the benefit of this intervention.

Adhesions can cause long term problems, such as:

- Infertility, which may end when adhesions distort the tissues of the ovaries and tubes, impeding the normal passage of the egg (ovum) from the ovary to the uterus. One in five infertility cases may be adhesion related (stoval)
- Chronic pelvic pain, which may result when adhesions are present in the pelvis. Almost 50% of chronic pelvic pain cases are estimated to be adhesion related (stoval)
- Small bowel obstruction – the disruption of normal bowel flow, which can result when adhesions twist or pull the small bowel.

The risk of adhesion formation is one reason why vaginal delivery is usually considered safer than elective caesarean section where there is no medical indication for section for either maternal or fetal reasons.

Child

Non-medically indicated (elective) childbirth before 39 weeks gestation "carry significant risks for the baby with no known benefit to the mother." Complications from elective caesarean before 39 weeks include: newborn mortality at 37 weeks may be up to 3 times the number at 40 weeks, and was elevated compared to 38 weeks gestation. These “early term” births were associated with more death during



Suturing of the uterus after extraction.



Closed Incision for *low transverse abdominal incision* after stapling has been completed.

infancy, compared to those occurring at 39 to 41 weeks ("full term").^[29] Researchers in one study and another review found many benefits to going full term, but “no adverse effects” in the health of the mothers or babies.^{[29][30]}

The American Congress of Obstetricians and Gynecologists and medical policy makers review research studies and find more incidence of suspected or proven sepsis, RDS, hypoglycemia, need for respiratory support, need for NICU admission, and need for hospitalization > 4–5 days. In the case of caesarean sections, rates of respiratory death were 14 times higher in pre-labor at 37 compared with 40 weeks gestation, and 8.2 times higher for pre-labor caesarean at 38 weeks. In this review, no studies found decreased neonatal morbidity due to non-medically indicated (elective) delivery before 39 weeks.^[29]

For otherwise healthy twin pregnancies where both twins are head down a trial of vaginal delivery is recommended at between 37 and 38 weeks.^{[10][31]} Vaginal delivery in this case does not worsen the outcome for either infant as compared with caesarean section.^[31] There is some controversy on the best method of delivery where the first twin is head first and the second is not, but most obstetricians will recommend normal delivery unless there are other reasons to avoid vaginal birth.^[31] When the first twin is not head down, a caesarean section is often recommended.^[31] Regardless of whether the twins are delivered by section or vaginally, the medical literature recommends delivery of dichorionic twins at 38 weeks, and monochorionic twins (identical twins sharing a placenta) by 37 weeks due to the increased risk of stillbirth in monochorionic twins who remain in utero after 37 weeks.^{[32][33]} The consensus is that late preterm delivery of monochorionic twins is justified because the risk of stillbirth for post-37 week delivery is significantly higher than the risks posed by delivering monochorionic twins near term (i.e., 36–37 weeks).^[34] The consensus concerning monoamniotic twins (identical twins sharing an amniotic sac), the highest risk type of twins, is that they should be delivered by caesarean section at or shortly after 32 weeks, since the risks of intrauterine death of one or both twins is higher after this gestation than the risk of complications of prematurity.^{[35][36][37]}

In a research study widely publicized, singleton children born earlier than 39 weeks may have developmental problems, including slower learning in reading and math.^[38]

Other risks include:

- Wet lung: Retention of fluid in the lungs can occur if not expelled by the pressure of contractions during labor.^[39]
- Potential for early delivery and complications: Preterm delivery may be inadvertently carried out if due-date calculation is inaccurate. One study found an increased complication risk if a repeat elective caesarean section is performed even a few days before the recommended 39 weeks.^[40]
- Higher infant mortality risk: In caesarean sections performed with no indicated medical risk (singleton at full term in a head-down position with no other obstetric or medical complications), the risk of death in the first 28 days of life has been cited as 1.77 per 1,000 live births among women who had caesarean sections, compared to 0.62 per 1,000 for women who delivered vaginally.^[41]

Birth by caesarean section also seems to be associated with worse health outcomes later in life,

including overweight or obesitas and problems in the immune system.^[42]

Classification

Caesarean sections have been classified in various ways by different perspectives.^[43] One way to discuss all classification systems is to group them by their focus either on the urgency of the procedure, characteristics of the mother, or as a group based on other, less commonly discussed factors.^[43]

It is most common to classify caesarean sections by the urgency of performing them.^[43]

By urgency

Conventionally, caesarean sections are classified as being either an elective surgery or an emergency operation.^[44] Classification is used to help communication between the obstetric, midwifery and anaesthetic team for discussion of the most appropriate method of anaesthesia. The decision whether to perform general anesthesia or regional anesthesia (spinal or epidural anaesthetic) is important and is based on many indications, including how urgent the delivery needs to be as well as the medical and obstetric history of the woman.^[44] Regional anaesthetic is almost always safer for the woman and the baby but sometimes general anaesthetic is safer for one or both, and the classification of urgency of the delivery is an important issue affecting this decision.

A planned caesarean (or elective/scheduled caesarean), arranged ahead of time, is most commonly arranged for medical indications which have developed before or during the pregnancy, and ideally after 39 weeks of gestation. In the UK this is classified as a 'grade 4' section (delivery timed to suit the needs of the service) since there is no rush in these situations. Emergency caesarean sections (those where vaginal delivery has been planned beforehand, and the indication for section has developed since this plan was agreed, usually after assessment by a healthcare professional) are classified in the UK as grade 3 (delivery within 4 hours of the decision, no maternal or fetal compromise), grade 2 (delivery required within 90 minutes of the decision but no immediate threat to the life of the woman or the fetus) or grade 1 (delivery required within 30 minutes of the decision: immediate threat to the life of the mother or the baby or both.)

Elective caesarean sections may be performed on the basis of an obstetrical or medical indication, or because of a medically non-indicated maternal request.^[10] Among women in the United Kingdom, Sweden and Australian about 7% preferred caesarean section as a method of delivery.^[10] In cases without medical indications the American Congress of Obstetricians and Gynecologists and the UK Royal College of Obstetricians and Gynaecologists recommend a planned vaginal delivery.^[45] The National Institute for Health and Care Excellence recommends that if after a women has been provided information on the risk of a planned caesarean section and she still insists on the procedure it should be provided.^[10] If provided this should be done at 39 weeks of gestation or later.^[45]

By characteristics of the mother

Caesarean delivery on maternal request

Caesarean delivery on maternal request (CDMR) is a medically unnecessary caesarean section, where the conduct of a childbirth via a caesarean section is requested by the pregnant patient even though there is not a medical indication to have the surgery.^[46]

After previous Caesarean

Mothers who have previously had a caesarean section are more likely to have a caesarean section for future pregnancies than mothers who have never had a caesarean section. There is discussion about the circumstances under which women should have a vaginal birth after a previous caesarean.

Vaginal birth after caesarean (VBAC) is the practice of birthing a baby vaginally after a previous baby has been delivered by caesarean section (surgically).^[47] According to The American Congress of Obstetricians and Gynecologists (ACOG), successful VBAC is associated with decreased maternal morbidity and a decreased risk of complications in future pregnancies.^[48] According to the American Pregnancy Association, 90% of women who have undergone caesarean deliveries are candidates for VBAC.^[26] Approximately 60-80% of women opting for VBAC will successfully give birth vaginally, which is comparable to the overall vaginal delivery rate in the United States in 2010.^{[26][27][49]}

Twins

For otherwise healthy twin pregnancies where both twins are head down a trial of vaginal delivery is recommended at between 37 and 38 weeks.^{[10][31]} Vaginal delivery in this case does not worsen the outcome for either infant as compared with caesarean section.^[31] There is controversy on the best method of delivery where the first twin is head first and the second is not.^[31] When the first twin is not head down at the point of labour starting, a caesarean section should be recommended.^[31] Although the second twin typically has a higher frequency of problems, it is not known if a planned caesarean section affects this.^[10] It is estimated that 75% of twin pregnancies in the United States were delivered by caesarean section in 2008.^[50]

Breech birth

A breech birth is the birth of a baby from a breech presentation, in which the baby exits the pelvis with the buttocks or feet first as opposed to the normal head-first presentation. In breech presentation, fetal heart sounds are heard just above the umbilicus.

The bottom-down position presents some hazards to the baby during the process of birth, and the mode of delivery (vaginal versus caesarean) is controversial in the fields of obstetrics and midwifery.

Though vaginal birth is possible for the breech baby, certain fetal and maternal factors influence the safety of vaginal breech birth. The majority of breech babies born in the United States and the UK are delivered by caesarean section as studies have shown increased risks of morbidity and mortality for vaginal breech delivery, and most obstetricians counsel against planned vaginal breech birth for this reason. As a result of reduced numbers of actual vaginal breech deliveries, obstetricians and midwives are at risk of de-skilling in this important skill. All those involved in delivery of obstetric and midwifery care in the UK undergo mandatory training in conducting breech deliveries in the simulation environment (using dummy pelvises and mannequins to allow practice of this important skill) and this training is carried out regularly to keep skills up to date.

Resuscitative hysterotomy

A resuscitative hysterotomy, also known as a peri-mortem caesarean delivery, is an emergency caesarean delivery carried out where maternal cardiac arrest has occurred, to assist in resuscitation of the mother by removing the aortocaval compression generated by the gravid uterus. Unlike other forms of caesarean section, the welfare of the fetus is a secondary priority only, and the procedure may be performed even prior to the limit of fetal viability if it is judged to be of benefit to the mother.

Other ways, including by surgery technique

There are several types of caesarean section (CS). An important distinction lies in the type of incision (longitudinal or transverse) made on the uterus, apart from the incision on the skin: the vast majority of skin incisions are a transverse suprapubic approach known as a Pfannenstiel incision but there is no way of knowing from the skin scar which way the uterine incision was conducted.

- The classical caesarean section involves a midline incision on the uterus longitudinal incision which allows a larger space to deliver the baby. It is performed at very early gestations where the lower segment of the uterus is unformed as it is safer in this situation for the baby: but it is rarely performed other than at these early gestations, as the operation is more prone to complications than a low transverse uterine incision. Any woman who has had a classical section will be recommended to have an elective repeat section in subsequent pregnancies as the vertical incision is much more likely to rupture in labour than the transverse incision.
- The lower uterine segment section is the procedure most commonly used today; it involves a transverse cut just above the edge of the bladder. It results in less blood loss and has fewer early and late complications for the mother, as well as allowing her to consider a vaginal birth in the next pregnancy.
- A caesarean hysterectomy consists of a caesarean section followed by the removal of the uterus. This may be done in cases of intractable bleeding or when the placenta cannot be separated from the uterus.

The EXIT procedure is a specialized surgical delivery procedure used to deliver babies who have airway compression.

The Misgav Ladach method is a modified caesarean section which has been used nearly all over the world since the 1990s. It was described by Michael Stark, the president of the New European Surgical Academy, at the time he was the director of Misgav Ladach, a general hospital in Jerusalem. The method was presented during a FIGO conference in Montréal in 1994^[51] and then distributed by the

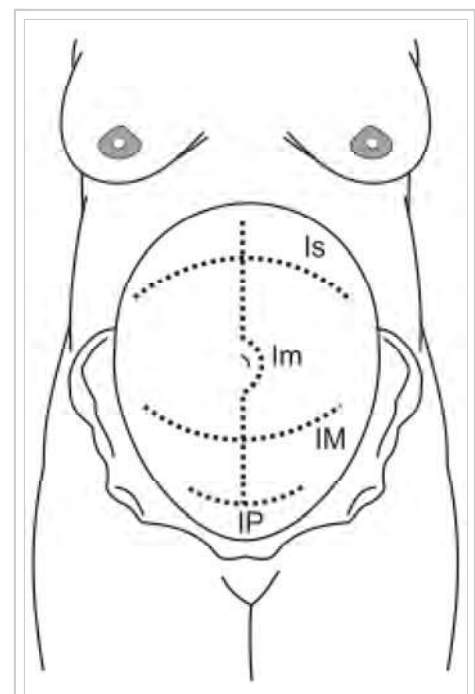
University of Uppsala, Sweden, in more than 100 countries. This method is based on minimalistic principles. He examined all steps in caesarean sections in use, analyzed them for their necessity and, if found necessary, for their optimal way of performance. For the abdominal incision he used the modified Joel Cohen incision and compared the longitudinal abdominal structures to strings on musical instruments. As blood vessels and muscles have lateral sway, it is possible to stretch rather than cut them. The peritoneum is opened by repeat stretching, no abdominal swabs are used, the uterus is closed in one layer with a big needle to reduce the amount of foreign body as much as possible, the peritoneal layers remain unsutured and the abdomen is closed with two layers only. Women undergoing this operation recover quickly and can look after the newborns soon after surgery. There are many publications showing the advantages over traditional caesarean section methods. However, there is an increased risk of abruptio placenta and uterine rupture in subsequent pregnancies for women who underwent this method in prior deliveries.^{[52][53]}

Technique

Antibiotic prophylaxis is used before an incision.^[54] The uterus is incised, and this incision is extended with blunt pressure along a cephalad-caudad axis.^[54] The infant is delivered, and the placenta is then removed.^[54] The surgeon then makes a decision about uterine exteriorization.^[54] Single-layer uterine closure is used when the mother does not want a future pregnancy.^[54] When subcutaneous tissue is 2 cm thick or more, surgical suture is used.^[54] Discouraged practices include manual cervical dilation, any subcutaneous drain, or supplemental oxygen therapy with intent to prevent infection.^[54]

Caesarean section can be performed with single or double layer suturing of the uterine incision.^[55] Single layer closure compared with double layer closure has been observed to result in reduced blood loss during the surgery. It is uncertain whether this is the direct effect of the suturing technique or if other factors such as the type and site of abdominal incision contribute to reduced blood loss.^[56] Standard procedure includes the closure of the peritoneum. However, research questions this may not be needed, with some studies indicating peritoneal closure is associated with longer operative time and hospital stay.^[57] The Misgave Ladach method is a surgery technical that may have fewer secondary complications and faster healing, due to the insertion into the muscle.^[58]

In many hospitals the mother's partner is encouraged to attend the surgery to support the mother and share the experience. The anaesthetist will usually lower the drape temporarily as the child is delivered so the parents can see their newborn.



Several caesarean sections
 Is: supra-umbilical incision
 Im: median incision
 IM: Maylard incision
 IP: Pfannenstiell incision

Anaesthesia

Both general and regional anaesthesia (spinal, epidural or combined spinal and epidural anaesthesia) are acceptable for use during Caesarean section. Regional anaesthesia is preferred as it allows the mother to be awake and interact immediately with her baby.^[59] Other advantages of regional anaesthesia include the absence of typical risks of general anaesthesia: pulmonary aspiration (which has a relatively high incidence in patients undergoing anaesthesia in late pregnancy) of gastric contents and esophageal intubation.^[60]

Regional anaesthesia is used in 95% of deliveries, with spinal and combined spinal and epidural anaesthesia being the most commonly used regional techniques in scheduled Caesarean section.^[61] Regional anaesthesia during Caesarean section is different from the analgesia (pain relief) used in labor and vaginal delivery. The pain that is experienced because of surgery is greater than that of labor and therefore requires a more intense nerve block. The dermatomal level of anaesthesia required for Caesarean delivery is also higher than that required for labor analgesia.^[60]

General anaesthesia may be necessary because of specific risks to mother or child. Patients with heavy, uncontrolled bleeding may not tolerate the hemodynamic effects of regional anaesthesia. General anaesthesia is also preferred in very urgent cases, such as severe fetal distress, when there is no time to perform a regional anaesthesia.

Prevention of complications

Postpartum infection is one of the main causes of bad outcomes^{[10][62]} and death around childbirth, accounting for around 10% of maternal deaths globally.^[63] Caesarean section greatly increases the risk of infection and associated morbidity (estimated to be between 5 and 20 times as high), and routine use of antibiotic prophylaxis to prevent infections is recommended.^[62] Infection can occur in around 8% of women who have caesareans,^[10] largely endometritis, urinary tract infections and wound infections.

Women who have caesareans need to understand the signs of fever that indicate the possibility of wound infection.^[10] Antibiotic prophylaxis is effective for endometritis, preventing as many as 3 out of 4 cases.^{[10][62]} Taking antibiotics before skin incision^[62] rather than after cord clamping reduces the risk for the mother, without increasing adverse effects for the baby.^{[10][64]} Whether a particular type of skin cleaner improves outcomes is unclear.^[65]



Pulling out the baby

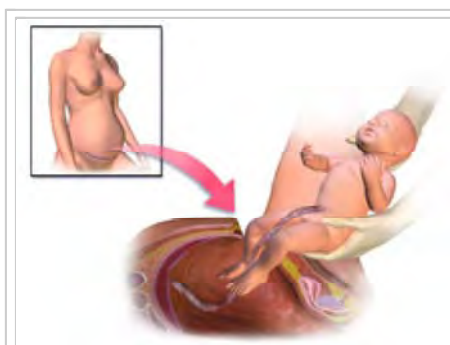


Illustration depicting Caesarean section.

Some doctors believe that during a caesarean section, mechanical cervical dilation with a finger or forceps will prevent the obstruction of blood and lochia drainage, and thereby benefit the mother by reducing risk of death.^[66] The available clinical evidence is not sufficient to draw a conclusion on the effect of this practice.^[66]

Recovery

It is common for women who undergo caesarian section to experience reduced or absent bowel movements for hours to days, resolving without any intervention in most. During this period of bowel inactivity, women may experience abdominal cramps, nausea and vomiting. There is low quality evidence that chewing gums within the first day of surgery could help earlier return of bowel functions.^[67] Abdominal, wound and back pain can continue for months after a caesarean section, with some evidence that non-steroidal anti-inflammatory drugs are helpful.^[10] Women who have had a caesarean are more likely to experience pain that interferes with their usual activities than women who have vaginal births, although by six months there is generally no longer a difference.^[68] However, pain during sexual intercourse is less likely than after vaginal birth, although again, by six months there is no difference.^[10]

There may be a somewhat higher incidence of postnatal depression in the first weeks after childbirth for women who have caesarean sections, but this difference does not persist.^[10] Some women who have had caesarean sections, especially emergency caesareans, experience post-traumatic stress disorder.^[10]

Usage

In the United Kingdom, in 2008, the Caesarean section rate was 24%.^[69] In Ireland the rate was 26.1% in 2009.^[70] The Canadian rate was 26% in 2005–2006.^[71] Australia has a high Caesarean section rate, at 31% in 2007.^[72] In the United States the rate of C-section is around 33% and varies from 23% to 40% depending on the state in question.^[3]

In Italy the incidence of Caesarean sections is particularly high, although it varies from region to region.^[73] In Campania, 60% of 2008 births reportedly occurred via Caesarean sections.^[74] In the Rome region, the mean incidence is around 44%, but can reach as high as 85% in some private clinics.^{[75][76]}

With nearly 1.3 million stays, Caesarean section was one of the most common procedures performed in U.S. hospitals in 2011. It was the second-most common procedure performed for people ages 18 to 44 years old.^[77] Caesarean rates in the U.S. have risen considerably since 1996.^[78] The procedure increased 60% from 1996 to 2009. In 2010, the Caesarean delivery rate was 32.8% of all births (a slight decrease from 2009's high of 32.9% of all births).^[79] A study found that in 2011, women covered by private insurance were 11% more likely to have a caesarean section delivery than those covered by Medicaid.^[80]

China has been cited as having the highest rates of C-sections in the world at 46% as of 2008.^[81]

Studies have shown that continuity of care with a known carer may significantly decrease the rate of Caesarean delivery^[82] but there is also research that appears to show that there is no significant difference in Caesarean rates when comparing midwife continuity care to conventional fragmented care.^[83]

More emergency Caesareans—about 66%—are performed during the day rather than during the night.^[84]

The rate has risen to 46% in China and to levels of 25% and above in many Asian, European and Latin American countries.^[85] The rate has increased in the United States, to 33% of all births in 2012, up from 21% in 1996.^[3] Across Europe, there are differences between countries: in Italy the Caesarean section rate is 40%, while in the Nordic countries it is 14%.^[86]

Increasing use

In the United States C-section rates have increased from just over 20% in 1996 to 33% in 2011.^[3] This increase has not resulted in improved outcomes resulting in the position that C-sections may be done too frequently.^[3]

The World Health Organization officially withdrew its previous recommendation of a 15% C-section rates in June 2010. Their official statement read, "There is no empirical evidence for an optimum percentage. What matters most is that all women who need caesarean sections receive them."^[87]

The US National Institutes of Health says rises in rates of Caesarean sections are not, in isolation, a cause for concern, but may reflect changing reproductive patterns: "The World Health Organization has determined an "ideal rate" of all caesarean deliveries (such as 15 percent) for a population. One surgeon's opinion is that there is no consistency in this ideal rate, and artificial declarations of an ideal rate should be discouraged. Goals for achieving an optimal caesarean delivery rate should be based on maximizing the best possible maternal and neonatal outcomes, taking into account available medical and health resources and maternal preferences. This opinion is based on the idea that if left unchallenged, optimal caesarean delivery rates will vary over time and across different populations according to individual and societal circumstances."^[46]

Joseph Walsh has speculated that caesarean section rates have increased due to a relationship between birth weight and maternal pelvis size, positing on the basis of Darwinian-inspired logic that since the advent of successful Caesarean birth over the last 150 years, more mothers with small pelvises and babies with large birth weights have survived and contributed to these traits. He notes that this hypothesis would predict an increased average birth weight, which some studies have borne out. However, Walsh cautions that it is unclear what component of this trend is due to evolution, as environmental factors may be responsible as well.^[88]

History

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.^{[89][90]}

According to the ancient Chinese *Records of the Grand Historian*, Luzhong, a sixth-generation descendant of the Yellow Emperor, had six sons, all born by "cutting open the body". The sixth son Jilian founded the House of Mi that ruled the State of Chu (c. 1030–223 BCE).^[91]



A Caesarean section performed by indigenous healers in Kahura, Uganda. As observed by R. W. Felkin in 1879.

In the Irish mythological text the Ulster Cycle, the character Furbaide Ferbend is said to have been born by posthumous caesarean section, after his mother was murdered by his evil aunt Medb.

The Babylonian Talmud, an ancient Jewish religious text, mentions a procedure similar to the caesarean section. The procedure is termed *yotzei dofen*.^[90]

Pliny the Elder theorized that Julius Caesar's name came from an ancestor who was born by caesarean section, but the truth of this is debated (see the discussion of the etymology of *Caesar*). The Ancient Roman caesarean section was first performed to remove a baby from the womb of a mother who died during childbirth. Julius Caesar's mother, Aurelia, lived through childbirth and successfully gave birth to her son, ruling out the possibility the Roman ruler and general was born by caesarean section. His first wife however died in childbirth, giving birth to a stillborn son who might have lived had a caesarean taken place.

The Catalan saint Raymond Nonnatus (1204–1240), received his surname—from the Latin *non-natus* ("not born")—because he was born by caesarean section. His mother died while giving birth to him.^[92]

An early account of caesarean section in Iran is mentioned in the book of Shahnameh, written around 1000 AD, and relates to the birth of Rostam, the national legendary hero of Iran.^{[93][94]} According to the Shahnameh, the Simurgh instructed Zal upon how to perform a Caesarean section, thus saving Rudaba and the child Rostam.^[95]

Caesarean section usually resulted in the death of the mother. Possibly the first account of a woman surviving the procedure was that of the seventeen year old Beatrice of Bourbon, Queen of Bohemia in 1337.^[96] In a later account in the 1580s, in Siegershausen, Switzerland, Jakob Nufer a pig gelder, is supposed to have performed the operation on his wife after a prolonged labour.^[97] However, there is also some basis for supposing that Jewish women regularly survived the operation in Roman times.^[98] For most of the time since the 16th century, the procedure had a high mortality rate. However, it was long

considered an extreme measure, performed only when the mother was already dead or considered to be beyond help. In Great Britain and Ireland, the mortality rate in 1865 was 85%. Key steps in reducing mortality were:

- Introduction of the transverse incision technique to minimize bleeding by Ferdinand Adolf Kehrer in 1881 is thought to be first modern CS performed.
- The introduction of uterine suturing by Max Sänger in 1882
- Modification by Hermann Johannes Pfannenstiel in 1900, see Pfannenstiel incision
- Extraperitoneal CS and then moving to low transverse incision (Krönig, 1912)
- Adherence to principles of asepsis
- Anesthesia advances
- Blood transfusion
- Antibiotics

European travelers in the Great Lakes region of Africa during the 19th century observed Caesarean sections being performed on a regular basis.^[99] The expectant mother was normally anesthetized with alcohol, and herbal mixtures were used to encourage healing. From the well-developed nature of the procedures employed, European observers concluded they had been employed for some time.^[99] Dr. James Barry carried out the first successful Caesarean by a European doctor in Africa in Cape Town, while posted there between 1817 and 1828.^[100]

The first successful Caesarean section to be performed in America took place in Mason County, Virginia (now Mason County, West Virginia), in 1794. The procedure was performed by Dr. Jesse Bennett on his wife Elizabeth.^[101]

On March 5, 2000, in Mexico, Inés Ramírez performed a Caesarean section on herself and survived, as did her son, Orlando Ruiz Ramírez.^[102]

Society and culture

Etymology

The Roman *Lex Regia* (royal law), later the *Lex Caesarea* (imperial law), of Numa Pompilius (715–673 BCE),^[103] required the child of a mother dead in childbirth to be cut from her womb.^[104] There was a cultural taboo that mothers not be buried pregnant,^[105] that may have reflected a way of saving some fetuses. Roman practice requiring a living mother to be in her tenth month of pregnancy before resorting to the procedure, reflecting the knowledge that she could not survive the delivery.^[106] Speculation that the Roman dictator Julius Caesar was born by the method now known as C-section is apparently false.^[107] Although Caesarean sections were performed in Roman times, no classical source records a mother surviving such a delivery.^{[104][108]} As late as the 12th century, scholar and physician Maimonides expresses doubt over the possibility of a woman's surviving this procedure and again falling pregnant (see Commentary to Mishnah Bekhorot 8:2). The term has also been explained as deriving from the verb *caedere*, "to cut", with children delivered this way referred to as *caesones*. Pliny the Elder refers to a certain Julius Caesar (an ancestor of the famous Roman statesman) as *ab utero caeso*, "cut from the



Fictional 15th century depiction of the birth of Julius Caesar

womb" giving this as an explanation for the cognomen "Caesar" which was then carried by his descendents.^[104] Nonetheless, even if the etymological hypothesis linking the caesarean section to Julius Caesar is a false etymology, it has been widely believed. For example, the *Oxford English Dictionary* defines Caesarean birth as "the delivery of a child by cutting through the walls of the abdomen when delivery cannot take place in the natural way, as was done in the case of Julius Caesar".^[109] *Merriam-Webster's Collegiate Dictionary* (11th edition) leaves room for etymological uncertainty with the phrase, "from the legendary association of such a delivery with the Roman cognomen *Caesar*".^[110]

Some link with Julius Caesar or with Roman emperors exists in other languages as well. For example, the modern German, Norwegian, Danish, Dutch, Swedish, Turkish and Hungarian terms are respectively *Kaiserschnitt*, *keisersnitt*, *kejsersnit*, *keizersnede*, *kejsarsnitt*, *sezaryen*, and

császármetszés (literally: "Emperor's cut").^[111] The German term has also been imported into Japanese (帝王切開 *teiōsekkai*) and Korean (제왕 절개 *jewang jeolgae*), both literally meaning "emperor incision". Similar in western Slavic (Polish) *cięcie cesarskie*, (Czech) *císařský řez* and (Slovak) *cisársky rez* (literally "imperial cut"), whereas the south Slavic term is Serbian *чарска пез* and Slovenian *cárski réz*, which literally means "tzar" cut. The Russian term *kesarevo secheniye* (Кесарево сечение *késarevo sečénije*) literally means *Caesar's section*. The Arabic term (ولادة قيصرية *wilaada qaySariyya*) also means "Caesarean birth." The Hebrew term ניתוח קיסרי (*nitúakh Keisári*) translates literally as Caesarean surgery. In Romania and Portugal,^[112] it is usually called *cesariana*, meaning from (or related to) Caesar.

According to *Shahnameh* ancient Persian book, the hero Rostam was the first person who was born with this method and term رستمینه (*rostamineh*) is corresponded to Caesarean. Also, Hindu mythical monkey god Hanuman was born through a similar procedure on his mother Anjani.

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.^[113]

Special cases

In Judaism there is a dispute among the *poskim* (Rabbinic authorities) as to whether a first-born son from a Caesarean section has the laws of a *bechor*.^[114] Traditionally, a male child delivered by Caesarean is not eligible for the *Pidyon HaBen* dedication ritual.^{[115][116]}

In rare cases, caesarean sections can be used to remove a dead fetus. A late-term abortion using Caesarean section procedures is termed a hysterotomy abortion and is very rarely performed.^[117]

Self-inflicted caesarean section is the concept of a mother alone performing her own caesarean section. There have apparently been a few successful cases, notably Inés Ramírez Pérez of Mexico who in March 2000, performed a successful Caesarean section on herself.^{[118][119]}

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