Caesarean section evidence based medicine

Historical note

Prague 1337:

The first successful Caesarean section, during which both mother and child survived, probably took place in Prague at the court of the Czech King John of Luxembourg.

Strange birth circumstances

John of Luxembourg (50)
(1296–1346)

Wenceslaus I, Duke of Luxembourg (46)
(1337–1383)

Beatrice of Bourbon (65)
(1318–1383)
2nd spouse

Prague 1337, the first successful caesarean section in which both mother and child survived may have occurred in the court of John of Luxembourg, King of Bohemia

Pařízek A.[1], **Drška V.**[2], **Říhová M.**[3]

[1]Charles University in Prague, First Medical Faculty, Department of Obstetric and Gynecology
[2]Charles University in Prague, Philosophy Faculty, Institute of World History
[3]Charles University in Prague, First Medical Faculty, Institute of Medical History and Foreign Language

ABSTRACT

Objective: An interdisciplinary historical-medical study, analysis of historical sources, and critical interpretation of the indirect evidence surrounding the childbirth of Beatrice of Bourbon, the second wife of the Bohemian King John of Luxembourg.
Study type: A material-based study founded on a comparative analysis of available private and public sources, particularly surviving letters, and narrative sources. The conclusions are reached based on a textual interpretation according to historical methods.
Settings: Department of Obstetrics and Gynecology of the First Faculty of Medicine of Charles University and General University Hospital in Prague.
Methods and results: Until the second half of the 19th century, medical knowledge of antiseptics and anesthesia was lacking, and techniques for cleaning wounds and staunching bleeding were primitive.
Because no effective anesthetics were known before that time, people did not know how to perform painless abdominal surgery. There are a very few credible reports of caesarean sections performed on living women as early as the 17th century. However, before the 19th century, a caesarean section meant almost certain death for the mother, with related mortality as high as 90%. If the woman did not die of stress from the pain of the abdominal surgery, then she usually died of either bleeding or later of sepsis. However, there is some indirect evidence that the first caesarean section that was survived by both the mother and child was performed in Prague in 1337. The mother was Beatrice of Bourbon (1318–1383), the second wife of the King of Bohemia John of Luxembourg (1296–1346). Beatrice gave birth to the king's son Wenceslaus I (1337–1383), later the duke of Luxembourg, Brabant, and Limburg, and who became the half brother of the later King of Bohemia and Holy Roman Emperor, Charles IV (1316–1378).
Conclusions: From a historical analysis based on the indirect evidence, it is not possible to unequivocally determine whether a caesarean section that was survived by both the mother and child was actually performed in the 14th century. From a medical standpoint in the context of all the known surrounding circumstances, however, this rare event could indeed have taken place.

KEYWORDS

Prague, caesarean section, first, survived, mother, child, John of Luxembourg, Beatrice of Bourbon, 1337, anesthesia, mortality, morbidity

Čes. Gynek., 2016, 81, č. 4, p. I–X

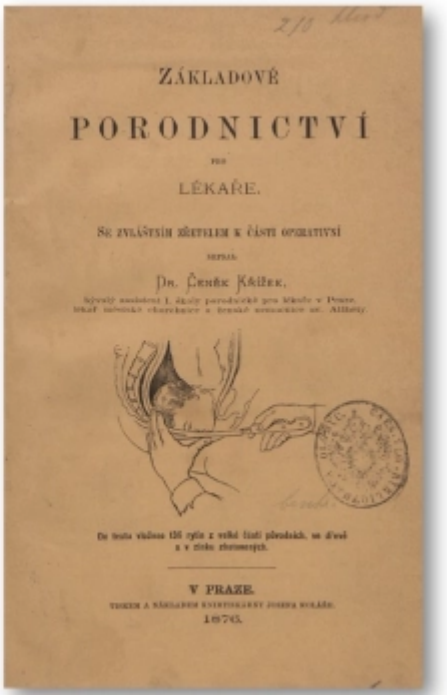
INTRODUCTION

The caesarean section is currently the most common obstetric operation used to facilitate childbirth. It is also probably the most frequent abdominal operation overall. In some countries, every fourth or even third child comes into the world through caesarean section [1]. Though routine today, however, this surgical procedure has a very long and quite dramatic history, accompanied by many myths and rumors.

Caesarean sections as we know them today are , like all surgeries in the abdominal cavity, a relatively "young" surgery. Fundamental changes occurred in the field of surgery in the second half of the 19th century. Until that time, knowledge of antiseptics/aseptics was lacking, techniques for cleaning wounds and materials to staunch bleeding were primitive, and critically – there was no anesthesia, the basis for pain-free surgery. Opening the abdominal cavity and performing sur-

Caesarean section
until the second half of the 19th century

- almost certain death of the woman
- in connection with Caesarean section
  up to 90% of mothers died



Caesarean section
present

- Low maternal mortality (anaesthesia)
- Low maternal morbidity (operational technique + ATB)

Caesarean section

- nowadays the most common obstetric operation (used for delivering the fetus)
- probably the most frequent abdominal surgery
- in some countries, every fourth or even third child is born by Caesarean section

Examples:

- USA (2020) 31.8%
- UK (2020) 25%
- Germany (2021) 29.6%
- Czech Republic (2021) 25.8%

FIGO position paper: how to stop the Caesarean section epidemic

- "There is an alarming increase in the number of Caesarean sections worldwide.
- The medical profession alone cannot reverse this trend.
- There is an urgent need to stop unnecessary Caesarean sections and enable women and families to ensure they receive the most appropriate maternity care."

Visser GHA, Ayres-de-Campos D, Barnea ER, de Bernis L, Di Renzo GC, Vidarte MFE, Lloyd I, Nassar AH, Nicholson W, Shah PK, Stones W, Sun L, Theron GB, Walani S. *Lancet. 2018;392(10155):1286-1287.*

Indication for Caesarean section:

- from the mother's perspective
- from the fetus's perspective
- mixed

The most common indication for Caesarean section:

- fetal hypoxia
- non-progressive labour
- fetal presentation

Increase in the number of Caesarean sections
↑ multiple births

↑ older and often polymorbid mothers

↑ conditions after Caesarean sections

↑ high-risk pregnancy and IVF

↓ vaginal deliveries after Caesarean section

↓ vaginal births with pelvic end presentation

Caesarean sectionPregnancy

- planned (if possible > 39+0 week of pregnancy, even at 38th week = worse newborn adaptation after birth)
- acute

Birth

- planned
- acute

Urgent (emergency Cesarean section/delivery)

Sources

Cesarean delivery: an evidence-based review of the technique.

Luigi Carbone , Gabriele Saccone, Alessandro Conforti, Giuseppe M Maruotti, Vincenzo Berghella, Minerva Obstet Gynecol 2021; 73(1):57-66.

The Surgical Technique of Caesarean Section: What is Evidence Based?

Jan-Simon Lanowski and Constantin S. von Kaisenberg, Caesarean Section, 2018

Cesarean delivery

A.Dhanya Mackeen and Meike Schuster, Obstetric Evidence Based Guidelines Fourth Edition, 2022

Patient interview/consent
A conversation about the Caesarean section should be preceded by:

- indications, benefits, risks/possible complications
- alternatives to termination of pregnancy in a particular pregnant woman

Informed consent should always be obtained after consultation

Checklist

- preoperative, intraoperative, and postoperative steps to prevent complications

Caesarean section
Caesarean delivery on maternal request (CDMR) or other planned Caesarean section should not be performed before 39th week.

The optimal incidence of Caesarean section is not known

- although Caesarean section incidence ≥ 19% is associated with lower maternal and neonatal mortality
- Caesarean section incidence lower than 15-19% is, on the contrary, associated with higher neonatal mortality

Contribute to reducing the number of Caesarean sections:

- prenatal preparation of the patient
- indication consultation within the perinatology team
- Caesarean section audit

Preoperative measures
Intrauterine fetal monitoring

Time (from indication to the fetal delivery)

- 30 minutes for C-section in case of impending fetal hypoxia
- 60 minutes for C-section in non-progressive labour (it always depends on the indication)

Intrauterine fetal monitoring
Until the beginning of the disinfection of the abdominal wall, including the application of regional anaesthesia

If there is no continuous CTG, then repeat listening to fetal sounds for 2-3 min. after application of regional anaesthesia

CAVE:
Regional anaesthesia can negatively affect the fetus (hypotension of the mother = hypoxia of the fetus)

Caesarean section and the ATB prophylaxis
Prophylactic antibiotics should be administered prior to each Caesarean section.

Evidence suggests that a single dose of cefazolin (e.g., 1 gram) or ampicillin should be given intravenously 30-60 minutes before skin incision.

Higher doses (e.g. 2-3 grams) are suitable for patients with a higher body mass index (BMI).

If CD is performed during labour or after rupture of membranes (PROM) > 4-6 hours, azithromycin can be considered.

Antibiotics prophylaxis↓ by 62% endometritis

↓ by 60% early infection in SC

↓ by 55% febris in 6 weeks postpartum period

↓ by 69% urinary tract infections

ATB prophylaxis is recommended

Preoperative disinfection of the vagina

It reduces the occurrence of endometritis and fever in the puerperium, especially in patients with advanced labour and after the drainage of amniotic fluid.

It improves the effect of peroperative ATB on the occurrence of infectious complications.

Caesarean section and the prevention of the VTE

All women undergoing CD should receive mechanical venous thromboembolism (VTE) prophylaxis

- compression stockings
- lower limb bandage

Prevention should be ensured preoperatively and should continue until the mother is fully mobilized.

In women with a history of VTE or hereditary thrombophilia, pharmacologic prophylaxis with subcutaneous enoxaparin 40 mg daily (preferred) or heparin 5000 IU every 8-12 hours should also be initiated and continued for 6 weeks postpartum.

In women with these risk factors and obesity III. class, enoxaparin 40 mg every 12 hours should be considered.

Prevention of thromboembolism
European guidelines recommend the use of pharmacological treatment.

Apply prophylaxis every 12-24 hours for at least 6 weeks after delivery in high-risk patients. The application can be started 12-24 hours after the spinal block.

All women mechanical prophylaxis (compression stockings)

93% of hospitals administer at least 3 days of heparin to all women

Caesarean section and prevention of aortocaval compression

Manual pushers may be better for positioning the mother than the left tilt of the operating table.

Caesarean section and preparation
In the event of removal of pubic hair, it is better to use an electric trimmer applied in the morning of the operation instead of shaving.

The use of chlorhexidine (preferred) or povidone-iodine is recommended for cleaning the skin before incision in CD.

Vaginal cleansing with chlorhexidine or povidone-iodine is recommended before CD.

Caesarean section and drape
Adhesive drapes should be avoided in CD due to their association with a higher incidence of wound infection.

Caesarean delivery and access to the abdominal cavity and uterus
The fascia can initially be incised transversely with a scalpel and the incision bluntly or sharply extended with scissors.

Routine bladder contraction is not necessary in CD.

The uterus should be incised transversely with a scalpel and the incision bluntly widened with the fingers.

Skin incision
Recommended is:

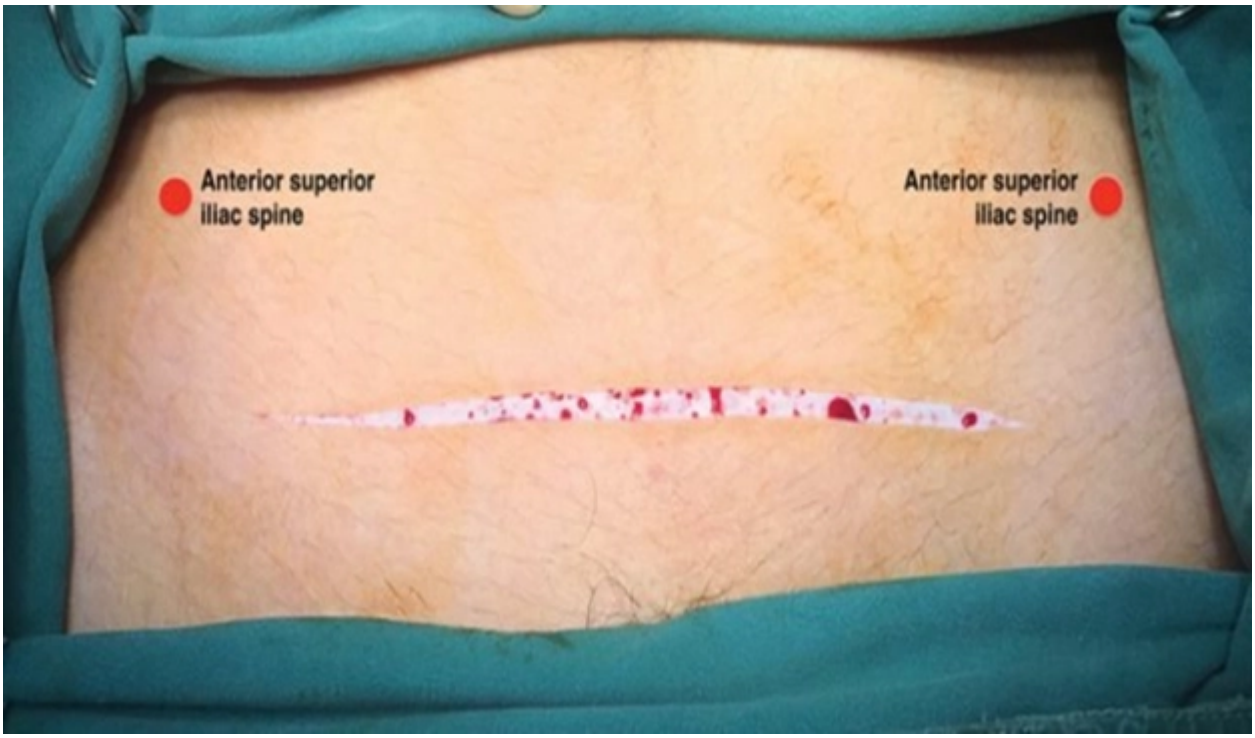
- transversal suprapubic incision
- slightly curved incision 2-3 cm or 2 fingers above the symphysis - sec. Pfannenstiel

Straight incision 3 cm below the junction of the spina iliaca superior anterior - sec. Joel-Cohen

↓ postoperative pain

↑ cosmetic effect

The length of the skin incision is about 15 cm to ensure an optimal result.



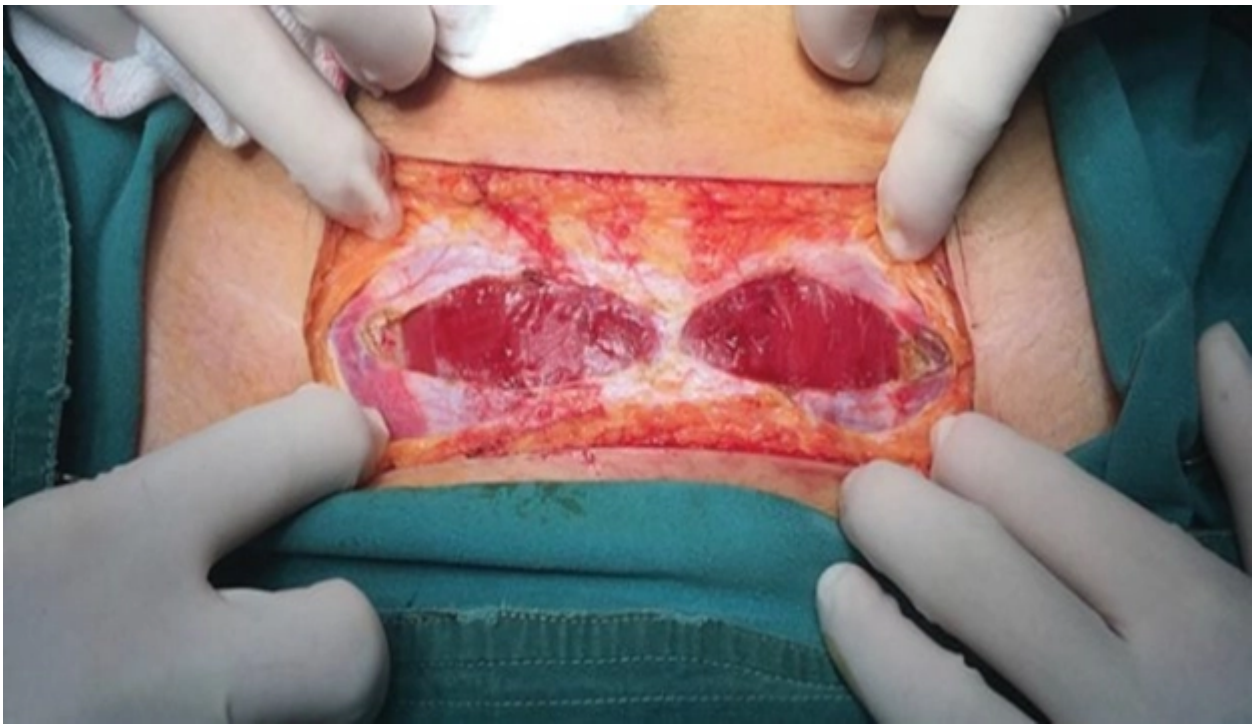
Subcutis

- blunt preparation prevails
- blunt preparation shortens operative time
- use of electrocoagulation

Connection with less blood loss, shorter penetration time through the anatomical layers to the peritoneum and less postoperative pain.

Fascia

- transverse scalpel incision →dilation with scissors
- digital splitting of the fascia = an alternative associated with less blood loss, shorter operative time, less postoperative pain and fever
- no difference in herniation



Mm. recti abdominis

- blunt split
- sharp incision is not suitable

Peritoneum

- blunt versus sharp
- high above the urinary bladder and injury to the surrounding organs must be avoided
- blunt - less blood loss, shorter operating time, less postoperative pain and fever

Bladder

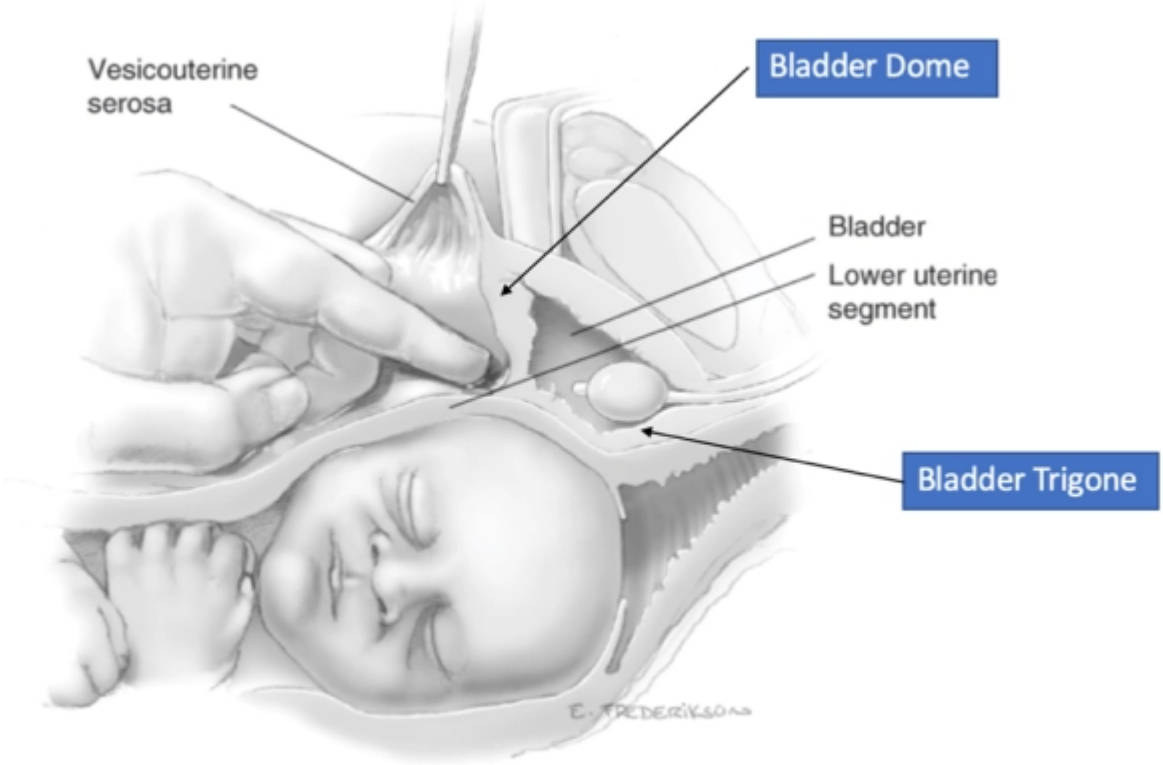
Incision of the pleura and deflation of the bladder vs. direct incision 1 cm above the pleural attachment prolongs performance (by at least 1 min)

↑ dysuria after C-section

No differences in bladder injury rate or blood loss

No better long-term effects (adhesion, urinary function, fertility)

Bladder deflation in CD is not beneficial and should be abandoned.



Source: F. Gary Cunningham, Kenneth J. Leveno, Steven L. Bloom, Catherine Y. Spong, Jodi S. Dashe, Barbara L. Hoffman, Brian M. Casey, Jeanne S. Sheffield: *Williams Obstetrics*, 25th Edition

Incision of the uterine wall

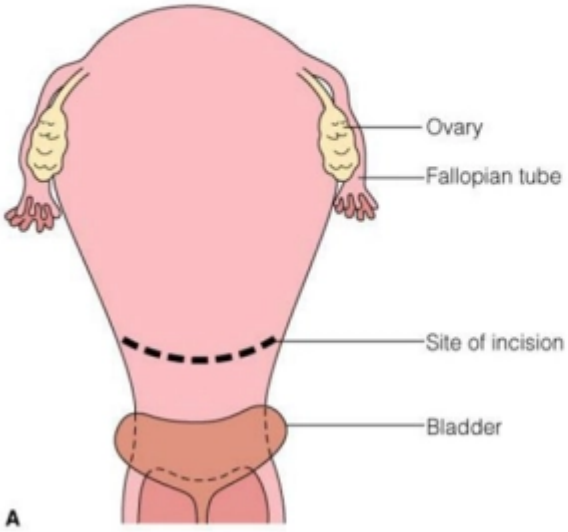
Transverse incision of the lower uterine segment and blunt extension of the transverse incision

- less blood loss
- enables TOLAC (trial of labour after Caesarean section) in the next pregnancy

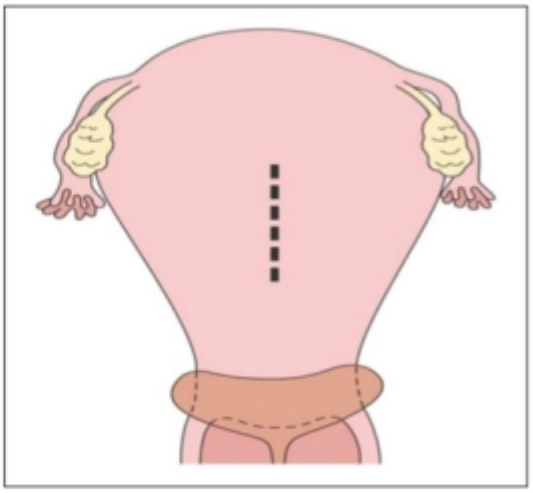
“Classic“ vertical incision

- lower uterine segment is not developed (< 25th week or with uterus myomatosus)
- more blood loss
- imminent rupture of the scar in the next pregnancy

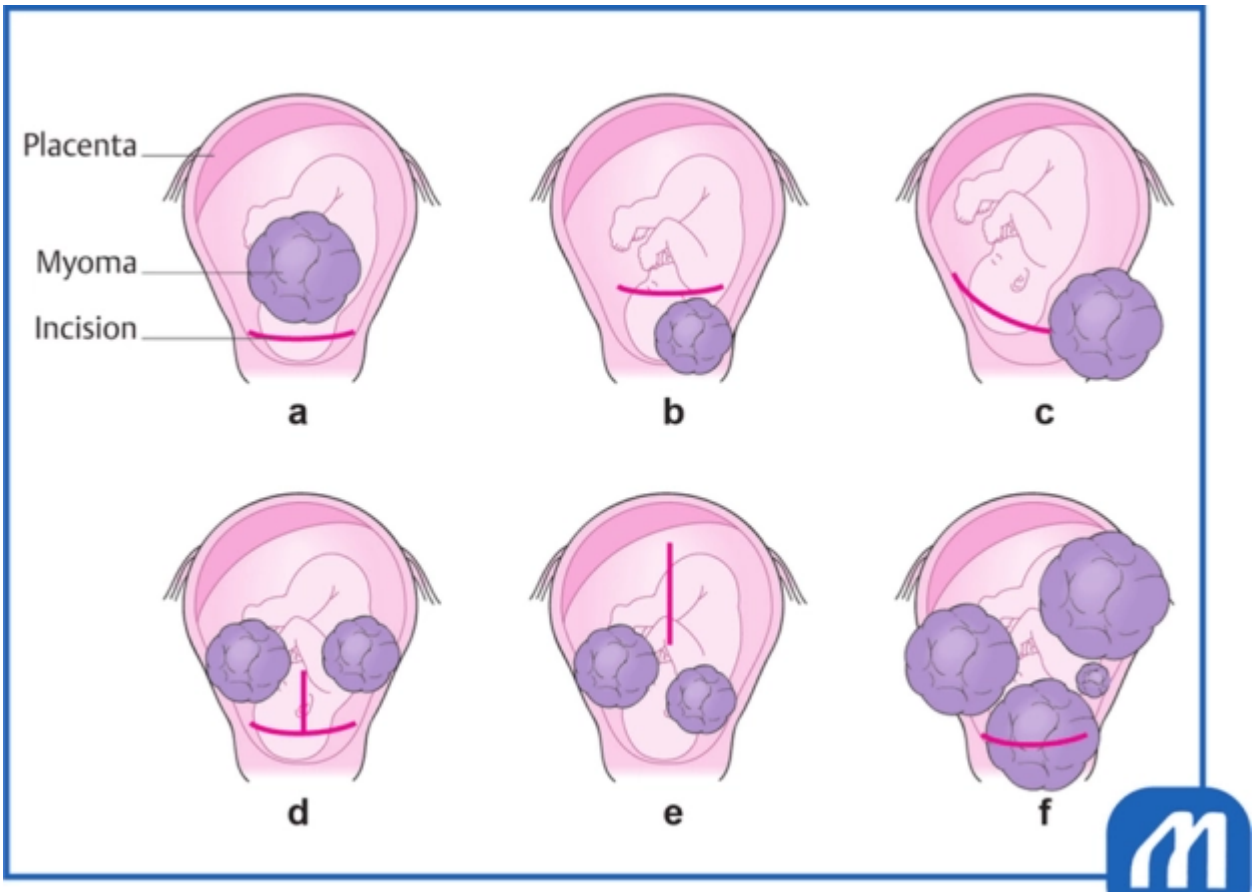
Pfannenstiel Incision



Classical Incision



increased risk of uterine rupture in subsequent pregnancies and labor.



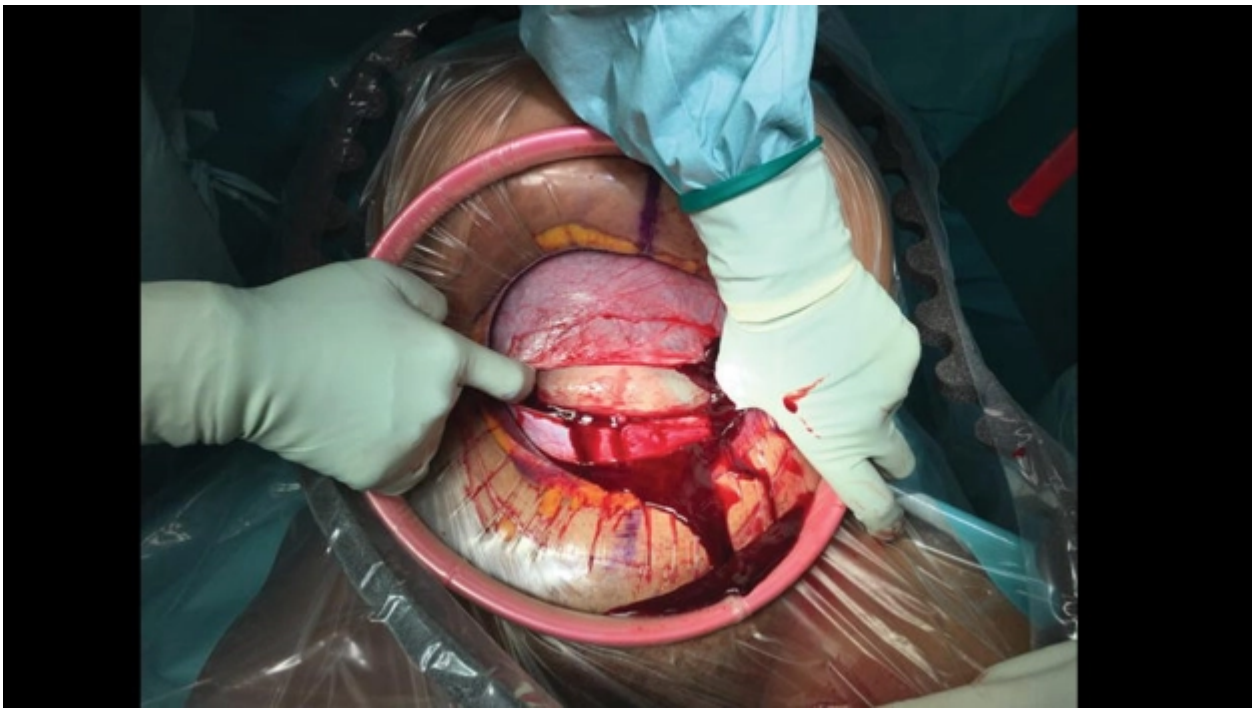
Extension of hysterotomy

blunt (digital) vs. sharply with scissors

↓ blood loss
↓ blood transfusion
↑ speed of operation

↓ risk of fetal injury with scalpel

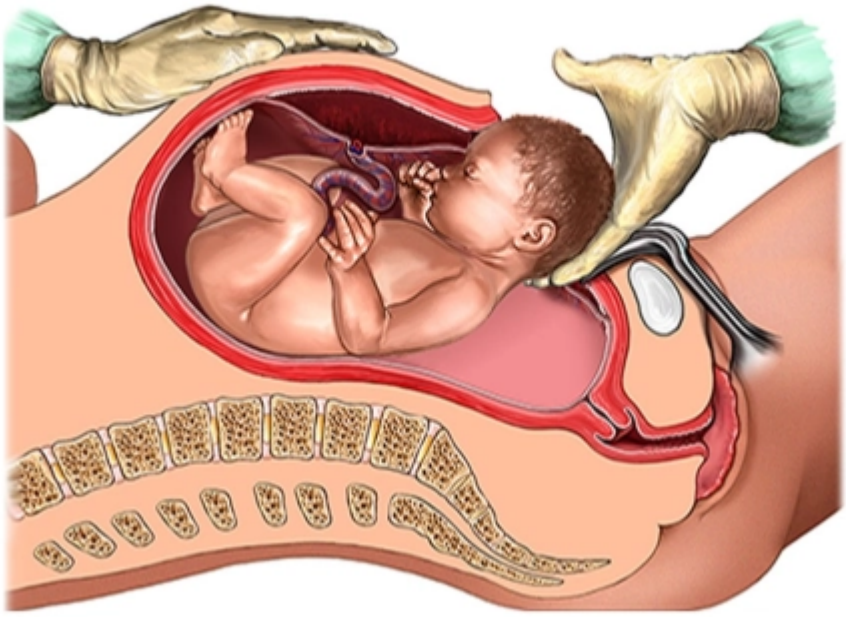
A blunt (digital) approach should be used.



Fetus delivery

Instrumental delivery (forceps/vex) has not yet been definitively evaluated.

Manual delivery always preferred.



Prevention of excessive blood loss

Misoprostol plus oxytocin or carbetocin is more effective than oxytocin alone for the prevention of postpartum haemorrhage (PPH) ≥ 500 mL in CD.

Tranexamic acid should be used prophylactically before surgery, especially in women with increased risk of PPH.

Gentle cord traction with uterine massage is recommended for spontaneous removal of the placenta.

Misoprostol
600 - 800 mcg sublingually or per rectum.

In combination with oxytocin

↓ blood loss

↓ the need to apply additional uterotonics

Recommended for patients with a higher risk of postpartum bleeding.

Tranexamic acid
It inhibits fibrinolysis, which supports the blood clotting system.

It should be used to prevent bleeding.

The half-life is 2-10 hours and it works immediately after intravenous administration.

TA 1 g or 10 mg/kg can be administered i.v. 10-20 min. before skin incision or spinal anaesthesia.

↓ intraoperative, postoperative and total blood loss

↓ need for additional uterotonics

↓ blood transfusion

↓ lower drop in hemoglobin

Prevention of uterine atony

Carbetocin 100 microgram single dose

- more effective prevention of uterine atony
- ↓ need for repeated doses, ↓ PPH, ↓ blood transfusion (compared with 8 or 16 h oxytocin infusion)

Carbetocin (if available) **should be preferred over oxytocin**
Higher dosage recommended for obese patients BMI ≥ 40, CAVE tachycardia,

hypotension, arrhythmia

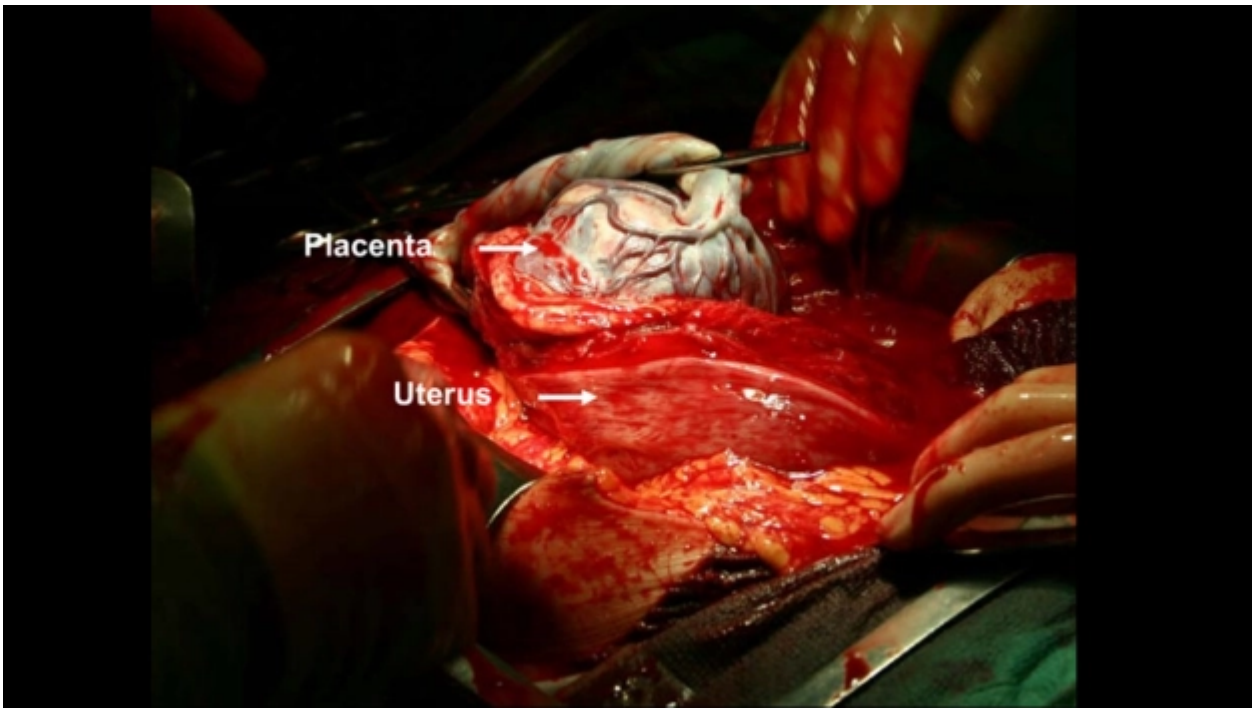
Delivery of the placenta in SC
Spontaneous with uterine massage and light traction of the umbilical cord

vs

Manual separation/delivery

Spontaneous with uterine massage and light traction of the umbilical cord

↓ blood loss (Hb, Hct)
↓ postoperative endometritis



Exteriorization of the uterus
vs Intra-abdominal placement

No difference in fertility or incidence of ectopic pregnancy 3 years after Caesarean section.

Exteriorization of the uterus for easier suturing of the uterotomy.

Cochrane review for **intra-abdominal uterine suture**

↓ incidence of fever ↓ operating time ↓ postoperative pain
↓ nausea/vomiting ↓ uterine atony

Both are acceptable

Caesarean section
Revision of the uterine cavity from remnants of the placenta and blood clots not necessary.

Cervical dilation is not associated with a reduction in postpartum bleeding, endometritis or fevers even in women with a closed cervix.

Treatment of uterine incision
Continued single-layer, full-thickness uterine closure/suture is recommended unless the woman is planning another pregnancy.

For women planning another pregnancy, especially after the first CD, it is more appropriate to close the uterus in two layers.

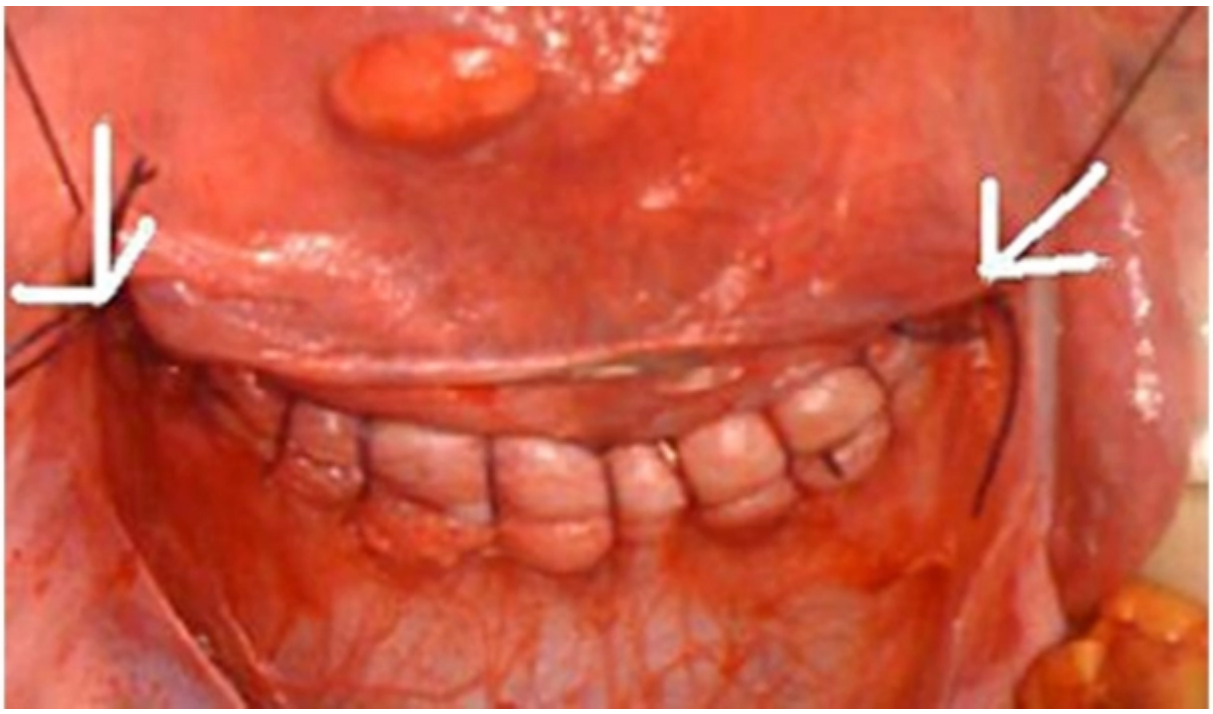
Suture of the uterus
Full-thickness uterine incision suture

↓ lower incidence of incomplete healing
↓ lower incidence of niches

(documented on transvag. US about 40 days after Caesarean section)

Running stitch vs knot stitch

↓operating time
↓blood loss



Caesarean section

Routine lavage of the abdominal cavity is not recommended.

Routine use of anti-adhesive agents is not recommended.

There is no evidence to justify the time taken and the cost of peritoneal closure, so it should be avoided.

Visceral/parietal peritoneum sutureNo suture

↓shortens the operating time (6 min.)
↓postoperative pain

A new peritoneum is formed in 24-48 hours from coelom cells. The peritoneum regenerates within 5-6 days.

The benefit of the peritoneal suture as a barrier, thereby reducing wound dehiscence and minimizing adhesions, has not been proven.

There is currently no evidence that suturing the peritoneum is necessary.

Suction drains
Minimize !

Drain:
↑ intra-abdominal infections
↑ bleeding
↑ soreness

Suture/approach mm. recti abdominis

- it is not necessary, they will find the right position themselves
- increased postoperative pain during movement

Fascia suture

- continuous suture with slowly resorbable material, non-locking, with 5-10 mm intervals

Continuous non-locking fascial closure with delayed absorbable suture at about 5 to 10 mm intervals should be considered.
Subcutaneous tissue should be irrigated and closed with sutures, especially if ≥2 cm in thickness. Routine drainage should be avoided.
The low transverse Caesarean skin incision should be closed with suture,

regardless of obesity status.

Subcutis
Subcutaneous suture > 2 cm vs no suture

- ↓ wound dehiscence
- ↓ seroma-type complications
- **Subcutaneous suture is recommended**

Redon's suction drain (Ø7 mm)

- the drain is taken out with one pole of the suture and is removed on the 1st day after SC
- not recommended

Caesarean section
Gum chewing after CD, typically three times/day for at least 30 minutes each time, is associated with earlier return of bowel sounds, passage of flatus and stool, and less ileus.

Early oral fluids and even food within 6–8 hours after CD is recommended.

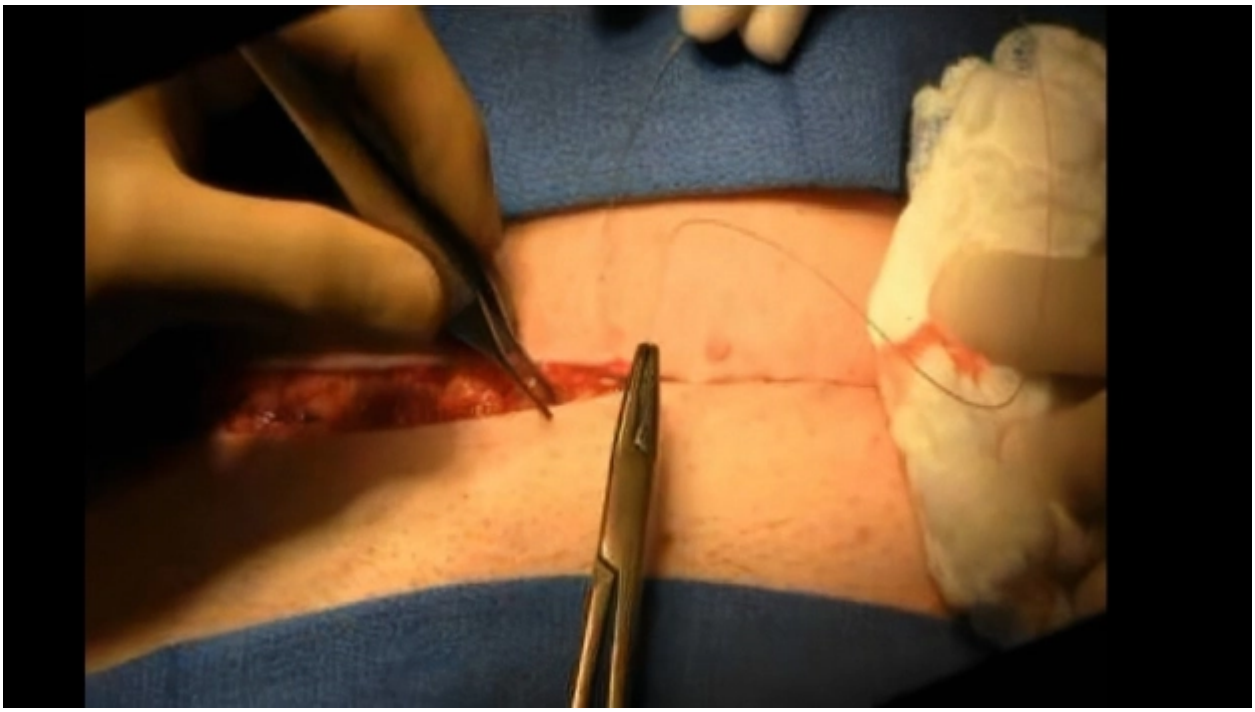
Nonsteroidal anti-inflammatory drugs (NSAIDs) and acetaminophen should be administered around the clock for post-CD pain relief. Wound infiltration with local analgesia and abdominal nerve blocks can also be utilized. Narcotics should only be used if and when these interventions do not control the pain.

Skin suture
Surgical staples

- they shorten the operating performance
- ↑ complication of surgical wound healing - requires stronger pain medication, increases the risk of dehiscence and early infection

Skin suture

- continued intradermal suture hurts less
- better cosmetic appearance



Enhanced recovery after surgery (ERAS) protocol

1. No intestine preparation strong evidence
2. Drink up to 2 hours before Caesarean section strong evidence
3. Light food up to 6 hours before Caesarean section strong evidence
4. Antibiotics strong evidence
5. Do not administer heparin routinely **weak evidence**
6. Remove Foley immediately after surgery strong evidence

7. Normal diet 2 hours after Caesarean section strong evidence
8. NO drain strong evidence
9. Fast verticalization strong evidence