

REVIEW ARTICLE

# Bladder injuries at caesarean section: risk factors and management

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## Abstract

Iatrogenic injury to the urinary bladder may occur during caesarean section (CS) due to the close anatomic proximity of the two organs. Risk factors predisposing to bladder injuries during caesarean deliveries include dense adhesions, CS in advanced/prolonged labour, failed instrumental deliveries, uterine rupture, and attempts to control bleeding following repeat CS. An awareness of the risk factors and mechanisms of injury should help the obstetrician prevent bladder injuries. Early recognition of injury and intraoperative repair during the primary surgery most often result in less morbidity for the patient and a more successful outcome.

**Keywords:** *bladder; lower urinary tract; caesarean section; injury*

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The word caesarean section (CS) is derived from two Latin words: *sectio*, meaning to cut and *cedere*, meaning to cut. There are other explanations for the origin of this word. Numa Pompilius, the second King of Rome, in 715 BCE, brought in a law which would forbid the burial of a pregnant woman unless her child had been removed from the abdomen and buried separately. This practice became known as Lex Caesarea in 200 BCE. At this time, the operation was only performed postmortem. Contrary to popular belief, Julius Caesar could not have been so delivered, for his mother, Aurelia, was alive when he invaded Great Britain [1].

It was in the 16th century that the real records of the CS began. The first recorded successful CS was performed by the Swiss swine gelder, Jacob Nufe, in 1588. His wife had a prolonged and obstructed labour, and he used his swine-gelding instruments to cut the baby out. His wife survived and had subsequent pregnancies. James Barlow was the first physician in England to perform a CS on a live patient in 1793, and she survived. After the advent of general anaesthesia in 1846, the rate of CS increased, but maternal mortality was very high. In 1882, Sanger described a technique of suturing the classical uterine incision, using two rows of sutures. This, along with the introduction of safer anaesthesia and antiseptic techniques, contributed to a reduction in maternal mortality.

The evolution of CS during the twentieth century, as a relatively safe procedure, has revolutionised obstetric practice. CS is now one of the most commonly performed surgical procedures globally, and the literature

indicates an increase in the frequency of this operation [2, 3]. Repeat sections have been a major contributor to the increased frequency as the number of patients with a previous CS keeps rising [3, 4].

Iatrogenic injury to the lower urinary tract may occur during pelvic surgery due to its close anatomic proximity to the reproductive organs. The bladder and distal ureters are the most commonly involved organs. CS have been associated with lower rates of urological complications than other types of pelvic surgery. However, as the urinary bladder is adjacent to the uterus, it is susceptible to intraoperative injury during CS. With the high prevalence of Caesarean deliveries, awareness of this complication is important to prevent maternal morbidity [5, 6].

## Method

A search of the Cochrane, Embase, and Medline databases was performed from 1990 to 2025 using key terms related to bladder, lower urinary tract, CS, and injury, with a focus on the English language. Publications in other languages were excluded. Publications that did not address risk factors or the management of bladder injuries were excluded. Publications focusing on ureteric injuries only were also excluded. Eligible studies described risk factors and/or management of iatrogenic bladder injuries during CS. Ninety-two eligible studies were identified and included in this narrative review. The rationale for choosing a narrative review is that it enables researchers to describe what is known on a topic while conducting a comprehensive, subjective examination of the entire

body of literature. Authors can explain the topic's current status, provide insights on advancing the field or view current evidence from different perspectives. This narrative review focuses on published identifiable risk factors and the current evidence-based management options available to clinicians when bladder injuries occur during CS.

### Incidence

The reported incidence of bladder injury at the time of CS ranges from 0.2 to 0.35%. Maureen et al. [7] reported 42 cases of bladder injury, with an overall incidence of 0.28%. Incidence in repeat CS was 0.56% and in primary caesarean deliveries was 0.14%. Eisenkop et al. [8] reported 23 cases of bladder injury with an overall incidence of 0.31% (0.6% in repeat sections and 0.19% in primary sections). Onura et al. [9] reported 10 cases of bladder injury in 4,622 CSs (0.21%) while Buchholz et al. [10] analysed 1,438 CS deliveries and reported 0.35% bladder injuries. Some authors reported a lower incidence of bladder injury at CS. Rajasekar and Hall [11] reported an incidence of 0.14% of bladder injuries in 11,284 Caesarean deliveries while Safrai et al. [12] analysed 17,794 CS deliveries over 14 years (2014–2018) at their institution and reported 14 cases of bladder injury an incidence of 0.08%. A recent systematic review by Wei et al. [13] in 2022 reported an incidence of 312 bladder injuries in 144,816 CS deliveries (0.27%). In summary, with the pooled results, the overall incidence of bladder injury during primary CS is about 0.2% and 0.6% for repeat CS.

### Risk factors

The literature review identified the following risk factors as being associated with a significantly higher chance of intraoperative bladder injury [14].

- Prolonged or obstructed labour with bladder distension
- Pregnancy with scarred uterus, for example previous Caesarean birth, myomectomy, reconstructive surgery to repair a uterine congenital anomaly, or repaired uterine perforation.
- Intra-abdominal adhesions, for example previous ectopic pregnancy, endometriosis, inflammatory bowel disease, chronic pelvic inflammatory disease.
- Distorted pelvic anatomy – by masses such as cervical or lower uterine segment fibroid and congenital urogenital anomaly.
- Caesarean birth in advanced labour and emergency CS for failed instrumental delivery
- Placenta accreta spectrum
- Caesarean hysterectomy or concurrent uterine rupture
- Repeat CS (especially >3 CS)

Caesarean hysterectomy causes about 1–4% of bladder injury [15] and CS in women with PAS doubles the risk of bladder injury [16]. Women with >3 previous CS are 5 times more prone to injury than women with one previous CS [17, 18]. Emergency CS has a higher chance of bladder injury compared to elective CS (31% vs. 11%). CS in labouring women also carries more risk of bladder injury compared to non-labouring women (83% vs. 61%) [19]. Consideration should be given to minimising the chance of injury with adequate intrapartum bladder care, careful adhesiolysis, and the presence of a suitably experienced clinician in the operating theatre. The surgical skill of the operator is a contributing factor in some cases, as Rajasekar and Hall [11] reported that a significant number of injuries happened during the early hours of the morning when the junior doctor is often without direct supervision. Other factors such as labour induction, chorioamnionitis, foetal position, gestational age, and maternal illnesses were found to be non-significant [7].

### Mechanisms of injury

The majority of the bladder injuries which occur during Caesarean are intraperitoneal injuries to the dome of the bladder, 6–10 cm away from the trigone. Intraperitoneal injuries are generally more significant and involve a higher risk of complications than extraperitoneal injuries [5]. The bladder injuries occur due to:

1. Surgical difficulty encountered while developing the bladder flap over the lower uterine segment. The difficulty is usually caused by scar tissue from previous surgery [6].
2. Inadvertent cystotomy during uterine incision is another common cause [20].
3. Extension of the uterine incision into the bladder may occur along with the extension of the incision into the cervix or vagina.
4. Bladder injury due to incision into the vagina rather than the lower uterine segment has also been reported [4]. With an effaced and dilated cervix, the vagina was mistaken for the lower uterine segment, and it was difficult to separate the bladder from the vagina.
5. Bisection of the bladder during CS and delivery through the bladder has also been reported [4, 10]. The posterior wall of the bladder, completely emptied of urine, was mistaken for the uterine peritoneum and was sectioned transversely.

An awareness of the above risk factors and mechanism of injury should assist the obstetrician in preventing injuries to the urinary tract and take steps to avoid bladder injuries during CS [7, 11, 12]. Sorinola et al. [21] described these prevention strategies in detail (Table 1).

**Table 1.** Prevention of urinary tract injuries during caesarean section

- The bladder should be adequately drained by a Foley's catheter before a caesarean section.
- The peritoneal cavity should be entered at the most superior aspect of the abdominal incision, especially in patients undergoing repeat caesarean section.
- Careful, sharp dissection should be used to mobilise the bladder flap adequately in patients with extensive scarring between the bladder and the lower uterine segment. This provides better visualisation of the lower uterine segment and moves the ureters out of the field.
- The lower uterine scar should be pointing upwards at each end.
- While attaining haemostasis, it is best to use compression on the bleeding area rather than blind haemostatic sutures.
- The uterus can be exteriorised for better exposure during suturing.
- If there is any suspicion of ureteric injury, it is best to involve a urologist.

### Intraoperative recognition/classification of bladder injury

Most bladder injuries are grossly apparent intraoperatively [5–8]. A red, vascular appearance of the muscularis, urine draining through the bladder dome or in the operative field, visualisation of the transurethral Foley's bulb, and haematuria are telltale signs of bladder injury. If there is any suspicion of injury, it can be confirmed by instillation of diluted dye (methylene blue) through the transurethral catheter into the urinary bladder and observing the coloured leak. If a significant or posterior injury is suspected, cystoscopy, ureteric catheterisation, or indigo carmine intravenous administration should be performed by a urogynaecologist and/or urologist.

Bladder injuries are graded according to the American Association for the Surgery of Trauma [22] as follows:

Grade 1: Contusion, intramural hematoma or partial thickness laceration

Grade 2: Extraperitoneal bladder wall laceration <2 cm

Grade 3: Extraperitoneal >2 cm or intraperitoneal <2 cm laceration

Grade 4: Intraperitoneal bladder wall laceration >2 cm

Grade 5: Intra or extraperitoneal bladder wall laceration extending into the trigone or bladder neck

### Management

Early recognition of bladder injury and repair during primary surgery most often results in less morbidity for the patient, a more successful outcome and increased ease of repair [13].

The first step in the management of unplanned cystotomy is a thorough evaluation of the extent of damage, including the size and location of the injury, and a determination of whether the trigone or ureters are involved. Most injuries are located in the dome of the bladder and do not involve the trigone or ureters, and can be repaired immediately. Exceptions to immediate repair include some cases of placenta accreta spectrum or intractable post-partum haemorrhage, in which case the injury can be repaired in stages after controlling the bleeding. Figure 1 details the algorithm for managing bladder injury according to the grade.

### Grades 1–2

Grade 1 injuries limited to the serosa and Grade 2 injuries should be managed conservatively with prolonged drainage with an indwelling transurethral catheter for at least 10–14 days. These do not typically warrant surgical management.

### Grade 3

Simple cystotomy in the dome is closed in two layers with non-locking absorbable sutures such as Polyglactin suture (Vicryl) 2–0/3–0. In the absence of this suture, in resource-poor settings, atraumatic chromic catgut no 2–0 can be used. The first layer closes the mucosa and muscularis, and the second layer closes the serosa. The integrity of the repair should be checked with at least 300 mL of saline with dye (e.g., methylene blue), which is instilled into the bladder through a transurethral Foley's catheter to confirm a watertight repair. If there is leakage of dye, a top-up third layer of imbricating (overlapping) sutures should be considered to achieve a watertight closure. The effectiveness of the repair should be confirmed by further bladder-filling assessment and/or cystoscopy. If leakage is present through sutures, a urologist should be requested to attend. Postoperatively, an indwelling transurethral catheter should be used for at least 10–14 days to drain the bladder. If an additional abdominal drain is used to identify urinary leakage in the pelvis, this can be removed within 48–72 h if the output remains minimal. If there is high volume output, consider sending a sample of the fluid for assessment of creatinine to compare to plasma levels and/or radiological imaging of the urinary tract.

### Grade 4–5

A minority of injuries extend to the trigone or ureters. The repair of extensive damage will require the assistance of a urologist, and ureteral integrity must be confirmed prior to repair of the cystotomy. This may be done by injecting 5 mL of indigo carmine dye intravenously and visualising bilateral spill of the dye from the ureteral orifices directly through the cystotomy defect. If the spill of the dye is symmetric and no dye is noted in the

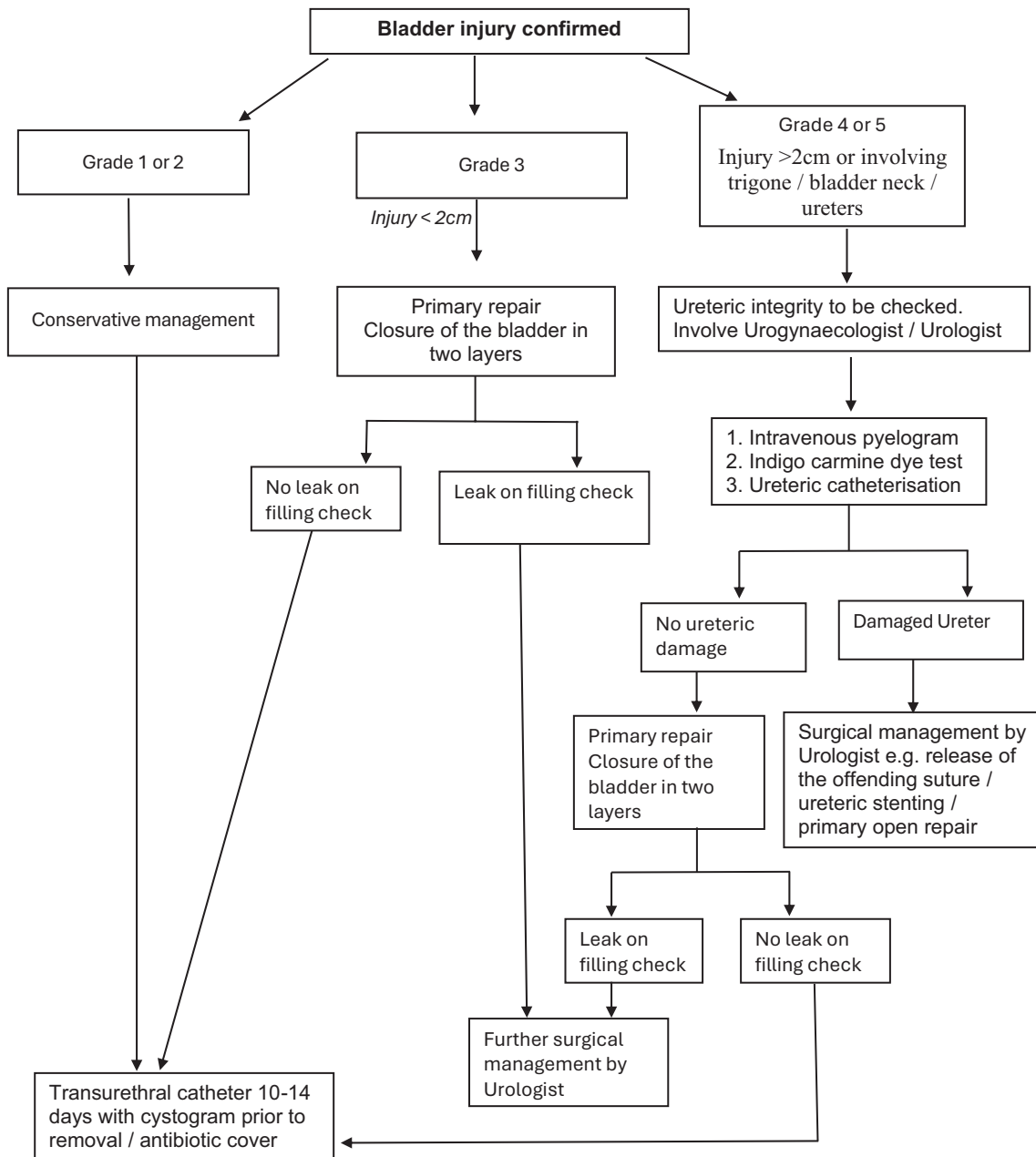


Fig. 1. Schematic flow chart for the management of intra-operative bladder injuries at the Caesarean section.

retroperitoneal space, the bladder defect can be closed, with care taken not to damage the ureters.

Alternatively, ureteric catheters can be passed in a retrograde manner through the ureteric orifices. Passage to the renal pelvis ensures ureteral patency; however, partial ureteral transections may not be diagnosed by this method. An intraoperative intravenous pyelogram (IVP) may confirm ureteral integrity if dye can be traced in both ureters to the bladder. If ureteric injury is noted, a urologist's assistance will be required.

#### Delayed identification of bladder injury

A bladder injury that was not identified at the time of CS or where the primary repair has been unsuccessful will usually present clinically in the early postoperative period. Signs can include drainage from the surgical incision, increased output from surgical drains, vaginal leakage of urine, abdominal distension secondary to ileus or urinary ascites, and oliguria. A CT cystogram can be used to confirm the diagnosis. A urology specialist should perform any delayed or secondary repair.

### Genito-urinary fistulae

Bladder injuries, if unrecognised, may give rise to vesico-vaginal and vesico-uterine fistulae. Vesico-uterine fistulae may develop immediately after CS, manifest late in the puerperium, or occur after repeated procedure [23]. The fistulous communication is usually between the posterior supratrigonal part of the bladder and the anterior lower segment of the uterus or, rarely, the cervix. Delayed fistula formation may result from infection, devascularisation, clamping, or hematoma formation in the urinary bladder. Repeat CS may cause progressive devitalization and scarring of the bladder base, injuring its vascular network, hence a fistulous tract [23]. Typical presentations are vaginal urinary leakage, cyclical haematuria (menouria), amenorrhoea, infertility, and first-trimester abortions. Imaging investigations include cystography, hystero-graphy, intravenous pyelography, computed tomography, and magnetic resonance imaging. Spontaneous healing is reported in 5% of cases [22]. Conservative management by bladder catheterisation for at least 6–8 weeks is indicated when the fistula is detected just after delivery, since there is a good chance for spontaneous closure. Surgery is the mainstay of treatment, with pretreatment for urinary tract infections. It is advisable that after fistula repair, delivery should be performed by repeat CS.

### Conclusion

This narrative review has highlighted the importance of understanding the risk factors and mechanisms leading to bladder injuries at CS, and even though CS is associated with lower rates of urological complications than other types of pelvic surgery, the high prevalence of Caesarean deliveries makes awareness of this complication a very important obstetric issue. There are some limitations of the review, including limitations to the English language and not including papers that discussed ureteric injuries only, but might have also discussed risk factors that apply to bladder injuries. Furthermore, most papers described what happens in a developed world context and setting with the availability of all necessary equipment, investigations, infrastructure, and support. However, we believe most of our findings, prevention strategies, and key practice points are applicable globally and will help in reducing morbidity in these cases. A summary of the key practice points is presented further in the text.

### Key practice points

- Injury to the urinary tract during CS is not that common but knowledge of the obstetric, surgical, and anatomical factors that can predispose to injury is the key to prevention.
- The majority of bladder injuries are easily recognised, and early treatment will reduce morbidity and the risk of fistula formation.

- The site, size, and grade of the injury should be clearly documented as along with details of the surgical repair and the technique used.
- Appropriate follow-up should be instituted to make sure that the bladder injury has healed completely.

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