INTRAOPERATIVE INJURIES OF THE URINARY TRACT SYSTEM DURING CAESAREAN SECTION: ARTICLE REVIEW

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Abstract

During obstetric or gynecologic surgery, urologic injuries are the most common, with the most often damaged organ being the bladder. Previous caesarean deliveries, adhesions, emergent caesarean deliveries, and caesarean sections done during the second stage of labour are risk factors for bladder damage during caesarean sections. The majority of bladder injuries are identified during surgery, which is crucial because prompt identification and treatment are linked to a markedly lower patient death rate. While caesarean sections are the cornerstone of obstetrics, there is a dearth of evidence in the literature to support or refute particular procedures that are used in practice today. Urinary tract damage is a caesarean section complication that is infrequently documented in the literature. Furthermore, although bladder flap formation is a common procedure during caesarean sections, there is little evidence to support its use in lowering the risk of bladder injury. Thus, the current study set out to assess the causes, identification, and management of urinary tract injuries sustained after caesarean sections.

Keywords: Urinary Tract injuries; Intraoperative Injuries; Caesarean section

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INTRODUCTION

When a caesarean section (CS) is performed, the nearby urinary bladder is one location that can sustain intraoperative damage. Predisposing variables for bladder injury after caesarean surgery include advanced labour, prolonged labour, scarred uterus, intraabdominal adhesion, emergency CS, and caesarean hysterectomy, among others. When performing surgery under such circumstances, one should be careful to consider the risk of bladder damage **(1)**.

Over 30% of deliveries in the US happen via caesarean section, making it the most prevalent surgical procedure. Given the declining rates of primary caesarean delivery at the request of the mother and vaginal birth after caesarean section (VBAC), which involves an inherent risk of intraoperative problems, this number is anticipated to rise **(2)**.

To reduce the risk of bladder injury during caesarean section, there is evidence to support double-layer closure of the hysterotomy, routine use of adhesive barriers, and executing a Pfannenstiel skin incision rather than a vertical midline subumbilical incision **(3)**.

Since caesarean sections have been performed on a much higher number of babies in recent years, more people are anticipated to experience pelvic minor adhesions on a more regular basis. The biggest cause of bladder injury risk factors are intrauterine adhesions. Relatively seldom can a caesarean section cause injury to the bladder. Anticipating the potential for this complication, diagnosing it early during surgery, and administering the proper care when it does arise, however, is crucial **(4,5)**.

While, there has been a substantial decrease in maternal morbidity and death rates following caesarean sections over the past century, an increasing number of urological complications are predicted to occur. The most frequent urological consequence following a caesarean section is bladder injury **(6)**.

RISK FACTORS

In the bladder damage group, 60% of the women had adhesions, while in the control group, 10% had them ($P < 0.01$). Naturally, as the number of caesarean deliveries rises, so does the rate of cystotomy: 0.13% for the first, 0.09% for the second, 0.28% for the third, 1.17% for the fourth, 1.94% for the fifth, and 4.49% for the sixth caesarean delivery **(7).**

Similar to previous studies, bladder injury was more likely to occur with emergent delivery (31% versus 11%). This suggests that, in some cases, delivering a distressed foetus quickly may not necessarily come before precise and cautious dissection. Additionally, individuals who underwent caesarean sections during labour had an increased risk of bladder damage (83% versus 61%). Failed TOLAC (Trial of labour after caesarean section) was more common in the bladder damage group (64% versus 22%) among individuals who had previously undergone a caesarean delivery. In comparison to 0% of controls, concurrent uterine rupture was observed in 14% of bladder injuries. Finally, 60% of patients with bladder injury were found to have adhesions at the time of repeat cesarean delivery versus the 10% of controls. No statistically significant differences were found regarding type of uterine incision (classical versus low vertical), induction of labor, presence of chorioamnionitis, fetal position, gestational age, or maternal illnesses **(7).**

Secondary to adhesive disease developed at the index surgery, previous caesarean delivery has been revealed to be a substantial risk factor for bladder injury. Following an initial caesarean delivery, the incidence of adhesion illness varies from 46 to 65%. Though most surgical adhesions form right away at the moment of operation, they can persist for up to one month following surgery. Fibrin, coagulation factors, and inflammatory cells all play a part in the intricate pathophysiology of adhesion creation, which involves healing the injured peritoneum. Adhesiolysis, tissue ischemia, severe tissue manipulation, infection, and increased blood loss during surgery are risk factors for the development of adhesions **(8).**

Bladder injury is also affected by when a caesarean birth occurs during the first or second stage of labour. When a caesarean delivery occurs in the second stage of labour as opposed to the first, the likelihood of an inadvertent cystotomy rises (0.4% versus 0.1%, respectively). P value (.004). These results are influenced by several distinctions between caesarean sections performed in the first and second stages of labour. The attempt to displace and remove an infant that may be secured in the true pelvis might result in considerable surgical trauma around the bladder for women undergoing caesarean delivery for an arrest disorder, notably arrest of descent. Furthermore, it is often more difficult to delineate the bladder from the lower uterine segment in a uterus that has been labored. Although incidental cystotomy was found to be higher in patients who were undergoing cesarean delivery during the second stage of labor,

this finding was still rare (0.4%). These findings should not lead one to prematurely counsel a patient toward cesarean delivery in order to mitigate an insignificant complication if the patient has not had an adequate trial of labor **(8).**
Finally, the risk of bladder injury in women who had a previous cesarean delivery does not appear to be affected by the planned mode of delivery. This is an important point, as women who are considering a TOLAC require extensive counseling, and physicians must be aware of the risks and benefits of TOLAC **(9)**.

In a multicenter retrospective study that looked at over 25,000 previous cesarean deliveries in which they calculated that the risk of bladder injury was 0.43%. They determined there was no difference in risk for bladder injury between TOLAC and elective repeat cesarean delivery (0.44% compared with 0.42%), they did determine that the absolute risk of bladder injury in patients with previous cesarean delivery increased as follows: successful VBAC (0.2%), elective repeat cesarean delivery after one previous cesarean (0.3%), elective repeat cesarean delivery after more than one prior cesarean delivery (0.7%), unsuccessful TOLAC (1.1%)**.** Unsuccessful TOLAC to be associated with the highest incidence of bladder injury **(10)**. Regarding composite maternal risk, VBAC is still associated with fewer maternal complications, and an unsuccessful TOLAC is associated with more complications than elective repeat cesarean delivery. Nevertheless, the overall risk of bladder injury is still small at only 1.1%. These results are not significant enough to dissuade women who desire TOLAC **(8).**

DIAGNOSIS AND MANAGEMENT

A bladder injury during a caesarean section most often occurs at the dome of the bladder, accounting for 95% of cases; the remaining 4% occur at the trigone. The average length of an injury to the bladder is 4.2 cm (1–10 cm). The most common time an injury occurs is when a bladder flap is being created (43%), followed by entry into the peritoneal cavity (33%), and uterine incision or delivery (24%) **(11).**
Recognition of bladder injury is imperative in order to take measures during surgery to repair this complication, as inadequate diagnosis and treatment at the time of surgery may lead to grave ramifications. The most important prognostic factor of bladder injury is intraoperative recognition and surgical correction. Injuries repaired intraoperatively have a high likelihood for a return of normal urologic function. failure to diagnose a bladder injury during surgery may later lead to vesicovaginal, vesicouterine, or ureterovaginal fistula**.** Although bladder injury at the time of cesarean section is infrequent, most of the injuries are fortunately identified at the time of surgery - 62% of injuries are identified at the time of delivery of the infant and repair of the hysterotomy**.** Twenty-one (21) % of bladder injuries are recognized during the creation of the bladder flaps, 12% during entry into the peritoneal cavity, and 5% prior to fascial closure **(11).**

Extravasation of urine, the appearance of the Foley bulb, extensive hematuria in the Foley bag, and apparent laceration of the detrusor muscle are among the several intraoperative signs that point to bladder injury. Using a urethral catheter, sterilised milk, methylene blue, or indigo carmine can be injected into the bladder. The surgeon can locate the damage and determine its location thanks to the extravasation of this substance from the bladder. Until there is no more fluid leaking, surgeons may continue to implant these compounds; at that time, bladder integrity can be verified **(12).**
After recognizing an unplanned cystotomy, the first step should be to thoroughly examine the defect to determine the extent of the injury. An important consideration is to determine whether the trigone or ureters have been affected by the cystotomy. As previously demonstrated, most bladder injuries that occur during the time of cesarean occur at the dome of the bladder and are easily repaired with a layered closure**.** If there is concern whether there may have been ureteral involvement in the injury, then the obstetrician may consider having the anesthesiologist inject 40 mg of Indigo carmine into the patient's IV to examine for extravasation of dye proximal to the bladder, which would suggest ureteral injury. To reiterate an important point, if there is ever concern for possible ureteral injury that may be out of the scope of practice of the individual surgeon then urology should be consulted intraoperatively (**13).**

Various methods have been described on how to perform bladder closure. A simple cystotomy is normally repaired in two to three layers, with the first layer consisting of a simple running closure of the mucosa with a 3–0 absorbable suture **(12)**.
It is important to note here that the use of permanent suture, especially silk, is contraindicated, as it can serve as an impetus for stone formation. The second layer may be closed with a running imbricating stitch using either 2–0 or 3–0 absorbable suture to include the submucosa and muscularis. In order to confirm bladder

integrity, one may back fill the bladder with sterile milk or methylene blue dye. Two advantages of using the former material are that it is readily available on labor and delivery, and it does not stain tissue like methylene blue, which may limit one to detect the presence of a recurrent leak **(12)**. After bladder integrity is confirmed, the surgeon may consider placing a third running stitch of absorbable suture if the serosal margins can be approximated. The bladder should be continuously drained with the use of a Foley catheter for at least 7–10 days postoperatively. Upon removing the Foley catheter, one does not need to obtain a voiding cystourethrogram unless extensive repairs are performed **(14)**.

Overall the febrile morbidity has not been found to be statistically significant in comparing patients who had a bladder injury to those who did not have a bladder injury **(15)**. As a result, there is no evidence at this time to support the use of prophylactic antibiotic therapy for incidental cystotomy. Providers need to individualize their practice based on the clinical scenario but keep into consideration concerns with providing unnecessary antibiotic treatment with regards to facilitating the growth of drug-resistant organisms. Providers may consider obtaining a terminal urinalysis and culture to determine need for antibiotic therapy **(15)**.

The discussion of ureteral damage and repair is more extensive and outside the scope of this article. Ureteral injuries occurring proximal to the bladder or within the latter third of the course of the ureter are typically repaired by performing an ureteroneocystostomy **(16)**. The most important principle of this repair is to ensure there is no tension on the ureter. Surgeons may consider performing a Psoas hitch, which helps mobilize the bladder closer to the side of ureteral injury in order to facilitate a tension-free repair, which is associated with better repair rates **(17)**.

Although uncommon, incidental cystotomy may be missed at the time of surgery. There are multiple signs and symptoms suggestive of bladder injury that can manifest in the early postoperative period such as hematuria, oliguria, lower abdominal pain, ileus, ascites, peritonitis, sepsis, fistula, and elevation of the blood urea nitrogen/creatinine ration**.** Retrograde cystography is a useful diagnostic procedure to consider in postoperative patients who are stable and may have potential evidence for urologic injury. Providers may also use the stress cystographic technique, as small injuries may not be identified unless some pressure is placed over the bladder. Abdominal CT with cystography is a valuable tool to use in patients with acute abdominal pain who may also have findings of bladder injury. Finally, one should always consider exploratory laparotomy for patients who are unstable or where there is high suspicion for bladder injury **(18)**.

PREVENTION

1- Adhesions

Adhesions at the time of cesarean delivery are among the most important sources for bladder injury secondary to a distortion of normal anatomy and difficulty dissecting through dense adhesive disease**.** Surgeons can use various techniques during cesarean section to lessen the chance of creating adhesive disease. Techniques that may reduce adhesions include respect of tissue during dissection, avoidance of increased blood loss, and maintenance of tissue moisture. Closure of the hysterotomy and peritoneum may also play a role in adhesion formation **(19).**

Hysterotomy incisions are currently closed either in a single- or double-layer closure. Some argue that double-layer closure leads to better hemostasis, but one of the most convincing arguments for double-layer closure is to prevent uterine rupture in a subsequent trial of labor **(20).** Double-layer closure is an important consideration when performing a cesarean section on a woman who may be a candidate for a trial of labor in a future pregnancy to prevent her risk for uterine rupture in a subsequent TOLAC. Regarding urologic injury, the choice of closing the hysterotomy with single- versus double-layer may also be a factor in the future prevention of bladder injury. When controlling for confounders, single-layer hysterotomy closure has been found to have a nearly sevenfold increase in the odds of developing bladder adhesions when compared with double-layer closure **(21).**

Double-layer closure likely reduces the exposure of raw surgical surfaces, which can lead to fibrosis and adhesion formation**.**There are no studies that comment specifically on the type of hysterotomy closure relating to bladder injury. One may assume that increasing adhesions proximal to the bladder will inherently increase the risk for bladder injury during subsequent cesarean delivery. As a result, it may be beneficial to perform double-layer closure to decrease the risk of bladder injury. More research is needed to support this claim. **(21).**

Peritoneal closure during cesarean section is a controversial topic, as there is conflicting opinion on whether this step decreases the adhesion rate. A

Cochrane review examining nine trials demonstrated not closing the peritoneum has been found to show improved short-term benefits such as shorter operative time, decreased postoperative fever, and decreased postoperative hospitalization**.** There was no difference in adhesive disease if the surgeon closed both the parietal and visceral peritoneum **(22).**

A systematic review and metaanalysis that demonstrated that there is a 2.6% increased risk for adhesion formation in patients who did not have closure of the peritoneum versus patients who had closure of the peritoneum (OR 2.6, 95% CI 1.48–4.56)**.** These findings were similar to those demonstrated, which showed parietal peritoneal closure at primary cesarean delivery was associated with a nearly fivefold decreased risk for adhesions (OR 0.20, 95% CI .08–0.49). The current conflicting data with no evidence examining the long-term effects of closing the peritoneum provides limited evidence to justify peritoneal closure at this time **(23)**.
There are multiple adhesive barriers {Seprafilm (Genzyme Biosurgery, Framingham, MA, USA); Interceed (Ethicon, Johnson & Johnson Company, USA)} on the market today that are theorized to mitigate the formation of adhesions. Multiple studies have demonstrated that adhesive barriers placed at the time of laparotomy are beneficial in reducing the risk of adhesion formation. Additionally, a retrospective cohort study recently identified that the use of adhesive barriers in comparison with no use of adhesive barriers was found to have a significant reduction of adhesions at the time of the next surgery. Two hundred and sixty-two women who had a primary cesarean delivery were followed with 43% of women having repeat cesarean delivery. Of these 112 women, 74% who had an adhesive barrier placed at the initial surgery were found to have no adhesions at the time of repeat cesarean delivery. However, only 22% of women who did not have an adhesive barrier were found to have no adhesions at repeat cesarean delivery (P = 0.011) **(24)**.

2-Bladder Flap

There are many variations in surgical technique during cesarean section with one of the most controversial being whether to create a bladder flap. The bladder flap is created by first identifying the vesicouterine peritoneum and then making a horizontal incision just superior to this line to allow the surgeon to push the bladder caudally. Although one may think the initial reason to perform a bladder flap was to prevent urologic injury, in actuality surgeons initially created a bladder flap to prevent spread of intrauterine infection to the peritoneal cavity during the preantibiotic era**.** A secondary benefit of the bladder flap was then believed to prevent injury to the bladder at time of delivery. There is no evidence to support this claim **(25)**.

A small randomized clinical trial (n=102) showing the omission of a bladder flap leads to a reduction in the time from incision to delivery, reduced blood loss, and decreased need for analgesia. This study did not determine whether bladder flap creation has any effect on bladder injury, as the required sample size would have to be over 40,000 to show statistical significance since the rate of bladder injury is so small, conducted another small, randomized clinical trial (n = 258) that examined the utility of the bladder flap with the primary outcome looking at total operating room time. Secondary outcomes were bladder injury, incision-to-delivery time, incision-to-fascia time, estimated blood loss, postoperative microhematuria, postoperative pain, hospital days, endometritis, and urinary tract infections. They identified that omission of the bladder flap at both primary and repeat cesarean deliveries does not increase intraoperative or postoperative complications. However, this study also did not power their study to demonstrate whether omission of the bladder flap decreased the rate of bladder injury **(25)**.

Although at this time there are no studies demonstrating whether creating a bladder flap reduces the incidence of bladder injury, there are theoretical reasons why one could argue against bladder flap creation. One of the most convincing arguments against the creation of a bladder flap is that most bladder injuries occur while attempting to create a bladder flap **(26).** Hysterotomy is created just above the vesicouterine peritoneal fold, and then the bladder naturally descends from the hysterotomy. Forgoing the creation of a bladder flap also leads to less bleeding and vascular injury. This limits the need for hemostatic sutures, which are often placed in close proximity to the bladder. At this time there is no definitive data to argue for or against bladder flap creation with regards to bladder injury. A significantly large study would be required to determine statistical significance. The data suggests that one may argue against routinely creating a bladder flap during cesarean section unless there is a specific indication for bladder dissection **(27)**.

CONCLUSION:

Nowadays, caesarean sections are the most common obstetric procedure performed worldwide, with an annual rise in their number . Over the past century, reduced rates of maternal illness and mortality have been linked to caesarean deliveries. Urologic injury, however, is the most frequent side effect of pelvic surgery; bladder injuries are said to be the most common organ injuries after pelvic surgery.

In light of this, obstetricians and their patients need to be informed about the possible risks involved in performing this surgery. The intraoperative complications of a caesarean operation are influenced by a number of characteristics, including gestational age, parity, and mother age. If there are several probable damage approaches, they can be used to diagnose a bladder injury.

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