



ORIGINAL ARTICLE

## Intraoperative Urinary Tract System Injuries during Caesarean Section: A Retrospective Analysis

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Submit Date 16-11-2023

Revise Date 28-11-2023

Accept Date 04-12-2023



### ABSTRACT

**Background:** Maternal mortality rates have been linked to caesarean deliveries. Urologic injury, on the other hand, is a frequent side effect of pelvic surgery. The aim of the present study is to determine the causes, types and treatment of the urinary tract injury during caesarean section.

**Methods:** This retrospective study was carried out on a total of 15220 cesarean sections which were done through last five years, from which only 94 (0.618%) women had urinary tract (UT) injuries. **Results:** There is a significant difference between the two groups regarding age and BMI. There is a significant difference between the two groups regarding parity, number of prior cesareans, adhesions and history of previous gynecological surgery. There is a significant difference between the two groups regarding timing of delivery, station  $\geq 1$  and uterine rupture, ruptured chorionic membranes, skin incision to uterine incision and estimated blood loss. BMI, previous pelvic surgery, higher parity, adhesions and repeated CS were found to significant risk factors for urinary tract injury during CS. **Conclusion:** The incidence of bladder injury during caesarean section is relatively infrequent. The most significant risk factor for bladder injury during caesarean section is previous cesarean delivery due to adhesive disease.

**Keywords:** Caesarean section; Urinary Tract System; Intraoperative Injuries **Keywords:** Conjunctival autograft, suture, glue, autologous blood.

### INTRODUCTION

One well-known side effect of obstetric procedures, particularly caesarean sections, is urinary tract injury. Early repair is made possible by intraoperative injury diagnosis, which also may reduce postoperative problems such as patient morbidity and expense. Failure to diagnose urinary tract injuries promptly can lead to the development of genitourinary fistulas, kidney damage, sepsis, and even death [1]. The two most significant risk factors for urinary tract injuries following caesarean sections are

repeated caesarean operations and any kind of morbidly adhered placenta [2].

The most frequent injury to the urinary organs is a bladder injury, while partial or total ureteric stricture can also result in harm. When the peritoneum is opened, bladder damage may result, particularly if prior surgery was performed to securely attach the bladder to the anterior side of the uterus and if caution was not exercised to empty the bladder with a catheter before surgery. The bladder or the area where it connects to the uterine vessels is the most common location

for ureteral damage. The risk of ureteric damage rises following a hysterectomy [3,4].

The prevalence of urinary tract injuries is higher in patients with endometriosis, pelvic infections, history of pelvic abdominal surgery, pelvic masses, pelvic malignancies and congenital urinary system defects [5]. The most frequent ureteric injuries are ligation and transection, although there are also potential for heat injury, kinking, devascularization and perforation. Urine leaks immediately during the first 24 hours of complete ureteric dissection, whereas ligation and thermal damage take time to manifest after tissue necrosis [6,7].

Low gestational age (less than 32 weeks), preterm rupture of membranes, prior caesarean section and the experience of the surgeon-obstetrician are the most significant factors shown to be associated with urinary tract injuries during caesarean delivery [8].

The most common reason for urinary tract injury following caesarean section is adhesions of the abdominal wall, bladder and uterus with the parietal peritoneum. The peritoneum is repaired by fibrin, clotting factors and inflammatory cells throughout the intricate pathophysiology of adhesion formation [9]. Additionally, urologist consultation is required for the assessment of the extent of damage to the bladder trigone and ureter [10, 11]. Therefore, this study aimed to determine the causes, types and treatment of the urinary tract injury during caesarean section.

## METHODS

The Retrospective study was carried out in Department of Obstetrics and Gynecology at Zagazig University Hospitals, from patient files saved in the hospital for the last 5 years. The period of study was performed from 2018 till 2023. Inclusion criteria were pregnant women in whom caesarean section was the mode of delivery. While exclusion criteria were pregnant females with known urinary tract diseases as tumors, ureteric fistula from

trauma, radiation therapy and granulomatous infection. For ethical consideration, an approval of the study was obtained from Zagazig University Academic and Ethical Committee. Written informed consent of all the participants was obtained (IRB#: 6012-5-3-2020). This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Each case that satisfied the requirements for inclusion underwent the following: Reviewing the records of patients who had caesarean sections. Completing a full medical history, covering personal, past, present and family information; obstetric (containing information about the last pregnancy, such as Gravida, term pregnancies, premature births, abortions, live births and multiple gestations and births); contraception and menstruation history. Gestational age is assessed by means of last menstrual period (LMP) and ultrasonography from records.

Evaluation of surgical and obstetrical details; mechanism of UTI; anatomical site; diagnosis; treatment and surgical result.

Statistical analysis: Using Microsoft Excel software, data was examined. The Statistical Package for the Social Sciences (SPSS version 20.0) programme was then used to import the data and analyse it. Contingent on the type of data, mean±SD is used to represent the group in quantitative data, while numbers and percentages are used in qualitative data. variations between independent multiples that are quantified using ANOVA. For significant results, the P value was set at <0.05, and for highly significant results, at <0.001.

## RESULTS

A total of 15220 cesarean sections which were done through last five years, from which only 94 (0.618%) women had urinary tract(UT) injuries (Table 1,2).

There a significant difference between the two groups regarding age and BMI (Table

3).There is a significant difference between the two groups regarding parity, number of prior cesareans, adhesions and history of previous gynecological surgery (Table 4).There is a significant difference between the two groups regarding timing of delivery, station  $\geq 1$ , and uterine rupture, ruptured

chorionic membranes, skin incision to uterine incision and estimated blood loss (Table 5).BMI, previous pelvic surgery, higher parity, adhesions and repeated CS were found to significant risk factors for urinary tract injury during CS (Table 6).

**Table (1):** Monthly CS deliveries through study period

Month	2018	2019	2020	2021	2022	Total
January	300	280	304	243	294	1421
February	300	260	243	209	243	1255
March	293	271	212	271	236	1283
April	317	229	231	208	222	1207
May	331	219	197	244	247	1238
June	295	311	185	285	265	1341
July	217	347	264	308	274	1410
August	308	342	276	319	302	1547
September	307	365	282	323	303	1580
October	313	347	348	274	309	1591
November	304	279	263	337	276	1459
December	305	322	273	265	317	1482
Total	3590	3572	3078	3286	3288	16814

**Table (2):** Monthly urinary tract injuries during CS through study period.

Month	2018 (n=3590)		2019 (n=3572)		2020 (n=3078)		2021 (n=3286)		2022 (n=3288)	
	N	%	N	%	N	%	N	%	N	%
January	0	--	0	--	1	.032	2	.061	1	.03
February	0	--	0	--	1	.032	1	.03	0	--
March	0	--	0	--	0	--	1	.03	1	.03
April	0	--	0	--	0	--	2	.061	0	--
May	1	.028	0	--	1	.032	1	.03	2	.061
June	0	--	1	.028	2	.065	1	.03	1	.03
July	0	--	0	--	2	.065	0	--	0	--
August	2	.056	1	.028	0	--	1	.03	2	.061
September	0	--	1	.028	1	.032	2	.061	1	.03
October	1	.028	0	--	0	--	1	.03	1	.03
November	1	.028	0	--	1	.032	0	--	2	.061
December	0	--	0	--	0	--	1	--	1	.03
Total	5	0.139	3	0.084	9	0.292	13	0.396	12	0.365

**Table (3):** Demographic characteristics of the studied patients

	<i>UT injuries</i> (n=42)	<i>No UT injuries</i> (n=16772)	<i>P</i>
<i>Maternal age (years)</i> <i>Mean ± SD</i>	34.25 ± 6.22	30.92 ± 5.84	<0.001
<i>BMI (kg/m<sup>2</sup>)</i> <i>Mean ± SD</i>	26.46 ± 3.51	28.53 ± 3.17	<0.001
<i>GA (years)</i> <i>Mean ± SD</i>	37.83 ± 3.1	37.36 ± 3.19	.341

**Table (4):** Clinical characteristics of the studied patients

	<i>UT injuries</i> (n=42)		<i>No UT injuries</i> (n=16772)		<i>P</i>
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	
<i>Parity</i>					.008
0	11	26.2	7808	46.6	
≥1	31	73.8	8964	53.4	
<i>Number of prior cesareans</i>					.000
0	14	33.3	11050	65.9	
1	18	42.9	4438	26.5	
≥2	10	23.8	1284	7.7	
<i>Adhesions</i>					.000
Present	26	61.9	2866	17.1	
Absent	16	38.1	13906	92.9	
<i>Gynecological surgery history</i>	10	23.8	1083	6.5	.000

**Table (5):** Labor and delivery characteristics of the studied patients

	<i>UT injuries</i> (n=42)		<i>No UT injuries</i> (n=16772)		<i>P</i>
	<i>N</i>	<i>%</i>	<i>N</i>	<i>%</i>	
<i>Type of uterine incision</i>					.303
Classical	5	11.9	1284	7.7	
Low transverse	37	88.1	15488	92.3	
<i>Timing of delivery</i>					.003
Scheduled	16	38.1	4726	28.2	
Urgent	15	35.7	9954	59.3	
Emergent	11	26.2	2092	12.5	
Station ≥1	12	28.6	1890	11.3	<0.001
Uterine rupture	5	11.9	382	2.3	<0.001
<i>Ruptured chorionic membranes</i>	30	71.4	8896	53	.017
<i>Skin to uterine incision (min)</i> <i>Mean ± SD</i>	13.34 ± 8.56		9.82 ± 5.31		<0.001
<i>Estimated blood loss (ml)</i> <i>Mean ± SD</i>	1018.75 ± 545.8		667.2 ± 258.4		<0.001

**Table (6):** Multivariate regression analysis to identify the potential risk factors for UT injury

	<i>OR</i>	<i>S.E.</i>	<i>Sig.</i>	<i>95 % Confidence Interval for OR</i>
<i>Age</i>	.151	.107	.176	.075 - .378
<i>BMI</i>	.981	.029	.012	.020 - 1.142
<i>Previous surgery</i>	1.019	.024	.015	1.007 - 2.132
<i>Parity</i>	.863	.031	.026	.062 - 1.346
<i>Ruptured chorionic membranes</i>	.095	.215	.663	.360 - .550
<i>Emergent delivery</i>	.213	.156	.095	.116 - .541
<i>Adhesions</i>	1.066	.011	.000	.404 - 2.089
<i>Repeated CS</i>	1.109	.014	.000	.180 - 3.108
<i>Uterine rupture</i>	1.537	.382	.103	.737 - 2.338

### DISCUSSION

Nowadays, caesarean sections are the most common obstetric procedure performed worldwide, with an annual rise in their number. With light of this, obstetricians and their patients need to be informed about any possible risks involved with performing this surgery [10]. It is critical to foresee the potential for bladder damage, to diagnose it early during surgery and to start treating patients as soon as necessary. Urinary tract damage is a caesarean section complication that is infrequently documented in the literature [7]. This was a retrospective study, from patient files saved in the hospital for the last 5 years. The study was carried out on a total of 15220 cesarean sections which were done through last five years, from which only 94 (0.618%) women had UT injuries.

The incidence of ureteric and bladder injuries in our study is significantly greater than in prior literature reports, which ranged from 0.029% to 0.09% for ureteric injuries and from 0.0016% to 0.94% for bladder injuries [12,13]. In comparison with the retrospective review of Dauleh et al. [14] reported that 21,337 caesarean sections (17.5%) were performed out of 121,688 deliveries at the Women's Hospital of Hamad Medical Corporation in the eleven-year period from

1994 to 2004. Fifteen women experienced an unintentional cystostomy on their own, while one woman also experienced injury to her ureter. All of the ladies had previously had caesarean sections, with the exception of one. Twelve of the injuries happened during emergency caesarean sections and four happened during elective ones. Of the elective patients, one had seven prior caesarean procedures (0.0047%), two had four prior caesarean sections (0.0094) and the fourth had two prior caesarean sections. With seven cases for every 10,000 caesarean sections, the injury rate was 0.07%.

Rautet al. [15] revealed 1.23% and 0.11%, respectively, for the incidence of bladder and ureteric injuries in gynecologic surgery, while 0.67% and 0.33%, respectively, were found for obstetric procedures.

In the current study, we found the Mean ± SD of age of women with UT injuries was 34.25 ± 6.22, and was 30.92 ± 5.84 years in women without UT injuries, the Mean ± SD of BMI of women with UT injuries was 26.46 ± 3.51 kg/m<sup>2</sup>, Mean ± SD of BMI of women without UT injuries was 28.53 ± 3.17 and there was a significant difference between the two groups regarding age and BMI.

Başaranoğlu et al.[16] reported that an analysis was conducted on eight patients who

were diagnosed at our clinic during the intraoperative or post-operative phase and fifteen patients who were sent to us following an external clinic procedure. Ten of the injuries were obstetric and thirteen were gynecologic. Patients under surgery ranged in age from  $34.2 \pm 9.4$  (23-65) years. Another study done by Sikora-Szczesniak [17] examined the origins and varieties of urinary organ damage associated with previous births. Women with UT injuries had an average age of  $35.64 \pm 3.80$  years and an average body mass index of  $26.39 \pm 3.58$  kg/m<sup>2</sup>.

El-Mogyet al. [18] comprised 97 female patients who had urological injuries after obstetric or gynecological procedures. The study individuals had a mean age of  $40.94 \pm 8.44$  years and a mean BMI of  $31.58 \pm 5.23$ .

Moreover, Chill et al. [19] revealed that unintentional bladder injuries were found in sixty-eight (0.3%) of the cases. A comparative analysis was conducted between bladder injury and CD. Bladder injury cases were associated with increased age ( $33.7 \pm 5.2$  vs.  $31.9 \pm 6.0$  years,  $p = 0.021$ ), lower rate of nulliparity (17.6% vs. 31.7%,  $p = 0.015$ ), higher rate of previous CD (75.0% vs. 44.8%,  $p < 0.001$ ), shorter duration of the first and second stage of labor ( $7.0 \pm 18.4$  vs.  $15.3 \pm 10.2$  and  $1.5 \pm 1.5$  vs.  $2.7 \pm 2.8$ ,  $p = 0.007$  and  $0.032$ ; respectively), higher average cervical dilatation ( $7.9 \pm 2.9$  vs.  $5.3 \pm 3.4$ ,  $p < 0.001$ ), lower head station ( $-0.4 \pm 1.4$  vs.  $-1.7 \pm 1.8$ ,  $p < 0.001$ ).

There is an increasing incidence of morbid adherent placenta in subsequent pregnancies as a result of the increased use of caesarean sections. More bladder involvement and bladder injuries (total urinary tract injury 21.7%, bladder 11.7%, ureter 4.7%, and bladder with ureter 5.3%) are linked to morbid adherent placentas (accreta, increta and percreta) [20].

In the current study, we found that there is a significant difference between the two groups regarding parity, number of prior cesareans, adhesions and history of previous gynecological surgery where women with UT injuries had higher rate of previous cesarean section, presence of adhesions and previous gynecological surgery while lower parity.

A case-control study of women undergoing caesarean delivery by Phipps et al. [13] yielded 42 bladder injuries out of 14,757 deliveries (incidence 0.28%), making it one of the largest studies looking at bladder damage after caesarean section. For every one of the 42 instances involving bladder injury, the authors randomly selected two cases from women who also had caesarean deliveries as controls. In repeat caesarean births, there were 28 incidences of bladder damage.

According to a straightforward logistic model, women who have had a previous caesarean delivery are 4.22 times more likely than women who have not to have one to get a bladder damage during childbirth. More significantly, compared to 10% of the women in the control group, adhesions were discovered in 60% of the women who had bladder injuries ( $P < 0.01$ ). 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 [21].

Similar to Rahman et al. [22] who examined 7,708 caesarean deliveries and found 34 bladder injuries (incidence 0.44%); 41.2% of bladder injuries happened during the primary caesarean delivery and 58.5% occurred during the repeat caesarean delivery. Women who had previously undergone a caesarean delivery had an incidence of incidental cystotomy that was three times greater (0.81% vs. 0.27%,  $P = 0.0014$ ). The majority of patients in this group who had previously undergone caesarean delivery had adhesive disease, and

the authors hypothesized that the majority of bladder injuries resulted from significant adhesive disease in the lower uterine section. The majority of bladder injuries, according to this study, also happened as the bladder flap was being created and the peritoneal cavity was opened. Moreover, Gungorduk et al.[23] suggested that the more caesarean sections performed, the higher the risk of bladder injury. Many writers state that the risk of bladder injury increases four to five times after a repeat caesarean section. Peritoneal adhesions are the primary risk factor for bladder injury. The risk of bladder injury is increased tenfold when prior caesarean surgery is combined with peritoneal adhesions. The likelihood of adhesions increases with each additional caesarean section. The timing of delivery, station  $\geq 1$ , uterine rupture, ruptured chorionic membranes, skin incision to uterine incision and estimated blood loss were other significant differences between the two groups.

In terms of other risk factors, Tarney's study [21] showed statistically significant differences between cases and controls. During emergency delivery, bladder damage was more likely to happen (31% versus 11%). Also, Rahman et al. [22] revealed the same results. However, when trying to deliver a distressed fetus as quickly as possible, precise and painstaking dissection is not often the first concern. Additionally, individuals who underwent caesarean sections during labor had an increased risk of bladder damage (83% versus 61%). Failed TOLAC (Trial of labor 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. Lastly, compared to 10% of controls, 60% of patients with bladder injuries

had adhesions during their subsequent caesarean delivery.

Chill et al. [19] reported that the group with bladder injuries had greater rates of a number of characteristics, including uterine scar tearing and dehiscence during labor trial, fetal extraction via breech position or legs, and vaginal pressing of the fetal head during extraction. Along with unplanned uterine incision extension, the extent and downward direction (as opposed to lateral) of uterine incision extension, as well as urinary bladder adhesions, were also considerably more common in the bladder injury group.

In terms of fetal extraction by breech or legs, uterine scar rip and dehiscence during labor trial, and vaginal pushing of the fetal head during labor, the group with the bladder damage had greater rates of all these criteria. In addition, the incidence of urinary bladder adhesions, unintentional uterine incision extension and the degree and downward orientation (as opposed to lateral) of such extension were all markedly higher in the bladder injury group [20].

A case series revealed that the following, in decreasing order, were risk factors for bladder injuries: bladder flap creation in patients who have had prior caesarean sections; abdominal wall adhesions from prior caesarean sections in primigravid patients; extraperitoneal caesarean sections because of extension towards the bladder or ureter; uterine rupture; and distended bladder [1].

In the current study, we found that BMI, previous pelvic surgery, higher parity, adhesions and repeated CS were found to be significant risk factors for urinary tract injury during CS. Rahman et al. [22] revealed that the presence of adhesions and repeat CS were statistically significant risk factors, but operator experience and the emergency nature of the CS were thought to be risk factors in a small number of bladder damage cases. According to the study's data, bladder injuries

that are properly healed almost never result in problems. Before surgery, patients should be informed about the considerable risk of bladder injury from multiple caesarean deliveries during subsequent caesarean sections.

In contrast to our study, Alcocer et al. [24] stated that parity had no bearing on whether bladder damage occurred or not. Another distinction between that study and ours is that in ours, the likelihood of harm was unaffected by the existence or nonexistence of prior surgery. Even though their small sample size (n=19) may have contributed to the large interval, the presence of adhesions was a significant factor that increased the risk of injury 67.5 times (OR 67.5, CI 95% 11.14-408.79). They also found differences in the type of skin incision; our results indicate a higher risk of injury in cases where a Pfannenstiel incision was made.

Makoha et al. [25] suggested that a raw OR of 6.7 (CI 95%, 2.6-16.5) for the midline incision and 3.89 (CI 95%, 1.4-8.9) after accounting for known confounding factors (number of caesareans, surgeon experience, and adhesions), the midline incision was linked to a higher risk of bladder injury than the Pfannenstiel incision.

In contrast to the study by Phipps et al.[13] that showed a higher risk of bladder damage in those undergoing an urgent surgery, preterm membrane rupture, fetal head engagement and labour. Moreover, Alcocer et al.[24] reported the group with bladder damage had higher bleeding and operation time with statistically significant differences compared to the control group: 744.73 cc + 425.21 cc versus 509.2 cc + 108.96 cc and 135.52 min + 40.16 min vs 58.31 min + 14.99 min, respectively.

In our study, the presence of adhesions is very important, as it increases the likelihood of bladder injury; this can be controlled by reducing the number of unnecessary pelvic

abdominal interventions, considering the possibility of performing minimally-invasive surgery, or when access to the cavity is required, do so with no tissue damage, by verifying adequate hemostasis and by trying not to introduce foreign objects that may increase the development of adhesions. A bladder injury with immediate detection and appropriate repair has a very favorable prognosis with almost no sequel, particularly if the lesion does not include the trigone [26]. This study has a number of disadvantages in addition to its retrospective design, such as missing data for several factors. The lack of an internal or external validation process and the absence of a bladder damage prediction model restrict the generalizability of our findings. These emphasize the necessity of developing a customized risk calculator and comparing to other medical facilities.

In summary, the high rate of caesarean deliveries is anticipated to increase due to declining VBAC rates as well as the practice of performing caesarean deliveries at the desire of the mother. Adhesive disease-related prior caesarean delivery is the biggest risk factor for bladder damage during a C-section. Consequently, when operating on patients who have had several caesarean births in the past, healthcare professionals need to be aware of these risks and prepare for potential difficulties. Regrettably, the evidence for different approaches to lower the risk of bladder injury is not very strong. Surgeons are understandably terrified about urological injuries, but patients should rest easy knowing that intraoperatively diagnosed and corrected bladder injuries do not have a history of short- or long-term implications.

## CONCLUSION

The incidence of bladder injury during cesarean section is relatively infrequent. The most significant risk factor for bladder injury during cesarean section is previous cesarean delivery due to adhesive disease.



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### Citation:

Ali, A., Noseir, W., Mohamed, A., Kamar El-Dawla, B. Intraoperative Urinary Tract System Injuries during Caesarean Section: A Retrospective Analysis. *Zagazig University Medical Journal*, 2024; (2739-2748): -. doi: 10.21608/zumj.2023.249279.3006