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Original Research Article

## Obstetric-associated lower urinary tract injuries: a single-center study

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### ABSTRACT

**Background:** Urinary tract injury is a known complication of obstetric and gynecologic surgery. Intraoperative identification of injury permits prompt repair and potentially lessens postoperative sequelae including patient morbidity and cost. Delayed diagnosis of urinary tract injuries can result in physical complications beyond the site of the injury, such as genitourinary fistula formation, renal injury, sepsis, death, and psychosocial dysfunction.

**Methods:** We describe the management of 27 patients with such injuries, including their demographic profile, associated factors, and complications at a tertiary institution in a retrospective study from February 2013 to March 2021.

**Results:** Bladder injuries were the most common (81.5%), mostly occurring during emergency cesarean delivery, with previous cesarean delivery and adhesions being risk factors. A primary repair was attempted at the referring institution in 18.5% of cases. Repair at the tertiary institution was mostly performed by consultants (66.7%).

**Conclusions:** Early recognition and primary repair are associated with fewer complications.

**Keywords:** Bladder, Cesarean, Injury, Repair, Sepsis

### INTRODUCTION

The genital tract and the lower urinary tract in females are anatomically situated in close proximity to one another. Though injuries to the lower urinary tract (LUT) are uncommon during childbirth, they have been the recognized complications of parturition. The reported incidence of obstetric-associated bladder injuries is between 0.14% and 0.94%, with the majority of bladder injuries occurring at cesarean section (CS).<sup>1-5</sup> Moodliar et al reported an incidence of bladder injuries at CS of 0.4% in 2004.<sup>6</sup> The incidence of ureteric injuries at CS has been reported to be between 0.013% to 0.09%.<sup>1,2,5,7,8</sup> The current rise in the CS rate may therefore result in an increase in urological injuries during obstetric surgery.<sup>1,3,4,7</sup> A

previous lower uterine segment CS, intraabdominal adhesions, frozen pelvis-endometriosis, uterine rupture, and obstetric hysterectomy are the proven risk factors for bladder injuries at emergency delivery.<sup>1,2,5,9,10</sup> Complications related to urological injuries up to 3-6% have also been reported in cesarean hysterectomies by Tarney et al and Oliphant et al.<sup>2,5</sup> Incorrect application of forceps or suction cups of the vacuum and failure to empty the bladder prior to performing assisted deliveries may result in direct trauma to the urogenital structures.<sup>11,12</sup> A high index of suspicion is required for the early detection of ureteric injuries.<sup>8</sup> A delay in diagnosing the bladder and/or ureteric injury may lead to fistula formation, incontinence, and renal damage.<sup>13</sup> It may lead to severe physical and psychosocial stress.<sup>2,7,13</sup> The interval between

the time of injury to the time of recognition and primary repair of the injuries are important prognostic factors in their outcome.<sup>8</sup> Often, primary lower urinary tract (LUT) injuries particularly bladder injuries, especially if recognized at the time of CS, are managed by obstetricians at several hospitals without the supervision of a urologist or general surgeon.

The aim of our study was to identify and assess the circumstances in which these injuries occur and recommend measures to reduce their risk and improve the success of repair, where necessary.

## METHODS

This was a retrospective study, carried out at a single center, Lions General Hospital, a tertiary care institution in Mehsana, Gujarat, India. The population targeted were obstetric cases referred to and delivered from February 2013 to March 2021.

### Inclusion criteria

Post-delivery cases referred to or delivered at the tertiary hospital with ureteric, bladder, or urethral injury sustained during vaginal delivery or CS, where the primary repair was performed at the referring institution or at our tertiary facility, or secondary repair carried out at our facility. Lower urinary tract (LUT) injuries occurred during vaginal delivery or CS at our center.

### Exclusion criteria

All non-obstetric urinary tract injuries, injuries identified outside the puerperium. Urinary tract injuries sustained as a result of non-obstetric pelvic surgeries. Patients with pre-existing urogenital abnormalities.

Admission and discharge records from the hospital were used to identify cases. The patient records were retrieved from the hospital medical records department. Microsoft Word was used as a data collection tool to extract relevant information from each case record. The data sheet was designed to capture patient demographics, previous mode of delivery, type of delivery, type of injury, the circumstances under which the injury occurred, and information regarding the primary repair of the LUT injury. The information obtained was imported into Microsoft Excel for statistical analysis and further analysed. The final data analysis was reported utilizing mean, range, relative frequencies, and tables. Incidence rates are reported with total deliveries for the health district (Mehsana) as the denominator. Informed consent was not necessary as this was a retrospective study and the patient records were not captured for the purpose of the study. Confidentiality was maintained at all times.

## RESULTS

Twenty seven cases were studied with an overall incidence of obstetric-associated LUT injuries of 0.23%. The mean age was 29.8 years (range: 20-39 years), and the majority were multiparous (92.6%). The demographic data are shown in Table 1.

**Table 1: Demographic characteristics of the study population.**

Age	N (%)
<20 years old	2(7.40)
20-34 years old	21(77.8)
>35 years old	4(14.8)
The mean year of age	29.8 years old
Parity	N (%)
1	2 (7.40)
2	15 (55.6)
3	8 (29.6)
4+	2 (7.40)
Weight	Kg
Maximum	58.0 kg
Minimum	137.0 kg
Mean	74.7 kg
Height	Cm
Maximum	147.0 cm
Minimum	181.0 cm
Mean	161.2 cm

**Table 2: Data from referring sites.**

Referring site	N (%)
Rural health centers	13 (48.1)
Community health centers	9 (33.3)
Tertiary health centers (in-house)	5 (18.6)
Recognition of injury	
During delivery	15 (55.6)
Post-delivery	9 (33.3)
Delayed	2 (7.40)
Unknown	1 (3.70)
Repair at referring site	
Yes	10 (37.1)
No	17 (62.9)
Number of attempts at repair before referral	
1	9 (90)
2	1 (10)
Time of repair at referring site	
At the time of delivery associated injury	9 (90)
Delayed	1 (10)

Referrals were from both rural health centers and community hospitals (48.1% and 33.3%) respectively, with in-house cases accounting for 18.6% of cases. Recognition of LUT injury at the time of delivery was identified in 55.6%, and 33.3% in post-delivery; 7.40% were delayed in recognition (Table 2). The primary repair

had been attempted prior to referral to our facility in 37.1% of cases (Table 2).

**Table 3: Type of lower urinary tract injuries and associated factors.**

Type of injury	N (%)
Urethral	3 (11.1)
Bladder	20 (74.1)
Ureteric	2 (7.40)
Bladder and ureteric	2 (7.40)
<b>Mode of delivery</b>	
Vaginal	2 (7.40)
Instrumentation delivery	1 (3.70)
Cesarean section	24 (88.9)
<b>Level of expertise at the time of injury</b>	
Midwife	2 (7.40)
Residents	5 (18.6)
Junior obstetrician*	18 (66.6)
Senior obstetrician**	2 (7.40)
<b>Previous cesarean delivery</b>	
0	3 (11.1)
1	16 (59.3)
2	4 (14.8)
3	4 (14.8)
<b>Bleeding</b>	
Yes	5 (18.6)
No	20 (74.0)
Unknown	2 (7.40)
<b>Adhesions</b>	
Yes	16 (59.3)
No	8 (29.6)
Unknown	3 (11.1)
<b>Birth weight Grams</b>	
Minimum	650
Maximum	3900
Mean	2560.7

\*Junior obstetrician-  $\leq 2$  years of post-residency experience

\*\*Senior obstetrician-  $> 2$  years of post-residency experience

Most LUT injuries occurred during CS (incidence of 0.05%). Only 10.5% of cases occurred during vaginal birth (Table 3). A total of 20 bladder injuries (incidence of 0.05%), 3 urethral injuries (11.1%), and 2 ureteric injuries (incidence of 0.003%) were identified.

All urethral injuries only occurred at vaginal birth whereas all bladder and ureteric injuries occurred during CS, where 81.5% were injuries to the bladder alone and only 9.25% to both bladder and ureter (Table 4). The surgical expertise at CS varied: 75% was performed by a junior obstetrician ( $< 2$  years of experience), 8.33% by a senior medical officer (with  $> 2$  years of experience), and 16.67% by a resident (Table 4). A total of 88.9% had a prior history of CS, most being a single previous CD. 14.8% of cases in the study group had  $> 2$  previous CS. 87.5% of patients had not undergone any prior abdominal or other pelvic surgery. Excessive bleeding ( $> 1$  litre blood loss) at CS was reported

in 20.83% and adhesions were reported in 66.7% (Table 4). 2 (8.33%) cesarean hysterectomies had been performed in the study group (Table 4).

**Table 4: Cesarean deliveries associated with lower urinary tract injuries.**

Type of delivery	n (%)
Emergency	20 (81.5)
Elective	4 (18.5)
<b>Type of injury</b>	
Bladder only	20 (81.5)
Ureteric only	2 (9.25)
Bladder and ureteric only	2 (9.25)
<b>Indication for cesarean delivery</b>	
Cephalo-pelvic disproportion	5 (20.83)
Placenta percreta	2 (8.33)
Fetal compromise	2 (8.33)
Failed trial of labour after cesarean delivery	3 (12.5)
Previous cesarean delivery	10 (41.67)
Other	1 (4.17)
Unknown	1 (4.17)
<b>Level of expertise at the time of injury</b>	
Residents	4 (16.67)
Junior Obstetrician	18 (75.0)
Senior Obstetrician	2 (8.33)
unknown	0 (0)
<b>Previous cesarean delivery</b>	
0	3 (11.11)
1	16 (59.27)
2	4 (14.81)
3	4 (14.81)
Cesarean hysterectomy	2 (8.33)
<b>Bleeding</b>	
Yes	5 (20.83)
No	18 (75.0)
Unknown	1 (4.17)
<b>Adhesions</b>	
Yes	16 (66.7)
No	8 (33.3)
Unknown	0 (0)
<b>Skin incision</b>	
Pfannenstiel incision	19 (79.17)
Midline	3 (12.5)
Pfannenstiel extended to the midline	2 (8.33)
Unknown	0
<b>Prior abdominal or pelvic surgeries</b>	
Abdominal	2 (8.33)
Pelvic	1 (4.17)
Not any	21 (87.5)

\*Junior obstetrician-  $\leq 2$  years of post-residency experience

\*\*Senior obstetrician-  $> 2$  years of post-residency experience

At CS, most LUT injuries occurred during an emergency delivery (81.5%). The most common indication for CS was previous CD (41.67%). An analysis of the surgical

technique used at CS showed that 79.17% had Pfannenstiel skin and transverse lower segment uterine incisions (Table 4).

**Table 5: Surgical procedures and outcomes at a tertiary center.**

Surgical approach	N (%)
Vaginal	3 (11.1)
Abdominal	18 (66.7)
None	1 (3.7)
Unknown	5 (18.5)
<b>Type of repair</b>	
Closure of bladder injury	15 (68.2)
Urethral tear repair	3 (13.6)
Ureteric re-implantation	0 (0)
Ureteric resection and re-anastomosis+ ureteric stenting	0 (0)
Bladder injury repair + ureteric stenting	4 (18.2)
<b>Number of repairs at the tertiary center</b>	
0	5
1	21 (95.5)
2	1 (4.5)
<b>Surgical expertise in repair</b>	
Resident	1 (3.70)
Junior obstetrician	3 (11.1)
Senior obstetrician	8 (29.6)
General surgeon/ urologist	10 (37.1)
Unknown	5 (18.5)
<b>Complications</b>	
Long term admission	10 (37.1)
ICU admission	4 (14.8)
Sepsis	2 (7.4)
Wound breakdown	3 (11.1)
Acute renal failure	2 (7.4)
Incontinence	1 (3.7)
Urinary retention	0 (0)
None	5 (18.5)

\*Junior obstetrician-  $\leq 2$  years of post-residency experience

\*\*Senior obstetrician-  $>2$  years of post-residency experience

A total of 22/27 were repaired at our center with a 95.5% success rate following a single attempt at repair. The three urethral injuries were repaired vaginally at our center (Table 5). Five bladder injury cases had been repaired prior to referral, of which two required further surgical intervention at our center. Conservative management comprising free bladder drainage with urinary catheterization was not carried out in any case. In two cases, where both a bladder and ureteric injury had occurred a private hospital during an emergency CS for placenta percreta, a classical uterine incision had been made. The ureteric injury was managed by placement of a ureteric stent, and the bladder was repaired surgically. Two cases with isolated ureteric injury had been managed by Ureteric stent placement. Surgical expertise in repair was

performed by either a general surgeon/urologist or a senior obstetrician (37.1% and 29.6% respectively) (Table 5).

Post-operative morbidity was accounted for by 37.1% being admitted for long-term care, and 14.8% to intensive care; 7.4% were diagnosed with sepsis and 3.7% reported urinary incontinence. No complications were reported in 18.5% of cases and renal impairment/failure was identified in 7.4% of cases (Table 5).

## DISCUSSION

In this retrospective study, the majority of obstetric-associated LUT injuries occurred during cesarean delivery. In our study, the incidence of obstetric-associated LUT injuries at CS (0.05%) was lower when compared to the studies by Oliphant et al (0.3%), Yossepowitch et al (0.3%) and Lee et al (0.08%).<sup>5,8,13</sup> While assisted vaginal delivery is known to be a risk factor for vesicovaginal fistulae (VVF) in obstetrics, there was only one assisted vaginal delivery in our study.<sup>14</sup> LUT injury commonly occurred during an emergency CS, which we find in our study is also correlated with current evidence.<sup>2,3,5,8</sup> At emergency CS, it is thought to be a more stressful environment to expedite delivery and careful dissection may not always be a priority.<sup>2,8</sup> Cesarean hysterectomy has been reported to be a significant risk factor for sustaining obstetric-associated LUT injuries, two cases were reported in this study while doing obstetric hysterectomy for placenta percreta.<sup>5</sup> This series demonstrated that previous cesarean section, failed trial of labour after CS and cephalopelvic disproportion were the most frequent indications of CS. As previously highlighted by Rashid et al, Moodliar et al, and Yossepowitch et al.<sup>1,6,8</sup> We also noticed previous CS to be a significant risk factor for bladder injury at CS. While other reports showed that the rate of bladder injury increases with an increasing number of previous CS, a single previous CS was the most frequent factor in our study.<sup>2</sup> This is also because adhesions from a previous CS increase the risk of a bladder injury at the time of CS, which is also found in other studies.<sup>3,9,10</sup> Our findings that the Pfannenstiel skin and lower uterine segment incisions were most commonly associated with LUT injuries were similar to that of Phipps et al but these were different from those of Tarney et al who showed that most injuries occurred from midline skin incisions.<sup>2,3</sup> There is limited data on different uterine incisions and urological complications at present. Early recognition and repair reduce the risk of complications and can be used as a prognostication tool.<sup>1,2,8,13</sup> In our study, the majority of LUT injuries were identified early and primary repair was not delayed, highlighting that intraoperative recognition and early repair can result in a satisfactory repair and fewer complications.<sup>2,4,7,8</sup> The surgical expertise in repair may have also contributed to the success of the primary repair, since most of the repairs were performed by a specialist. The discipline of these specialists varied (obstetrician, urologist, and general surgeon). The outcomes of repair were similar to those of well-developed nations where residents and obstetricians were present and the urologist

was consulted for most cases.<sup>8,15</sup> The complications identified as a result of the LUT injury or the repair in our study were similar to that of Rahman et al.<sup>4</sup> Most patients had a prolonged stay in the hospital and there had been reports of sepsis and urinary incontinence. Due to most cases being recognized and treated timeously, major complications do not occur frequently.<sup>1,4,10</sup>

This study was a retrospective study at a single center. The data presented are only for patients managed at a tertiary hospital and some cases may have been managed at private hospitals before being referred to the tertiary center. Poor record keeping contributed to missing information in patient records cases and may have also resulted in fewer cases being identified during the study period.

## CONCLUSION

LUT injuries at delivery should be avoided. Our study suggested that women are at higher risk of sustaining a LUT injury at CS than vaginal delivery. Emphasis on preventing the first cesarean delivery is crucial in reducing the risk of urological and psychosocial complications. Training in operative vaginal deliveries should occur frequently to reduce the rate of complications during these interventions. All maternity units should have protocols in place when offering a trial of labour after CS. This will assist in appropriate patient selection and adequate intrapartum monitoring. In cases where dense adhesions have been identified, sharp dissection rather than blunt dissection should be performed to reflect the bladder. If the anatomy is distorted, filling the bladder may assist with recognizing structures. Prompt management of excessive hemorrhage can improve visibility and reduce the risk of LUT injury.

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