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ORIGINAL ARTICLE

Urinary tract injuries during cesarean section in patients with morbid placental adherence: retrospective cohort study

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ABSTRACT

Background/objective: The purpose of this study is to evaluate the cases of lower urinary tract injuries during cesarean section with or without hysterectomy in cases with morbid placental adherence.

Methods: This record based retrospective study was conducted at Ain Shams University Maternity Hospital in Cairo, Egypt during the period between January 2014 and December 2016. It included all patients who had urinary tract injuries during cesarean section with or without hysterectomy in the cases with morbid placental adherence and they were collected from files of pregnant women who were admitted at hospital planned for termination of pregnancy. Patients were enrolled in four groups, Group 1: cases without urinary tract injuries. Group 2: cases with injuries to the bladder. Group 3: cases with injuries of the ureter. Group 4: cases with injuries to the bladder and ureter.

Results: This study gave us new information about the incidence of urinary tract injuries during cesarean section with morbid adherence placenta was 21.7% (Bladder 11.7%, Ureter 4.7%, and bladder with ureter 5.3%). There were various types of repair of urinary tract injury, as the following, bladder repair 10.8%, ureteric catheterization 0.9%, ureterovesical repair or reimplantation 1.5%, bladder repair and ureterovesical 1.2%, bladder repair and ureteric catheterization 2.3%, ureteric catheterization and ureterovesical 1.5 and 6.4% of cases needed urologic consultations. There is a real relation between urinary tract injury and obesity (55.3%). Bladder invasion was found in only 26.9% of all cases according to sonography findings. Most of the cases were delivered by cesarean section in 67.5%, and the remainders were delivered by cesarean hysterectomy 32.5%. About 96.5% of cases needed a blood transfusion.

Conclusions: The morbid adherent placenta is still a challenge, which faces us as obstetricians, due to high morbidity and mortality. A multidisciplinary team is mandatory to avoid complications.

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Cesarean section; lower urinary tract injuries; morbid placental adherence

Background

Morbid Placental adherence is a potentially life-threatening obstetric condition that requires a multidisciplinary approach to management. The incidence of placenta accrete has progressively risen in the past three decades, possibly as a consequence of increasing cesarean section rates. Advances in grayscale and Doppler ultrasound have facilitated prenatal diagnosis of abnormal placentation to allow the development of multidisciplinary management plans to achieve the best outcomes for mother and baby [1].

Although the rate of cesarean delivery is increasing, the annual rate of lower urinary tract injury did not vary significantly (0.3% of all cesarean deliveries). Full and partial bladder injuries have unique risk profiles, full injury was associated with increasing maternal age, blood transfusion, and second stage of the labor while, partial one was associated with increasing maternal age and delivery in the first stage of the labor [2]. Ninety-five percent (95%) of bladder injuries during cesarean section occur at the dome of the bladder with the remaining occurring at the trigone. The average length of bladder injury is 4.2 cm (1–10 cm). Bladder injuries occur more frequently during creation of bladder flap (43%), while 33% occur at the time of entry into the peritoneal cavity, and the remaining 24% occur during uterine incision or delivery [3].

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Morbidly adherent placenta or placenta accreta often involve cesarean delivery hysterectomies; uterus-sparing alternatives to manage this condition can be an option in selected cases [4]. Women with placenta accreta, increta, or percreta who have no attempt to remove any of their placentae, with the aim of conserving their uterus, or prior to hysterectomy, have reduced levels of hemorrhage and a reduced need for blood transfusion, supporting the recommendation of this practice [5]. The purpose of this study is to evaluate the cases of lower urinary tract injuries during cesarean section with or without hysterectomy in cases with morbid placental adherence in the period between years 2014 and 2016.

Materials and methods

This retrospective cohort study was conducted at Ain Shams University Maternity Hospital in Cairo, Egypt during the period between January 2014 and December 2016. It included those patients who were suspected antenatally as having morbid adherent placenta through the following sonographic criteria: *Gray-scale and color Doppler* showing loss of echolucent area located between uterus and placenta, thinning or interruption of the hyperechoic interface between uterine serosa and bladder wall and presence of placental lacunae with the turbulent high-velocity flow. *Three-dimensional power Doppler* showing neovascularization: limited to basal layer in a case of the morbidly adherent placenta (MAP) without percreta and extended to entire placental parenchyma in case of placenta percreta [6].

Morbid adherent placentae were confirmed intraoperative. The intervention was consistent for all the patients, (according to adopted local protocol at Ain Shams University Maternity Hospital). No preoperative rigid cystoscopy was performed for any of the patients and no ureteral stenting was done. Dissection of the bladder was the first stage in conservative surgery for abnormal placentation and also a necessary step during hysterectomy for such placentation. Bladder traction with Allis clamps allowed finding a correct plane for the dissection between the uterus and the bladder. The dissection started from inside round ligament to midline and a small buttonhole made to allow the passage of a dissection clamp. The vesicouterine fold then identified and cut near the uterine surface. After minor dissection, surgical forceps used to grasp part of the peritoneal vesicouterine fold that included both evident and hidden neoformed vessels (NFV). Double ligatures used in the peritoneum and neoformed vessels, after which cuts made between the ligatures. Ligation of neoformed vessels provided secure management. Electrocautery was not used because of the fragility of these newly formed vessels. Retrovesical dissection is complete when all of the NFV between the bladder, uterus, and placenta had been ligated and there was clear access to the cephalic sector of the vagina. At this point movement of the bladder allowed access to the upper part of the vagina. In this situation, single-step conservative surgery or hysterectomy can be performed without the problems that usually occur in this type of placental invasion. Regardless of whether the procedure finally chosen was hysterectomy or a conservative procedure, retrovesical dissection provided excellent visualization of the area of placental invasion and the pedicles within it.

Parametrial invasion has occurred in about 6% of our patients which was diagnosed intraoperatively. Ureteral invasion is the result of exuberant NFV induced by parametrial placental invasion, and is not caused by placental tissue itself. The ureter was identified as crossing internal iliac/external iliac vessels, the posterior peritoneum opened, and medial dissection of the ureter was done to avoid ureteral devascularization and medial displacement using suture is done in some cases. Before closure of the abdomen, we examined for any additional points of bleeding in the posterior wall of the bladder. In cases of extensive bladder repair, infusion of methylene blue through a Foley catheter revealed invisible holes in the bladder wall.

The patients are enrolled in four groups:

Group 1: cases without urinary tract injuries

Group 2: cases with injuries of the bladder

Group 3: cases with injuries of the ureter

Group 4: cases with injuries to the bladder and ureter.

According to the relevant operative and sonographic findings, the following data were collected:

- Patients' demographic data: age, parity, gestational age at delivery, maternal body mass index (BMI).
- Risk factors: prior and repeat cesarean delivery (number of previous cesarean sections), adhesions and obesity (BMI $>30\,kg/m^2$).
- Type of operation: cesarean section and cesarean hysterectomy.
- Bladder invasion.
- Urinary tract injury:
  - Group 1: cases without urinary tract injuries.
  - Group 2: cases with injuries of the bladder.
  - Group 3: cases with injuries of the ureter.
  - Group 4: cases with injuries to the bladder and ureter.

Table 1. Demographic data.

Demographic data	N	Minimum	Maximum	Mean	SD
Age	342	20.00	42.00	31.04	4.76
Parity	342	0.00	8.00	2.77	1.34
Gestational age at termination	342	21.00	40.00	34.93	3.13
Maternal BMI	342	25.2	34.6	31.6	2.58

SD: standard deviation.

- Parametrial invasion
- Need for urological consultation.
- Type of surgical repair:
  - repair of the bladder.
  - need for ureteric catheterization.
  - ureterovesical reimplantation.
  - other surgical procedure.
- Blood transfusion.

Sample size calculation

The total number of sample is all the cases of morbid placental adherence during cesarean section in Ain Shams Maternity Hospital in the period between January 2014 and December 2016. Detailed chart review of all cases of urinary tract injuries during cesarean section with or without hysterectomy in cases with morbid placental adherence were collected from files of pregnant women, who were admitted to hospital planned for termination of pregnancy.

Statistical analysis

All results were tabulated and analyzed statistically. Comparison of data were performed using chi-square test $\times 2$ (results were presented as percentages and the corresponding p value). The difference in parametric data was assessed based on Students t-test. The data was coded, entered, and processed on a computer using SPSS (version 15). The level $p < .05$ was considered the cut-off value for significance.

Results

The current retrospective study was conducted on 342 women with morbid adherent placenta previa managed at Ain Shams University Maternity Hospital over a 3-year interval; during the period between January 2014 and December 2016. These cases were collected from files of pregnant women, who have admitted to hospital for terminating the pregnancy. Demographic features and characteristics of study groups are shown in Table 1.

The risk factors of urinary tracts injury in our study were suggestive of prior cesarean section with minimum ($N = 0$) and maximum ($N = 7$) (Mean = 2.67, SD = 1.25), intra-abdominal adhesion in 160 women (46.8%) and obesity in 200 women (55.3%) (Table 2).

Table 2. Risk factors of UT injury.

Risk factors of UT injury	Number	Minimum	Maximum	Mean	SD
Prior CS	342	0.00	7.00	2.67	1.25
Risk factors of UT injury		**Number**		**%**	
Adhesion	No	182		53.2	
	Yes	160		46.8	
Obesity	No	142		41.5	
	Yes	200		58.5	

Table 3. Type of operation.

Type of operation	N	%
CS	231	67.5
Cesarean hysterectomy	111	32.5
Total	342	100.0

Table 4. Bladder invasion.

Bladder invasion	N	%
No	250	73.1
Yes	92	26.9
Total	342	100.0

Table 5. Incidence of UT injury.

Study Groups	N	%
Group I (no injury)	268	78.4
Group II (injury to bladder)	40	11.7
Group III (injury to ureter)	16	4.7
Group IV (injury to bladder and ureter)	18	5.3
Total	342	100

Of the included 342 women, 231 cases of morbid adherent placenta previa (67.5% of total operations) are cesarean section and 32.5% of total operations are a cesarean hysterectomy (111 Cases) (Table 3).

We found about 26.9% of morbid placenta adherence cases with bladder invasion according to sonography findings (Number = 92) (Table 4).

The incidence of urinary tract injuries in our study with injury to bladder 11.7% (Number = 40), with injury to ureter 4.7% (Number = 16) with injury to bladder and ureter 5.3% (Number = 18); and the incidence of the rest of cases with no injury 78.4% (Number = 268) (Table 5; Figure 1).

We found about 6.5% of morbid placenta adherence cases with parametrial involvement. It was an intraoperative diagnosis (Number = 22) (Table 6).

Three hundred thirty women needed a blood transfusion (96.5%) and 22 women needed also urologic consultations (6.4%) (Table 7).

Most of the cases in our study need no surgical repair for a urinary tract in 270 women (78.9%). In general, the surgical repairs for urinary tract injury in a

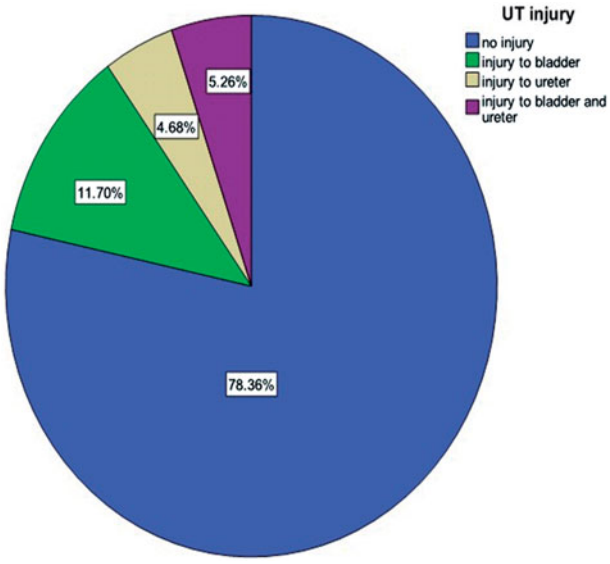

Figure 1. Incidence of UT injury.

Table 6. Incidence of parametrial invasion.

Parametrial invasion	N	%
No	320	93.5
Yes	22	6.5
Total	342	100.0

Table 7. Blood transfusion and urologic consultation.

	N	%
Blood transfusion		
No	12	3.5
Yes	330	96.5
Total	342	100.0
Urologic consultation		
No	320	93.6
Yes	22	6.4
Total	342	100.0

Table 8. Type of surgical repair.

Type of surgical repair	N	%
No repair	270	78.9
Repair of bladder	37	10.8
Need for ureteric catheterization	3	0.9
Ureterovesical repair with reimplantation	7	2.1
Bladder and ureterovesical	4	1.2
Bladder repair with ureteric catheterization	8	2.3
All types	13	3.8
Total	342	100.0

patient with morbid placenta adherence during cesarean section or cesarean hysterectomy were low percentage. Bladder repair was done in 37 women (10.8%), 3 women needed ureteric catheterization (0.9%), uretero-vesical implantation was done in 2 women only (0.6%) bladder repair with uretero-vesical implantation in 4 women (1.2%), bladder repair with ureteric catheterization in 8 women (2.3%), bladder repair with ureteric catheterization and ureterovesical repair in 5 women (1.5%) and all types of surgical repair in 13 women (3.8%) (Table 8).

Four factors were associated with urinary tract injury, they were affected by age in 31.03 years, parity in 2.68, Maternal weight (BMI) 31.6, and gestational age in 34.99 weeks (Table 9).

We could observe that cesarean hysterectomy in patients with morbid adherence placenta was a high risk for urinary tract injury (40.5%), where cesarean section was a low risk (10.4%) (Table 10).

In the current study, we can recognize logistic regression analysis for risk factors of urinary tract injury, as the following (Table 11):

- Odd ratio 1.022, B 0.022 and sig 0.850 for parity.
- Odd ratio 5.050, B 1.619 and Sig <0.001 for type of operation.
- Odd ratio 2.404, B 0.877 and sig 0.004 for adhesion

Discussion

The purpose of this study was to evaluate the cases of lower urinary tract injuries during cesarean section with or without hysterectomy in cases with morbid placental adherence in the period between years 2014 and 2016. This study was carried out in Ain Shams University Maternity Hospital in Cairo, Egypt.

In pregnant women with morbid placental adherence, there was a great liability for urinary tract Injuries. In this study, we enrolled 342 women with morbid placental adherence and we found that urinary tract injuries occurred in 74 women (21.7%). In this study, in cases with morbid placental adherence, it was found that 11.7% of cases with injury to the

Table 9. Relation between demographic factors and UT injury.

	UT injury					
	No UT injury (N = 273)		Injury to bladder or ureter (N = 69)			
	Mean	SD	Mean	SD	Student t-test	p value
Age	31.03	4.79	31.10	4.69	0.12	.91 NS
Parity	2.68	1.31	3.12	1.44	2.42	.02 S
Gestational age	34.99	3.00	34.70	3.61	0.69	.49 NS
Maternal weight (BMI)	31.6	2.58	32.2	2.7	0.45	.01 S

Table 10. Relation between the type of operation and UT injury.

	UT injury					
	No UT injury ($N = 273$)		Injury to bladder or ureter ($N = 69$)			
Relation between type of operation and UT injury	*N*	%	*N*	%	Chi-Square test	*p* value
CS ($N = 231$)	207	89.6	24	10.4	42.32	<.001
Cesarean hysterectomy ($N = 111$)	66	59.5	45	40.5		

Table 11. Logistic regression analysis for risk factors of UT injury.

				95% CI for odds ratio	
Logistic regression analysis for risk factors of UT injury	B	Sig.	Odds ratio	Lower	Upper
Parity	0.022	0.850	1.022	0.815	1.281
Type of operation	1.619	<0.001	5.050	2.740	9.307
Adhesion	0.877	0.004	2.404	1.313	4.404
Constant	−4.451	<0.001	0.012		

bladder, 4.7% of cases with injury to the ureter, and 5.3% of cases with injury to bladder and ureter. Chan et al. noticed that; the bladder and distal ureters are the most commonly involved organs [7]. Reynaldo et al. found the most frequently injured during obstetric procedures is bladder, because it is a retroperitoneal structure, its trigone rests over the anterior vaginal fornix and the base rests on the lower uterine segment and cervix. In Reynaldo and his college study, the incidence of urinary tract injuries was 61% during cesarean section with placenta accreta, 1.8% during cesarean section [8]. In Mendez study, the urinary tract injuries were 1.5% during gynecological surgeries, per 1000 cases have been reported [9]. According to Carley and his colleague's study in 2002, the incidence of bladder and ureter injuries, respectively, was 0.58 and 0.36% for abdominal hysterectomy, 1.86 and 0% for vaginal hysterectomy, and 5.13 and 1.71% for obstetric hysterectomy with placenta accreta [10]. Tam and his colleagues admitted 292 women with placenta accreta, which were managed by hysterectomy. There were 83 (29%) cases of Urinary Tract injury [11]. In this study, it was noticed that urinary tract injuries was managed as following: bladder repair 10.8%, ureteric catheterization 0.9%, ureterovesical repair or reimplantation 1.5%, bladder repair and ureterovesical 1.2%, bladder repair and ureteric catheterization 2.3%, and ureteric catheterization and ureterovesical 1.5%. Abbas et al. dealt the urinary tract injury in placenta accreta cases with this trial; removal of invasion area in the posterior bladder and distal ureters and resection the bladder base with the distal ureters but this trial carried the risk of coagulopathy, transfusion reaction, sepsis, adult respiratory distress syndrome, multiorgan failure, and vesicovaginal fistula due to aggressive blood transfusion and extensive surgery [12]. Tam and his colleagues tried the use of ureteral stents and they found the decreased risk of urologic injury ($p = .01$) [11]. Multiple logistic regression analysis identified antenatal diagnosis as the significant predictor of an intact urinary tract. The type of operation in this study was; cesarean section 67.5% and hysterectomy 32.5%. American Congress of Obstetricians and Gynaecologists recommended that generally the management of suspected placenta accreta is planned preterm cesarean hysterectomy with the placenta left *in situ* because removal of the placenta is associated with significant hemorrhagic morbidity. However, this approach might not be considered first-line treatment for women who have a strong desire for future fertility. Therefore, surgical management of placenta accreta may be individualized [13]. According to the current study, the mean age of women was 31.04 years, the mean Gestational age was 34.93, and the mean parity was 2.77. Richa et al. found with placenta accreta cases in critical review study; the mean age of the women was 27.7 ± 4.2 years with three women (15%) having age more than 35 years. The mean parity was 2.5 ± 0.9. One woman was primigravida, while none of the women was grand multiparous. Fourteen (70%) women had previous cesarean section scar, four (20%) women had undergone prior curettage, but they all had a history of the cesarean section also. Placenta previa was associated in 14 (70%) women. Two (10%) women had no known risk factors [14]. We had in this current study 26.9% of cases with invasive bladder according to sonography criteria findings. In Konijeti and his colleague's research about placenta

percreta found, placenta percreta can affect any neighboring uterine structure, is a life-threatening condition. When it involves the urinary bladder, a multidisciplinary approach utilizing a team of physicians and surgeons representing urology, radiology and obstetrics/gynecology is the key to successful management. Every attempt should be made to achieve the diagnosis antenatally, to minimize blood loss, and to preserve the bladder [15]. In this study, we noticed that 7.0% with no prior cesarean section and the maximum with seven prior sections. In Silver and his colleague's study found that in the presence of a placenta previa, the risk of placenta accrete was 3, 11, 40, 61 and 67% of the first, second, third, fourth and fifth or greater repeat cesarean deliveries, respectively [16].

Although Vu et al. noticed the infrequency of surgical injuries to the bladder during cesarean section, providers need to be aware of potential complications in order to appropriately counsel patients and also prepare themselves for possible intraoperative complications. Potential ramifications of bladder injury include prolonged operative time, urinary tract infection, prolonged indwelling catheter time, and formation of vesicouterine or vesicovaginal fistula [17]. Keettel recognized injury of the bladder 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 for bladder injury is intraoperative recognition and surgical correction. Injuries repaired intraoperatively have a high likelihood of a return of normal urologic function. However, failure to diagnose a bladder injury during surgery may later lead to vesicovaginal, vesicouterine or ureterovaginal fistula [18].

Most of the cases in this study needed a blood transfusion (96.5%) and about 28.9% needed intensive care unit (ICU) admission. In 2012 American Congress of Obstetricians and Gynaecologists estimated 90% of patients with placenta accreta require a blood transfusion, and 40% require more than 10 units of packed red blood cells, therefore these cases are mostly admitted to ICU [13].

In our study, we find that relation between adhesion and urinary tract injury was nonsignificant and the relation between obesity and urinary tract injury was significant. The Phipps and his colleague's study were considered one of the largest studies looking at bladder injury during cesarean section comes from risk factors for the development of adhesions include infection, excessive manipulation of tissue, increased blood loss during surgery, adhesion, tissue ischemia, and infection [3].

In this study, we find that 58.5% of cases with obesity and the mean Maternal BMI was 31.6 ± 2.58. Whereas in Vladimir and his colleague's study found that, the distribution of BMI was the same across categories of complications (the Kruskal–Wallis test). Neither univariate analysis nor multivariate regression analysis revealed any statistically significant influence of BMI (<30, ≥ 30) on the incidence of bladder injury or urinary retention [19].

Conclusions

The morbid adherent placenta still really a challenge, which is facing us as obstetricians, due to high morbidity and mortality. This study showed us that; the incidence of urinary tract injuries during cesarean section with morbid adherence placenta is 21.7% (Bladder 11.7%, Ureter 4.7%, and bladder with ureter 5.3%). We could observe that, cesarean hysterectomy in patients with morbid adherence placenta was a markedly high risk for urinary tract injury (40.5%), where a cesarean section was with a low incidence (10.4%). About 96.5% of cases needed a blood transfusion. The good procedures should be done by Multidisciplinary team, which is the golden management antenatal to avoid complication of these cases. When the morbid adherent placenta is diagnosed or suspected antenatally, the patient must be referred to a tertiary center. Preoperative ureteral catheterization is recommended in cases of parametrial invasion of the uterus or cases in which total hysterectomy is planned because of abnormal placentation. Residency program is needed to train residents on different methods to avoid urinary tract injury during cesarean section for morbid placental adherence.

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Disclosure statement

All the authors declare no conflict of interest.

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