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Unintentional transvesical caesarean section: incidence, risk factors, surgical technique and post-operative management

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ABSTRACT

Objective(s): To assess incidence, risk factors, management, and short and long-term outcomes of unintentional transvesical caesarean section (UTV-CS) defined as any extraction of the fetus through a double full thickness bladder wall cystotomy.
Study design: Data about all UTV-CS between January 2013 and December 2017 were retrieved searching the diagnosis of bladder injury and bladder repair during caesarean section (CS) in our comprehensive computerized labor and delivery database and register. CS with bladder wall injury not classified as UTV-CS were excluded. Data analysis included maternal history, demographics and obstetric parameters, details regarding CSs, bladder injury location and extension, and short- and long-term maternal outcomes.
Results: Among 28,822 deliveries, 7,616 (26.42%) were CSs. Three cases of UTV-CS were identified with comprehensive incidence of 0.039%. We provided details of the reported cases and described bladder repair procedure.
Conclusion(s): This is the first study that assessed the incidence of UTV-CS. UTV-CS risk factors are consistent with factors related to milder bladder injuries. The risk of bladder injury during CS should be always considered, despite the low incidence of this complication. Prompt diagnosis and surgical repair seem to allow avoiding severe complications and recovery of a normal urological function even in UTV-CS.

Introduction

Iatrogenic urinary tract and bladder injury may occur during procedures that involve the abdominal and/or pelvic cavity including gynecologic, general or urologic surgeries. Obstetric and gynecologic procedures accounted for most iatrogenic injuries: hysterectomy and caesarean section (CS) are respectively the first and second most common reported causes, owing to the substantial incidence of these procedures [1,2]. Urinary tract and bladder injury during CS is a relatively rare complication with a reported incidence varying from 0.016% to 0.94% [3,4]. Reported risk factors for bladder injury during CS include: presence of adhesions, repeated CS, urgent CS and attempted vaginal birth after CS [3–5]. Nevertheless, previous CS and peritoneal adhesions accounted for the main risk factors of bladder injury and have been associated with a 5.0- and 10.0-fold increased risk for bladder injury, respectively, after controlling for other factors [4]. Furthermore, bladder injuries may occur during different steps of the CS procedure: the opening of the peritoneal cavity, the creation of the bladder flap, the hysterotomy or hysterotomy extension, and rarely the uterine suture [5,6].

To date there are limited studies regarding incidence, risk factors, management and short- and long-term outcomes after bladder injuries during CS [3,7]. Furthermore, many studies do not address injury severity, that may limit the applicability of their findings [6], and limited data are available about the unintentional transvesical CS (UTV-CS) [8,9]. UTV-CS consists in the extraction of the fetus through a double full thickness bladder wall cystotomy, a bladder injury classified from IV to V stage according to the American Association for Surgery of Trauma Organ Injury Scale (AAST-OIS), and accounts for one of the most severe CS-related bladder trauma [10] (Fig. 1). Thus, in this retrospective study we aimed to assess the incidence of UTV-CS and related risk-factors, to

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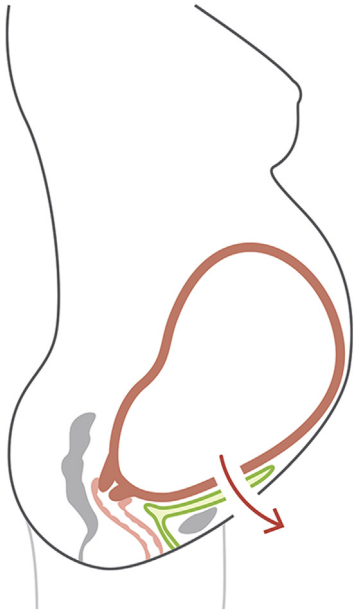

Fig. 1. Unintentional transvesical caesarean section (UTV-CS) is a bladder injury caused by the extraction of the fetus through a double full thickness bladder wall cystotomy (arrow).

report surgical and post-operative management, and to evaluate the short- and long-term maternal outcomes.

Materials and methods

We conducted a retrospective study in two tertiary University Hospitals. The studied period was between January 2013 and December 2017. UTV-CS was defined as any extraction of the fetus through a double full thickness bladder wall cystotomy. We identified cases by searching the diagnosis of bladder injury and bladder repair during CS in our comprehensive computerized labor and delivery database, delivery register, and operating room record book. All charts and description of surgical procedures were manually reviewed to confirm the diagnosis of UTV-CS. Cases of bladder wall injury without a UTV-CS were excluded. We retrieved data on maternal history, demographics characteristics, obstetric parameters, and details regarding the CS, bladder injury location and extension, and surgical technique. Data about surgeon experience were recorded. Short-term outcomes included catheterization period, cystography results (if performed), any febrile event and/or need for second operation prior to maternal discharge were recorded. Long-term outcomes are about final bladder function. The primary outcome of the study was the incidence of UTV-CS among pregnant women undergoing CS, that was calculated on the comprehensive number of CS preformed in the two centers in the study period.

Ethics and methodological standards

The design, analysis, interpretation of data, drafting and revisions conform the Helsinki Declaration, the Committee on Publication Ethics (COPE) guidelines (http://publicationethics.org/), the RECORD (reporting of studies conducted using observational routinely-collected health data) statement [11] and the Consensus-based Clinical Case Reporting (CARE) Guideline available through the EQUATOR (enhancing the quality and transparency of health research) network (www.equator-network.org). The retrospective study design and development, with anonymized handling of the data, was approved by the Institutional Review Board of the two study centers. All patients reported in this study signed an informed consent for all the procedures they underwent. Furthermore, patients signed a consent allowing data collection for research purposes and gave full approval to report and to publish information and images of the cases. The study was non-advertised, and no remuneration was offered to encourage patients to give consent for collection and analysis of their data.

Results

During the study period, at the University Hospital of Verona, out of 16,394 deliveries, 4,582 CSs were performed (27.95%). During the same period at the University Hospital of Varese there were 12,428 deliveries, and 3,034 were CSs (24.41%). Out of a total of 28,822 deliveries, 7,616 (26.42%) patients had CS, with any full thickness bladder wall injury diagnosed in 23 patients (0.302%) of them. Cases of bladder injury without a UTV-CS were excluded. Three CSs were complicated by extensive bladder injury with unintentional extraction of the fetus through the bladder. Comprehensive resulted incidence of UTV-CS was 0.039% (1 in 2,564 CS). One more case of UTV-CS (case 4) was managed in the postoperative period with relaparotomy after CS performed in a peripheric hospital, and it was not included in the assessment of UTV-CS incidence. Statistical analysis about risk factors could not be conducted due to the limited number of cases. Details, short- and long-term outcomes of the cases are reported in Tables 1–3.

The surgical technique

Here we describe the surgical technique and postoperative management proposed and used in the three cases managed at our institutions (case 1, 2 and 3). Iatrogenic bladder injury was identified after the extraction of the fetus and before uterine repair by visual inspection and Foley urinary catheter identification. The first step performed was the bladder exploration with identification of the injury extension. In order to exclude injuries involving bladder trigone or distal and intramural ureteral portion, an intravenous dye (e.g. indigo carmine or methylene blue) and/or retrograde ureteral catheterization with Bracci catheter (6/8 Ch) were used. Furthermore, urethral inspection, following Foley catheter, was performed.

Table 1
Characteristics of the patient and pregnancy.

Case no.	Age, years	Gestational age [a], weeks	Gravity and parity	No. of previous CS	Pregnancy	Admission	Surgical history (excluded CS)	Medical history
1	39	40	G1P0	0	Uneventful	PROM and UCA	Appendicectomy	//
2	36	39	G2P1	1	Uneventful	Trial of labour	//	//
3	28	39	G1P0	0	Uneventful	CTG abnormalities	//	//
4	32	38	G5P4	4	Uneventful	Haemorrhages, anaemia, anuria post CS	//	//

[a] Gestational age at delivery; CS = Caesarean section; CTG = cardiotocography; PROM = Premature rupture of membrane; UCA = Uterine contractile activity.

Table 2
Characteristics of the labour and caesarean section.

Case no.	Labour	Elective/ Urgent CS	CS indication	Peritoneal cavity	Bladder flap creation	Foetal weight g/ outcome	Foetal presentation	Main risk factor
1	Spontaneous	Urgent	Arrest of first stage of labour	Extensive adhesions between uterus, bowel, bladder; bladder stretched over the uterus	yes	3,532/ viable	cephalic	Unreported previous urogenital trauma and surgery
2	Spontaneous	Urgent	Arrest of second stage of labour	Bladder strongly attached to the uterus anterior wall covering the lower segment	yes	3,180/ viable	cephalic	Previous CS + Second stage of labour
3	Induced	Urgent	CTG abnormalities	Peritoneal adhesion to the anterior wall of the uterus up to the superior third, bladder checked in normal site	no	3,445/ viable	cephalic	None anamnestic, Intraoperative adhesions
4	no	Elective	4 previous CSs	Explorative laparotomy: regular uterine tone, a high adherent bladder flap stretched over the uterine fundus with anterior bladder wall sutured with the upper edge of the hysterotomy, severe peritoneal adhesions.	yes	3,754/ viable	cephalic	4 previous CSs

CS = Caesarean section; CTG = cardiotocography.

Table 3
Characteristics of caesarean section, bladder injury, management, short and long-term outcomes.

Case no.	CS step of injury	Time of injury identification	Mode of injury identification	Bladder injury extension	Surgeon experience	Timing of Foley removal	Timing of cystography	Short-term outcome	Long-term outcome
1	Hysterotomy	After foetus extraction	Foley balloon identification	> 10 cm	> 200 CS	12 POD	10 POD	Uneventful	Bladder function recovery
2	Hysterotomy	After foetus extraction	Foley balloon identification	> 10 cm	> 200 CS	12 POD	11 POD	Uneventful	Bladder function recovery
3	Hysterotomy	After foetus extraction	Foley balloon identification	8 cm	> 200 CS	20 POD	19 POD	Uneventful	Bladder function recovery
4	Hysterotomy	1° POD	Anuria, tense abdomen, relaparotomy	> 10 cm	> 100 CS	15 POD	15 POD	Uneventful	Bladder function recovery

POD = Post-operative day; CS = Caesarean section.

If injury involves bladder trigon and/or ureters and/or urethra, a multidisciplinary approach with the urologist is recommended [12]. Once trigonal, ureteral or urethral injuries are excluded, as in the three cases, the bladder injury can be repair.

The second performed step was the dissection between posterior bladder wall and anterior wall of lower uterine segment carried caudal to the level of bladder trigone and cervix. The posterior bladder wall was dissected away from the uterus wall as much as needed to elevate the edge of the posterior cystotomy, enough to ensure a tension-free repair (Fig. 2). This step further allowed to expose uterine incision and to perform uterine repair with usual technique (third step). The fourth step was the bladder repair. Anterior and posterior bladder walls were closed in two to three layers with 3-0 and 4-0 delayed-absorbable and absorbable sutures. The mucosal layer was closed with running suture. The submucosal and muscular layers were closed with running or interrupted suture with the inversion of mucosal layer. Posterior wall was the first closed, submucosal and muscular layers were sutured firstly with extravesical approach (3-0 delayed-absorbable suture) (Fig. 3) and subsequently bladder mucosa was sutured with intravesical approach (4-0 absorbable suture) (Fig. 4). The anterior wall was subsequently sutured, firstly the mucosal layer and secondly the submucosal and muscular layers (Fig. 5). After bladder repair, bladder integrity was checked with dye instilled into the bladder in a retrograde fashion through Foley catheter. An

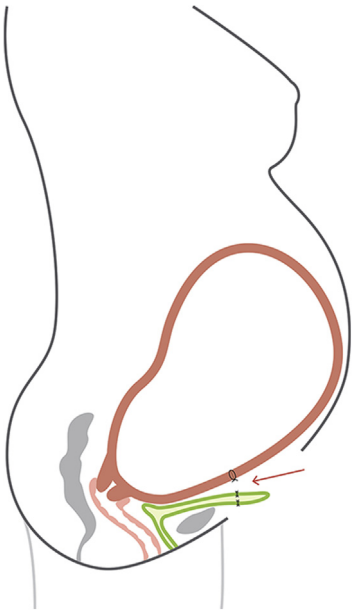

Fig. 2. Dissection performed caudally, between posterior bladder wall and anterior uterine wall (arrow), allows to achieve a tension-free reconstructive suture of the anterior and posterior bladder wall.

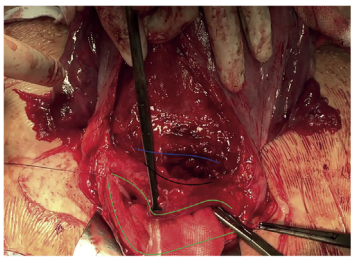

Fig. 3. The figure shows the results after: dissection between posterior bladder wall and anterior uterine wall; hysterotomy repaired with usual technique; posterior bladder wall first suture layer: submucosal and muscular layers are sutured with extravesical approach. Blue line: suture of hysterotomy. Black line: posterior bladder wall suture (first external layer). Green lines: anterior bladder wall cystotomy. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

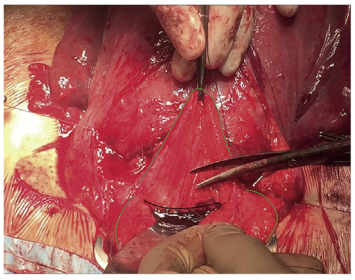

Fig. 4. The figure shows the second suture layer of posterior bladder wall cystotomy; bladder mucosa is sutured with intravesical approach. Black line: posterior bladder wall suture (second internal layer). Green lines: anterior bladder wall cystotomy. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

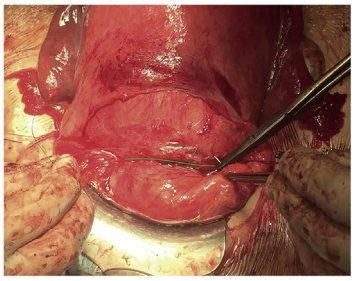

Fig. 5. The figure shows the suture of anterior bladder wall cystotomy with bladder reconstruction. Green line: anterior bladder wall suture. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

omental flap positioned between uterus and bladder was considered in one case (number 3). Bladder drainage was continuous and unobstructed for 10 to 15 days. Residual urine volume was measured after discontinuing the Foley's catheter drainage to exclude urinary retention, and cystography was performed prior to catheter removal considering this type of bladder injury with both the anterior and the posterior wall involvement. Fig. 6 shows cystography of the case 2. The used techniques were aimed to achieve vascularized margins of the bladder wound with a tension-free suture. With these results the organ heals quickly without complications [8].

In all the cases, the antibiotic prophylaxis at the beginning of surgery was performed with penicillin combined with beta-lactamases as routine management of CSs, and it was repeated based on duration of surgery. Additional antibiotic prophylaxis was not performed, although it is recommended in case of fever or urinary symptoms.

Comment

Our results reported an expected incidence of UTV-CS of 1 in 2,564 CS (0.039%) and an overall incidence of bladder wall injury of 1 in 331 CS (0.302%). Although the severity of bladder trauma, prompt diagnosis and proper surgical repair allowed to recover a normal urological function in all the cases reported. Risk factors seem to be consistent with factors related to milder bladder injuries.

CS is one of the most common pelvic surgeries and it has been associated with low rates of maternal morbidity and mortality [13]. Nevertheless, owing to the high incidence, hysterectomy and CS are respectively the first and second most common iatrogenic causes of urinary tract and bladder injuries [1,14]. Different studies have investigated incidence and risk factors of bladder injury during CS [6]. Nevertheless, in most of studies bladder injury was defined as any full thickness defect of the bladder that required surgical repair or was less defined [3–7], and a classification as the AAST-OIS of bladder injuries was rarely used [1,10]. In this retrospective study we investigated only the grade IV and V bladder injuries according to AAST-OIS, which are represented by UTV-CS characterized by extraction of the fetus through a double full thickness bladder wall cystotomy.

Intentional TV-CS has been reported necessary in case of previous major genitourinary tract reconstruction, as the new bladder position makes it very difficult to expose the lower uterine segment [8,15–17]. Conversely, TV-CS may occur unplanned and unintentionally, and only a few cases of this complication have been described so far [8,9]. The incidence of UTV-CS within CSs in our study was 0.039%. Although not clearly stated, Rahman at el. reported 2 bladder injuries occurred at the time of the uterine incision which were discovered after extraction of the fetus with an incidence of 0.025% [5]. Furthermore, Phipps et al. and Gungorduk et al. reported respectively 5 and 24 bladder injuries occurred at the time of the uterine incision or delivery, with an incidence of 0.033% and of 0.042%, respectively [3,4]. Although cases reported could not be considered UTV-CS and other cases could not be excluded, the incidences calculated are consistent with our results.

Although bladder injury during CS and UTV-CS are infrequent, all obstetricians performing CS should evaluate the presence of risk factors for these complications, and promptly recognize and repair the lesion. Identification and immediate repair of damage during surgery is of paramount importance reducing the risk of further surgical procedures as well as possible complications, with a high likelihood for a return of normal urologic function [4–7,18,19]. In our study, when bladder injury repair was performed during CS, normal urologic function was achieved.

Previous CS and peritoneal adhesions accounted for the main risk factors of bladder injury [3–7], and both CS and peritoneal adhesions are independent causative factors [3–5,19]. As well as previous CS, major genitourinary tract surgery, myomectomy [9] and laparotomy rise the likelihood of peritoneal adhesions and the risk of bladder injury [19,20]. Furthermore, any condition making difficult to delineate the bladder from the lower uterine segment rise bladder injury risk, as well as peritoneal adhesion, CS during the second stage of labor, endometriosis, presence of large fibroids, previous irradiation, and congenital and acquired abnormalities of the urogenital system [19]. In all the cases of UTV-CS reported, risk factors related to a bladder malposition and adhesion between bladder and anterior uterine wall were present. Nevertheless, due to the paucity of UTV-CS cases, analysis about risk factors and any differences with bladder injury in general could not be done, the

Fig. 6. Supine position, postero-anterior images (A) and left oblique-anterior images (B) of case 2 post-operative cystography showing normal bladder anatomy and function.

same for the dynamic of injury. Bladder injury is reported more commonly during entry into the peritoneal cavity or during separation of the bladder flap [3–7]. On that basis, in case of suspected extensive and severe adhesions, the peritoneal cavity should be opened at a higher level than usual, and separation of tissues should be carried out using the sharp method, in order to decrease the risk of bladder injuries during entry into the peritoneal cavity. Nevertheless, UTV-CS in the cases reported complicated the lower segment uterine incision step performed through a double cystotomy despite the previous apparent creation of a bladder flap, that was related to a bladder strongly attached to anterior wall of the uterus, rather than adhesion with abdominal wall [8,9].

In three cases, the surgeons suspected the bladder lesion immediately after the fetus extraction seeing the Foley catheter balloon in the surgical field. Identification and immediate repair of damage during surgery is of paramount importance, therefore intraoperative markers of bladder injury should be checked in cases with preoperative and intraoperative risk factors. The reported markers of bladder injury are the presence of urine outside the bladder, the visualization of Foley catheter, the hematuria in the Foley bag, and the visible wound or mucous membrane of the bladder. When in doubt, the intravesical instillation of dye through the Foley catheter is a helpful selective intraoperative adjunct [4,5]. Furthermore, injuries to the bladder and ureters should be graded by the AAST-OIS and should be managed according to the extent and the type of injury as described for UTV-CS in the surgical technique [10]. Cystography was performed in all the cases. Although the role of cystography in evaluating bladder function after bladder injury repair is controversial, we routinely perform and recommend it prior to catheter removal [7,21].

In the reported cases, the antibiotic prophylaxis at the beginning of surgery was performed with penicillin combined with beta-lactamases as routine management of CSs, and it was repeated based on duration of surgery. Alternative antibiotics are usually cephalosporins and clindamycin. About the use of prophylactic antibiotic therapy during the 10–15 days of Foley catheter placement, there is no enough evidence to support it for incidental cystotomy as effective strategy to reduce post-operative complications, when the lesion is detected and repaired immediately [10,12,14,18,19]. In general, although the most common postoperative complication is represented by urinary tract infection, in these cases antibiotic therapy was administered only in case of fever or urinary symptoms. A culture-directed antibiotic can be preferred, omitting it if the urine culture is negative [22]. Although a precautionary postoperative prophylaxis with antibiotics compatible with lactation such as cephalosporines and penicillins combined with beta-lactamases could be considered, it has not been demonstrated to be beneficial in patients undergoing clean intermittent catheterization or long-term catheterization because of the key role of intraoperative prophylaxis [22].

Conclusion

In summary, the risk of bladder injury during CS should be always considered although the low incidence of this complication. This is the first study that assessed the incidence of UTV-CS, and this may reflect obstetricians' unwillingness to report severe CS related bladder injuries. Indeed, this complication occurs, in 3 out of 4 cases, in CS performed by senior consultant with extensive experience in obstetric surgery (more than 200 CS performed). Furthermore, results show that reported UTV-CS risk factors seem to be consistent with factors related to bladder injury in general. Nevertheless, due to the low incidence of UTV-CS an evaluation of related risk factors compared to milder bladder injuries could not be performed, and the few identified cases limit conclusions. However, a proper risk assessment for bladder injury before and during surgery, and an immediate recognition of this complication are of paramount importance. Before hysterotomy it is mandatory to perform a careful evaluation of the anatomical planes among muscles, bladder and uterus, and after delivery the integrity of the bladder and lower uterine segment had to be checked in all cases at risk. In smaller hospitals, where an appropriate level of surgical expertise may not be present, and a multidisciplinary approach may not be available, patients with recognized risk factors might should be sent to a referral center for elective caesarean delivery. Even in UTV-CSs, appropriate procedures at the time of surgery and in the post-operative period seem to allow avoiding severe complications and recovery of a normal urological function.

Authors' contribution

All the authors conform the International Committee of Medical Journal Editors (ICMJE) criteria for authorship, contributed to the intellectual content of the study and gave approval for the final version of the article. The authors alone are responsible for the content and writing of the paper.

Franchi M, Ghezzi F and Raffaelli R: study conceptualization and protocol planning and design, supervision. Franchi M, Ghezzi F, Cromi A, Garzon S and Laganà AS: manuscript writing/editing.

Zanconato G, Baggio S, Scollo M, Cromi A, Casarin J, Garzon S and Laganà AS: clinical data search, collection and analysis.

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Disclosure of interest

All the authors have no proprietary, financial, professional or other personal interest of any nature in any product, service or company. The authors alone are responsible for the content and writing of the paper.

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