# Prevention and management of iatrogenic bladder injuries in gynecologic and obstetric surgery

# Prevenção e abordagem de lesões iatrogénicas da bexiga em cirurgia ginecológica e obstétrica

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## Abstract

Iatrogenic bladder injuries are rare in gynecologic and obstetric surgical procedures. However, bladder injuries occurring during those procedures account for the majority of all non-endoscopic iatrogenic bladder trauma. Their diagnosis can be made intra- or post-operative with different approaches. Prevention and early recognition are crucial in reducing intra and post-operative morbidity and mortality. In this review we summarize the current evidence on epidemiology, etiology, diagnosis, treatment and prevention of iatrogenic bladder lesions during gynecologic and obstetric surgical procedures.

**Keywords:** Gynecologic surgery; Obstetric surgery; Iatrogenic disease; Urinary bladder.

## Resumo

As lesões iatrogénicas da bexiga são raras em cirurgia ginecológica e obstétrica. No entanto, representam a maioria das lesões iatrogénicas realizadas em procedimentos não endoscópicos. O seu diagnóstico pode ser intra ou pós-operatório, implicando diferentes abordagens. A prevenção e o reconhecimento precoce são essenciais para a redução da morbilidade e mortalidade pós-operatórias. Esta revisão sumariza a evidência mais recente acerca da epidemiologia, etiologia, diagnóstico, tratamento e prevenção de lesões iatrogénicas da bexiga durante cirurgia ginecológica e obstétrica.

**Palavras-chave:** Cirurgia ginecológica; Cirurgia obstétrica; Lesões iatrogénicas; Bexiga.

## INTRODUCTION

Iatrogenic bladder trauma (IBT) can be caused by internal injuries often resulting from endoscopic urological procedures (such as transurethral resection of the bladder or prostate), or external injuries that occur during urologic, gynecologic/obstetric and intestinal pelvic surgeries (open, laparoscopic or robotic).

Most gynecological and obstetric surgeries can lead to iatrogenic injuries on the urinary system organs. The bladder is the most common affected organ due to its anatomical proximity to ovaries, uterus and vagina. Gynecologic and obstetric procedures are the leading cause of non-endoscopic IBT[1]. However, this complication

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is rare and occurs in less than 1% of all gynecologic and obstetric surgeries.

Despite its rareness, IBT early recognition in intra or post-operative period can allow an early treatment leading to reduced morbidity. Therefore, it is of utmost importance for gynecologic and obstetric surgeons to know how to prevent, recognize and approach these lesions.

In this narrative review we summarize the current literature concerning the epidemiology, etiology, diagnosis, treatment and prevention of iatrogenic bladder lesions during gynecologic and obstetric surgical procedures.

## EPIDEMIOLOGY AND RISK FACTORS

Bladder perforation during gynecologic or obstetric procedures represents 65% of all non-endoscopic IBT[1]. However, IBT are rare and occur in less than 1% of all gynecologic and obstetric procedures[2-4].

Among these, abdominal/laparoscopic/robot-assisted hysterectomy and midurethral retropubic sling have the highest rates of IBT described. Table I summarizes the incidence of IBT in different gynecological and obstetric surgeries[5].

Some patient-related risk factors can contribute to these lesions. The presence of endometriosis has been associated with IBT during laparoscopic hysterectomy for benign disease[6]. Some studies also found an association between previous caesarean delivery and higher IBT occurrence during hysterectomy[7-9].

Using monopolar or bipolar electrosurgical energy can potentially lead to thermal injuries. As a result of thermal spread, which extends several millimeters beyond macroscopically evident dissection during surgery, these injuries may manifest later in the postoperative period[10]. Therefore, care must be taken when using these energy sources near the bladder.

## DIAGNOSIS

Bladder perforations are detected intra-operatively in 85% of the cases[6]. Intra-operative signs of IBT include macroscopic hematuria, the presence of clear fluid or methylene blue (when the bladder has been previously filled with it) in the operative field and the presence of air in the urine collector bag during laparoscopic or robot-assisted surgery. In order to confirm the diagnosis, a retrograde instillation with methylene blue diluted with saline can be made through the bladder foley catheter previously inserted. The lesion can also be confirmed by intra-operative cystoscopy, which allows identification of the location and dimension of the orifice, as well as ureteral meatus inspection[11]. Most

**TABLE I. INCIDENCE OF IBT IN GYNECOLOGIC AND OBSTETRIC SURGICAL PROCEDURES (ADAPTED FROM REFERENCES [3], [5] AND [6]).**

| Surgical procedure | Incidence of IBT (%) |
|---|---|
| Laparoscopic/abdominal hysterectomy (benign) | 1.00 – 11.10 |
| Abdominal radical hysterectomy (malignant) | 2.37 – 7.40 |
| Midurethral sling (retropubic) | 4.91 – 5.50 |
| Laparoscopic/robot assisted radical hysterectomy (malignant) | 4.19 – 4.59 |
| Transvaginal mesh surgery | 2.84 |
| Autologous pubovaginal sling | 2.80 |
| Vaginal hysterectomy (benign) | 0.60 – 2.50 |
| Laparoscopic sacrocolpopexy | 1.90 |
| Midurethral sling (transobturator) | 1.61 |
| Burch colposuspension | 1.00 – 1.20 |
| Caesarean delivery | 0.08 – 0.94 |
| Native tissue colporraphy | 0.53 |

injuries occur at the bladder dome, but care must be taken with lesions affecting the trigone because of possible ureteral involvement[10].

The European Association of Urology (EAU) recommends routine cystoscopy in retropubic suburethral sling placement[5]. Routine use of cystoscopy in other gynecologic procedures has been largely debated. A previously published systematic review and meta-analysis found that its universal use during hysterectomy resulted in a higher intra-operative IBT detection rate[12]. Another retrospective study showed that universal use of cystoscopy during hysterectomy did not lead to a lower 30-day rate of genitourinary tract injury compared with no cystoscopy[13]. Other studies report a low cost-effective benefit of its universal use during hysterectomy[14,15]. Therefore, EAU does not recommend routine cystoscopy during other gynecologic or obstetric procedures[5].

Bladder injury can also be diagnosed in the post--operative period. Suggestive signs include macroscopic hematuria, abdominal distention, ileus, urinary outflow reduction, serum creatinine rise (due to intraperitoneal reabsorption), urine drainage through the surgical wound and sepsis. A non-identified lesion can ultimately lead to urinary fistula to adjacent organs[5].

Cystography is the preferred imaging modality to confirm the suspicion of an IBT post-operatively. It can be done either with plain x-ray or using computed tomography (CT). According to the European Association of Urology Guidelines on Urological Trauma, cystography must be done after active instillation of minimum 300-350 mL of diluted contrast material into the bladder through the bladder foley catheter. Passive bladder filling by clamping the foley catheter in the excretory phase of CT does not exclude bladder perforation accurately[5]. Cystography can show the presence of contrast around bowel loops or abdominal viscera which is suggestive of intraperitoneal rupture. In the presence of extraperitoneal rupture of the bladder, flame-shaped areas of contrast around perivesical tissue can be visualized. If contrast medium is visualized in the vagina, vesico-vaginal fistula must be suspected.

In the post-operative period, the presence of high output of a clear liquid through a surgical drain placed during surgery can also indicate IBT. The biochemical analysis of this fluid shows a creatinine value higher than that observed in patients' blood, suggestive of urine leakage in the operative field[11].

## PREVENTION

The risk of bladder injury during gynecologic and obstetric procedures can be reduced by emptying the bladder through an urethral catheterisation in all procedures that carry an IBT risk. Additionally, some special precautions can be taken during these surgeries to avoid IBT. In patients previously submitted to cesarean section or other pelvic surgeries, attention must be taken to possible anatomical distortion. The bladder may be adherent to anterior peritoneal planes at the umbilicus level, thus requiring extra care at placing laparoscopic trocars or during laparotomy incision. Palpation of the foley balloon may help during dissection, and sharp instead of blunt dissection may be preferable. If needed, the bladder can be filled with saline (with or without methylene blue) to help differentiate the dissection planes. During laparoscopic hysterectomy, uterine traction using a uterine manipulator and countertraction in vesicouterine peritoneum can also help dissection[11].

When performing vaginal hysterectomy, a downward traction to the cervix can be applied to facilitate entry into anterior cul-de-sac, as well as dissection at a 45 degree angle, palpation of anterior peritoneal layer and retrograde bladder instillation. As said before, extremely careful use of thermal energy should also be taken into account[10].

During surgery for prolapse repair or insertion of suburethral slings by vaginal approach, hydrodissection with injection of saline solution in vesicovaginal space can help separate the anatomical planes and avoid bladder lesions[11]. For hemostasis and hydrodissection, a dilute vasopressin solution (20 units in 50 or 100 mL normal saline) can be injected in the midline and out laterally to the sidewalls, as described for anterior compartment prolapse correction.[16] In the University Hospital's Urogynecology Unit where two of the authors of this paper (AH and AVL) work, the protocol for hydrodissection in reconstructive pelvic surgery consists of: filling the bladder with 50mL of saline with methylene blue; hydrodissection of vesicovaginal space with a solution of 100 mL cold saline and 20 mL 1%

lidocaine with adrenaline. This hydrodissection together with bladder filling can facilitate dissection, reduce bleeding and help detect eventual lesions if methylene blue is visualized in the operative field.

Other maneuvers during transvaginal sling procedures can help reduce the risk of IBT. During retropubic suburethral sling placement, the metallic trocar should be close to the pubic symphysis as much as possible during its passage. Furthermore, placement of a rigid sound in the urethra can help mobilize it in the opposite direction of the trocar movement. During placement of a suburethral sling using a transobturator approach the metallic trocar should also be close to the inferior pubic ramus during its passage, and the surgeon must place a finger in the paraurethral space behind the vaginal mucosa flap to guide the trocar away from the urethra[17].

## TREATMENT

A bladder perforation detected intra-operatively should be immediately repaired. With adequate expertise, iatrogenic lesions can be successfully repaired during laparoscopic or robotic surgery, without the need of conversion to open surgery.

Nevertheless, the principles of repair are the same for all types of approach. The repair should be done with an absorbable synthetic suture (for example Polyglactin, preferably 2-0 or 3-0)[11]. Non-absorbable sutures such as silk are contraindicated due to risk of stone formation when in contact with urine[18]. The repair is usually done in a two-layer fashion – a first running suture including the mucosa and muscularis, and a second running or interrupted suture incorporating the serosa[11]. In complex injuries additional layers can be done, for example using omental flaps to cover large defects. Care must be taken in defects with necrotic tissue or previous radiation exposure, as well as when there is a lesion of bladder trigone/neck suggesting eventual ureteral lesion requiring repair, stenting or reimplantation. In these complex cases the collaboration of an experienced urologic surgeon is recommended[10].

After repair, a retrograde instillation with 300 mL saline or diluted methylene blue through the foley catheter should be done to confirm the absence of leakage. There is usually no need for prophylactic antibiotics unless there is a confirmed urinary tract infection[10].

For IBT detected post-operatively, the gold standard treatment is surgical exploration with repair in intraperitoneal ruptures. Conservative treatment with an indwelling bladder catheter (ideal timing explained in follow-up section) and prophylactic antibiotics can be adequate for extraperitoneal injuries. Prophylactic antibiotics should be initiated on the day of the injury and maintained for 7 days[19] but there is no recommendation concerning a specific antibiotic regimen. In extraperitoneal ruptures with symptomatic extravesical collections surgical exploration with drainage and perforation suturing are indicated[5].

In cases where small IBT is detected during midurethral sling or transvaginal mesh procedures, sling can be reinserted and bladder catheter maintained in the postoperative period. However when the urethra is also affected all foreign material should be immediately extracted and an indwelling bladder catheter placed to allow healing (duration of catheterization explained in follow-up section)[17].

## FOLLOW-UP

After an IBT, continuous bladder drainage (without clamping the catheter) should be maintained. There is no specific recommendation regarding the type of foley catheter, but for catheterization superior than 7 days a silicone catheter may be preferred. Silicone bladder catheters have higher biocompatibility and higher resistance to kinking, thus allowing a better continuous drainage of a healing bladder[20]. There is also no specific recommendation regarding the ideal size and number of lumens of the bladder catheter. The most common size used in women is 14Fr or 16Fr, but if hematuria is expected a 18Fr or 20Fr catheter can be used to allow a better evacuation of eventual clots. A three-lumen catheter can be used to continuously wash the bladder in case of hematuria, but this should be avoided as much as possible in a recently sutured bladder.

The duration of bladder catheterization after an IBT treated surgically or conservatively is a common debatable question. There are currently no published prospective trials evaluating the ideal duration of

catheterization after an IBT. A previous study in animal models found that the normal bladder mucosa is completely epithelialized 4 days after a cystostomy[21]. Another paper reports not only that the bladder mucosa is reepithelialized at day 4 but also that it regains its normal tensile strength at day 21 after suturing[18]. Therefore, EAU recommends indwelling bladder catheterization during 7-10 days after a surgical repair of an uncomplicated injury in an healthy patient[5]. In cases of an IBT during transvaginal mesh placement (for stress urinary incontinence or pelvic organ prolapse treatment), some groups advise a shorter catheterisation for 2-7 days[17].

In patients with complex injuries (trigone involvement, ureteric injury, local necrotic or infected tissue) or with adverse risk factors for wound healing (malnutrition, steroid therapy) a cystography with active retrograde instillation of contrast through the foley catheter is recommended at post-operative day 10. Aside from these patients, routine post-operative cystography is not mandatory. If no urinary leakage is observed at day 10 cystography, the foley catheter can be removed at that time[5]. When urine leakage is observed at this first cystography, studies made in non-iatrogenic bladder trauma patients lead to recommendation of performing a cystoscopy, as well as maintaining the indwelling bladder catheter until repetition of cystography one week later. No specific recommendations exist for ongoing urine leakage on the first cystography after IBT repair[5].

In patients with IBT treated only conservatively, the bladder catheter can be removed at days 5-7 after a confirmatory cystography[5].

After surgical repair of IBT, patients can have bladder spasms caused by the presence of suture and the indwelling bladder catheter. Resulting irritative symptoms (suprapubic pain, urgency, urine leakage around catheter) can be managed with anticholinergic (e.g., solifenacin, oxybutynin) or beta-adrenergic agonist (mirabegron) drugs while the symptoms persist.

## CONCLUSIONS

Iatrogenic bladder trauma is rare in gynecological and obstetrical procedures, in spite of representing the leading cause of non-endoscopic IBT. Its early recognition in intra- or post-operative period can avoid late complications and reduce morbidity and mortality. Gynecologic/obstetric surgeons should have special care in patients with known risk factors and adopt some preventive measures to avoid bladder perforation during surgeries. Furthermore, maintaining a high index of suspicion and knowing the intra and post-operative management principles is of utmost importance for a successful diagnosis and treatment of these patients.

## REFERENCES

1. Cordon BH, Fracchia JA, Armenakas NA. Iatrogenic Nonendoscopic Bladder Injuries Over 24 Years: 127 Cases at a Single Institution. Urology. 2014;84(1):222-226. doi:10.1016/j.urology.2014.03.028

2. Ozdemir E, Ozturk U, Celen S, et al. Urinary complications of gynecologic surgery: iatrogenic urinary tract system injuries in obstetrics and gynecology operations. Clin Exp Obstet Gynecol. 2011;38(3):217-220. https://www.ncbi.nlm.nih.gov/pubmed/21995149

3. Satitniramai S, Manonai J. Urologic injuries during gynecologic surgery, a 10-year review. J Obstet Gynaecol Res. 2017;43(3):557-563. doi:10.1111/jog.13238

4. Wong JMK, Bortoletto P, Tolentino J, Jung MJ, Milad MP. Urinary Tract Injury in Gynecologic Laparoscopy for Benign Indication: A Systematic Review. Obstet Gynecol. 2018;131(1):100-108. doi:10.1097/AOG.0000000000002414

5. N.D. Kitrey, N. Djakovic, P. Hallscheidt, F.E. Kuehhas, N. Lumen, E. Serafetinidis, D.M. Sharma. EAU Guidelines on Urological Trauma. Accessed August 8, 2021. https://uroweb.org/guideline/urological-trauma/

6. Tan-Kim J, Menefee SA, Reinsch CS, et al. Laparoscopic Hysterectomy and Urinary Tract Injury: Experience in a Health Maintenance Organization. J Minim Invasive Gynecol. 2015;22(7):1278--1286. doi:10.1016/j.jmig.2015.07.016

7. Rooney CM, Crawford AT, Vassallo BJ, Kleeman SD, Karram MM. Is previous cesarean section a risk for incidental cystotomy at the time of hysterectomy? A case-controlled study. Am J Obstet Gynecol. 2005;193(6):2041-2044. doi:10.1016/j.ajog.2005.07.090

8. Brummer THI, Jalkanen J, Fraser J, et al. FINHYST, a prospective study of 5279 hysterectomies: complications and their risk factors. Hum Reprod. 2011;26(7):1741-1751. doi:10.1093/humrep/der116

9. Mamik MM, Antosh D, White DE, et al. Risk Factors of Lower Urinary Tract Injury at the Time of Hysterectomy for Benign Reasons. Obstet Gynecol Surv. 2014;69(5):254-255. doi:10.1097/01.ogx.0000450116.17401.73

10. Glaser LM, Milad MP. Bowel and Bladder Injury Repair and Follow-up After Gynecologic Surgery. Obstet Gynecol. 2019;133(2):313-322. doi:10.1097/AOG.0000000000003067

11. Wright EJ. Chapter 35 – Management of Intraoperative Injury To the Urinary Tract. In: Handa VL, Van Le L, eds. Te Linde's Operative Gynecology. Lippincott Williams & Wilkins; 2019:636--642.

12. Teeluckdharry B, Gilmour D, Flowerdew G. Urinary Tract Injury at Benign Gynecologic Surgery and the Role of Cystoscopy: A Systematic Review and Meta-analysis. Obstet Gynecol. 2015;126(6): 1161-1169. doi:10.1097/AOG.0000000000001096

13. Barber EL, Polan RM, Strohl AE, Siedhoff MT, Clarke-Pearson DL. Cystoscopy at the Time of Hysterectomy for Benign Indications and Delayed Lower Genitourinary Tract Injury. Obstet Gynecol. 2019;133(5):888-895. doi:10.1097/aog.0000000000003192

14. Visco AG, Taber KH, Weidner AC, Barber MD, Myers ER. Cost-effectiveness of universal cystoscopy to identify ureteral injury at hysterectomy. Obstet Gynecol. 2001;97(5 Pt 1):685-692. doi:10.1016/s0029-7844(01)01193-0

15. Sandberg EM, Cohen SL, Hurwitz S, Einarsson JI. Utility of cystoscopy during hysterectomy. Obstet Gynecol. 2012;120(6): 1363-1370. doi:10.1097/aog.0b013e318272393b

16. Grimes C. Chapter 29 - Colporrhaphy and Enterocele Repair. In: Handa VL, Van Le L, eds. Te Linde's Operative Gynecology. Lippincott Williams & Wilkins; 2019.

17. MacDonald S, Terlecki R, Costantini E, Badlani G. Complications of Transvaginal Mesh for Pelvic Organ Prolapse and Stress Urinary Incontinence: Tips for Prevention, Recognition, and Management. Eur Urol Focus. 2016;2(3):260-267. doi:10.1016/j.euf.2016.06.016

18. Hastings JC, Van Winkle W, Barker E, Hines D, Nichols W. The effect of suture materials on healing wounds of the bladder. Surg Gynecol Obstet. 1975;140(6):933-937. https://www.ncbi.nlm.nih.gov/pubmed/1129685

19. Morey AF, Simhan J. Chapter 133 – Genital and Lower Urinary Tract Trauma. In: Partin AW, Dmochowski RR, Kavoussi LR, Peters CA, Wein AJ, eds. Campbell Walsh Wein Urology. 12th ed. Elsevier; 2020:3054-3057.

20. Feneley RCL, Hopley IB, Wells PNT. Urinary catheters: history, current status, adverse events and research agenda. J Med Eng Technol. 2015;39(8):459-470. doi:10.3109/03091902.2015.1085600

21. Hepperlen TW, Stinson W, Hutson J, Bartone FF. Epithelialization after cystotomy. Invest Urol. 1975;12(4):269-271. https://www.ncbi.nlm.nih.gov/pubmed/1112657

## AUTHORS' CONTRIBUTIONS

Concept and design of the work JP, AH, AVL; Data collection and analysis JP; Drafting of the manuscript JP; Critical revision of the manuscript AH, AVL; Supervision AH, AVL.

## AUTHORS DISCLOSURE

The authors do not have any conflict of interest to declare.

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**RECEIVED:** 05/10/2021
**ACCEPTED:** 25/10/2022