Urological complications of laparoscopic hysterectomy: a four-year review at KK Women's and Children's Hospital, Singapore

Siow A, Nikam Y A, Ng C, Su B M C

ABSTRACT

Introduction: This review assessed the incidence, predisposing conditions, and key surgical steps, where urological injuries occurred during laparoscopic hysterectomies at the Minimally Invasive Surgery Unit, KK Women's and Children's Hospital over a four-year period.

Methods: A retrospective review of 495 cases of laparoscopic assisted vaginal hysterectomies (LAVH) and total laparoscopic hysterectomy (TLH) from January 2001 to December 2004 was conducted.

Results: A total of eight urological injuries occurred, all within the initial two years of review. There were seven unintentional bladder injuries occurring at LAVH during dissection of the bladder off the utero-vaginal attachment. The associated factors included previous caesarean section and fibroids. All bladder injuries were diagnosed and repaired intraoperatively with no long-term complications. A single case of ureteric injury occurred with TLH. The patient presented on the ninth postoperative day with fever and continuous vaginal discharge. The most likely aetiology was thermal damage from electrocautery used to secure haemostasis of the uterine artery pedicle. Ureteric re-implantation was eventually required in the patient.

Conclusion: Urological injuries occurred in 1.6 percent of laparoscopic hysterectomies in our hospital. The predisposing factors include previous caesarean surgery, multiple fibroids and severe endometriosis. A definite learning curve exists with laparoscopic hysterectomy with a thorough knowledge of pelvic anatomy being an essential prerequisite for advanced pelvic surgery. Similarly, good exposure of the surgical field, vigilant dissection and judicious use of electro-surgery are important practices to adopt to prevent injuries.

Keywords: bladder injuries, laparoscopic hysterectomy, ureteric injuries, urological complications

Singapore Med J 2007; 48(3):217–221

Minimally Invasive Surgery Unit, KK Women's & Children's Hospital, 100 Bukit Timah Road, Singapore 229899

Siow A, MMed, MRANZCOG, MRCOG
Consultant and Gynae-Laparoscopist

Nikam YA, MBBS, MS
Clinical Fellow

Su BMC, MMed, MRANZCOG, MRCOG
Senior Consultant and Head

Division of General Obstetrics and Gynaecology

Ng C, MMed, FRANZCOG, FAMS
Associate Consultant

Correspondence to:
Dr Anthony Siow
Tel : (65) 6293 4044
Fax : (65) 6298 6343
Email: anthony.siow.ym@kkh.com.sg

INTRODUCTION

Urological injury is a serious complication in gynaecological operations. Not only is it associated with the morbidity of vesicovaginal fistula and ureteric stenosis, long-term complications like hydronephrosis with variable degrees of renal impairment and failure may ensue. Urological injury is also the basis of medico-legal suits. In Canada, ureteric injuries, in particular, account for 17% of non-obstetric legal actions against gynaecologists.[1] Urological complications during laparoscopic pelvic surgery thus remain an important concern for all gynaecologists. Such complications can occur even in the hands of experienced surgeons. It is therefore prudent that gynaecologists are mindful of prevention, early detection and management of urological injuries.

The purpose of this study focuses on the incidence of urological injuries during laparoscopic hysterectomy at our hospital, identifying the associated factors and key surgical steps where these injuries occur. This empowers us to take preventive measures to reduce their incidence and also to demonstrate optimal management strategies.

METHODS

A retrospective review of all urological injuries sustained during elective laparoscopic hysterectomy carried out

from January 2001 to December 2004 at KK Women's and Children's Hospital, Singapore was undertaken. The cases of urological injuries were examined for the clinical and coexisting pathological conditions that may predispose to the injury, the indication for surgery, time of recognition of injury, method of repair and postoperative outcome.

All cases of laparoscopic hysterectomy were performed with video recording. Pneumoperitoneum was created using a Verres needle. A 10 mm laparoscope was inserted sub-umbilically and two to three 5.5 mm trocars were inserted in the suprapubic region and lateral to the inferior epigastric vessels. Following the laparoscopic setup, the patient was placed in the steep Trendelenberg position. We used the following 5 mm instruments to perform the hysterectomy: scissors with monopolar coagulation connected, grasping forceps with and without teeth, Klappinger bipolar diathermy forceps and monopolar point diathermy needle. To manipulate the uterus for hysterectomy, a 10 mm laparoscopic spoon grasper was inserted transcervically. All instruments except the laparoscopic scissors were reusable. Stapling devices were not used.

The round ligaments were first divided and salphingo-oophorectomy was performed if indicated. The ureters were visualised transperitoneally at the pelvic brim and in the pelvic side wall before the infundibulopelvic ligaments were coagulated with bipolar cautery and cut. The uterovesical peritoneal reflection was incised and the bladder was dissected off its utero-vaginal attachment. The broad ligament was trimmed to isolate the uterine vessels before they were coagulated with bipolar diathermy and cut.

In 2001, the majority of laparoscopic hysterectomy was completed vaginally. Colpotomy, division of uterosacral-cardinal ligament complex and closure of vault were carried out vaginally. This conforms to the Type II laparoscopic hysterectomy of the American Association of Gynecological Laparoscopy (AAGL) classification for laparoscopic hysterectomy. In this review, we have taken Type II laparoscopic hysterectomy to be synonymous with laparoscopic assisted vaginal hysterectomy (LAVH).

From 2002 onwards, we began to perform more Type IV total laparoscopic hysterectomy (TLH) with the KOH Colpotomizer™ System (CooperSurgical Inc, Shelton, CT, USA) to complete the hysterectomy. Following division of the uterine vessels, the 10 mm laparoscopic spoon grasper was replaced with the KOH Colpotomizer. Colpotomy and division of uterosacral-cardinal ligament complexes were carried out laparoscopically using a monopolar point diathermy needle. After the uterus was removed vaginally, closure of the vault was carried out laparoscopically. A combination of interrupted sutures with extracorporal knot tie or continuous suturing with intracoporal knot tie using monofilament absorbable sutures completed the TLH.

RESULTS

A total of 495 cases of laparoscopic hysterectomy were performed during the review period. There were seven cases of bladder injury (1.4%) and one case of ureteric injury (0.2%), giving a total urological complication rate of 1.6%. All the urological complications were confined to the first two years of review. All cases of bladder injuries were detected intraoperatively, while the case of ureteric injury presented nine days after surgery.

The major indications for hysterectomy included uterine fibroids (51.9%), endometriosis (25.1%), endometrial hyperplasia (8.3%), abnormal uterine bleeding (3.2%) and cervical cancer stage 1A1 (3.0%). The average operative time required for LAVH was 167 minutes in 2001. This was reduced to 138 minutes in 2004. The corresponding operative times for TLH were 145 minutes and 136 minutes, respectively. Table I details the seven cases of bladder injuries that occurred during LAVH. The main indication for hysterectomy in these cases was uterine fibroids and the average weight of extirpated specimen was 351 g (range, 130–750 g).

Three cases of full thickness bladder injury occurred during the vaginal phase of LAVH. In two of these cases, unintentional cystotomy was created during vaginal dissection to delineate the uterovesical space, as dense pelvic adhesion precluded the laparoscopic approach. The third case of inadvertent cystotomy occurred during vaginal colpotomy in a patient with early cervical cancer where a wider margin of excision was performed. These three bladder injuries were subsequently repaired vaginally.

Four cases of bladder injuries occurred during laparoscopic dissection. Repeated previous caesarean sections and an enlarged uterine size appeared to be the associated factors. Laparoscopic repair of the bladder injuries were undertaken in these cases. Regardless of the route of bladder repair, the cystotomy was closed in two layers using delayed absorbable sutures. Bladder integrity was confirmed by filling the bladder with 200 ml of saline stained with methylene blue. The indwelling urinary catheter was removed after five days of free drainage and all patients recovered without further urinary complications.

A single case of ureteric injury occurred in a 41-year-old woman with severe pelvic endometriosis. The uterus was 12 weeks in size and an endometrioma was present in the left ovary. The pouch of Douglas was obliterated with bowel adhesions and dense endometriosis involved the recto-vaginal septum and uterosacral ligaments. A Type IV TLH and left salphingo-oophorectomy took 230 minutes to complete. A review of the video recording of

Table I. Details of bladder injuries during LAVH.

No.	Diagnosis	Factors associated with bladder injury	Time of diagnosis	Type of bladder injury	Stage of operation when injury occurred
1.	Fibroid, pelvic pain	None	Intraoperative	Sero-muscular tear	Laparoscopic sharp dissection into UV space
2.	Fibroid, endometriosis	Two previous LSCS Dense adhesion at UV fold Bladder drawn cephalad and adherent to anterior wall of uterus	Intraoperative	Full thickness	Laparoscopic sharp dissection into UV space
3.	Fibroid, endometriosis	16-week size uterus 6 cm fibroid on right uterine wall 4 cm fibroid on left uterine wall Extirpated specimen weighed 42 g	At cystoscopy after hysterectomy	Full thickness	Laparoscopic sharp dissection into UV space
4.	Fibroid	Two previous LSCS Dense adhesion at UV fold precluding laparoscopic dissection of bladder of anterior uterus	Intraoperative	Full thickness	Dissecting bladder off cervix vaginally
5.	Cervical cancer stage Ia1	None	Intraoperative	Full thickness	Dissecting bladder off cervix vaginally
6.	Fibroid	Two previous LSCS 10 cm fibroid in right broad ligament Extirpated specimen weighed 750 g	At cystoscopy after hysterectomy	Full thickness	Laparoscopic sharp dissection into UV space
7.	Fibroid	Previous myomectomy, LSCS and tubal ligation Bowel adhesion to left round ligament Omental adhesion to anterior abdominal wall and uterus obliterating UV fold	Intraoperative	Full thickness	Dissecting bladder off cervix vaginally

LSCS: Lower segment caesarean section; UV: Utero-vaginal

the surgery suggested thermal damage as the aetiology for ureteric injury. Profuse bleeding from the left uterine vessels was encountered during division of the cardinal ligaments and prolonged bipolar coagulation was used to secure haemostatsis in the region of the severed left uterine vessels. Although cystoscopy at the end of surgery showed good excretion of urine from both ureters, the patient presented nine days later with fever and continuous watery vaginal discharge. Pelvic computed tomography revealed a urinoma in the pouch of Douglas and a dilated left ureter with flow of contrast ending in the urinoma. A ureteric stent was inserted initially but ureteric re-implantation was eventually required as healing was suboptimal.

DISCUSSION

Laparoscopic hysterectomy is still a relatively new method that requires a significant learning phase and years of experience to master. Although the number of laparoscopic hysterectomies performed at our hospital is small, we felt it prudent to review our complication rates and identify possible preventive measures to reduce their occurrence.

Our rate of urological complications (1.6%) is comparable to various published review articles where bladder injuries ranged from 1.0% to 1.8% and ureteric injuries, 0.2%–0.4%.[2–5] In a survey carried out by the AAGL in 1995, bladder injury occurred in 1.0%

and ureteric injury in 0.3% of 14,911 laparoscopic hysterectomy procedures.[3] A palpable learning curve for laparoscopic hysterectomy is indeed evident as all the urological injuries occurred in the first two years of review.

Bladder injury appears to be the most prominent urological complication in our review. It occurs most commonly during the incision into the utero-vesicle space to dissect the bladder caudally. Our experience is similar to Carley et al where a history of prior caesarean delivery was significantly greater in women who sustained unintended cystotomy during abdominal hysterectomy.[4] It is conceivably so because of the increased scarring that may occur between the bladder base and pubo-vesico-cervical fascia. At laparoscopic hysterectomy, two other factors may have compounded the risk of bladder injury: (i) the difference in direct tactile sensation as compared to open surgery during the dissection, and (ii) the limitation of movement as dictated by the fixed positions of the laparoscopic port sites.

With increasing experience over the years, we have realised that the dense scarring at the bladder base following caesarean section can indeed be tackled laparoscopically with precise electro-surgical dissection. With the utero-vesical fold placed on tension, short application of monopolar cutting current applied in the centre invariably allows a clean cut to be made right down to the pubo-vesico-cervical fascia. With this fascia exposed centrally, dissection can then be brought laterally to free the bladder. We have employed this method of dissection to date and have not encountered further bladder complications or the need to free the bladder vaginally. We find that placing the suprapubic port at the same level as the lateral ports for this dissection improves the ergonomics of laparoscopy, thus allowing for greater dexterity and precision during dissection.

Ureteric injuries can occur at the pelvic brim, near the infundibulopelvic ligament and at the pelvic side wall, where the ureter passes beneath the uterine artery. The risk of ureteric injury becomes elevated, particularly in the presence of endometriosis, pelvic adhesions or large pelvic masses, where the normal anatomy is distorted. Although ureteric injuries are typically cited to occur in the presence of these predisposing factors, it is imperative to note that one half of ureteric injuries in laparoscopic hysterectomy occur during simple, uncomplicated hysterectomy.[5] To reduce the risk of ureteric injuries, some gynaecologists routinely expose the ureter by retroperitoneal dissection to visualise its course. There has been no prospective study to assess the efficacy of this method but a retrospective analysis by Neumann et al showed a statistically significant reduction in ureteric injury following routine retroperitoneal dissection of the ureter.[6] Ureteric injuries for abdominal hysterectomy were reduced from 0.7% to 0.2% when the ureters were thus exposed.

Retroperitoneal dissection to visualise the course of the ureter at laparoscopy requires a fair degree of dexterity. The dissection is also not without risk to the major vessels lying beneath the peritoneum. Hence to prevent ureteric injury near the vaginal vault, some surgeons advocate a simple step of creating a "window" over the anterior and posterior broad ligaments to push the areolar tissue, in which the ureter is embedded, inferiorly and laterally.[7] This displaces the ureter away from the uterine vessels, thereby reducing the risk to the ureter while dividing the uterine vessels. Our experience has prompted us to use a traction manoeuvre during division of the uterine vessels to increase the safety margin around the ureters. With the uterus pushed tautly to the contralateral side, the traction on the ipsilateral uterine vessels displaces it further away from the ureter. With the tissues under traction, the increased distance between the uterine vessels and ureter reduces the lateral thermal spread from electro-surgery. Division of the uterine vessels and cardinal ligaments can often be done layer by layer off the sides of the uterus safely. The placement of ureteric stents preoperatively has not been shown to decrease the risk of ureteric injuries as demonstrated by Kuno et al.[8] In fact, the presence of the ureteric stents may actually make the ureter less pliable and more rigid thereby increasing the risk of injury during dissection to mobilise it.

One of the key issues in laparoscopic hysterectomy is the ubiquitous use of electro-surgery in dissection, excision and division of tissue planes, pedicles and vessels. A comprehensive understanding of the principles of electro-surgery and its effects on tissue and surrounding structures is therefore a pre-requisite for safe laparoscopic hysterectomy. In our review, excessive electro-coagulation of the uterine vessels and cardinal ligaments near the ureter appeared to be the aetiology for the case of ureteric injury. We have learnt that in such precarious situations where bleeding appears profuse, an effective manoeuvre is to first clamp the bleeding site with a locking grasping forceps to stem the bleed. This temporary haemostatic manoeuvre then enables lavage of the area concerned in order to visualise the bleeding point clearly. Precise and short bipolar energy can then be delivered accurately and effectively to secure haemostasis with the least amount of lateral thermal spread. Indiscriminate use of electro-coagulation coupled with prolonged activation over a bleeding source in a pool of blood is highly ineffective and will only lead to more complications.

Early diagnosis of urological injuries is vital to allow prompt repair and limit postoperative morbidity. Intraoperative cystoscopy with intravenous indigo carmine is a simple and good method to rule out gross ureteric lesions and bladder perforations. In our review,

two cases of bladder injuries were thus detected. This method however can still provide a false negative result in cases of urological injures secondary to thermal damage. When injuries are diagnosed intraoperatively, repair with proper technique can provide near 100% success rates.[9] Unfortunately, in most cases, diagnosis of urological injuries, especially to the ureter, is made postoperatively. A high index of suspicion must be maintained in patients with unexplained haematuria, fever, abdominal or flank pain and poor urine output. Stanhope et al observed that there was a mean rise in serum creatinine of 71 mmol/L (range, 27–124 mmols/L) 36–48 hours postoperatively from preoperative levels in patients with unilateral ureteric obstruction.[10] These index cases of ureteric obstruction however were caused by suture entrapment rather than thermal damage. Regardless of the aetiology of urological damage, prompt radiological investigation in the form of intravenous pyelogram or contrast-enhanced computed tomography is ultimately required for diagnosis to prevent delay of treatment.

To conclude, the incidence of urological injuries during laparoscopic hysterectomy from January 2001 to December 2004 at KK Women's and Children's Hospital was 1.6%. The commonest urological injury was to the bladder (1.4%). These injuries occurred during dissection to free the bladder in cases with previous caesarean section and enlarged uterus. There was only one case of ureteric injury (0.2%) that occurred as a result of lateral thermal damage while trying to secure haemostasis of the uterine vessels. A comprehensive understanding of the anatomy of urological structures, adequate surgical exposure, and meticulous dissection in the proper planes with appropriate traction manoeuvre can reduce the risk of urological injuries. A thorough understanding of the principles of electro-surgery and its effect on tissues and surrounding structures is a pre-requisite for safe laparoscopic hysterectomy.

REFERENCES

1. Vilos GA, Dow DJ, Allen HH. Litigation following ureteral injuries associated with gynaecological surgery. J Soc Obstet Gynaecol Can 1999; 21:31-45.
2. Harris WJ, Daniell JF. Early complications of laparoscopic hysterectomy. Obstet Gynecol Surv 1996; 51:559–67.
3. Hulka JF, Levy BS, Parker WH, Phillips JM. Laparoscopic-assisted vaginal hysterectomy: American Association of Gynecologic Laparoscopists' 1995 membership survey. J Am Assoc Gynecol Laparosc 1997; 4:167–71.
4. Carley ME, McIntire D, Carley JM, Schaffer J. Incidence, risk factors and morbidity of unintended bladder or ureter injury during hysterectomy. Int Urogynecol J Pelvic Floor Dysfunct 2002; 13:18-21.
5. Harkki-Siren P, Sjoberg J, Tiitinen A. Urinary tract injuries after hysterectomy. Obstet Gynecol 1998; 92:113-8.
6. Neuman M, Eidelman A, Langer R, et al. Iatrogenic injuries to the ureter during gynecologic and obstetric operations. Surg Gynecol Obstet 1991; 173:268-72.
7. Koh LW, Koh PH, Lin LC, et al. A simple procedure for the prevention of ureteral injury in laparoscopic-assisted vaginal hysterectomy. J Am Assoc Gynecol Laparosc 2004; 11:167-9.
8. Kuno K, Menzin A, Kauder HH, Sison C, Gal D. Prophylactic ureteral catheterization in gynecologic surgery. Urology 1998; 52:1004-8.
9. Petri E. Urological trauma in gynaecological surgery: diagnosis and management. Curr Opin Obstet Gynecol. 1999; 11:495-8.
10. Stanhope CR, Wilson TO, Utz WJ, Smith LH, O'Brien PC. Suture entrapment and secondary ureteral obstruction. Am J Obstet Gynecol 1991; 164:1513-9.