Ureteral complications from laparoscopic hysterectomy indicated for benign uterine pathologies: a 13-year experience in a continuous series of 1300 patients

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BACKGROUND: The aim of this study was to evaluate the risk of ureteral injuries and to discuss how to avoid their occurrence after laparoscopic hysterectomy indicated for benign uterine pathologies. METHODS: This observational study covers the period from January 1993 to December 2005 (retrospective study from 1993 to 2000 and prospective from 2001). We reviewed incidence, methods of diagnosis and management of ureteral injuries. RESULTS: The rate of ureteral injuries was 0.3% (four patients). Three patients presented a ureteral fistula diagnosed secondarily some time after the operation. The fourth patient presented a ureteral injury that was diagnosed peroperatively. Three out of four of the lesions were observed on the right side. In every case, there were preoperative risk factors connected with a past history of surgery, or the lateral location of uterine myomas. All four patients needed ureterovesical reimplantation. The outcome was good in all four cases. CONCLUSIONS: The rate of ureteral complications after laparoscopic hysterectomy is low and comparable to that observed after hysterectomy by laparotomy. The risk should not prevent laparoscopic hysterectomy being used more widely. Prevention depends on training in the technique and the surgeon’s experience.

Keywords: hysterectomy; operative laparoscopy; laparoscopic hysterectomy; complications; ureteral injuries

Introduction

Total hysterectomy for benign uterine lesions is the most frequent gynaecological surgical operation not connected with pregnancy (Dicker et al., 1982; Rutkow, 1986). In 1989, Reich et al. demonstrated that this operation could be carried out via laparoscopy (Reich et al., 1989). Laparoscopic hysterectomy is indicated as alternative to laparotomy or when vaginal surgery is difficult (Chapron and Dubuisson, 1995). Multicentre studies have shown that most total hysterectomies are still carried out by laparotomy (Harkki-Siren et al., 1998; Gimbel et al., 2001; Mäkinen et al., 2001; Farquhar and Steiner, 2002). One of the major risks with total hysterectomy is that of urological complications, notably ureteral lesions (Harkki-Siren et al., 1998; Vakili et al., 2005; Gilmour et al., 2006; Mteta et al., 2006). This is due to the fact that the ureters are located ~2.3 cm from the lateral edge of the cervix in women with normal pelvic anatomy (Hurd et al., 1992). Even if operative laparoscopy is not inherently dangerous (Chapron et al., 2002), some authors consider that the risk of ureteral injury is higher after laparoscopic hysterectomy compared with traditional hysterectomy (Harkki-Siren et al., 1998; Mäkinen et al., 2001; Johnson et al., 2005).

The goal of our work, which is based on a large and continuous series of laparoscopic hysterectomy indicated for benign pathologies, is to evaluate the risk of ureteral complications and to discuss how to avoid their occurrence.

Materials and Methods

Between January 1993 and December 2005, all patients who underwent laparoscopic hysterectomy were included in the study. All the operations were carried out according to a technique described previously (Chapron et al., 1994). The main characteristics of the operative technique are as follows: (i) the total hysterectomy was indicated for a benign pathology in every case; (ii) the operation was carried out via laparoscopy from the (conservative or radical) adnexal phase right up to the time of colpotomy; (iii) bipolar coagulation was used for all haemostasis procedures and (iv) all surgical procedures were carried out with reusable instruments (Karl Storz Endoscopie, Paris,
France). Patients with genital prolapse and/or urinary stress incontinence were excluded.

The following are the main points in the operating technique aimed at avoiding ureteral complications. Uterine cannulation is essential. It provides the means for the assistant placed between the patient’s legs to push the uterus towards the side away from the ureter being treated, in order to increase the distance between the ureter and uterine artery. Bipolar coagulation forceps used for uterine artery haemostasis must be inserted via the supra pubic trocar homolateral to the artery. With this configuration, the bipolar forceps will be perpendicular to the lateral edge of the body of the uterus, and thus the ascending portion of the uterine artery. Bipolar coagulation—section of the uterine artery must take place on the ascending portion of the uterine artery, level with the middle third of the lateral edge of the uterus, well above its arch. The ureter is at a good distance from this point. It lies well outside and below the coagulation area, and all the more so when exposure has been optimized using the uterine cannulation. Once bipolar coagulation—section of the uterine artery has been achieved, dissection should continue but remaining without fail inside from the uterine artery. All the haemostasis procedures are then gradually carried out, as far as the cervix and the vagina. By remaining strictly within this plane with the lateral edge of the uterus inwards and the sectioned uterine artery outwards, it is theoretically impossible to injure the ureter, which is located outside the uterine artery. If there is any difficulty in achieving perfect haemostasis, it is preferable to use clips to avoid secondary complications due to electrocautery. In the event that adnexectomy is associated with the total hysterectomy, the first phase must consist of identifying the trajectory of the ureter, and if there are any adhesions, carrying out preliminary adhesiolysis. When there are severe adhesions, it may be necessary to use a retroperitoneal approach to identify the ureter trajectory. In our experience, ureterolysis is not used systematically. Ureterolysis is carried out only in difficult cases (abdomino-pelvic surgery, endometriosis, myoma in the broad ligament etc.).

Between January 1993 and December 2000, medical, operative and pathological reports for each patient were collected retrospectively. The same analyses were performed prospectively for patients operated between January 2001 and December 2005. For each case, the following data were systematically collected and entered into a data base: (i) patient’s characteristics [age, height, weight, body mass index (BMI), gravidity, parity, menopausal status, preoperative transvaginal ultrasonography results (length, width and thickness of the uterus), indications for laparoscopic hysterectomy, previous history of vaginal delivery, of caesarean section and of adhesiogenous abdominopelvic surgery (Leonard et al., 2005)]; (ii) operative and post-operative results (operating time, uterine weight and associated surgical procedure (adhesiolysis, adnexectomy etc.)); (iii) surgeon’s experience (junior or senior): by definition, we considered that only those practitioners who had carried out more than 50 laparoscopic hysterectomy could be considered as senior surgeons and (iv) ureteral complications (incidence, surgical symptoms, methods of diagnosis, ureteral side and site, type of injury, causal instrument, treatment modalities, follow-up and sequelae).

Table 1: Patients’ characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mean ± SD</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>47.6 ± 6.76</td>
<td>762 58.6</td>
<td></td>
</tr>
<tr>
<td>Height (cm)</td>
<td>163.0 ± 6.0</td>
<td>762 58.6</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>62.3 ± 11.3</td>
<td>762 58.6</td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.44 ± 3.86</td>
<td>762 58.6</td>
<td></td>
</tr>
<tr>
<td>Gravidity</td>
<td>1.89 ± 1.57</td>
<td>762 58.6</td>
<td></td>
</tr>
<tr>
<td>Parity</td>
<td>1.5 ± 1.29</td>
<td>762 58.6</td>
<td></td>
</tr>
<tr>
<td>Post-menopausal state</td>
<td>340 26.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous C-section</td>
<td>179 13.8</td>
<td></td>
<td></td>
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<tr>
<td>No previous vaginal delivery</td>
<td>473 36.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous history of adhesiogenous abdominopelvic surgery</td>
<td>338 26.0</td>
<td></td>
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</table>

*Indications for Laparoscopic hysterectomy:
- Menometrorrhagia with uterine myomas: 762 (58.6%)
- Menometrorrhagia without uterine myomas: 207 (15.9%)
- Menometrorrhagia with associated non-suspicious ovarian cysts: 40 (3.1%)
- Pelvic pain with myomas: 112 (9.6%)
- Pelvic pain without myomas: 125 (9.4%)
- Precancerous lesions: 42 (3.2%)

*Sometimes more than one for the same patient.

Results

During the study period, 1300 patients underwent a laparoscopic hysterectomy. Patients’ characteristics and indications for laparoscopic hysterectomy are presented in Table 1. The mean uterine weight was 257.5 ± 160.7 g and the mean operating time was 133.9 ± 49.5 min. During the same anaesthesia, adhesiolysis was carried out in 25.2% (327 patients) of cases, and in 40.4% (525 patients) of cases, adnexectomy was associated with laparoscopic hysterectomy. The rate of ureteral injuries was 0.3% (4 patients). Three patients presented a secondary ureteral fistula. The fourth patient presented a ureteral injury that was diagnosed operatively.

A summary of patients with ureteral injury after laparoscopic hysterectomy is presented in Table 2. Details are the following:

Case 1:

This concerned a right ureterorectal fistula diagnosed 2 months after laparoscopic hysterectomy. The operation was carried out by a senior surgeon, and was indicated in a patient aged 38 for heavy menorrhagia that persisted despite hormonal treatments, in a context of adenomyotic uterus. The patient had a past history of pelvic surgery on several occasions (endometriosis and adhesiolysis). On the second day post-operatively, the onset of fever associated with right lumbar pain prompted renal ultrasound examination and intravenous pyelogram, which revealed dilatation of the right pyelo-calicial cavities. No sign of any ureteral lesion was seen at ureteroscopy and a double J catheter was installed as a precaution. When the double J catheter was removed 2 months after laparoscopic hysterectomy, gassy diarrhoea appeared. Cystoscopy revealed a right vesico-rectal fistula. During repair of this vesico-rectal fistula by laparotomy, a right ureterorectal fistula was also discovered, which was repaired during the same anaesthesia by ureterovesical reimplantation. Five years later, the patient has no functional urinary symptoms, and renal ultrasound is normal.
Case 2:
Laparoscopic hysterectomy was indicated for menometrorrhagia with uterine myomas in a patient aged 40. A 4 cm myoma had developed in each of the two broad ligaments. The operation was carried out by a skilled surgeon and went perfectly well. On the 10th post-operative day the patient was taken back into hospital in a context of febrile occlusion. Investigation by abdominopelvic scan revealed the existence of intra-peritoneal effusion with moderate dilatation of the right pyelocalicial but no visible obstacle. Intravenous pyelogram did not reveal any fistula. Installation of a double J catheter relieved the symptoms and the renal cavity dilatation ceased.

When the double J catheter was removed 2 months after the operation, the appearance of vaginal discharge enabled the diagnosis of ureterovaginal fistula to be made. An ureterovesical reimplantation was carried out. Three years later, the patient is cured with no urinary sequelae.

Case 3:
Laparoscopic hysterectomy with bilateral salpingooophorectomy was indicated for persistant menometrorrhagia associated with severe dysmenorrhea for a 51-year-old patient with considerable adenomyosis. The operation was carried out by a skilled surgeon but was difficult due to the presence of endometriosis on the posterior surface of the left broad ligament. The immediate post-operative history was uncomplicated apart from a delay in the return to normal bowel function (day 3). On the 10th post-operative day, biological results were normal. On the 10th post-operative day, the patient was re-admitted to hospital for peritonitis. On the third post-operative day, the patient was re-admitted to hospital for peritonitis. The operation was carried out by a skilled surgeon and went perfectly well. On the 10th post-operative day the patient was taken back into hospital in a context of febrile occlusion. Investigation by abdominopelvic scan revealed the existence of intra-peritoneal effusion with moderate dilatation of the right pyelocalicial but no visible obstacle. Intravenous pyelogram did not reveal any fistula. Installation of a double J catheter relieved the symptoms and the renal cavity dilatation ceased.

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Case 4:
This patient aged 48 presented a past history of several pelvic surgery interventions, and suffered from pelvic pain associated with menometrorrhagia in a context of uterine adenomyosis. A laparoscopic hysterectomy with bilateral salpingooophorectomy was decided. The existence of pelvic adhesions subsequent to the previous operations increased the difficulty of the operation, carried out by a junior surgeon. During dissection of the right uterine artery using laparoscopic scissors, there was partial section of the right ureter. During the same anesthesia and in collaboration with a urological surgeon, direct suture was carried out with installation of a double J catheter. The patient developed secondary ureteral stenosis with dilatation of the right pyelocalicial cavities. After repeated ureteral dilatation procedures failed, right ureteral reimplantation took place 12 months later. Two years after treatment for this complication, the patient presents no problems.

Discussion
The rate of ureteral injuries was 0.3%. These operations were in every case made more difficult because of peroperative risks connected with a past history of surgery or uterine myomas in a lateral location. Similarly to other authors (Wattiez et al., 2002), we have observed that ureteral injuries occur most frequently on the right side. In every case, the lesions...
were observed at the distal ureter, close to the uterine artery and the uterosacral ligament. None of the complications was secondary to bipolar coagulation—section of the infundibulopelvic ligament for those patients who underwent adnexectomy associated with laparoscopic hysterectomy. Only one of the four ureteral injuries was diagnosed peroperatively. For the other three patients, the complications were diagnosed some time after the operation due to ureteral necrosis secondary to the use of bipolar coagulation to ensure haemostasis of the uterine pedicles. These ureteral injuries are serious complications that justify specialized surgical management. All the patients had to undergo ureterovesical reimplantation and two laparotomies were needed for one patient (Case 3). At present, some time after the event, all the patients have been cured and have neither sequelae nor residual functional symptoms.

It is appropriate to take these results into account when specifying how total hysterectomies should be conducted. Our results are indeed comparable to those seen by other teams (Table 3). Provided the surgeons are experienced in laparoscopic surgery, the risk of ureteral complications after laparoscopic hysterectomy is comparable with the rate of 0.2–0.4% observed when total hysterectomy takes place by laparotomy (Harkki-Siren et al., 1998; Mäkinen et al., 2001; Carley et al., 2002; Dorairajan et al., 2004; Vakili et al., 2005). This observation is essential, given that laparoscopic surgery ought to be considered as an alternative to laparotomy (Chapron and Dubuisson, 1995). In other words, the fact of carrying out a total hysterectomy by laparoscopy rather than by laparotomy does not increase the risk of ureteral complications (Chapron et al., 2002). This factor is all the more important in that for each of the four complications we observed, there were preoperative risk factors (previous adhesiogeneous abdomino-pelvic surgery, endometriosis and myomas in the broad ligament) which counter-indicated vaginal surgery as a method for this operation. The risk of ureteral complications must no longer be used as an argument against the more widespread use of laparoscopic hysterectomy. The only real problem is that of training for surgeons in this technique in order to be able to reduce the number of hysterectomies carried out by laparotomy. Evaluation of the learning curve of laparoscopic hysterectomy demonstrates that the majority of major complications occur during the learning stage (Kreiker et al., 2004).

One of the characteristics of ureteral injuries is that they are often only diagnosed after the operation (Saïdi et al., 1996; Oh et al., 2000). In our experience, only one of the four ureteral complications was diagnosed during laparoscopic hysterectomy. The problem is that routine cystoscopy does not guarantee recognition of all ureteral injuries (Councell et al., 1994; Dwyer et al., 1999; Dandolu et al., 2003). The value of cystoscopy to diagnose ureteral injury seems greater when uterine vessel haemostasis is performed by suture rather than by bipolar coagulation (Ribeiro et al., 1999). Although there is no consensus at present (Gilmour et al., 1999; Visco et al., 2001), like Vakili et al. (2005), we recommend cystoscopy after intravenous injection of indigo carmin for all cases of difficult laparoscopic hysterectomy. After operative laparoscopy, the recovery ought to be uneventful. In case of fever, flank pain or haematuria, the surgeon must be ready to consider the possibility of ureteral complications and to request blood samples and radiological investigation. Prompt recognition is essential to minimize secondary morbidity.

The modalities for prevention of ureteral injuries during laparoscopic hysterectomy are summarized in Table 4. The most important points are the following. The surgeon must be certain where the ureters are located during all phases of the operation. It is important to ensure ureteral safeguarding during all phases of the operation, as the ureters are close to the uterine artery and the uterosacral ligament. None of the complications was secondary to bipolar coagulation—section of the infundibulopelvic ligament for those patients who underwent adnexectomy associated with laparoscopic hysterectomy. Only one of the four ureteral injuries was diagnosed peroperatively. For the other three patients, the complications were diagnosed some time after the operation due to ureteral necrosis secondary to the use of bipolar coagulation to ensure haemostasis of the uterine pedicles. These ureteral injuries are serious complications that justify specialized surgical management. All the patients had to undergo ureterovesical reimplantation and two laparotomies were needed for one patient (Case 3). At present, some time after the event, all the patients have been cured and have neither sequelae nor residual functional symptoms.

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**Table 4: Prevention of ureteral complications during laparoscopic hysterectomy**

<table>
<thead>
<tr>
<th>Modality</th>
<th>Prevention of ureteral complications during laparoscopic hysterectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfactory surgical indications</td>
<td>For hysterectomy: Knowledge and respect of risk factors for conversion to laparotomy</td>
</tr>
<tr>
<td></td>
<td>For the route of hysterectomy: Adequate exposure</td>
</tr>
<tr>
<td>Technical surgical points</td>
<td>Setting-up: Safety rules; Knowledge of anatomic landmarks; Knowledge of electrosurgery principles</td>
</tr>
<tr>
<td></td>
<td>Adequate exposure: Depth, penetration and spread</td>
</tr>
<tr>
<td>Peroperative recognition</td>
<td>Precise ureteral identification: At all times during the procedure</td>
</tr>
<tr>
<td></td>
<td>High risk surgical procedures*: Adhesiolyis liver; Ureterolysis; Retroperitoneal approach</td>
</tr>
<tr>
<td>Multidisciplinary management</td>
<td>Cystoscopy: intravenous injection with indigo carmin; Collaboration with urological surgeon</td>
</tr>
<tr>
<td>Satisfactory follow-up</td>
<td>Quick postoperative diagnosis: Questioning; Temperature; Pain; Gas and stool; Serum biological change</td>
</tr>
</tbody>
</table>

*SPrevious adhesiogeneous abdomino-pelvic surgery, dense adhesions, deep endometriosis and large myomas in the broad ligament.*
the operation. Because with operative laparoscopic surgery the surgeon has a much improved visibility of the pelvic structures, we do not agree with the use of ureteral stents as recommended by some authors (Phipps and Tyrrell, 1992; Paulson, 1996), especially since stents may lead to complications (Wood et al., 1996). In difficult situations (associated adnexal masses adherent to the lateral pelvic sidewall, endometriosis, dense adhesions and myoma in the broad ligament), the surgeon must be capable of using a retroperitoneal approach and carrying out ureterolysis (Kadar, 1995). Although some authors (Wattiez et al., 2002) recommend using a uterine manipulator to improve exposure, systematic use of this instrument does not significantly reduce the risk of ureteral injuries. In case of bleeding near the ureter during ureterolysis, haemostasis must not be performed with bipolar coagulation but by using endoscopic clips to avoid thermal injuries. Bipolar coagulation of the uterine artery must be performed only at the level of the ascending branch in order to remain as far as possible from the ureter. The surgeon’s experience in these advanced laparoscopic surgical procedures is an essential factor. The risk levels for ureteral complications during laparoscopic hysterectomy are shown to be three to four times higher in multicentre studies (Harkki-Siren et al., 1997, 1998; Mäkinen et al., 2001) than for expert surgeons (Liu and Reich, 1994; Nezhat et al., 1995; Wattiez et al., 2002) (this study) (on average 1.3 versus 0.3). The results presented in the national Finnish register (Harkki-Siren et al., 2001) also show that ureteral injuries are more common in local hospitals where the expertise is not as great as in university teams (2.7% versus 0.9%). Whatever the surgeon’s experience, ureteral injuries significantly decrease with expertise (O’Shea et al., 2000; Harkki-Siren et al., 2001; McMaster-Fay and Jones, 2006). Finally, to prevent complications secondary to these ureteral injuries, management must include collaboration with an urologist.

Conclusion

The risk of ureteral complications after laparoscopic hysterectomy is comparable to that observed with laparotomy, provided the surgeon has sufficient experience. This risk should no longer be used as an argument against laparoscopic hysterectomy being used more widely. Careful identification and of necessary ureterolysis are the most important means of avoiding injury. Early diagnosis is the best way to prevent long-term sequelae. The challenge in the years to come is that of teaching this technique in order to increase the surgeons’ experience, with the aim of reducing the numbers of hysterectomies still carried out by laparotomy.

References


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