

Laparoscopic ureteral repair in gynaecological surgery

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Purpose of review

To review laparoscopic surgery in the treatment options for ureteral lesions in gynaecological surgery.

Recent findings

Laparoscopic treatment of ureteral injuries has been increasingly reported over the past years. Treatment has progressively shifted from ureteroneocystostomy performed by laparotomy to less invasive treatment options such as ureteral stenting or dilatation in case of stricture, stenting under laparoscopic guidance and laparoscopic stitching of lacerations, laparoscopic ureteral reanastomosis or laparoscopic ureteroneocystostomy for transections. Deep endometriosis surgery of an associated hydronephrosis is associated with a high incidence of ureteral lesions making preoperative stenting desirable in order to facilitate the eventual repair, while avoiding the more problematic insertion of a stent after a lesion is made.

The available data confirm the excellent outcome of stenting obstructive lesions. When stenting proves difficult or in case of a ureteral leakage, laparoscopic aided stenting is strongly suggested, in order to avoid further damage while permitting simultaneous repair if necessary. Laparoscopic suturing of a laceration over a stent is clearly superior to stenting only. Results of ureteral reanastomosis of a transected ureter vary from 88 to 100%; an occasional subsequent stenosis can be treated with dilatation. Bladder reimplantation has become feasible by laparoscopy and results seem promising. Laparoscopic bladder reimplantation is suggested as the method of choice in case of failure of a previous laparoscopic treatment.

Summary

Data strongly support laparoscopy as the method of choice for the management of ureteral lesions.

Keywords

endometriosis, gynaecology, laparoscopy, repair, ureter

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Introduction

Ureteral lesions are often considered a complication of gynaecological surgery due to the anatomic proximity of reproductive organs to the pelvic ureter; most of the lesions in gynaecology indeed occur in the distal part of the ureter [1•]. Some ureteral lesions, however, are unavoidable and necessary as in hydronephrosis with a stenosis over a longer segment due to, for example, deep endometriosis [2]. Gynaecological surgery is associated with ureteral lesions with an incidence ranging from 0.1 to 1.5% for benign procedures, and up to 5% for oncologic procedures [3,4]. Medicolegally, at least 6% of the claims in Obstetrics and Gynaecology are related to ureteral injury [5,6]. Almost invariably, however, the exact cause of the injury is difficult to pinpoint since it varies from avoidable accidents, to unavoidable and necessary surgery involving the ureter [7].

Treatment of ureteral lesions traditionally has been done according to the recommendations of Harrow [8] in 1968. The transition of laparotomy to laparoscopic surgery profoundly impacted upon both the prevention and treatment of ureteral lesions. Laparoscopy allows a mini-invasive evaluation of the ureteral lesion, and simultaneous treatment including both ureteral reanastomosis and bladder reimplantation [9].

We therefore aim at reviewing the evidence published over the past 18 months, either confirming known data, or adding new data while highlighting the role of laparoscopic surgery in this.

Incidence

Incidence of ureteral lesions obviously depends on the complexity of the procedure and on ureteral involvement. The reported incidences are 0.03–2% for

abdominal hysterectomies, 0.02–0.5% for vaginal hysterectomy, 0.2–6% for laparoscopic assisted vaginal hysterectomy, 1.7–3% for urogynaecological procedures and 4.4% in Wertheims [3,4]. In deep endometriosis surgery [2] lesions vary with the ureteral involvement. Incidence, in fact, is of 1.5% in deep endometriosis surgery without hydronephrosis and 21% in deep endometriosis surgery with hydronephrosis.

A key discussion over the past decades has been whether endoscopic surgery was associated with more ureteral lesions than laparotomy [4]. This, however, can be difficult to evaluate since the risk of lesions is expected to be higher during the learning curve, and experience is rarely explicitly given [10^{••}]. Moreover, the increase of complex surgery progressively performed by laparoscopy will obviously reflect on the incidence of ureteral lesions. Today, in the absence of data, the prevailing impression is that the risk of ureteral lesion is not increased by laparoscopic surgery.

Prevention of ureteral lesions

It has been suggested that ureteral integrity should be checked at the end of (complex) procedures involving dissection in proximity of the ureter, for example by blue dye injection or cystoscopy [3,11], the latter being considered important to recognize a ureteral injury during surgery permitting immediate repair.

Prophylactic stenting in case of deep endometriosis is advocated by many authors [12], but remains debated. The potential advantages of facilitating recognition and dissection of the ureter have never been proven. Obviously, a stent will facilitate recognition and repair in case of injury. Stenting, however, also carries the risk of complications such as discomfort, irritative bladder symptoms, haematuria, bacteriuria, fever and flank pain; rare complications are stent migration, encrustation, fragmentation, breakage [13] and, most importantly, eventual ureteral fibrosis transforming the ureter into a rigid tube. Unfortunately, however, these rare complications are based upon case reports, whereas the true incidence remains unknown.

In conclusion, given that the risk of ureteral lesion during deep endometriosis surgery, considered difficult surgery, is less than 0.5% in the absence of hydronephrosis and for nodules less than 3–4 cm in diameter (Koninckx PR, unpublished data), we consider systematic prophylactic stenting over treatment. The 21% risk of ureteral damage associated with hydronephrosis surgery [2] strongly suggests that prophylactic stenting is mandatory since facilitating ureteral repair, even if not preventing injury. Systematic cystoscopy is suggested as a routine procedure in order to ascertain, after complex surgery, that the

Key points

- A laceration of the ureter should be treated by laparoscopic-guided stenting and stitching.
- A laparoscopic reanastomosis is the treatment of choice for a ureteral transection.
- A delay in diagnosis does not impair the outcome.
- If a first laparoscopic treatment fails, a laparoscopic ureteral reimplantation becomes an option.
- The indications for laparotomic reimplantation have become very limited, unless laparoscopy is not available.

ureters are not occluded. Whether systematic blue dye injection is warranted is unclear.

Delayed diagnosis and treatment and subsequent outcome

Postoperative diagnosis of ureteral lesion is based upon clinical suspicion and imaging. Obstructions are typically characterized by increasing flank pain in the postoperative period, whereas ureteral leakage can cause, in addition, abdominal pain and fever. Occasionally, symptoms are nonspecific, such as ileus and abdominal distension; some patients might be asymptomatic notwithstanding the lesion, thus causing a delay in diagnosis. In case of uretero-vaginal fistula, urine loss from the vagina will be evident. Whenever a ureteral lesion is suspected, an intravenous pyelogram or computed tomography scan pyelography should be performed, permitting to evaluate the presence of a leakage or of an obstruction. If ureteral pain persists for longer periods, a hydronephrosis should be excluded. In case a uretero-vaginal fistula is suspected, vaginal discharge after injection of blue dye intravenously will confirm the diagnosis [1^{••},2,9].

Delay in diagnosis and treatment was claimed to worsen outcome of ureteral lesions based upon theoretical considerations of inflammation and tissue adhesions [4,14].

We recently [2,9] found – although the series are small – no differences in outcome of ureteral repair when the diagnosis had not been delayed for even up to 20 days after surgery.

The main impact of endoscopic surgery is that most, if not all, repairs can be done by laparoscopy. In absence of a laparoscopic team skilled to do ureteral repair a referral to a laparoscopic group should be considered. Common sense obviously suggests that in case of stenosis with evidence of hydronephrosis, stenting should always be attempted prior to referral. Considering the excellent outcome of laparoscopic ureteral repair, robotic surgery will have difficulty to prove any superiority.

Treatment of ureteral lesions

Treatment of ureteral lesions has been considered to depend on many factors such as the general condition of the patient, the location of injury and the type of lesion. Lesions to the ureter are stenosis, lacerations, transections and uretero-vaginal fistulas.

Stenosis

Stenosis can be the consequence of a coagulation, a crush, a kinking or a ligation. Following obstruction, in case of devascularization of the ureteral wall, a subsequent leak could develop. Traditionally blind stenting has been used as the first line of treatment of stenosis. If difficult, laparoscopic-aided stent insertion is recommended because of several advantages [10^{••}]. First the ureter can be stretched to help stent insertion, perforation can be prevented, and a suture can be removed while the ureteral devascularization can be judged [2].

Outcome is excellent [2,15,16]. Subsequent stenosis [1^{••}] was reported but seems rare; anyway these can be treated by dilatation (Table 1) [1^{••},2,10^{••},15–18,19[•],20,21[•],22,23^{••}].

Laceration

Laceration is defined as a partial opening of the ureter; this definition includes pinpoint defects and wider openings.

Traditionally, blind stenting and, in case of failure, laparotomic reimplantation have been used to repair ureter lacerations, since suturing was considered too risky for possible stenosis.

Laparoscopy has renewed the interest for conservative treatment, that is, suturing of the defect over a stent. Results showed clearly the statistically significant superiority of laparoscopic suturing over a stent in comparison

Table 1 Outcome of stenting and laparoscopic repair of ureteral lesions in gynaecological surgery

Author	Year	Type of lesion	Treatment	Number	Uneventful outcome	Details
Stepniewska <i>et al.</i> [23 ^{••}]	2011	Deep endometriosis	Reimplantation	20	20 (100%)	
Donnez and Squifflet [20]	2010	Leakage	Stent	4	3 (75%)	One patient required reimplantation
Mereu <i>et al.</i> [21 [•]]	2010	Deep endometriosis	Reanastomosis	17	15 (88%)	Two patients required reimplantation due to ureteral stricture following reanastomosis
Azioni <i>et al.</i> [22]	2010	Deep endometriosis	Reimplantation	6	6 (100%)	
Choi <i>et al.</i> [19 [•]]	2010	Transection	Reanastomosis	3	3 (100%)	
		Uretero-vaginal fistula	Reanastomosis	1	1 (100%)	
Lim <i>et al.</i> [10 ^{••}]	2010	Injuries post hysterectomy	Stent	9	5 (56%)	In 2/9 ureters failure to insert or to keep Double-J stent
Vetere and Apostolis [17]	2010	Leakage	Stent	1	0	A subsequent stricture developed requiring dilatation
Kim <i>et al.</i> [1 ^{••}]	2010	Ureteral injuries following gynaecological surgery	Stent	9	4 (44%)	In 2/9 ureters failure to insert or to keep Double-J stent. In 3 ureters obstruction developed after stenting, resolved with dilatation in 2 cases The third case was lost at follow-up
Camanni <i>et al.</i> [18]	2010	Laceration	Stent	1	1 (100%)	
Tinelli <i>et al.</i> [16]	2009	Stricture	Stent	1	1 (100%)	
		Uretero-vaginal fistula	Stent	1	1 (100%)	
Persson <i>et al.</i> [15]	2009	Stricture	Stent	1	1 (100%)	
De Cicco <i>et al.</i> [2]	2009	Ligation	Deligation	1	1 (100%)	
		Stricture	Stent	4	4 (100%)	
		Laceration	Stent	5	3 (60%)	One laceration persisted and a subsequent reimplantation was performed
		Pinpoint laceration	Stent	2	2 (100%)	
		Laceration	Suture	20	20 (100%)	
		Transection	Reanastomosis	7	7 (100%)	
		Fistula	Stent	1	0 (100%)	Fistula persisted and reimplantation was subsequently performed
		Fistula	Dissection + suture	2	2 (100%)	

with blind stenting [2,17,18,19*,20] (Table 1). This has made blind stenting, with the need of a subsequent ureteral reimplantation in 50% of cases, obsolete.

Transection

Transection of the ureter was traditionally performed by laparotomic reimplantation, because of fear of stenosis and a second intervention after reanastomosis. Ureteral reanastomosis performed by laparoscopy gained renewed interest since it is anyway minimally invasive, together with the advantages of magnification and the ease of access and dissection to the lower ureter. Reported results of laparoscopic reanastomosis vary from 88 to 100% [2,9,21*] (Table 1); the major risk is the postoperative stenosis, that can generally be treated by dilatation [1**,17].

Laparoscopic ureteral reanastomosis has for these reasons shifted the balance between laparotomic reimplantation and laparoscopic reanastomosis to the latter one, because of its minimally invasive character and the excellent results. Technique consists of oblique section of the ureter ends to prevent stenosis, insertion of a stent and circular suturing. It probably is not that important whether four or five stitches are used, whether Polyglecaprone 25 5–0 (Monocryl, Ethicon) or another resorbable suture is used. Clinical experience, however, strongly suggests that suturing is facilitated greatly when smaller and lighter 3 mm instruments are used (Koh set, Storz, AG Tuttingen) [2].

Whether robotic technology has technical advantages for ureteral repair is unclear. It is claimed that three-dimensional vision, tremor reduction, motion scaling, extended range of motion for the surgical arms and better ergonomics should be an advantage. Superiority in ureteral repair, however, is unproven (only a few case reports are available) [24,25], whereas anyway it will be difficult to prove better outcome given the excellent results of laparoscopic repair. The industry claimed advantages of robotics are not today therefore substantiated for ureteral repair in gynaecological surgery, whereas reports of increased costs are obvious [26].

The most important conclusion today is that a bladder reimplantation has to be considered the second-line treatment after a first failed laparoscopic approach.

Uretero-vaginal fistulas

Uretero-vaginal fistulas are a rare and feared complication of pelvic surgery. As for the other lesions, the classic approach consisted of blind stenting and laparotomic reimplantation in case of failure.

We reported the first two uretero-vaginal fistulas successfully treated by laparoscopic dissection and repair [2]. Technique consisted of a 5 stitch circular, almost

watertight, suture of the ureter, a two-layer watertight running suture of the vagina and interposition of the omentum. Choi *et al.* [19*] reported a case of uretero-vaginal repair performed by laparoscopic reanastomosis and recently Tinelli *et al.* [16] a case treated by stenting only.

Available data (Table 1) describe feasibility of laparoscopic-guided stenting and stitching, and 50% success rate of blind stenting, demonstrating similar results to those reported for laparoscopic suture of laceration. Considering the few cases reported, solid conclusions cannot be made. The excellent results of 3/3 laparoscopic treatments of uretero-vaginal fistulas, together with the excellent results of laparoscopic reanastomosis and repair of lacerations, strongly suggest, however, that for uretero-vaginal fistulas also a laparoscopic repair should be considered.

Bladder reimplantation

Reimplantation of the ureter in the bladder has been the traditional treatment of ureteral injury with excellent results [9].

Recently several reports demonstrated feasibility by laparoscopy with equally excellent results [22,23**].

Conclusion

In conclusion, recent findings confirm that laparoscopic repair of ureteral lesions following gynaecological surgery is feasible with excellent results for obstructions, lacerations and transections. Also laparoscopic uretero-vaginal fistula repair and laparoscopic reimplantation have been successfully reported, but series are small for firm conclusions. Taken together, however, these data strongly suggest that laparoscopic repair should be considered as the first-line treatment option for all ureteral lesions and that, in case of failure, a laparoscopic bladder reimplantation should be considered.

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References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (p. 305).

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