Complications of 2735 Retrograde Semirigid Ureteroscopy Procedures: A Single-Center Experience

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Abstract

Background and Purpose: Ureteroscopy is nowadays one of the techniques most widely used for upper urinary-tract pathology. Our goal is to describe its complications in a large series of patients.

Patients and Methods: Between June 1994 and February 2005, 2436 patients aged 5 to 87 years underwent retrograde ureteroscopy (2735 procedures) under video and fluoroscopic assistance. We used semirigid ureteroscopes (8/9.8F Wolf, 6.5F Olympus, 8F and 10F Storz) for 384 diagnostic and 2351 therapeutic procedures. Upper urinary-tract lithiasis (2041 cases), ureteropelvic junction stenosis (95 cases), benign ureteral stenosis (29 cases), tumoral extrinsic ureteral stenosis (84 cases), iatrogenic trauma (35 cases), superficial ureteral tumors (16 cases), superficial pelvic tumors (7 cases), and ascending displaced stents (44 cases) were the indications. The mean follow-up period was 56 months (range 4–112 months).

Results: The rate of intraoperative incidents was 5.9% (162 cases). Intraoperative incidents consisted of the impossibility of accessing calculi (3.7%), trapped stone extractors (0.7%), equipment damage (0.7%), and double-J stent malpositioning (0.76%). In addition, migration of calculi or stone fragments during lithotripsy was apparent in 116 cases (4.24%). The general rate of intraoperative complications was 3.6% (98 cases). We also saw mucosal injury (abrasion [1.5%] or false passage [1%]), ureteral perforation (0.65%), extraureteral stone migration (0.18%), bleeding (0.1%), and ureteral avulsions (0.11%). Early complications were described in 10.64%: fever or sepsis (1.13%), persistent hematuria (2.04%), renal colic (2.23%), migrated double-J stent (0.66%), and transitory vesicoureteral reflux (4.58%, especially in cases with indwelling double-J stents). We also found late complications such as ureteral stenosis (3 cases) and persistent vesicoureteral reflux (2 cases). Most (87%) of the complications followed ureteroscopic therapy for stones. Three fourths (76%) of the complications occurred in the first 5 years of the series.

Conclusions: According to our experience, mastery of ureteroscopic technique allows the urologist to proceed endourologically with minimum morbidity. Despite the new smaller semirigid instruments, this minimally invasive maneuver may sometimes be aggressive, and adequate training is imperative.

Introduction

Upper urinary-tract observation and treatment have been augmented by recent advances in ureteroscopic technology. Ureteroscopy has gradually become a major technique for the diagnosis and treatment of lesions of both the ureter and the intrarenal collecting systems.

The tendency of modern urology has been very clearly emphasized by most articles published during the last few years: the endoscopic approach to the upper urinary tract for an impressive variety of pathologies. The indications and results of ureteroscopy in the treatment of an increasing number of diseases have already been analyzed over a significant period of time. From upper-tract lithiasis (regardless of size and location) to the malformations to traumatic or iatrogenic lesions, the use of ureteroscopic approach has been increasing continuously.

Improvements in ureteroscope design and technique have determined the success of diagnostic and therapeutic ureteroscopy and reduced the incidence of serious complications. Despite significant technologic advances, however, surgical misadventures still occur, some of which have lasting consequences. Careful attention to instrument selection and surgical technique
are critical for reducing untoward events related to ureteroscopy. As such, adverse sequelae associated with ureteroscopy should be related to the underlying pathology rather than to the treatment.

PATIENTS AND METHODS

Between June 1994 and February 2005, in our clinical department, 2436 patients underwent 2735 ureteroscopic procedures under video and fluoroscopic assistance. In 125 cases, we performed bilateral ureteroscopy, and 174 patients underwent multiple procedure. The patient age was between 5 and 87 years, with a peak in the fifth decade. Of the series, 1441 (59.1%) were men and 995 (40.9%) women. Slightly more than half (57%) of the procedures were on the right side. The procedure was diagnostic in 384 cases and therapeutic in 2351. Diagnostic ureteroscopy was necessary for establishing the source of hematuria undiagnosed by other means (227 cases), establishing the etiology of filling defects (65 cases), clarification of bifid ureter pathology (32 cases), diagnosis of upper-tract tumors (37 patients), follow-up of upper-tract tumors treated conservatively (14 procedures), and evaluation of retrograde endopyelotomy results (9 patients). The multitude of imaging investigations used for the diagnosis of various pathologies of the upper urinary tract led to a relatively small number of exploratory procedures. Therapeutic procedures were performed for upper-tract lithiasis (2041 cases), ureteropelvic junction (UPJ) stenosis (95 cases), benign ureteral stenosis (29 cases), tumoral extrinsic stenosis (84 cases), iatrogenic trauma (35 cases), superficial ureteral tumors (16 cases), superficial pelvic tumors (7 cases), and ascending displaced stents (44 cases). We used semirigid ureteroscopes (8F/9.8F Wolf, 6.5 F Olympus, 8F and 10F Storz), video systems with Wolf and Olympus endocameras, ballistic (Wolf) and electrokinetic (Lithospec) lithotripters, and a Siemens fluoroscope. The irrigation liquid was sorbitol, sterile water, or saline.

In the majority of patients (2415 cases; 92.5%), retrograde ureteroscopy was performed with spinal or peridural anesthesia. General anesthesia was necessary in 134 patients (5.1%). In 61 patients, ureteroscopy was performed under local anesthesia with intravenous sedation. Routine antibiotic prophylaxis was given in all cases.

A retrograde pyelogram was performed, and a safety wire was placed into the renal pelvis. If passage of a guidewire was unsuccessful under fluoroscopic guidance, the guidewire was placed in the renal pelvis under direct vision. Balloon dilation of the ureteral orifice and intramural ureter was used in 1696 patients (62%) and axial dilation in 214 patients (7.8%). In 198 cases (7.2%), negotiation of the ureteral orifice was facilitated using two guidewires.

Placement of ureteral stents after procedure was necessary in 1832 cases (67%). The mean follow-up period was 56 months (range 4–112 months).

RESULTS

Intraoperative incidents included the impossibility of calculi access, trapped stone extractors, equipment damage, and double-J stent malpositioning. The rate of intraoperative incidents was 5.9% (162 cases).

The most common of the intraoperative incidents was the impossibility of gaining access to the calculi because of failure to negotiate the ureteral orifice (47 cases; 1.7%) or to inability to reach the stone (56 cases; 2%). The use of hydraulic dilation significantly reduced the rate of difficulties in negotiating the ureteral orifice. Placing a ureteral stent for 48 hours after initial failure allowed a subsequent ureteroscopic approach in 79 cases.

The incidence of trapped stone extractors was 0.7% (19 cases). In 18, this problem was solved by taking the Dormia basket to pieces, pulling the ureteroscope back, and reintroducing it past the fixed basket. This was followed by lithotripsy of the calculi (fixed between the wires) and probe extraction. One patient with a retained basket with an ensnared stone underwent open ureterolithotomy and removal of the basket.

The equipment damage (19 cases; 0.7%) included breakage of the tip of alligator forceps into the ureteral lumen (5 cases), Dormia fragmentation (4 cases), ureteroscope deformation (2 cases), guidewire breakage (3 cases), lithotripsy probe rupture (2 cases), dilation balloon breakage (1 case), and energy generator malfunction (2 cases). Stent malpositioning occurred in 21 cases (0.76%), in which repositioning became necessary (Fig. 1).

Additionally, in 116 cases (5.7% of the patients in whom ureteroscopy was performed for ureteral lithiasis), ascending migration of the calculi or fragments occurred during lithotripsy. In 59 cases, the lithotripsy maneuvers continued in the pyelocaliceal system using either semirigid instruments (36 cases) or a flexible ureteroscope (23 cases). In 57 cases, the procedure was halted, and a ureteral stent was inserted. In 98 cases (84.5%), the ascending migration appeared during lithotripsy for proximal-ureteral calculi. Migration could be prevented by fragmenting calculi between the wires of the Dormia basket or by using the Dretler cone.

FIG. 1. Ureteroscopic view of ascending displaced double-J stent.
Intraoperative complications included lesions of the ureteral mucosa, perforation, bleeding, avulsion, and extraureteral stone migration. The overall rate of intraoperative complications was 3.6% (98 cases). Superficial lesions of the ureteral mucosa, according to their gravity, consisted of mucosal abrasion (41 cases; 1.5%) (Fig. 2) or false passage (submucosal placement of ureteroscope) (28 cases; 1%) (Fig. 3). In three cases, the lesions of the ureteral mucosa were secondary to thermal injury from electrohydraulic lithotripsy. Treatment consisted of maintenance of a double-J stent for 30 to 45 days.

The incidence of full-thickness ureteral perforation (Fig. 4) was 0.65% (18 cases). It appeared during balloon dilation (1 case), passage of the ureteroscope (4 cases) or accessory instruments (3 cases), lithotripsy (6 cases), or calculus extraction (4 cases). Incidents were promoted by difficult local circumstances while introducing the ureteroscope, sometimes accompanied by the loss of fluoroscopic control with reduced visibility.

The treatment was chosen according to the special features of each case. Internal drainage by double-J stent was performed in 15 cases. In one case, open surgery was necessary after the appearance of a retroperitoneal urinoma. Percutaneous nephrostomy was applied in two cases. In one case, we used termino-terminal ureterorraphy with a ureteral endoprosthesis.

The incidence of extraureteral stone migration (Fig. 5) was 0.18% (5 cases).

Post-ureteroscopy bleeding was usually minor and was mostly a consequence of ureteral orifice trauma and lesions created during guidewire passage, calculi fragmentation, or manipulation. In 3 cases (0.1%), the visibility difficulties secondary to bleeding forced a halt to the procedure and insertion of a ureteral stent.

Ureteral avulsions (3 cases; 0.11%) were the most serious traumatic complication that occurred (Fig. 6). These injuries appeared to be attributable to attachment of the Dormia basket to the ureteral wall during calculi extraction maneuvers.

In one case, we performed endoscopic realignment of the ureter and ureteral endoprosthesis. The result was disappointing, marked by the appearance of a retroperitoneal urinoma that necessitate nephrectomy. One patient benefited from ureteroplasty, and in another patient, with a juxtavesical lesion, we performed ureterovesical reimplantation, with subsequent favorable evolution.

All intraoperative complications were identified immediately and treated appropriately. Nearly all (97.9%) followed therapeutic ureteroscopy (Table 1). The majority have been solved endoscopically, with open surgery being necessary in only 6 cases (0.22%).

Intraoperative complications were especially associated with proximal-ureteral calculi. The intraoperative complication rate was 5.6% for proximal calculi and 3.6% for distal stones (Table 2).
Early postoperative complications were described in 291 cases (10.64%): fever or sepsis (31 cases; 1.13%), persistent hematuria (56 cases; 2.04%), renal colic (61 cases; 2.23%), migrated double-J stent (18 cases; 0.66%), and transitory vesicoureteral reflux (125 cases; 4.58%, especially in patients with indwelling double-J stents). Late complications included ureteral stenosis (3 cases) (Fig. 7) and persistent vesicoureteral reflux (2 cases). The three cases of ureteral stenosis were discovered at 4, 6, and 12 months postoperatively. The treatment consisted of laser ureteroscopic endoureterotomy (Figs. 8 and 9). The results have been favorable, without recurrences during the follow-up period. For the cases of persistent vesicoureteral reflux, we performed submucosal injection of collagen (Fig. 10).

Three fourths (76%) of the complications appeared during the first 5 years of our study.

**DISCUSSION**

In urology, as in other disciplines, the trend toward a minimally invasive procedure is strong. With technological advancements, ureteroscopy has evolved dramatically in technique and instrumentation; this evolution has substantially expanded the indications for and use of ureteroscopy. However, as with most advances, after a period of enthusiasm for a new technique, drawbacks are observed, and reports of early and late complications have been collected. In 1979, Lyon and associates predicted that “disasters, such as perforation of the ureter, are a distinct possibility if care and thought are not practiced.”

With the widespread practice of ureteroscopy, however, have come various incidents or complications and new solutions for prevention. With growing experience and better equipment, however, the safety of the procedure has increased. Our experience confirms this point of view, the complication rate being dramatically reduced with growing experience and technical improvement. Thus, 77% of the complications appeared during the first 5 years and only 23% in the last 5 years.

Ureteroscopy, which represents a significant and valuable advance in urology, is a minimally invasive procedure but may result in ureteral injury at any time during the maneuver. Technical failure to negotiate the ureteral orifice has an incidence of 1.7%. Some authors have described techniques for semirigid ureteroscope access without dilation. On the other hand, balloon dilation permits more rapid, less forceful access through the ureteral orifice into the ureter and upper tract, which is im-

**TABLE 1. INTRAOPERATIVE COMPLICATIONS OF DIAGNOSTIC AND THERAPEUTIC URETEROSCOPY**

<table>
<thead>
<tr>
<th></th>
<th>No. procedures</th>
<th>Lesion of ureteral mucosa</th>
<th>Bleeding</th>
<th>Extraureteral stone</th>
<th>Perforation</th>
<th>Avulsion</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic</td>
<td>384</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0 (0.52)</td>
</tr>
<tr>
<td>Therapeutic</td>
<td>2351</td>
<td>67</td>
<td>3</td>
<td>5</td>
<td>18</td>
<td>3</td>
<td>96 (4.08)</td>
</tr>
<tr>
<td>Total</td>
<td>2735</td>
<td>69</td>
<td>3</td>
<td>5</td>
<td>18</td>
<td>3</td>
<td>98 (3.6)</td>
</tr>
</tbody>
</table>

FIG. 5. Ureteroscopic view of extrusion of stone through ureteral wall.

FIG. 6. Cystoscopic view of ureteral avulsion during removal of calculus within Dormia basket.
Ureteral dilation proved to be safe and free of long-term sequelae in multiple studies that have employed post-dilation voiding cystourethrography and excretory urography. Facilitating the approach to the ureteral orifice by using two guidewires represents a simple, efficient, and cheap way of avoiding ureteral-orifice dilation.

In our experience, the ureteroscope failed to reach the calculi in 56 cases (2%) because of either edema surrounding the calculi or some rigid, stenotic area of the ureteral lumen. This condition was most frequently subsequent to surgical interventions or related to a physiological narrowing of the lumen. The selection of appropriate patients and the careful choice of an adequate technique and instruments may reduce the likelihood of this problem. The use of smaller ureteroscopes may facilitate access to the upper urinary tract.

Trapping of the Dormia basket with fixed calculi between its wires occurred in 19 cases. The forced retraction of the basket in this situation may lead to an extremely serious complication, represented by the rupture of the ureteral zone in close contact with the calculi, as well as stripping of the ureter. In the majority of cases, this complication has been solved endoscopically, open surgery being necessary in only one case.

Although downsizing of ureteroscopes and miniaturization of instruments have expanded the versatility and applicability of ureteroscopy, the small-caliber ureteroscopes and their accessories are delicate and subject to malfunction and breakage. Equipment malfunction may be unavoidable, but proper care of instruments during cleaning, sterilization, storage, and use should minimize breakage and down time. In our experience, the incidence of equipment damage was 0.7%.

Although no formal classification system for ureteroscopic injuries has been established, most investigators segregate them either by chronologic order or by severity. Most incidents or complications are minor, being managed adequately with non-operative measures. Complications are considered major if operative intervention is required or if they are life-threatening. Major complications of ureteroscopy may have severe and lasting consequences.

In order to prevent traumatic lesions of the ureter, a refined surgical technique is necessary at every operative step. While introducing the ureteroscope, any forced maneuver must be avoided. Excellent visibility should be maintained throughout the intervention.

In our experience, the general rate of intraoperative complications was 3.6%.

False trajectories and minimal lesions of the ureteral mucosa may appear while introducing the guidewire, the ureteroscope, or different working instruments, subsequently perforating the ureteral mucosa. Abraded mucosa may bleed or become edematous, thereby reducing visibility and the maneuverability of the ureteroscope within the ureter.

Ureteral perforation has an incidence of 0.65%. Longer ureteroscopic procedures are strongly associated with perforation. Our study confirms previous observations that the majority of perforations can be treated by endoscopic insertion of a ureteral stent. Immediate double-J stenting represents the first line of management. No cases required open surgery.

### Table 2. Intraoperative Complications of Ureteroscopy in Ureteral Lithiasis

<table>
<thead>
<tr>
<th>Lesion of ureteral mucosa</th>
<th>Bleeding</th>
<th>Extraureteral stone</th>
<th>Perforation</th>
<th>Avulsion</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximal calculi</td>
<td>785</td>
<td>31</td>
<td>1</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Distal calculi</td>
<td>1256</td>
<td>34</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>2041</td>
<td>65</td>
<td>2</td>
<td>5</td>
<td>15</td>
</tr>
</tbody>
</table>

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therapeutic option under these circumstances and is successful in more than 80% of cases. If retrograde placement of a stent is not possible, this complication can be managed by percutaneous nephrostomy and antegrade stent insertion. In cases in which an endoscopic or percutaneous approach is impossible, open surgical interventions may be performed.

Extraureteral extrusion of calculi as a result of perforation is well documented, but Kreigmair and Schmellar have shown this to be a minor complication that only rarely leads to stricture formation. In our experience, the incidence of extraureteral stone migration was 0.2%, and no sequela have been identified during the follow-up period.

Bleeding associated with ureteroscopy is usually minor and self-limited. Blute and associates noted that minor bleeding that impaired visibility was the most common reason for repeat ureteroscopy in their series, although bleeding constituted the primary complication in only 1 of their 346 procedures (0.3%).

Ureteral stripping represents the most serious surgical complication. In our experience, its rate declined with experience. All three cases occurred during the first period of the study and were the result of forced extraction of calculi by the Dormia basket. The results of endoscopic management of this complication are disappointing, open surgery being the main remedy.

Schuster et al studied the predictive factors for complications of ureteroscopy using a database of 320 cases and showed a significant association of ureteral perforation with increased operative time. Significant association was initially noted in relation to stone in the kidney, operative time, and less surgeon experience. However, only longer operative time remained significant in multivariate analysis.

Complications are infrequent and generally can be treated endoscopically. Open surgery for the management of complications is rare and even when necessary leads to favorable outcomes.

Although most complications occur intraoperatively, the sequelae often appear in the early or late postoperative period. In addition, a few complications arise primarily postoperatively, such as infection or urinary retention, which are not foreseen by any intraoperative actions.

The risk of postoperative infectious complications is increased by the existence of urinary infection preoperatively. Routine antibiotic prophylaxis and ureteral stenting could reduce the risk of these complications.

Routine stenting does not appear to be warranted in those patients who do not require ureteral dilation during ureteroscopic procedures. Ureteral stent placement after ureteroscopy may therefore be avoided in many patients, thereby reducing operative time, surgical costs, and patient morbidity. Another reason for avoiding routine ureteral stenting is that it increases the risk of transitory vesicoureteral reflux.

Roberts and colleagues found that that stone impaction and ureteral perforation is the primary risk factor for subsequent stricture formation.

Further prospective studies limited to the new technologies that have supplanted the old wider ureteroscopes and lithotripsy extraction devices should aim at determining whether the low intraoperative complication rate may be further reduced.

CONCLUSIONS

Our results have shown that with technological advances, the treatment of ureteral lithiasis has improved, and major complications have decreased. However, with so many therapeutic options to choose from, there is a need to audit the various options and select those associated with the least morbidity. This minimally invasive technique is expanding worldwide. In time, the results will require repeated evaluations. Ureteroscopy is being applied increasingly in lithiasis treatment. Its use for malformation and tumoral pathologies still generates controversies regarding the safety and recurrence rate.

Although we very much appreciate the modern minimally invasive techniques, we must agree to the following fundamental remark: no modern method, no matter how seductive, should be performed without regard to efficiency and oncologic safety.

Carefully performed ureteroscopy is a superb tool for the urologist for either diagnostic or therapeutic purposes and has
a low rate of complications. The majority of these complications can be corrected by conservative management.

REFERENCES


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