REVIEW ARTICLE

Transperitoneal Laparoscopic Ureterolithotomy versus Retroperitoneoscopic Ureterolithotomy

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Abstract

Background and purpose: Most ureterolithiasis that require surgical management are currently managed with minimally invasive procedures like shockwave lithotripsy, ureteroscopy with lithotripsy and percutaneous nephrolithotripsy. In cases where the above procedures will most likely fail or has failed, laparoscopic ureterolithotomy in either transperitoneal laparoscopic ureterolithotomy (TPUL) or retroperitoneoscopic ureterolithotomy (RPU) is a viable option compared to open ureterolithotomy. The goal of this review is to compare the effectiveness and safety of transperitoneal laparoscopic ureterolithotomy and retroperitoneoscopic ureterolithotomy in the treatment of large, chronically impacted ureterolithiasis or as salvage treatment after failed shockwave lithotripsy, ureteroscopy and percutaneous nephrolithotomy by reviewing patient selection, operative time, blood loss, hospital stay, complications, open conversion rate and success rate.

Material and methods: A systematic literature search was performed using Highwire press, Medline, Springer link, Medscape, Google and article bibliographies to identify relevant references. Included studies must have reported outcome data for more than 20 patients with a minimum follow-up of 3 months. Stone size, operating time, blood loss, hospital stay, complications, open conversion rate and success rate were reviewed.

Aims and objectives: The aim of this study was to compare the effectiveness and safety of transperitoneal laparoscopic ureterolithotomy (TPUL) and retroperitoneoscopic ureterolithotomy (RPU) in the surgical management of ureterolithiasis. The following parameters were evaluated for both procedures.

1. Operative technique.
2. Stone size.
3. Operating time.
4. Hospital stay.
5. Intraoperative and postoperative complications.
6. Open conversion rate.
7. Success rate.

Conclusion: Transperitoneal Ureterolithotomy and retroperitoneoscopic ureterotomy were both effective procedures in the management of ureterolithiasis. Both procedures are comparable in terms of blood loss, hospital stay and success rates. RPU seemed to have a higher complication and open conversion rate compared to TPUL.

Keywords: Laparoscopy, retroperitoneoscopy, ureterolithiasis, ureterolithotomy, secondary treatment of ureteral stones.

INTRODUCTION

Currently, shockwave lithotripsy and ureteroscopy are the first line treatments for patients with ureterolithiasis requiring surgical management.[1] However, in certain difficult cases, such as with multiple, large, impacted stones and failure to the initial surgical treatment, other options may be considered.[1] In such cases, the results of these procedures are poor, and a good number of patients need multiple treatment sessions with their corresponding costs and morbidity.[2] Open ureterolithotomy is indicated in these situations,[3] but it has inherent patient morbidity, making it less acceptable to patients. Laparoscopy can reproduce the steps of open surgery in this circumstances but with far less invasive methods.[4-6] Laparoscopic approach to ureterolithiasis can transperitoneal[6-10] or retroperitoneal.[11-18] This paper will attempt to compare both procedures in terms of its efficacy, advantages and disadvantages and complications.

RESULTS

A total of 114 articles were found. Fourteen articles met the inclusion criteria. Two articles came from the same institution with a possibility of double counting so the article with the less number of patients was excluded. Five articles investigated TPUL (Table 1) while 8 articles investigated RPUL (Table 2). There was no randomized controlled trial (RCT) study comparing both procedures. One article is a RCT but it compared TPUL with percutaneous nephrolithotripsy (PCNL) and ureteroscopy (URS). Most of the articles were case series with one article comparing the operative time of TPUL and RPU only. A

total of 750 patients were enrolled with 752 procedures. 238 patients underwent TPUL while 414 patients underwent RPU.

PATIENT SELECTION

Of the 237 patients who underwent TPU, Turk and associates[7] had 21 patients, 10 of them were failures of SWL and ureteroscopy. Feyaerts[6] had 24 a total of 24 patients with 3 patients underwent RPU instead of TPUL. In 10 cases, the procedure was indicated as a salvage treatment after SWL, URS, both SWL and URS, laparoscopic ureterolithotomy, and even open ureterolithotomy failures. El-Feel[8] had 25 patients and studied the effect of BMI, location of stone (upper or lower ureter), and laterality on operative time. There was no significant difference between normal and overweight patients, upper or lower ureter as well as left or right ureter on operative time .[8] Simforoosh[9] in 2006 had the most number of patients enrolled at 123. 104 patients underwent TPUL and 19 patients underwent RPU. Basiri[10] did a RCT comparing TPUL with ureteroscopy (URS) with lithotripsy and PCNL in the management of stones in the upper and mid ureter. Results showed that TPUL had a significantly longer operative time and hospital stay compared to both URS and PCNL. On the other hand, TPUL had a significantly higher stone free rate at discharge (88%) compared to URS (54%) and PCNL (64%). Also, TPUL (10%) had a significantly lower secondary procedure rate compared to ureteroscopy (22%).

Seven articles investigated mostly on RPU and a total of 414 cases overall. Goel[11] did a study comparing RPU with open ureterolithotomy. RPU was comparable to open surgery in terms of operative time and blood loss but laparoscopic procedure was significantly better for analgesia, cosmesis, hospital stay, and convalescence. Gaur[12] in 2002 had 100 patients underwent RPU and 1 patient underwent TPUL. The procedure was done as a salvage treatment for failed URS and SWL in 37 cases and for chronically impacted stones in 36 cases. He noted that urine leakage postsurgery was longer if the ureter is left open and unstented (7.1 days) compared to when it is sutured (5 days), sutured without stenting (4.4 days) and sutured with stenting (3.2 days). Hemal[13] had 31 patients who underwent RPU with 18 of then as salvaged treatment after earlier attempts with URS and SWL failed. Demirci[14] in 2004 had 21 patients underwent RPU for failed SWL (16 cases) and impacted stones (5 cases). Soares[15] and associates had 34 patients underwent retroperitoneoscopic stone surgery to assess its effectiveness. 20 patients had proximal ureterolithiasis while 14 had renal stones. Most of the patients underwent the procedure as salvage therapy with only 8 cases as primary treatment modality. Flasko[16] had 73 patients who underwent 75 procedures, 69 cases with RPU and 6 cases with TPUL. Kivjikai[17]had 30 patients who were mostly treated with RPU as primary treatment and the rest for failed SWL or for patients who can't afford SWL. El-Moula[18] in 2008 had a total of 74 patients. 66 of them underwent RPU and 8 underwent TPUL. 38 patients underwent the procedure due to large impacted stones, 25 patients for failed SWL and 11 patients due to patient preference.

STONE SIZE

Only three articles had details on stone size in TPUL. El-Feel[8] reported stone size ranging from 1.3 to 2.9 cm with a mean size of 1.9 cm. Simforoosh[9] had patients with stone size ranging from 1 to 5.6 cm while Basiri reported patients with a mean stone size of 2.24+/– 3.2 cm. Six articles had details on stone size of patients who had RPU. Goel[11] reported stone size ranging from 0.7 to 3.3 cm with a mean size of 2.1 cm while Gaur[12] reported stone size ranging from 1-4.7 cm with a mean size of 1.6 cm. Hemal[13] reported a mean stone size of 2.2 cm in his patients. Also, Soares[15] reported stone size ranging from 0.5 to 6 cm but it included renal stones aside from ureterolithiases. Flasko[16] had patients with stone size ranging from 1.2 to 5.5 cm with a mean stone size of 2.5 cm while Kivjikai[17] reported patients with stone size ranging from 1 to 4 cm with a mean size of 1.9 cm. El-Moula[18] who had patients with middle and upper ureterolithiasis had stone size ranging from 1.5 to 2.8 cm with a mean stone size of 1.8 cm.

OPERATIVE TIME, BLOOD LOSS AND HOSPITAL STAY

Five articles reported details on the operative time in TPUL while six articles had details on operative time in patients who had RPU. Turk et al reported a mean operating time of 90 minutes.[7] Feyaerts[6] had a similar report with a mean operating time of 111 minutes (range, 45-180 minutes). El-Feel[8] had operating time ranging from 55 to 180 minutes with a mean operating time of 145 minutes. Simforoosh[9] reported a mean operating time 132+/– 52.2 minutes for TPU and 171.3+/– 91.3 minutes for RPU. This is the only study that compared operative time on both procedures with RPU taking a longer time than TPUL. Basiri[10] reported a mean operating time of 127.8+/– 41.8 minutes. In patients who underwent RPU, Goel[11] reported a mean operating time of 108.8 minutes (range, 40-275 minutes) while Gaur[12] had a mean operating time of 79 minutes. Hemal[13] reported a mean OR time of 67 minutes (range, 40-97 minutes) while Soares[15] had a variably longer mean OR time of 140 minutes (range, 60-260 minutes). Flasko[16] reported the shortest mean operating time of 45 minutes (range, 15-100 minutes) while Kivjikai[17] reported a mean operating time of 121.4 minutes (range, 75-240 minutes). El-Moula[18] had a mean OR time of 58.7 minutes, ranging from 30 to 125 minutes.

Regarding blood loss, only one article on TPUL had details. El-Feel[8] reported blood loss ranging from 50-100 ml with a mean blood loss of 62.5 ml. On patients who underwent RPU, 5 articles had details on blood loss. Goel[11] had a mean blood loss of 58.5 ml (range, 25-75 ml) while Gaur[12] had a mean blood loss of 25 ml (range, 5-100 ml). Demirci[14] reported blood loss ranging from 45-190 ml with a mean blood loss of 105 ml while Kivjikai[17] reported blood loss ranging from 20-100 ml with a mean blood loss of 39.31 ml. El-Moula[18] reported a mean blood loss of 90.6 ml (range, 30-200 ml). Blood loss was relatively insignificant on all studies with details and no blood transfusion was necessary.[8,11,12,14,17,18]

Four articles documented the length of hospital stay on patients who underwent TPUL. Turk[7] had hospital stay ranging from 1 to 4 days. Feyaerts[6] had an average hospital stay of 3.8 days (range, 2-10 days) while El-Feel[8] had an average hospital stay of 4.1 days (range, 2-21 days). Basiri[10] reported a mean hospital day of 5.8+/– 2.3 days. Eight articles provided details on hospital stay in RPU patients. Goel[11] reported hospital stay ranging from 2-14 days with an average hospital stay of 3.3 days. Gaur[12] had a mean hospital stay of 3.5 days while Hemal[13] had a mean hospital stay of 2.4 days (range, 2-3 days). Demirci[14] reported an average hospital stay of 6 days (range, 3-22 days) while Soares[15] had a mean hospital stay of 3 days (range, 1-10 days). Flasko[16] had hospital stay ranging from 2 to 5 days with an average of 3 days while Kivjikai[17] had an average hospital stay of approximately 3.86 days. He reported that he discharged patients a day after removal of the drains with averaged after 2.86 days. El-Also, Moula[18] reported an average hospital stay of 6.4 days (range, 1-12 days).

COMPLICATIONS, OPEN CONVERSIONS AND SUCCESS RATES

Feyaerts[6] reported 2 (8.3%) complications in his series. One patient had prolonged ileus and another patient had venous thrombosis. Both were managed conservatively and improved. He had 1(4%) open conversion. El-Feel[8] had only one (4%) complication. The patient had prolonged urinary leakage associated with ileus which was managed by inserting a double J Stent. He had no open conversion. Simforoosh[9] reported 14 minor complications and 1 reoperation for a total of 15 (12.2%) complications. He had 1(0.8%) open conversion due to stone migration into the peritoneum after removal from the ureter. Basiri[10] reported 9(18%) complications in his study in the form of urine leakage for more than 3 days. Two of these patients eventually needed double J stenting due to prolonged urine leak of more than 7 days. He had 2(4%) open conversions. In one patient, they could not locate the stone and in another patient, the stone dropped into the abdominal cavity. In RPUL, Goel[11] reported 10(18.2%) complications. The complications encountered were injury to the external iliac artery in one, peritoneal tear in three, fever in two and wound infection in two patients. Two patients had ureteric stricture after 3 months after surgery which was managed by balloon dilatation. He also had 10(18.2%) conversions. Two patients had stone migration into the kidney, inability to locate the stones due to periureteric fibrosis in five patients, 2 patients had peritoneal tear and one patient had vascular injury. Gaur[12] reported 30(30%) complications. Twenty patients had prolonged urine leak. One patient had bleeding, two had gross subcutaneous emphysema, two had high fever, 1 had ureteric avulsion, 1 had hypercarbia, and 3 had ureteric stricture. There were 8(8%) open conversions. In six patients, the stone could not be located laparoscopically, 1 patient had bleeding due to dense ureteric fibrosis and 1 patient had ureteric avulsion. Hemal[13] reported 2(6.45%) complications of persistent urine leakage after 48 hours which was managed with stenting. There was no open conversion. Demirci[14] reported a 100% complication rate in the form of urine leakage in all patients and 2 patients had pneumoscrotum. No open conversion was reported. Soares[15] reported 10(29.4%) complications. Two patients had bleeding intraoperatively due to injury of the gonadal vein and parietal vein respectively. One patient had retroperitoneal hematoma. These 3 cases need no blood transfusion. 2 cases had port site abscess. One patient who had a nephrostomy tube initially developed urinary sepsis after an inadvertent removal of the tube. One patient presented with pain and paresthesia on the lumbar area due to thermal injury of the intercostals nerve. One patient developed subcutaneous emphysema due to CO_2 insufflation. Two patients had prolonged urinary leakage which was managed by placement of internal stent. He reported one (2.9%) open conversion due to technical difficulty of locating the stone. Flasko[16] reported no major complications and one (2.9%) case of open conversion. Kivjikai[17] reported 3 (10%) cases of complications. One patient had prolonged urinary leakage and was managed by stent placement. 2 patients had pneumoscrotum which resolved spontaneously after a week. He reported 1 (3.3%) open conversion due to difficulty in locating the stone. El-Moula[18] reported 17 (23%) complications. Nine cases were intraoperative complications. Two patients had inadvertent peritoneal opening, 1 patient had stone migration to the kidney and 1 had severe adhesions. These 4 patients were converted to open procedures (5.4%). The five other intraoperative cases were gonadal injury in 3 patients and surgical emphysema in two patients which were managed without open conversion. There were 8 postoperative complications. Three for fever, 1 retroperitoneal hematoma which was drained on the 5th postoperative day, 1 patient with prolonged leakage which resolved spontaneously on the 11th postoperative day and 1 patient developed ureteric stricture. Two patients who underwent TPUL had mild ileus.

SUCCESS RATE

Success rates of both procedures were comparable. In TPUL success rates ranges form 86-100%[6-10] while in RPU was 80.9-100%.[11-18]

DISCUSSION

In 1979, Wickham pioneered retroperitoneoscopic ureterolithotomy[19] in the management of ureterolithiasis while Raboy in 1992 did the first transperitoneal ureterolithotomy.[20] Gaur[21] in 1993 popularized the retroperitoneal approach but due to the advent of SWL, PCNL and ureteroscopy, only a few reports were described[m]. But not all ureteral stones can be managed successfully with these three procedures and laparoscopic ureterolithotomy is a feasible alternative in the treatment of these cases.[22,23] Keeley[2] described the advantages of laparoscopic ureterolithotomy. It has a high probability of removing the entire stone in one procedure which was seen in

all of the articles included in this study. The high stone-free rate allows patients to be return to regular activities quickly.[2] Laparoscopic ureterolithotomy can be approach either transperitoneal[6-10] or retroperitoneal[11-18] Some authors advocated the transperitoneal approach for it has an advantage of providing a larger working space[2,20,24,25] while other authors preferred the retroperitoneal approach due to its direct access to the urinary tract and avoids manipulation and contact of urine with intraperitoneal organs.[15,21] In spite of the number of literatures published there had been no study comparing both procedures. In this review, we compared both in terms of stone size of patients done, operative time, intraoperative blood loss, hospital stay, as well as complications, open conversions and success rates. In all of the articles included in the study, the indications of doing both procedures were due to failure of other minimally invasive treatments like SWL, URS and PCNL as well as large impacted stones in the ureter that would most likely be unsuccessfully treated with the said minimally invasive modalities. Other indications were high cost of other procedures and patient preference.[15] There was no difference in both procedures in terms of stone size. There was a wide variability in the operative time in the studies even for the same procedure. It varies from one institution to another and it is dependent on the expertise of the surgeons doing the procedure. Blood losses were minimal in both procedures and no blood transfusion was necessary all cases. In terms of hospital stay, both procedures were similar. A nonrandomized controlled trial done by Goel and Hamel,[11] they demonstrated the superiority of laparoscopic retroperitoneal ureterolithotomy compared to open surgery in terms of shorter hospital stay, lower analgesia requirement and shorter convalescence but there was no difference in terms of operative time and blood loss. In terms of success rate, both TPUL and RPU had similar results with a success rate ranging from 80-100%. Open conversion rate were also almost similar on both groups (1-5%) except for 2 studies in the RPU group. Goel[11] had an open conversion rate of 10% while Gaur[g] had an open conversion rate of 8%. The high conversion rate in former happened in the early cases undertaken in their center. The high conversion rate reflected the need for experience and training of the surgeon and the inherent difficulty of the retroperitoneal approach.[2] In Gaur's[12] study, the main reason for failure was severe retroperitoneal fibrous reaction. The causes of open conversion noted for TPUL were stone migration into the peritoneal cavity[9,10] and the inability to locate the stone.[10] In RPU, the causes for open conversion were, inability to locate stones,[11,12,15] severe retroperitoneal fibrosis,[11,12,18] peritoneal tears,[11,18] stone migration into the kidney,[11,18] vascular injury[11] and ureteric avulsion[11] Hemal[13] suggested the following techniques to overcome these problems. Inability to locate stones can be avoided by using fluoroscopy or ultrasound while stone migration into the kidney by holding a Babcock forceps above the ureter. Peritoneal tears can be avoided by placement of secondary ports with digital guidance, using a fan retractor to retract the peritoneum, using a Veress needle to deflate the abdomen or increasing the rent to equalize the pressure. In terms of complications, RPUL seemed to have a higher complication rate compared to TPUL. Complications in TPUL included ileus,[6,8] urine leakage[8,10] and vein thrombosis.[6] In RPU, common complications include urine leakage,[12,14-18] vascular injury,[11,12,15] surgical emphysema 12,15,18 fever [11,12,15] ureteric stricture[11,12,18] peritoneal tear[11,18] and retroperitoneal hematoma.[15,18] These complications were probably inherent to the technique of the procedure. The small working space is one of the disadvantages of RPU.[12] Urine leakage which is common in both TPUL and RPU can be minimized with suturing of the ureterotomy[8,12]and insertion of a stent.[12] With regards to ureteric stricture, the etiologies are not clear. It can be due to suturing the ureterotomy too tight which can lead to wall ischemia and subsequent stenosis.[18] It can also be due to prolonged postoperative urine drainage leading to retroperitoneal fibrosis and ureteral stenosis.[26]

CONCLUSION

Transperitoneal ureterolithotomy and retroperitoneoscopic ureterotomy were both effective procedures in the management of ureterolithiasis after failed shockwave lithotripsy, ureteroscopy and percutaneous nephrolithotripsy as well as a primary treatment for large, impacted ureteral stones otherwise indicated for open ureterolithotomy. Both procedures are comparable in terms of blood loss, hospital stay and success rates. RPU seemed to have a higher complication and open conversion rate compared to TPUL.

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