EVALUATION OF STENOSIS AFTER LAPAROSCOPIC URETEROLITHOTOMY

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ABSTRACT

Objective: *This study aims to evaluate the probability of stenosis that occurs in the ureter due to the use of electrocautery during ureteral incision procedures in Laparoscopic ureterolithotomy (LU).* ***Material &Methods:*** *This study was conducted in Fatmawati Hospital Jakarta, we collected the data retrospectively in 22 patients diagnosed with ureteral stones who underwent LU procedure from 2014 to 2021, are eligible and have completed the follow-up protocol. The patient was evaluated by assessing the condition of the kidney after the procedure using ultrasound and CT scan to evaluate the presence of ureteral stenosis.* ***Result:*** *Ureteral stenosis was found in 6 of 22 patients (27.3%). Median follow-up time was 45 months (3-4 years). All of them were asymptomatic.* ***Conclusion:****There is a 27.3% chance patient will develop ureteral stenosis after LU. Though LU is one of the best methods for extracting large ureteral stone, the late complication after LU should be considered.*

Keywords:*Electrocautery, laparoscopy ureterolithotomy, ureteral stenosis.*

ABSTRAK

Tujuan: *Mengevaluasi kemungkinan stenosis yang terjadi pada ureter akibat penggunaan elektrokauter pada prosedur sayatan ureter pada Laparoskopi ureterolitotomi (LU).* ***Bahan& Cara:*** *Penelitian ini dilakukan di RS Fatmawati Jakarta, kami mengumpulkan data secara retrospektif pada 22 pasien terdiagnosis batu ureter yang menjalani prosedur LU dari tahun 2014 hingga 2021, memenuhi syarat dan telah menyelesaikan protokol tindak lanjut. Pasien dievaluasi dengan menilai kondisi ginjal pasca prosedur menggunakan USG dan CT scan untuk mengevaluasi adanya stenosis ureter.* ***Hasil:*** *Stenosis ureter ditemukan pada 6 dari 22 pasien (27.3%). Waktu tindak lanjut rerata adalah 45 bulan (3-4 tahun). Semuanya tidak menunjukkan gejala.* ***Simpulan:*** *Ada kemungkinan 27.3% pasien akan mengalami stenosis ureter setelah LU. Meskipun LU adalah salah satu metode terbaik untuk mengekstraksi batu ureter berukuran besar, komplikasi akhir setelah LU harus dipertimbangkan.*

Kata kunci: *Elektrokauter, laparoskopi ureterolitotomi, stenosis ureter.*

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INTRODUCTION

Management of large ureteral stones is currently carried out with various approaches, such as Ureterorenoscopy/ureteroscopy (URS) with laser, pushback PCNL, laparoscopy, and open ureterolithotomy (OU).[1-2] In recent developments, laparoscopic ureterolithotomy (LU) has replaced open approach surgery and now has been used as one of the best minimally invasive treatments for large and impacted ureteral stones.[3-4] However, there is a risk of postoperative ureteral stenosis after LU due to the use of heat energy sourced from electrocauter during the ureterotomy procedure. Electrocautery use for ureteral incision in the LU causes widespread electrical burns to the tissues and predisposes the formation of ureteral lesions that may appear later.[5-6] On the other hand, OU perform ureteral incision by using a knife makes the ureteral injury less extensive and the tissue more viable rather than using electrocautery.[4,6]

Although the risk of developing ureteral stenosis after LU and OU was not statistically significant,[7] several reports report widely varying data regarding the incidence of post-LU stenosis. Several case reports summarized by Nouira mention that ureteral stenosis is the main complication after LU with a percentage of 2.5%.[5] Another study from Ercil et al reported 4% and 12% ureteral stenosis in two consecutive groups in their research. Moreover, Takeda says that there are reports of 15–20% cases of ureteral stenosis in separate series.[8-9]

OBJECTIVE

This study aims to describe the occurrence of ureteral stenosis after LU as a result of ureterotomy incision. We conducted retrospective analysis in Fatmawati Hospital Jakarta, for patients undergoing LU from April 2014 up to April 2021.

MATERIAL& METHODS

This study was conducted in Fatmawati Hospital Jakarta. We collected and analyzed patients who underwent LU surgery in the period from April 2014 to April 2021. In the process, we reviewed the medical records of these patients retrospectively and contacted them to be followed up until December 2021.

All patient medical records were analyzed. Patient demographics and preoperative data were recorded, such as age, gender, stone size, number of stones, location of stones, grade of hydronephrosis, and history of pyonephrosis. Then, we collected data such as operation time, double J stent insertion, postoperative length of stay, postoperative complications, and duration of DJ stent insertion. A long-term follow-up with a median follow-up of 45 months (range 8 months to 7 years) was performed to assess the possibility of stenosis by observing the presence of hydronephrosis using ultrasound and followed by CT scan if hydronephrosis is present.

This research was conducted with the approval of the Urology Division of Fatmawati Hospital. All patients involved in this study had informed consent. There is no conflict of interest in this study.

Laparoscopy procedures were performed retroperitoneally. Retroperitoneal LU surgery was performed under general anesthesia, patients were placed in the lateral position. An entry point for 10mm trocar was made by making skin incision in the posterior axillary line, under the tip of the 12th costal, and then muscle and fascia were obtusely separated. A 10-mm trocar was then inserted as a camera port. The retroperitoneal space was inflated with a self-made balloon. Then another 5- or 10-mm trocar were inserted as working ports 2 and 3.

Location of the stone was identified by assessing the bulging portion of the ureter. Ureter was incised by using a fine electrocautery hook (Fig.1) with coagulation monopolar energy at the power setting level 40, then the calculi were taken out. Ureteral incision was performed using COVIDIEN Valleylab FT10 (Fig.2).

Figure 1. Cautery hook for laparoscopy procedure.

Figure 2. COVIDIEN Valleylab FT10.

A guidewire was inserted into a Double J (DJ) stent, and then DJ stent was inserted towards the lower part of the ureter through the incised ureter. When the DJ stent has been inserted almost completely into the ureter, the proximal tip of DJ stent was clamped with a forceps, and the guidewire was removed from the ureter. Then the proximal tip of the DJ stent was inserted into the upper part of ureter and continued until it reaches the renal pelvis. Ureter incision was sutured with 4-0 absorbable sutures interruptedly. A drainage tube was indwelled in the retroperitoneal cavity.

RESULTS

There were 70 patients who underwent LU from April 2014 to April 2021. However, due to various conditions, we were unable to obtain all patients for some reasons such as consent failure, contact loss, and vagrant citizen. At last, there were 22 patients who gave their consent to be followed up. Patient demographic data are presented in table 1. The mean age of the patients was 51.05±12.33 years. There were 11 male patients and 11 female patients.

The stones in the ureter were mostly found in the proximal ureter in 19 patients, 1 patient in the middle ureter, and 2 patients in the distal ureter. The

average stone size is 20.09±6.15mm. We found 4 patients with grade 2 hydronephrosis, 8 patients with grade 3 hydronephrosis, and 10 of our patients have grade 4 hydronephrosis. There were 3 patients with a history of pyonephrosis.

Table 1. Patients and stone characteristics.

Characteristics	
Total	22
Age	51.05±12.33
Gender	
Male	11 (50%)
Female	11 (50%)
Stone location	
Proximal (R/L)	19 (12/7)
Medial(R/L)	1 (1/0)
Distal (R/L)	2 (2/0)
Stone size (mm)	20.09±6.15
Number of Stone	
Single	21 (95.5%)
Multiple	1 (4.5%)
Grade of hydronephrosis	
Grade 2	4 (18.2%)
Grade 3	8 (36.4%)
Grade 4	10 (45.5%)
History of pyonephrosis	3 (13.6%)

History of pyonephrosis was recorded to see its correlation with the risk of developing ureteral stenosis.

Table 2. Operative and Post-Operative Clinical Data.

Item	
Operative time (min)	122.27±43.05
Intraoperative DJ Stent insertion	22 (100%)
Post-operative hospitalization time (days)	4.36±2.88
Postoperative Complication	
Myocardial Infarction	1(4.5%)
DJ Stent Malposition	2(9.1%)
Long term outcome	
Ureteral stenosis	6 (27.3%)
Stent Duration	
1 Month	4 (18.2%)
2 Month	2 (9.1%)
3 Month	16 (72.7%)

Intraoperative and postoperative data are shown in table 2. The average duration of surgery was 122.27±43.05 minutes. DJ stent placement was performed on all patients. All patient post-operative times mean 4.36 days with 2.88 standard deviations. There were 3 patients with postoperative complications that affected the duration of postoperative hospitalization. 1 patient had an acute myocardial infarction during treatment and had hematuria as a side effect of treatment by cardiologist. 2 other patients had DJ Stent malposition, as seen from the post-operative KUB X-Ray results, so these patients had to go back to the operating room to perform DJ stent reposition. DJ stent was removed 4-12 weeks post-surgery which depends on patient compliance to come for follow-up.

From all of our patients, the DJ stent of 16 patients was removed in the third month after surgery, 2 patients after 2 months, and 4 patients after 1 month.

Table 3. Demographics data of patient with stenosis complication.

Characteristics	
Total	6
Age	57.50±13.21
Male/Female ratio	3/3
Stone location	
Proximal	5
Distal	1
Stone size (mm)	21.50±6.80
History of pyonephrosis	0 (0%)
Stent Duration	
1 month	2
2 Month	1
3 Month	3

From a median follow-up of 45 months, we found 6 patients with hydronephrosis from ultrasound examination. These 6 patients were then subjected to a CT urography examination. CT scan examination showed that there was stenosis at the level of the stone position prior to surgery (Fig 3 and Fig. 4). All of the patients were asymptomatic. Patients with revealed stenosis had no previous history of pyonephrosis. Meanwhile, 3 patients who had a history of pyonephrosis did not have long-term complications in their ureters. Demographic data of these patient are summarized in Table 3.

DISCUSSION

Laparoscopic ureterolithotomy is the preferred minimally invasive treatment option for

large ureteral stones among several other options such as Ureterorenoscopy/ureteroscopy (URS), pushback PCNL, laparoscopy, and open ureterolithotomy (OU).[1-2]

In large ureteral stones, open surgery is still preferred method of approach due to its high stone-free rate and feasibility in many regions of Indonesia. However, LU has gained more popularity nowadays due to its similarity of stone-free rate and reduction in hospital length of stay. Meanwhile, the complications caused by LU and OU showed no significant difference.[10-11]

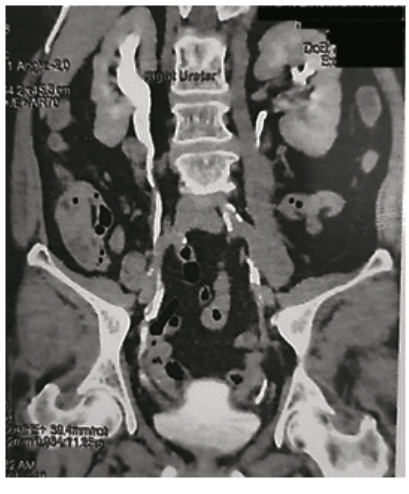

Figure 3. Right ureteral stenosis after LU in a patients.

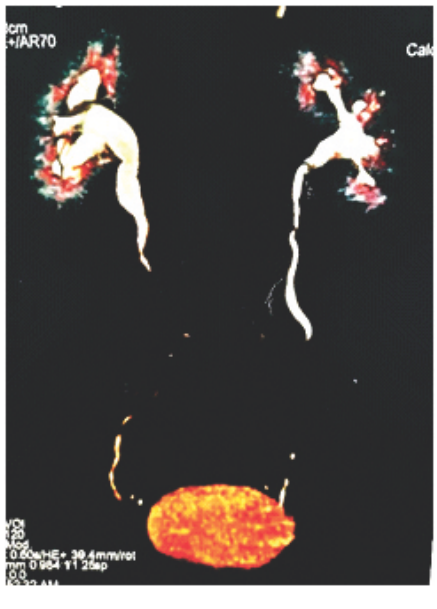

Figure 4. 3D model of the patient in Figure 3.

One of the substantials that changed between LU and OU during surgery is the ureteromy incision. While OU uses a cold knife, LU uses thermal energy. And so, it raises question of how does the effect of thermal energy confounds later in healing. It has been hypothesized the cause of ureteral injury is due to the thermal effect of electrocauter during ureteral incisions.[4]

Delayed necrosis of the ureter due to thermal injury will cause scarring of the ureteral wall which can lead to stenosis in the future.[6,12] Moreover, ureteral incision procedures, often using thermal hooks from monopolar energy, which known to have the highest probability of causing organ injury and risk of tissue ischemia compared to bipolar energies. Monopolar energy is actually more destructive and causes a larger collateral injury than bipolar energy. Tissues exposed to monopolar energy were found to have histological changes in the form of coagulative denaturation of collagen bundles and changes in the morphology of the nucleus, which lead to scar formation in ureteral wall.[6,13,14]

At our hospital, we use a fine, low-energy monopolar electrocautery hook to make an incision in the ureter thus the spread of thermal energy to tissues from electrosurgery instruments has a tendency to be more wide-ranging during a laparoscopic procedure, and monopolar energy is actually more destructive and has more widespread effect than bipolar energy.[12,6] Based on that, it is more likely we have higher incidence of stenosis after LU compared to other studies

So yes, we have a higher incidence of stenosis in this study, we got 27.3% from the total sample population. The number of incidents was obtained through a median follow-up of 45 months. When compared to other studies the risk of post-LU stenosis was found to vary widely ranging from 2.5% to 20%.[5,11] Other studies; Bayar et al stated that 10% of patients had post-LU stenosis in their study and he also found that the use of a non-electric scalpel for ureteral incision in an OU did not show any patients experiencing ureteral stenosis at 30-month follow-up (range 7-42 months).[4] Further strengthen the effect of thermal injuries in ureter compared to the cold knife. And so, our study reveals higher rate of stenosis compared to others.

Our study also evaluates the other factor that may be contributing to ureteral stenosis. However, there is no correlation between history of pyonephrosis, DJ stent duration, and the incidence of ureteral stenosis in this study. The insertion of a DJ

stent was performed in all patient populations in the study, but in the end, we concluded that delayed necrosis of the ureteral wall due to thermal injury can be considered as the most contributing factor of higher incidence of stenosis in this study.

CONCLUSION

There are 27.3% chance patients will develop ureteral stenosis after LU. This may be due to the delayed effect of thermal injury during the ureteral incision procedure. The use of cold knife during LU may be considered.

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