Comparison of Open Ureterolithotomy and Laparoscopic Ureterolithotomy in Ureteral Stones at Rural Hospital

I. Made Suyadnya and I. Putu Adi Kurniawan*

ABSTRACT

Treatment of ureterolithiasis has switched to mini-invasive procedures, such as ESWL and ureteroscopy. The laparoscopic ureterolithotomy method is more helpful for large and hard ureteral stones and minimizes the incidence of sepsis than ESWL or ureteroscopy. This study aims to compare open ureterolithotomy and laparoscopic ureterolithotomy. This retrospective cohort study used 27 samples. The inclusion criteria of this study were patients with proximal ureteral stones, having a stone size >2 cm, confirmed by CT scan findings, and receiving an open ureterolithotomy or retroperitoneal laparoscopic ureterolithotomy. The data collected has demographic characteristics and perioperative and postoperative parameters. Operating time in the laparoscopic group (171.00 ± 19.12 minutes) is longer than open ureterolithotomy (83.24 ± 7.49 minutes) with p-values of 0.001. Average blood loss (51.30 ± 12.04 ml) and analgesic needed (880.00 ± 647.73 mg) were better in the laparoscopic group, with each p-value being 0.006 and 0.004. Longer hospital stay was found in the open group with a mean is 2.53 ± 0.80 days (p =0.005). Perioperative complications were found in 1 person in the laparoscopic group (p = 0.370) and three postoperative complications in the open group (p = 0.274). Laparoscopic ureterolithotomy is effective and safe for proximal urethral stones larger than 2 cm.

Keywords: Laparoscopic ureterolithotomy, Open ureterolithotomy, Ureter stone.

1. Introduction

Stones in the ureters are a condition that is still a hot topic to discuss in various health studies because the incidence rate is quite high. Based on world epidemiology, ureteral stones have affected millions of people. The incidence and prevalence rates have continued to increase. The condition of ureteral stones causes sufferers to experience complaints in the form of severe pain that arises suddenly [1].

Ureterolithiasis is part of the upper urinary tract stones. Complications from upper urinary tract stones, if not treated promptly, are obstructive pyelonephritis and become a urological emergency with an increased risk of death from septic shock. Treating ureterolithiasis can use tamsulosin (an alpha-adrenergic blocker), but several studies state that tamsulosin is significantly less effective in overcoming stone passage. Active intervention is needed to assist in removing stones, especially stones that have caused obstruction or are large in size. Two active interventions can be shockwave lithotripsy (SWL) or ureteroscopy (URS) [1], [2].

The advent of ESWL and ureteroscopy has resulted in the obsolescence of open ureterolithotomy. However, it is still quite difficult to do this with this mini-invasive procedure for stones with hard, long-standing, impacted, and large characteristics. ESWL actions are also stated to cause increased pressure. Intrarenal and results in absorption of bacterial infection into the circulation, making it contraindicated in pyelonephritis. Therefore, the use of laparoscopic ureterolithotomy can be an option in dealing with complaints of stones with these characteristics and is an effective and safe procedure with a high stone-free rate and a low incidence of complications. It is also stated that the laparoscopic ureterolithotomy procedure does not cause an increase in intrarenal pressure without
irrigation. Aspiration of infected urine through a ureteral incision can be performed simultaneously during a laparoscopic procedure, so decompression and stone removal can be performed simultaneously in one procedure. The impact of these advantages is that laparoscopic ureterolithotomy can reduce the risk of postoperative sepsis [1], [3]–[5]. Considering that studies discussing the comparison of open ureterolithotomy and laparoscopic ureterolithotomy, this study is interested in raising this topic. This study wants to delve deeper into the differences between open ureterolithotomy and laparoscopic ureterolithotomy to help determine the level of effectiveness and safety of laparoscopic ureterolithotomy.

2. METHODS

This retrospective cohort study used medical record data from patients with proximal ureteral stones diagnosed with a CT scan at the Karangasem Hospital. The samples collected in this study were cases found in the period from 2020 to 2022. The inclusion criteria of this study were patients with proximal ureteral stones, having a stone size >2 cm, confirmed by CT scan findings, and receiving an open ureterolithotomy or retroperitoneal laparoscopic ureterolithotomy. Exclusion criteria from this study were patients with distal ureteral stones measuring >2 cm; patients who met the exclusion criteria were automatically excluded from the study criteria.

Demographic variables in this study included the total sample in each laparoscopic and open ureterolithotomy group, age, sex, body mass index (BMI), and stone size. Perioperative and postoperative parameters used as comparisons with laparoscopy and open ureterolithotomy were operating time, blood loss, analgesic needed, hospital stay, and perioperative and postoperative complications.

All data collected in this study were analyzed using SPSS 25 statistical software (SPSS Inc.). Categorical data was displayed in the form of numbers. First, numerical data will be tested for normality with Shapiro Wilk and declared generally distributed if the p-value is >0.05. Data typically distributed will be displayed as mean, ± standard deviation (SD). Numerical data were then tested with an Independent T-Test or Mann-Whitney Test depending on the normality test results, and categorical data were tested with chi-square to get a p-value.

3. RESULTS

There are a total of 27 samples in this retrospective cohort study. The mean age in the laparoscopic group was $52.1 \pm 4.75$ years and $52.9 \pm 4.44$ years in the open group ($p = 0.647$). In both groups, the dominant was male, 8/2 patients and 13/4 patients ($p = 1.00$). The laparoscopic group’s mean BMI and stone size were $23.18 \pm 3.03$ kg/m² and $2.5 \pm 0.24$ cm. The average BMI and stone size in the open group were $24.33 \pm 2.97$ kg/m² and $2.6 \pm 0.22$ cm. The p-value for BMI is 0.346, and the p-value for stone size is 0.633. More detailed data regarding the demographics of the sample in this study are shown in Table I.

After bivariate analysis, operating time was found in the laparoscopic group ($171.00 \pm 19.12$ minutes) longer than open ($83.24 \pm 7.49$ minutes) ($p = 0.001$). Average blood loss ($51.30 \pm 12.04$ ml) and analgesic needed ($880.00 \pm 647.73$ mg) were better in the laparoscopic group ($p = 0.006$ for blood loss and $p = 0.004$ for analgesic needed). More extended hospital stay was found in the open group with a mean is $2.53 \pm 0.80$ days ($p = 0.005$). Perioperative complications (peritoneal tear-conversion to open) were found in 1 person in the laparoscopic group ($p = 0.370$), and three postoperative complications (surgical wound infection, ureteric stenosis, and fever) in the open group ($p = 0.274$). Therefore, the success rate becomes 94.1%. More detailed data regarding perioperative and postoperative parameters are described in Table II.

4. DISCUSSION

In this retrospective cohort study, 27 samples were included, with 10 samples, from the laparoscopic group and 17 samples from the open ureterolithotomy group. The mean age in this study was $52.1 \pm 4.75$ years in the laparoscopic group and $52.9 \pm 4.44$ years in the open ureterolithotomy group. Males predominated in the laparoscopic (8 patients) and open ureterolithotomy (13 patients) groups. The mean body mass index of the samples in the laparoscopic group was $23.18 \pm 3.03$ kg/m² and $24.33 \pm 2.97$ kg/m² for the open ureterolithotomy group. The mean size of ureteral stones found in the laparoscopic group in this study was $2.5 \pm 0.24$ cm, which is not much different from the open group, which is $2.6 \pm 0.22$ cm. The study of Hu et al. [6] regarding retroperitoneal laparoscopic ureterolithotomy in proximal ureteral calculi showed in their demographic data that the male sex (116/81 patients) also predominated in this study with a mean age of 41 years (20–73 years). This study’s average size of ureteral stones was 22 mm (14–35 mm) [6].

Garg et al.’s study [7] had 30 patients in the open ureterolithotomy and laparoscopic laparotomy groups.

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TABLE I: Demographic and Characteristics of Study Objects

<table>
<thead>
<tr>
<th></th>
<th>Laparoscopic</th>
<th>Open</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patients (n)</td>
<td>10</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>$52.1 \pm 4.75$</td>
<td>$52.9 \pm 4.44$</td>
<td>0.647$^1$</td>
</tr>
<tr>
<td>Male/Female</td>
<td>8/2</td>
<td>13/4</td>
<td>1.00$^3$</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>$23.18 \pm 3.03$</td>
<td>$24.33 \pm 2.97$</td>
<td>0.346$^1$</td>
</tr>
<tr>
<td>Stone size (cm)</td>
<td>$2.5 \pm 0.24$</td>
<td>$2.6 \pm 0.22$</td>
<td>0.633$^1$</td>
</tr>
</tbody>
</table>

Note: $^1$independent T-Test, $^2$mann-Whitney Test, $^3$Chi-Square/Fisher’s Exact.

TABLE II: Perioperative and Postoperative Parameters

<table>
<thead>
<tr>
<th></th>
<th>Laparoscopic</th>
<th>Open</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating time (minute)</td>
<td>171.00</td>
<td>83.24</td>
<td>0.001$^2$</td>
</tr>
<tr>
<td>Blood loss (ml)</td>
<td>$51.30 \pm 12.04$</td>
<td>$69.35 \pm 16.67$</td>
<td>0.006$^1$</td>
</tr>
<tr>
<td>Analgesic needed (mg)</td>
<td>$880.00 \pm 647.73$</td>
<td>$1482.35 \pm 463.99$</td>
<td>0.004$^2$</td>
</tr>
<tr>
<td>Hospital stay (day)</td>
<td>$1.60 \pm 0.69$</td>
<td>$2.53 \pm 0.80$</td>
<td>0.005$^2$</td>
</tr>
<tr>
<td>Complication perioperative (n)</td>
<td>1</td>
<td>0</td>
<td>0.370$^3$</td>
</tr>
<tr>
<td>Complication postoperative (n)</td>
<td>0</td>
<td>3</td>
<td>0.274$^4$</td>
</tr>
</tbody>
</table>

Note: $^1$independent T-Test, $^2$mann-Whitney Test, $^3$Chi-Square/Fisher’s Exact.
The demographic data shows that the average age is 42.56 ± 11.45 years and 39.78 ± 12.63 years in the open ureterolithotomy and laparoscopic laparotomy groups. This study also found that men still dominated with a total of 17 patients (open ureterolithotomy) and 19 patients (laparoscopic laparotomy) with an average stone size of 2.5 ± 0.69 cm (open ureterolithotomy) and 2.3 ± 0.78 cm (laparoscopic laparotomy) [7]. Study of Giri et al. [8] also conducted a study to see the comparison of open ureterolithotomy and trans-peritoneal laparoscopic ureterolithotomy. The demographic data shows that the mean age of the sample is 44.19 ± 11.8 years (trans-peritoneal laparoscopic ureterolithotomy) and 40.05 ± 12.2 years (open ureterolithotomy), with men still dominating, namely 18/3 patients (trans-peritoneal laparoscopic ureterolithotomy) and 13/8 patients (open ureterolithotomy). Stone size in this study was a mean of 17 ± 5 mm in the trans-peritoneal laparoscopic ureterolithotomy group and 15 ± 5.2 mm in the open ureterolithotomy [8].

Priyosantos and Pramod’s study [9] in their case report study, stated that a 37-year-old patient with a diagnosis of right hydronephrosis resulted from proximal ureterolithiasis and stones in the inferior left calyx, which then migrated to the distal ureter. The laparoscopic ureterolithotomy procedure managed to overcome this condition with a duration of operation of 45 minutes. The patient was allowed to go home after being treated without complications for two days [9]. Wani and Durran’s study [10] succeeded in showing the results of their research regarding the use of laparoscopic ureterolithotomy to treat cases of upper and middle ureteric calculi with a size of more than 1 cm. The study found that all patients who underwent retroperitoneal laparoscopic ureterolithotomy successfully overcame these complaints, with an average operating time of 64.53 minutes. The mean blood loss was 39.83 ml, and it was found that three patients had minor intraoperative complications and post-operative complications (prolonged leak and subcutaneous emphysema). The average drain removal time was 2.7 days, with an average hospital stay of 3.3 days. After three months of follow-up, CT urography showed normal ureters [10].

Study Zia et al. [5] support the findings of previous studies. In his research discussing laparoscopic ureterolithotomy for cases of large lower urethral stones (mean size 2.5 cm) managed to show that out of a total of 7 cases, the average operating time was 52 minutes with an average length of stay of 2.5 days (2-4 days). No intraoperative and postoperative complications were found in all cases [5]. The study of Jia et al. [11] successfully demonstrated the success of retroperitoneal laparoscopic ureterolithotomy in cases of upper ureteric calculi. In total, 64 samples were included in this study with male predominance; the average stone size was 1.8 ± 0.3 cm. The mean operating time in this study was 85.4 ± 18.3 minutes, with an average length of stay of 7.5 ± 1.8 days. The rate of decrease in hemoglobin levels was found to be 7.8 ± 3.6 g/L, and the increase in procollagenin levels was 3.7 ± 1.8 ng/mL. No major complications (sepsis, bleeding, bowel injury, or cardiopulmonary morbidities) were found [11].

In an earlier study, Skrepetis et al. [3] demonstrated a comparison between open and laparoscopic ureterolithotomy. In this study, there were 36 people, 18 samples each in transperitoneal laparoscopic ureterolithotomies and open ureterolithotomies. It was found that all samples that underwent laparoscopic procedures were successful, with an average operating time of 130 minutes, the analgesic medication requirement per patient was one day, the average postoperative hospital stay was three days, and the convalescent time was 12 days. In the open ureterolithotomy group, the average operating time was 85 minutes, the analgesic medication requirements per patient was four days, the average postoperative hospital stay was eight days, and the convalescent time was 22 days. Each of these variables has a P value of <0.002, <0.001, <0.001, and <0.001 on the results of the bivariate test. This study also found that there was no need for blood transfusions but found postoperative complications in the form of urinary leak, subcutaneous hematoma, subcutaneous emphysema in transperitoneal laparoscopic ureterolithotomies, as well as wound cellulitis and urinary infection in open ureterolithotomy [3]. A study by Giri et al. [8] also compared transperitoneal laparoscopic ureterolithotomy and open ureterolithotomy. The results of this study show that the average operating time is 107.62 ± 32.84 minutes (TPLU) and 65.48 ± 15.72 minutes (OU) with a median length of stay of 2.19 ± 1.78 days (TPLU) and 4.62 ± 1.53 days (OU). The pain score at TPLU was significantly lower than that at OU, with a p-value <0.05 [8].

The study findings above support the results of this study. This study showed that the average operating time in the laparoscopic group (171.00 ± 19.12 minutes) was longer than open (83.24 ± 7.49 minutes) with a p-value of 0.001. The mean for analgesic needed, hospital stay, and blood loss in the laparoscopic group was 880.00 ± 647.73 mg, 1.60 ± 0.69 days, and 51.30 ± 12.04 ml. The mean for analgesic needed, hospital stay, and blood loss in the open ureterolithotomy group was 1482.35 ± 463.99 mg, 2.53 ± 0.80 days, and 69.35 ± 16.67 ml. The p-values for analgesic needed, hospital stay, and blood loss are 0.004, 0.005, 0.006. One patient had perioperative complications in the laparoscopic group (p = 0.370), and three had postoperative complications in the open ureterolithotomy group (p = 0.274).

The success rate of the laparoscopic procedure in treating cases of ureteral stones is in the range of 86 to 100%. Study Simforoosh et al. [12], who compared URS, percutaneous nephrolithotomy (PCNL), and laparoscopy, found that stone-free rates for each group were 56%, 64%, and 88%. A study by Giri et al. [8] also found that stone clearance with a laparoscopic procedure was 100% with a conversion rate of 8.14% and one case of re-operation due to a persistent leak from the ureter. Wani and Durran’s study [10] also stated that all cases of ureteral stones treated with a laparoscopic retroperitoneal procedure were successful. After three months of follow-up, CT urography results of all patients showed that the ureters were within normal limits, so a stone-free rate of 100% could be stated [5], [10], [12]. This study also found that the success rate of the laparoscopic procedure was 94.1%.
The limitation of this study is that it only uses one center, so it cannot be described for samples in other regions. The number of samples used is also small, and this study still needs to show a level of success in assessing the CT urogram findings after the procedure to determine whether the stones have completely disappeared or are remaining.

5. Conclusion

Laparoscopic ureterolithotomy has a longer duration of operation than open ureterolithotomy. However, the rate of blood loss, analgesic needed, and hospital stay from laparoscopic ureterolithotomy was lower than that of open ureterolithotomy. Perioperative complications were found in only one person, and no postoperative complications in the laparoscopic ureterolithotomy sample group. Therefore, it can be stated that laparoscopic ureterolithotomy is effective and safe for use in treating proximal ureteral stones that are more than 2 cm and more superior to use in Rural areas since there is no other more advanced equipment available.

Conflict of Interest

Authors declare that they do not have any conflict of interest.

References


