

# MANAGEMENT OF URETER STONES USING ESWL COMPARED TO URS

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## ABSTRACT

**Objective:** To evaluate the management of ureterolithiasis using Extracorporeal Shock Wave Lithotripsy (ESWL) EDAP Sonolith Technomed compared to ureteroscopy (URS) with holmium:YAG laser lithotripsy. **Material & Method:** Research was conducted at Central Pertamina Hospital Jakarta by comparative analysis. The data was taken from patients' medical records diagnosed with ureterolithiasis who had been treated from January to Desember 2009. **Results:** Central Hospital Pertamina Jakarta had treated 127 patients with urolithiasis from January to Desember 2009. Most frequent therapeutic modality was URS, which was followed by ESWL. Double J stents were used in 19,8% of the treatment in combination with URS, more common than ESWL. Stone free rate in urolithiasis was not significantly different between treatment with URS and ESWL, although stone free rate of URS was higher than ESWL. Use of DJ stent didn't affect stone free rate of urolithiasis from two of these modalities. **Conclusion:** Stone free rate of these modalities was below of stone free rate at literatures published, because evaluation from stone free rate of this research was taken after the treatment or 1-2 days after the treatment with imaging of KUB and USG.

**Keywords:** Urolithiasis, extracorporeal shock wave lithotripsy, ureteroscopic, DJ stent, stone free rate.

## ABSTRAK

**Tujuan Penelitian:** Mengevaluasi penanganan batu ureter dengan cara Extracorporeal Shock Wave Lithotripsy (ESWL) EDAP Sonolith Technomed dibandingkan dengan ureteroskopi (URS) dengan litotriptor laser holmium:YAG. **Bahan & Cara:** Penelitian dilakukan di Rumah Sakit Pusat Pertamina Jakarta secara analitik komparatif. Data pasien yang dirawat dengan batu ureter dari bulan Januari sampai Desember 2009. **Hasil Penelitian:** RS Pusat Pertamina Jakarta telah merawat 127 pasien dengan batu ureter dalam kurun waktu Januari sampai Desember 2009. Modalitas terapi pada batu ureter tersebut terbanyak dengan URS diikuti ESWL. Pemakaian DJ stent pada 19,8% tindakan dengan pemakaian terbanyak pasca URS dibandingkan dengan ESWL. Angka bebas batu pada batu ureter tidak bermakna antara pemakaian URS dibandingkan ESWL, walaupun angka bebas batu pada URS lebih tinggi daripada ESWL. Pemakaian DJ stent juga tidak mempengaruhi perbedaan angka bebas batu ureter pada kedua modalitas tindakan ini. **Simpulan:** Angka bebas batu pada kedua modalitas terapi ini masih di bawah nilai dari pustaka yang ada karena penilaian angka bebas batu diambil sesaat sesudah tindakan atau 1-2 hari sesudah tindakan dengan pencitraan foto polos abdomen dan USG.

**Kata kunci:** Batu ureter, extracorporeal shock wave lithotripsy, ureteroscopic, DJ stent, angka bebas batu.

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## INTRODUCTION

Indonesia is a country in the world located in the stone belt area, where there are epidemiologically proven many patients present with urinary tract stones.<sup>1</sup> The incidence of urinary tract stone disease in Indonesia is highest in the field of urology. According to medical records of RSUPN Cipto Mangunkusumo, Jakarta, the incidence of ureteric

stones is between 20-25% of all cases of urinary tract stones.<sup>2</sup>

The treatment of ureteric stones depends on stone size, stone location and kidney function.<sup>3,4</sup> Ureteric stone treatment modalities in the last decade has developed very rapidly by the presence of ureteroscopic (URS) lithotripsy, and stone breaker with shock waves, Extracorporeal Shock Wave Lithotripsy (ESWL).<sup>3-5</sup>

Since Perez Castro in 1980 successfully performed ureteroscopy for the first time with a tool designed specifically for ureteric stones removal, the technical development of ureteric stones removal through ureteroscopy have a high mean success rate, especially by the introduction of ultrasonic lithotripter, electrohydraulic lithotripter, and laser lithotripter.<sup>6</sup> A study by Lam, Greene and Gupta showed ureteroscopic lithotripsy with holmium:YAG laser is an acceptable treatment modality for proximal ureteric stones 1 cm or larger. As for stones 1 cm or smaller, ESWL remains the first-line therapy.<sup>7</sup> Studies conducted by Peschel, Janetschek and Bartsch, Macaluso, Thomas, Erturk indicated issues that need to be considered with the use of ureteroscopic lithotripsy compared with ESWL.<sup>8-10</sup>

**OBJECTIVE**

To evaluate ureteric stone treatment by ESWL EDAP Sonolith Technomed compared with holmium:YAG laser URS lithotripter.

**MATERIAL & METHOD**

This study was a comparative analytical study. Data were taken from the patients' medical records, including patients' identity, therapeutic modalities, the use of DJ stent, stone-free rate.

The study was conducted in Central Hospital Pertamina, Jakarta, from January to December 2009. The study population was the data of 243 patients' who underwent ESWL and URS on ureteric stones taken from medical records of Central Hospital Pertamina in Jakarta.

To determine whether DJ stent affected outcomes between ESWL and URS therapeutic modalities with stone-free rate, the use of DJ stents was used as a control variable.

**RESULT**

Table 1 shows the frequency of kidney stones is the highest (43,2%) followed by ureteric stones (42%), which were not much different from that of kidney stone.

Ureteric stones were found in 102 patients (42%), and ureteric stones along with multiple stones in other sites, in the kidney (9,9%), and kidney and bladder (0,4%) (Table 2). Overall, ureteric stones can be found in 52,3% of the patients. From 102 ureteric stones patients, 41 patients had proximal ureteric stones, 58 patients distal ureteric stones, 3 patients with distal and proximal multiple ureteric stones.

Table 3 shows that of 243 patients with urinary tract stones, the number of female patients was 70 (28,8%) and male patients 173 (71,2%).

**Table 1.** The number of patients based on the location of the stone.

Stone location	Prevalence(patients)	Percentage (%)
Kidney	105	43,2
Ureter	102	42,0
Bladder	10	4,1
Multiple (more than 1 location)	26	10,7
Total	243	100

**Table 2.** The number of patients based on the location of ureteric stones and concomitant stones in other sites.

Stone location	Prevalence (patients)	Percentage (%)
Kidney and ureter	24	9,9
Kidney, ureter and bladder	1	0,4
Ureter: proximal	41	16,9
distal	58	23,9
proximal and distal	3	1,2
Total	127	52,3

**Table 3.** The prevalence of stone sites by sex.

Sex	Proximal ureter stone	Distal ureter stone	Other bladder stones
Male	32 (78%)	43 (74,1%)	98 (68,1%)
Female	9 (22%)	15 (25,9%)	46 (31,9%)
Total	41	58	144

**Table 4.** Therapeutic modality in ureteric stones.

Therapeutic modality	Proximal ureter stone n (%) <sup>*</sup>	Distal ureter stone n (%) <sup>*</sup>	Total n (%) <sup>*</sup>
Conservative	3 (7,3%)	11 (19%)	14 (13,7%)
ESWL	16 (39%)	3 (5,2%)	19 (19,2%)
URS	25 (61%)	45 (77,6%)	70 (70,7%)
PCNL	1 (2,4%)	0	1 (0,9%)
Open surgery	1 (2,4%)	2 (3,4%)	3 (2,9%)
Total	46 <sup>**</sup>	61 <sup>***</sup>	107 <sup>****</sup>

\*) calculated based on the number of therapeutic modalities, percentage (%) is the number of therapeutic modalities compared with the number of patients

\*\*\*) there were 41 patients with proximal ureteric stones, 5 patients had 2 therapeutic modalities, 3 patients with ESWL and URS therapy modalities, 1 patient with conservative treatment modalities and URS; another patient with PCNL and URS therapeutic modalities, so the number of therapy modalities in proximal ureteric stones was 46 action.

\*\*\*\*) there were 58 patients with distal ureteric stones, 3 of whom had 2 therapy modalities: 1 patient with ESWL and URS modality therapy, 2 patients with conservative treatment modalities and URS, so that the number of therapeutic modalities on ureteric stones were 61 procedures

\*\*\*\*\*) the number of therapeutic modalities in proximal and distal ureteric stones (does not include data from multiple ureteric stones in 2 sites or more)

**Table 5.** ESWL and URS procedure modalities on ureteric stones.

Ureter stones	ESWL	URS	ESWL + URS	Other than ESWL and URS
Proximal	13	22	3	3
Distal	2	44	1	11
Total	15	66	4	14

**Table 6.** Comparison of the use of DJ stent with ESWL and URS on ureteric stones.

	Proximal ureter stone <sup>*</sup> n (%)	Distal ureter stone <sup>**</sup> n (%)	Total <sup>***</sup> n (%)
ESWL	1 (7,7%)	0 (0%)	1 (6,7%)
URS	9 (40,9%)	6 (13,6%)	15 (22,7%)
Total	10(28,6%)	6 (13%)	16 (19,8%)

\*)  $\chi^2 = 4,418$ ;  $df = 1$ ,  $p = 0,36$ ; 1 cells (25%) had an expected value of less than 5. Significance value was 0,055 for 2-sided (two tail) and 0,039 for 1-sided (one tail) of the Fisher's test

\*\*\*)  $\chi^2 = 0,314$ ;  $df = 1$ ,  $p = 0,575$ ; 2 cells (50%) had an expected value of less than 5. Significance value is 1,0 to 2-sided (two tail) and 0,754 for 1-sided (one tail) of the Fisher's test

\*\*\*\*\*)  $\chi^2 = 1,989$ ;  $df = 1$ ,  $p = 0,158$ ; 1 cells (25%) had an expected value of less than 5. Significance value is 0,281 for 2-sided (two tail) and 0,145 for 1-sided (one tail) of the Fisher's test

Therapeutic modalities, either proximal or distal ureteric stones, were mostly with URS, followed by ESWL in the proximal ureter, and conservative modality in distal ureter (table 4).

In Table 5, the subjects were patients with ESWL monotherapy without URS or URS without ESWL, so subjects for proximal ureteric stones comprised 35 procedures (13 procedures ESWL only + 22 procedures URS only); distal ureteric

stones 46 procedures (2 procedures ESWL only + 44 procedures URS only), and ureteric stones 81 procedures (total procedures of proximal and distal).

Table 6 shows that DJ stent use was relatively higher in URS with respect to the percentage difference between DJ stent use and no use, which was narrower than that with ESWL. However, the use of DJ stent in both treatment modalities were not significantly different.

**Table 7.** Comparison of the stone-free rate with ESWL and URS on ureteric stones.

	Proximal ureter stone* n (%)	Distal ureter stone** n (%)	Total*** n (%)
ESWL	9 (69,2%)	1 (50%)	10 (66,7%)
URS	13 (59,1%)	36 (81,8%)	49 (74,2%)
Total	22 (62,9%)	37 (80,4%)	59 (72,8%)

\*)  $p = 0,549$ ;  $\chi^2 = 0,36$ ;  $df = 1$ ; 1 cells (25%) had an expected value of less than 5. Significance value was 0.721 for 2-sided (two tail) and 0.409 for 1-sided (one tail) of the Fisher's test.

\*\*)  $\chi^2 = 1,231$ ;  $df = 1$ ,  $p = 0,267$ ; 2 cells (50%) had an expected value of less than 5. Significance value was 0,357 for 2-sided (two tail) and 0,357 for 1-sided (one tail) of the Fisher's test.

\*\*\*)  $\chi^2 = 0,355$ ;  $df = 1$ ,  $p = 0,552$ ; 1 cells (25%) had an expected value of less than 5. Significance value was 0,537 for 2-sided (two tail) and 0,381 for 1-sided (one tail) of the Fisher's test.

**Table 8.** Effect of DJ stent use on ESWL and URS in stone-free rate.

		With Procedure	Without Procedure	Jumlah
With DJ stent*	ESWL	1 (100%)	0 (0%)	1
	URS	7 (46,7%)	8 (53,3%)	15
	Total	8 (50%)	8 (50%)	16
Without DJ stent**	ESWL	9 (64,3%)	5 (35,7%)	14
	URS	42 (82,4%)	9 (17,6%)	51
	Total	51 (78,5%)	14 (21,5%)	65

\*)  $\chi^2 = 1,067$ ;  $df = 1$ ,  $p = 0,302$ ; 2 cells (50%) had an expected value of less than 5. Significance value was 1,0 for 2-sided (two tail) and 0,5 for the 1-sided (one tail) of the Fisher's test

\*\*)  $\chi^2 = 2,122$ ;  $df = 1$ ,  $p = 0,145$ ; 1 cells (25%) had an expected value of less than 5. Significance value was 0,16 for 2-sided (two tail) and 0,139 for 1-sided (one tail) of the Fisher's test.

In Table 7 the differences of proximal ureteric stone-free rate between ESWL and URS was 10,1% (from 69,2 to 59,1%); the difference of distal ureteric stone-free rate in table 10 was 31,8% (81,8 - 50%); difference of ureteric stone-free rate in Table 11 overall by 7,5% (from 74,2 to 66,7%). In hypothesis testing with Fisher's test, because the cells had expected values of less than five, the result of the three tables had  $p > 0,005$ , which could be interpreted as insignificant.

DJ stent usage did not affect the stone-free rate in ESWL and URS therapeutic modality in the ureter stones (Table 8).

## DISCUSSION

The sites of ureteric stone in this study was found in 42% of the patients. Compared to the study in Yogyakarta from 2001-2005, ureteric stones were found in 46,4% of the patients. However, data in Yogyakarta did not include stones that can be found in 2 sites or more in the same patient as the data in the study in RSPP Jakarta. Overall, ureteric stones in RSPP in the year 2009 can be found in 127 (52,3%) hospitalized patients.<sup>11</sup>

From 243 patients with urinary stones, the number of female patients was 70 (28,8%) and male patients 173 (71,2%). This ratio is almost similar to the whole ureter stones and to the comparisons of proximal and distal ureter. The ratio of patients with urinary tract stones between men and women was 7 : 3. This ratio does not vary with the ratio stated in the literature, in which men were 2-3 times more than women. Stone disease usually affects men more often than women. With a variety of indicators, including inpatient admission, outpatient, and emergency, men were three times more susceptible than women.<sup>12,13</sup> However, there is some evidence that the difference in incidence between men and women is decreased.<sup>14</sup>

Therapeutic modalities performed on ureteric stones were URS (70,7%), followed by ESWL (19,2%), conservative therapy (13,7%), open surgery (2,9%) and PCNL (2,9%). The treatment of ureteric stones in Central Hospital Pertamina, Jakarta, followed the guidelines of the management of urinary tract stones disease published by the Central Executive of Indonesian Association of Urology in year 2007.

This study only took the primary procedure

and did not take into account how many times the procedure was performed. Regarding the number, the procedures were distinguished into primary and secondary procedure. The definition of the primary procedure was a procedure used at the beginning of the action, while the secondary procedure was a procedure used for the next action that is different from the initial (primary) procedure. Therefore, the number of procedures in one patient's could consist of some primary procedures and some secondary procedures, or only some primary procedures only.<sup>15</sup> Data from studies in Cipto Mangunkusumo Hospital between 1997-2007 showed that in two studies there was an increased use of minimally invasive endourology action on kidney stones.<sup>16,17</sup> Ureteric stones, in particular, were also increasingly subjected to minimally invasive approaches such as endourology.<sup>1,13</sup>

In this research, ESWL was used more often than URS for the proximal and distal ureteric stones. For proximal ureteric stones, there were 35 procedures (13 procedures ESWL only, 22 procedures URS only); distal ureteric stones 46 procedures (2 procedures ESWL only, 44 procedures URS only).

From the literature, the use of URS with holmium:YAG laser lithotripsy is a procedure modality acceptable to all proximal ureteric stones and satisfactory results are obtained in stone size of 1 cm or larger. However, the same literature also mentions that ESWL remains the first-line therapy for proximal ureteric stones of less than 1 cm, because of lower morbidity, less anesthetic and analgesic needs than those in URS.<sup>7</sup>

Prospective study conducted by Reinhard Peschel in Austria (1999) concluded that for distal ureteric stones URS is recommended as the first treatment of distal ureteric stones. The research was conducted using semirigid ureteroscope 6.5 or 9.5 F compared to Dornier MFL 5000 ESWL in the distal ureter stone of less than 5 mm and 5 mm upwards. A prospective study conducted by Pearle concluded that URS and ESWL on ureteric stone is associated with a high success rate and low complication. However, this study showed that in stone size of 15 mm or less, ESWL had little operating time, and more frequently done for outpatients and tended to have fewer low back pain, dysuria, and complications, and faster recovery. So, ESWL is more efficient and with less morbidity than URS in distal ureter stones.<sup>9</sup>

Stents were used in 19,8% of procedures.

The procedure most widely used with stent was URS. The use of stent in ESWL was in 1 procedure and in URS as many as 15 procedures. Comparison based on the position of the ureteric stone, stents were used mostly in proximal ureteric stones, comprising 10 pieces of stents compared to distal stone, which used only 6 stents. From this research, the use of DJ stent did not affect the stone-free rate in ESWL and URS treatment modality for ureteric stones.

Routine stenting is not recommended as the part of treatment in urinary tract stones. Although not the preferred primary therapy, ureteric stenting sometimes plays an important role as an additional measure in the treatment of urinary tract stones. For example, in patients with sepsis accompanied by signs of obstruction, stent usage is necessary, as well as in impacted ureteric stones.<sup>15,18</sup>

Guidelines for the management of ureteric stones is based on the guidelines from the AUA (American Urological Association) and the EAU (Europe Association of Urology), which stated that routine stenting is not recommended as the part of shockwave lithotripsy (ESWL).<sup>18,19</sup> When the stent is inserted, patients often suffer from frequency, dysuria, urgency, and pain.<sup>20</sup> Routine stenting is no longer required prior to URS. However, pre-stenting facilitates ureteroscopic treatment, increases stone-free rate, and reduces complication rate.<sup>21-23</sup> Most urologists routinely include DJ stent in URS,<sup>24</sup> although several randomized prospective trial found that routine stenting after uncomplicated URS (complete stone removal) is no longer needed.<sup>21,25</sup> Stents should be inserted in patients who are at increased risk of complications (eg. residual fragments, bleeding, perforation, urinary tract infection or pregnancy). Stents should be included in all doubtful cases to avoid emergency situations. There is no evidence in the literature as to how long the stent should be maintained. In practice, most urologists chose 1-2 weeks after URS.<sup>21,24</sup> Patients with stenting should be followed by abdominal plain film (kidney-ureter-bladder), CT or ultrasound.

In this study, stone-free rate in the proximal ureter was 62,9%, which was lower than in the distal ureter, 80,4%. In proximal ureter, the stone-free rate was higher with ESWL (69,2%) than with URS (59,1%). In contrast, in the distal ureter, the stone-free rate was higher with URS (81,8%) than with ESWL (50%). In the whole ureter stones, stone-free rate with URS (74,2%) was higher than with ESWL (66,7%). However, with statistical assessment, the

stone-free rate in proximal ureter, distal ureter or whole ureter were meaningless. Further assessment should investigate the size of the stone, which was not done in this study, to obtain better results. DJ stent usage did not affect the difference in stone-free rate in ESWL and URS treatment modalities for ureteric stones.

Stone-free rate in this study was determined by evaluation of plain abdomen and ultrasound after the action. From the literature, various studies were conducted to determine the outcome of various stone therapeutic modalities. Some output indicators often used are stone-free rate, the number of procedures and complications. Methods used to determine the stone-free rate is through the evaluation of abdominal plain after the action. Especially for patients who underwent observation, determination of stone-free rate is slightly different because it has to consider the length of waiting time, stone location and the size of the stone.<sup>15</sup>

Stone-free rate is used to determine the therapeutic efficacy of ureteric stones. This is very important in ureteric stone because due to the presence of remaining stones fragments will continue to provide clinical complaints. Method used to determine the stone-free rate is through the evaluation of abdominal plain x-ray after the action. Especially for patients who underwent observation, the determination of stone-free rate is slightly different because it must consider the length of waiting time, stone location and size.<sup>15</sup>

The literature showed that there was no difference in overall stone-free rate between ESWL and URS for proximal stones. However, after stratification for the size of the stone, the size of proximal ureteric stones of < 10 mm, ESWL had a higher stone-free rate than URS, but for stones > 10 mm, URS had a higher stone-free rate. This difference existed because for proximal ureteric stones, the stone-free rate at URS did not vary significantly with size, whereas the stone-free rate in ESWL had correlation with the size of the stone.<sup>18</sup> For all of middle ureteric stones, URS was better than ESWL, but after stratification for the size of the stone, the stone-free rate at URS was higher, but did not reach statistical significance. For all distal ureteric stones, the overall results of stone-free rate in URS was better than that in other modalities.<sup>18</sup> Due to the absence of stone size, this study could not compare stone-free rates based on the size in treatment modalities ESWL and URS.<sup>18,19</sup>

Compared with the results in Table 9 to 11 with the results of meta-analysis of the collaborative project guidelines EAU/AUA, the stone-free rate in the two treatment modalities is still below the value of the results of the meta-analysis of this European research. Literatures on this meta-analysis found a stone-free rate with ESWL in the proximal ureter of 82% and distal 74%, and with URS in proximal ureter 82% and distal ureter 93%. This was because the study was conducted after the procedure or after 1-2 days after the procedure by plain abdominal imaging and ultrasound. The results of meta-analysis conducted with Cochrane Collaboration suggested that ureteric stones had higher stone-free rate with URS than ESWL, but the number of complications and length of stay was higher than that with ESWL.<sup>18</sup>

To avoid residual fragments or facilitate further cleaning, additional medical and physical therapy may be suggested. After ESWL and URS, adjunctive treatment with tamsulosin may increase fragment clearance and reduce the probability of stone fragments remaining. This study did not evaluate the use of tamsulosin, so that the efficacy of this treatment could not be evaluated.<sup>18</sup>

## CONCLUSION

Stone-free rate in these two treatment modalities was still below the value in the existing literatures because stone-free rate assessments were taken after the procedure or 1-2 days after the procedures with plain abdominal imaging and ultrasound.

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