Int Urol Nephrol (2014) 46:2087–2093
DOI 10.1007/s11255-014-0787-x

UROLOGY - ORIGINAL PAPER

Pneumatic versus laser ureteroscopic lithotripsy: a comparison of initial outcomes and cost

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Received: 1 May 2014 / Accepted: 3 July 2014 / Published online: 1 August 2014

Abstract
Purpose To audit the cost of laser versus pneumatic semirigid ureteroscopic lithotripsy and to analyze their relative *initial outcomes and cost*.
Methods Hundred and eighty-seven patients who underwent semirigid ureteroscopic lithotripsy were analyzed retrospectively in terms of age and sex of the patients; location and size of the stones; the type of probe and ancillary equipment such as guide wire, basket catheter, JJ stent requirements; irrigation amount; operation time; the cost of the anesthesia and further treatments such as a JJ stent removal operation and shock wave lithotripsy requirements and their costs. Two groups were formed based on this type of lithotripters, pneumatic and laser lithotripsy.
Results Operation times (min.) in terms of the stone size, for stones <100 and >100 mm^2 were 20.75 ± 10.78 and 25.82 ± 14.23, respectively ($p = 0.007$). Operation times for the pneumatic and laser groups were 33.05 ± 11.36 and 15.25 ± 6.14, respectively ($p < 0.05$).The stone-free rates for pneumatic and laser groups were 89.6 % ($n = 69$) and 98.2 % ($n = 108$), respectively ($p = 0.01$). The mean cost of the operations for each of the study groups was 261.5 ± 66.13 and 311.7 ± 51.97 US$, respectively ($p = 0.001$). The mean cost in terms of the stone size, for stones <100 and >100 mm^2, was 272.86 ± 53.05 and 323.71 ± 66.88 US$, respectively ($p = 0.01$).
Conclusions It seems that usage of laser lithotripsy (LL) in patients with ureteral stones is *more effective* than pneumatic lithotripsy (PL) in terms of operation time and SF rate. On the other hand, the mean cost of LL seems to be more expensive than PL. Urologists should think these parameters before the choice of these two treatment modalities. The higher the effectiveness, the greater the *cost*.

Keywords Cost · Pneumatic · Laser · Lithotripsy

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Introduction

Ureteroscopy is usually the first choice of treatment for ureteral stones in nearly all locations, as major technical improvements during the past 20 years include endoscope miniaturization, enhanced optical quality and tools and introduction of disposables [1]. Semirigid ureterorenoscopy (URS) for urinary stone management became a standard procedure in the 1990s. Today, small endoscopes with tip diameters <8Ch are most often used. In Europe, rigid URS is used for proximal and distal ureteral calculi, but an increasing number of urologists prefer flexible endoscopes for proximal calculi. However, rigid URS is safe even for proximal ureteral calculi [1–3].

Intracorporeal lithotripsy, including electrohydraulic, pneumatic, ultrasound and laser systems, is generally necessary before stone removal. There are some differences between these systems in terms of their efficacy and applicability to different types of URS. Flexible electrohydraulic lithotripsy probes are available for semirigid and flexible ureterorenoscopes. Electrohydraulic lithotripsy can disintegrate all types of stones (even cystine or hard stones, such as calcium oxalate monohydrate), even though there is an increased risk of surrounding tissue damage [4, 5]. Pneumatic or ballistic lithotripsy is often used with 2.4Ch probes for safe rigid URS and can achieve >90 % disintegration [6, 7]. Proximal stone migration is a common occurrence [8], but can be prevented by using a basket or special tools [9, 10]. Ultrasound can be used alone or in combination with pneumatic lithotripsy (PL). However, ultrasound can only be used in larger ureteroscopes [11]. The laser, especially Holmium: yttrium-aluminum-garnet (Ho: YAG), is the most efficient system for treatment of all types of stones in all locations [12] and is the gold standard for rigid and flexible URS [13].

There are many kinds of treatment modalities and types of ureteroscopes for ureteral stones. The success rate of the treatment depends not only on URS, but also on ancillary equipment such as a laser or pneumatic probes, or devices that prevent push-back of the stones. For that reason, the cost of the treatment modality may be important when deciding on the type of treatment. Apart from the ureteroscope, the main factor that affects the cost of the procedure is ancillary equipment such as the type of probe, devices that prevent stone migration, and guide wire and other supplies needed for ureteroscopic lithotripsy (URS-L).

It is accepted that laser URS-L is more expensive than PL. For that reason, the effectiveness of laser lithotripsy (LL) is mostly overlooked by many urology clinics. We aimed to audit the cost of laser versus pneumatic semirigid URS-L and to analyze their relative *initial outcomes and cost*.

Methods

Our study design was approved by the local ethics committee of our institution with 80576354-050-99/97. Between 2011 and 2014, a total of 187 patients who underwent semirigid URS-L due to ureteral stones in any location were analyzed retrospectively in terms of age and sex of the patients; location and size of the stones (stone size was calculated by measuring the length (mm) and width (mm) of the stone on the imaging equipment, mostly on CT, according to EAU guidelines [1]); the type of probe and ancillary equipment such as guide wire, basket catheter, JJ stent requirements; irrigation amount; a single-dose antibiotic that is used during the procedure; operation time (OT) (OT was the interval between insertion into the urethra and removal from the urethra of the ureteroscope); the cost of the anesthesia and further treatments such as a JJ stent removal operation and extracorporeal shock wave lithotripsy (ESWL) requirements and their costs. Further treatment decisions about ESWL or to establish a stone-free state were made from a kidney–ureter–bladder (KUB) plain film of the abdomen that is taken on the twenty-first day. Two groups were formed based on the type and life of lithotripters, PL and LL. Then, the data mentioned above were distributed according to their groups, and their costs were audited in US Dollars ($).

Some calculation methods

Initial purchase of the holmium: YAG laser (Litho™, 30 W holmium: Yag Laser, Italy) was $30,000, annual upkeep was $1,000, making a total of $3,000 for the study duration of 3 years, and the total sum was $33,000. Initial purchase of the PL (Vibrolith™, Elmed, Ankara, Turkey) was $7,500 in total, with no upkeep expenses. The number of other operations including flexible URS-L (Richard Wolf™, Knittengen, Germany) and endoscopic cystolithotripsy for the laser machine (33 cases) and percutaneous nephrolithotomy for the pneumatic machine (13 cases) that have been completed in our clinic were added to the whole number of operations in our study in order to audit the cost of the machines for one case correctly (the reason for the low number of flexible URS-L and percutaneous nephrolithotomies is the recent addition of these to our clinic). Namely, in order to audit the cost of only one case for each machine, the total cost of the pneumatic machine, $7,500, was divided by a total of 90 (77 + 13) cases, and for the laser machine, $33,000 was divided by a total of 143 (110 + 33) cases.

We audited the cost of the probes that are used according to their types, and life of one probe, i.e., pneumatic and laser, respectively. The cost of the probe that is used for a stone of 1 mm^2 was audited by dividing the total cost of a whole probe by the total growth of the stones of all patients in one group. Then, this value was multiplied by the stone size in order to audit the cost of the probe for that case. In this way, the cost of the probe for only one case was correctly audited in terms of the stone size. Namely, a pneumatic probe (PP) cost of $60 was divided by the total size of the stones of all patients in the PL group (7,078 mm^2). A laser probe cost of $1,350 was divided by the total size of the stones of all patients in the LL group (9,478 mm^2), and these values were multiplied by the stone size for that case. In addition, the durability of a basket catheter is an average of three cases; thus, the cost of a basket, $60, was divided by 3. The cost of the basket for only one case was calculated in this way.

The cases were operated by same experienced surgeons. Two surgeons were involved in the study. They have been working as specialists over 10 years with the experience of at least 300 ureteroscopic procedures.

Pneumatic URS-L procedure

All patients underwent general anesthesia after receiving a single dose of prophylactic antibiotic, and after that, were positioned into a dorsal lithotomy position. An 8.5/11.5 F semirigid ureteroscope (Richard Wolf™, Knittlingen, Germany) with two working channels was engaged, followed by passing a 0.038-inch floppy tip guide (Microvasive™, Boston scientific, USA) wire by the side of stone. The reason for preferring an 8.5/11.5 F semirigid ureteroscope is that having two large working channels allows the passage of both a basket catheter and a PP at the same time, in order to prevent the retropulsion of the stone in all locations in the ureter. Upon reaching the stone, it was grasped with a basket catheter (Zero tip™, Boston scientific, USA) in order to prevent push-back; if the stone could not fit into the basket, then the basket catheter was passed to the posterior of the stone, and the PP (Vibrolith™, Elmed, Ankara, Turkey) was inserted into the second working channel. Thus, the fragmentation of the stone was achieved.

Laser URS-L procedure

All patients underwent general anesthesia after receiving a single dose of prophylactic antibiotic, and after that, were positioned into a dorsal lithotomy position. A 4.5/6.5 F semirigid ureteroscope (Richard Wolf™, Knittlingen, Germany) with 1 working channel was engaged, followed by passing a 0.038-inch floppy tip guide wire (Microvasive™, Boston scientific, USA) by the side of the stone. The reason for preferring a 4.5/6.5 F semirigid ureteroscope is that it is thinner and reduces the need for balloon dilation of the ureter. In most cases, because of the low risk of retropulsion of stone in LL, a basket catheter (Zero tip™, Boston scientific, USA) was not used in order to reduce the cost of the procedure, but in some cases where there were proximal ureteral stones, the thicker ureteroscope was used for grasping the stone with a basket catheter. Upon reaching the stone, the LP [Holmium: YAG laser (Lumenis™, Santa Clara, USA)] was inserted into the ureteroscope. Thus, the fragmentation of the stone was achieved.

In this work, we researched the costs associated with performing pneumatic vs laser semirigid URS-L, including the costs of the ancillary equipment. Costs associated with staff and the hospital stay were not analyzed. The patients in whom JJ stents (Plastimed™, Ankara, Turkey) were inserted were discharged from the hospital on postoperative day 1 and the others on the day of surgery.

Statistical analysis

Results are given as mean ± standard deviation (SD). Data were analyzed using SPSS-16 for Windows (SPSS, Inc., Chicago, IL). Statistical analyses of the means of continuous variables were performed with Student's *t* test and one way ANOVA, followed by Tukey's test (for multicomparison analysis) for operation times in terms of the stone locations. Categorical variables were analyzed using chi-square tests, and a probability level of $p < 0.05$ was considered as significant.

Table 1 The characteristics of the patients and stones according to the study groups

	PL	LL	*p*
Number of patients	77	110	
Age (mean, years ±SD)	40.1 ± 15.6	41.8 ± 14.42	0.44
Male:female ratio	44:33	52:58	0.56
Stone size (mm^2)	91.92 ± 24.38	92.80 ± 19.01	0.78
Stone location			0.03
Proximal	10 (13 %)	27 (24.5 %)	
Middle	28 (36.4 %)	46 (41.8 %)	
Distal	39 (50.6 %)	37 (33.6 %)	
Total stone amount (mm^2)	7,078	9,478	

Table 2 Intraoperative characteristics

	PL	LL	*p*
Operation time (min, ±SD)	33.05 ± 11.36	15.23 ± 6.148	0.001
Basket using (*n*, %)	77 (100 %)	27 (24.5 %)	0.001
Double j stent using (*n*, %)	62 (80.5 %)	14 (12.7 %)	0.001

Results

The number of patients in the PL and LL groups was 77 and 110, respectively. Mean patient age, male: female ratio and stone size for PL and LL groups were 40.1 ± 15.6/41.8 ± 14.4, 44:33/52:58 and 91.92 ± 24.38/92.8 ± 19.01, respectively (Table 1).

Stone locations were categorized as proximal, middle and distal ureters. For the PL group, the number of stones according to their locations was 10 (13 %), 28 (36.4 %) and 39 (50.6 %), respectively, and for the LL group were 27 (24.5 %), 46 (41.8 %) and 37 (33.6%), respectively (Table 1). In patients with proximal ureteral stones, 27 and 10 received LL and PL, respectively ($p < 0{,}001$), and in cases with mid-ureteral stones, same result was achieved. Forty-six and twenty-eight received LL and PL, respectively ($p < 0{,}001$). On the other hand, 39 and 37 patients with distal ureteral stones received PL and LL, respectively ($p < 0{,}001$). The number of basket catheters used for PL and LL groups was 77 (100 %) and 27 (24.5 %), respectively (Pearson chi-square 0.001, $p < 0.05$). The number of double J stents used for PL and LL groups was 62 (80.5 %) and 14 (12.7 %), respectively (Table 2).

Table 3 The costs per one case

Pneumatic machine for one case (90 cases)	7,500:90	84$
Pneumatic probe for 1 mm^2 stone	60$:7,078 mm^2	0.008$
Pneumatic probe for average stone size	0.008*91.92	0.73$
Laser machine for one case (143 cases) (including upkeep)	33,000$:143	230$
Laser probe for 1 mm^2 stone	1,350$:9,478 mm^2	0.14$
Laser probe for average stone size	0.14*92.8	12.8$
Basket catheter for one case (its durability was for three cases)	60$:3	20$
Double J stent		15$
Antibiotics		7$
Guide wire		7$
Irrigation amount (for each 1,000 cc)		5$
Double J stent removal		100$
ESWL		100$

Table 4 The operation time and the cost according to the stone size

	<100 mm^2 ($n = 120$)	>100 mm^2 ($n = 67$)	p
Operation time (min, ±SD)	20.75 ± 10.78	25.82 ± 14.23	0.007
The cost ($, ±SD)	272.86 ± 53.05	323.71 ± 66.8	0.001

Table 5 The cost-effectivity results for the study

	PL	LL	p
Total cost ($, ±SD)	261.5 ± 66.13	311.7 ± 51.97	0.001
Stone-free rate (%, at the 21th day)	89.6 %	98.2 %	0.01
Operation time (min, ±SD)	33.05 ± 11.36	15.23 ± 6.14	0.001
ESWL requirement (n, %)	7 (9.1 %)	2 (1.8 %)	0.022

The costs per one case were shown in Table 3.

The total size of the stones for the PL and LL groups was calculated as 7,078 and 9,478 mm^2, respectively (Table 1). The mean stone size of the patients who underwent PL and LL was 91.92 ± 24.3 and 92.8 ± 19.01 mm, respectively ($p = 0.78$).

Operation times (min.) in terms of the stone size, for stones <100 and >100 mm^2 were 20.75 ± 10.78 and 25.82 ± 14.23, respectively ($p = 0.007$) (Table 4). Operation times in terms of the location of the stone, for the upper, middle and distal ureter were 26.08 ± 12.02, 23.65 ± 14.3 and 19.8 ± 9.6, respectively. There was a significant difference between upper and distal ureter locations ($p = 0.029$). Operation times for the PL and LL groups were 33.05 ± 11.36 and 15.25 ± 6.14, respectively ($p < 0.05$) (Table 2).

Table 6 The parameters related to surgeon experience

	Surgeon		Total
	AD	KÇ	
Pneumatic	42	35	77
Laser	54	56	110
p			
Operation time (min)	22.92 ± 13,7	22.2 ± 10,7	0.69
Double J stent usage	41/96 (42 %)	35/91 (38 %)	0.65
Stone-free rate	89/96 (92 %)	88/91 (96 %)	0.33

Table 7 The cost of the used devices in the study

The used devices in the study	cost ($)
Laser generator; Litho™, 30 W holmium:Yag Laser, Italy	30,000
Laser probe [Holmium: YAG laser (Lumenis™, Santa Clara, USA)]	1,350
Annual upkeep fee	1,000
Pneumatic lithotripter; Vibrolith™, Elmed, Ankara, Turkey	7,500
A 0.038-inch floppy tip guide (Microvasive™, Boston scientific, USA)	7
A basket catheter (Zero tip™, Boston scientific, USA)	60
Pneumatic probe (Vibrolith™, Elmed, Ankara, Turkey)	60
JJ stents (Plastimed™, Ankara, Turkey)	15

The stone-free rates for PL and LL were 89.6 % ($n = 69$) and 98.2 % ($n = 108$), respectively ($p = 0.01$). ESWL requirement rates for the groups were 9.1 % ($n = 7$) and 1.8 % ($n = 2$), respectively ($p = 0.02$) (Table 5).

The mean cost ($) of the operations for each of the study groups were 261.5 ± 66.13 and 311.7 ± 51.97, respectively ($p = 0.001$) (Table 5). The mean cost in terms of the stone size, for stones <100 and >100 mm^2 were 272.86 ± 53.05 and 323.71 ± 66.88, respectively ($p = 0.01$) (Table 4). There were no serious complications that affected the cost for either group. One laser and PP was sufficient for the treatment of 143 and 90 patients with urolithiasis including renal and bladder stones, respectively. The parameters related to surgeon experience and the cost of the used devices in the study were summarized in Tables 6 and 7.

Discussion

Economic evaluation methods, such as cost-effectiveness analysis (CEA), can be utilized to provide the most efficient distribution of scarce healthcare resources. A basic understanding of CEA is essential to achieve a suitable balance between good patient care and reasonable cost containment [14]. Economic evaluations in health care aim to determine the value for money associated with new interventions. CEA is one of many different types of economic evaluations, including cost-minimization analysis, cost–benefit analysis and cost-utility analysis [15]. In order to evaluate the cost-effectiveness of a new intervention, it must be compared with at least one other intervention. Typically, the new intervention under study is compared with the commonly accepted intervention, and two estimations must be made: the extra cost and the extra effect of the new modality. There are four possibilities when comparing two modalities: The new modality can be more expensive and more effective (1), more expensive and less effective (2), less expensive and less effective (3) and finally less expensive and more effective (4) [16]. Treatments that fall into the second category are said to be dominated by the other alternatives because one would not be willing to pay more for less benefit. Treatments that fall into the fourth category are considered dominant and offer health gains at a lower cost. Where CEA is most useful, however, is when considering treatments that fall into the other two categories. CEA helps with this decision by estimating the additional cost per unit of additional gain [17].

According to our investigations, our study of the *initial outcomes and cost* of PL and LL with semirigid URS-L for ureteral stones in all locations may be the first such study in the literature. Semirigid URS-L had been a standard procedure due to improvements in ureteroscope design and ancillary equipments, as well as in laser technology. These developments made ureteroscopy easier and safer when compared to the applications in the past. However, it seems that there is an extra cost for these procedures. For that reason, most urology clinics do not use these improvements. Because of that, we analyzed the *initial outcomes and cost* of the PL and LL by applying them to semirigid URS procedures in order to understand whether this comment is true or not.

According to the results of our study, the mean total cost ($) of the PL and LL were 261.5 ± 66.13 and 311.7 ± 51.97, respectively. This difference was statistically significant ($p = 0.001$). The most important factor that affected this result was the cost of the laser machine. If the cost of the laser machine is excluded, then the new mean cost ($) for PL and LL groups would be 177.48 ± 66.13 and 81.79 ± 51.97, respectively ($p = 0.001$). The implication of that calculation is that the more the laser machine is used, the higher the *cost*. The purchase and installation costs of a Ho: YAG lasertripsy unit vary with different laser companies, and the costs are also related to the cost of energy (20–100 W) [18]. Increasing the usage of the laser device by different departments, including general surgery, orthopedics, head and neck surgery and cardiovascular surgery, would make LT an acceptable and somewhat economical treatment choice. In addition, the cost of the operation is affected by stone size, according to our results. The operation costs for stones <100 and >100 mm^2 were 272.862 ± 53.05 and 323.71 ± 66.88, respectively ($p = 0.001$).

According to Isen's study, successful fragmentation was achieved in 88.5 % of stones by PL. The retreatment rate was 11.5 % [19]. This result was similar in our study for the PL group (89.6 %), but the further treatment rate with ESWL was 9.1 %. However, we established more efficacy in the LL group (98.2 %) and less further treatment that includes ESWL requirements (1.8 %). In addition, according to a study conducted by Binbay et al. [20], stone-free rates for PL and LL groups were close to ours, at 80 and 97.5 %, respectively. The main reason for the lower stone-free rate for their PL group is a difference in methodology, because their study included impacted ureter stones. These results were close to the results of a study conducted by Jeon et al. [21]: 84.6 and 96 %, respectively, for PL and LL groups.

We believe that the effect of the basket catheter on stone-free rate and no further treatment requirement is most important, as demonstrated in some studies in the literature [8, 10]. The ancillary equipment that is used with the PL group may have increased the stone-free rate by preventing the push-back of the stones. The semirigid probe and PL method have a high possibility of undesired retrograde displacement of the calculus [22, 23]. The degree of migration depends mainly on the energy source used for lithotripsy: pneumatic and electrohydraulic lithotripters are associated with a greater degree of retropulsion than lasers. Different stone-trapping strategies and devices have been developed to minimize stone migration; these devices are inserted proximal to the stone prior to the application of kinetic energy in order to prevent retrograde stone migration [24]. In order to increase the stone-free rate, we used a basket catheter to provide preventing push-back of the stones in all cases in the PL group. This approach increased not only the number of ancillary instruments such as basket catheters, but also the cost of the procedure. For that reason, by means of meticulous endoscopic procedures, the stone-free rate in our study was a bit higher than that in some studies in the literature [19–21, 25]. In a study by Jeon et al., the immediate stone-free rate in the LT group was significantly higher than in the PL group, 96 versus 73.1 %, respectively, but there was no significant difference in the 3-month stone-free rate between these two groups [21]. This result may be important in terms of quality of life for 3 months after surgery. According to the same study results, push-back rates of the stones were 19.2 and 4 %, respectively, for PL and LT groups [21]. However, the results in our study were 9.1 and 1.8 %, respectively. These patients were treated by ESWL. In our opinion, the main reason for the difference in our findings is the routine use of a basket catheter to prevent the push-back of the stone.

The double J stents, a piece of ancillary equipment that is especially used in PL, increased the cost of the PL. We preferred to insert a double J stent after an uncomplicated URS-L in order to prevent pain caused by edema because of the pneumatic effect on the ureter. Most urologists routinely insert a double J stent following URS, although several studies have found that routine stenting after uncomplicated URS is no longer necessary [1, 26], but they can be inserted into patients who are at increased risk of complications such as residual fragments, bleeding, perforation, infection or pregnancy [1].

According to a study by Binbay et al. [20], the mean OT was 48 $\pm$ 12.4 and 30 $\pm$ 9.2 min, respectively, in the PL and LT groups. These results were a bit longer than ours, but the average stone size in their study was greater than ours, 118.8 and 110.7 mm^2, respectively, for PL and LL groups, and they included impacted stones [20]. The other reason for these results may be the use of ancillary equipment in the PL group, which prolonged the operation time, as well as a low pneumatic effect on the stones, especially on those that are hard and impacted. The operation times (min) for PL and LL groups in our study were 33.05 $\pm$ 11.36 and 15.23 $\pm$ 6.148, respectively ($p = 0.001$). Namely, the LL procedure was two times faster than the PL procedure. This result may be important in terms of the incomes of the hospitals because it is possible to perform two times more of the same kind of operation in the same OT for LL than for the other kinds of operations. Namely, the usage of LL in place of PL can provide more effective use of operating rooms in terms of hospital income. In addition, according to our results, OT can be affected by stone location and size. The OT for proximal ureteral calculi is significantly different from that for distal ones ($p = 0.029$). The operation times (min) for stones <100 and >100 mm^2 were 20.75 $\pm$ 10.78 and 25.82 $\pm$ 14.23, respectively ($p = 0.007$).

There were no serious complications that affected the cost of the operations in either the LT group or the PL group, in both our study and Jeon et al.'s studies. However, in the PL group, mucosal injury and edema were the most frequent complications; this result demonstrates that LT is relatively safer than PL. According to our observations, the edema that was seen during operations depended on the stone size. For that reason, we excluded edema that was not associated with URS procedures. According to a study by Bapat et al. [27], ureteral perforation rates for PL and LL groups were 4.6 and 2.9 %, respectively. Auxiliary procedures included ESWL for 13.9 % patients in the pneumatic group and 1.9 % in the laser group and repeated URS for 2 patients in the pneumatic group. According to the results of our study, ESWL requirements for the LT and PL groups were 9.1 and 1.8 %, respectively. Bivariate analysis showed a significant association of ureteral perforation with increased operative time. Longer duration of the ureteroscopic procedure is strongly associated with ureteral perforation [28].

Lack of study

First limitation of our study is that we could not analyze long-term complications that require further treatment. The main reason for patients who underwent URS not coming to the study center unless they have a complaint is the distance between their home and the study center. However, we believe that long-term complications in PL are much more important in terms of the ureteral stricture risk, because of the high rate of mucosal injury and edema. Ureteral stricture risk is more likely because of the mucosal injury that is the most frequent and mildest complication in the PL group.

The second limitation of our study was not making a cost analysis associated with staff and the hospital stay because there is no any standardization among hospitals (especially for private hospitals) in terms of price policy for these subjects.

The third limitation was design of the study without assuming a power factor because the sample size of two groups was designed according to the life of probes.

The forth limitation of our study is that although one of the authors (AD) has studied about healthcare management and administration, no formal cost analysis by a chartered accountant was done in this study.

According to the effectiveness model described by Hoch et al. [17], our study falls into the first category, i.e., more expensive and more effective. CEA helps with this decision by estimating the additional cost per unit of additional gain.

Conclusions

It seems that usage of LL in patients with ureteral stones is more *effective* than PL in terms of OT and SF rate. On the other hand, the mean cost of LL seems to be more expensive than PL. Urologists should think these parameters before the choice of these two treatment modalities. The higher the effectiveness, the greater the *cost*.

Conflict of interest The authors declare that they have no conflict of interest.

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