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Original Article

A Comparative Study Between Pneumatic and Laser Lithotripsy for Ureteroscopic Extraction of Upper Ureteric Calculus: A Prospective Study

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ABSTRACT

Article information

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Background: The daily practice of urology includes managing patients with urolithiasis, and there are various methods for managing ureteral calculi. There are many techniques for fragmenting stones. The holmium: yttrium-aluminum-garnet [Ho: YAG] laser is often utilized in stone disintegration procedures.

Aim of the work: This research compares the effectiveness of laser and pneumatic lithotripsy in treating patients with upper ureteric calculi regarding the percentage of patients who remain stone-free, hospital stays, surgical times, and complications.

Patients and methods: Sixty individuals with upper ureteric calculus participated in this prospective comparative analysis. From February 2021 to March 2022, the patients were randomly divided into two groups [Laser Lithotripsy and Pneumatic Lithotripsy]. The main goals of both treatments were to break the stone into pieces smaller than 3 mm, which was confirmed by an X-ray [KUB] on the first post-operative day.

Results: The study's eligibility criteria were met by 60 individuals with upper ureteric stones [30 in the pneumatic group and 30 in the laser group]. In laser lithotripsy, the immediately stone-free rate was 93.3 percent, while in pneumatic lithotripsy, it was 70.0 percent [p value 0.059]. Proximal migration was 6.7% in Laser Lithotripsy and 26.6% in Pneumatic Lithotripsy [$p > 0.038$]. Pneumatic lithotripsy had a substantially longer operating time than laser lithotripsy [27.83±6.11 min vs. 24.47±5.08 min; $p=0.024$]. There were no statistically substantial variations between the two groups regarding the patients' age, sex, stone size, length of hospitalization, and complications.

Conclusion: Laser and pneumatic lithotripsy are safe and effective in the treatment of upper ureteric stone with few minor complications; however, laser lithotripsy has a better stone free rate, less operative time, less fluid irrigated and less upward stone migration than pneumatic lithotripsy.

Keywords: Pneumatic lithotripsy; Laser lithotripsy; Stone free rate; Proximal migration.

INTRODUCTION

The daily practice of urology includes managing patients with urolithiasis, and there are various methods for managing ureteral calculi, including open stone procedure, extracorporeal shock wave lithotripsy [ESWL], percutaneous nephrolithotomy, laparoscopic ureterolithotomy, and ureteroscopic procedures [1]. Open surgery was the most effective method of treating ureteral stones in the early 1980s, but the development of the tiny diameter ureterscope and the ESWL largely eliminated open surgery [1]. The fundamental advantage of ureteroscopic surgery is the ability to see into the ureter, which makes it possible to find and cure ureteral stones [2].

There are many techniques for fragmenting stones, such as laser, pneumatic, electro-hydraulic, and ultrasonic lithotripsy [PL] [LL]. The holmium: yttrium-aluminum-garnet [Ho: YAG] laser, which has been tested for the [LL] technique, was the most widely employed laser [3]. Ho: YAG laser, which is often utilized in stone disintegration procedures, has a pulsed mode, a 2140 nm wavelength, and tissue penetration qualities of≈ 0.5 mm4. Positive results are obtained with pneumatic lithotripsy and Ho: YAG lithotripsy [4]. By oscillating a metal probe against the stones, the Swiss LithoClast breaks up the stones. The thermal impact caused by Ho:YAG laser pulses is due to the evaporation of tiny bubbles. A shock wave is produced by the bubble's quick collapse near the fiber's tip, and it smashes the stones [5].

In this research, we assessed patients who had ureteroscopic pneumatic lithotripsy or laser lithotripsy to compare the two procedures' safety and effectiveness.

PATIENTS AND METHODS

Comparative research was conducted at the urology department of Al Zahraa University Hospital, Al-Azhar University and the urology department of Kobry elkobba military hospital, from February 2021 to March 2022 that done on 60 patients with upper ureteric stones and were managed by semi-rigid ureteroscopic lithotripsy with laser& pneumatic. Whole study was first approved from Ethics committee of the faculty and university, and a written informed consent and ethical approval were obtained for all patients participating in this study. All patients' data confidentially kept. The research conducted by qualified & trained personnel. Patients above 18 years, with radio-opaque upper ureteric stone were included in the trial, while patients with bleeding tendencies, urethral stricture, immune-compromised, pregnancy, abnormal renal function, impacted ureteral stone and active urinary tract infection were excluded from the trial. We define A urinary tract infection [UTI] is an infection in any part of your urinary system kidneys, ureters, bladder and urethra. Most infections involve the lower urinary tract the bladder and the urethra. The patients were divided into two groups of 30 each using double blinding. Pneumatic lithotripsy was utilized to treat Group I, while Holmium:YAG laser lithotripsy was used to treat Group II.

Surgical Technique: In both groups procedures the patient will be placed in the dorsal lithotomy position with the contralateral leg somewhat straighter and lower than the other leg to allow the surgeon more room to operate semi rigid ureterscope in line with the affected ureter.

The procedure: Starts with cystoscopy. Surveillance of Bladder cavity with Identification of ureteric orifice is done then a guide wire [0.035 inch] is introduced under fluoroscopic control and secured to the drapes. Intramural ureteral dilatation [using balloon dilator] is preferred to facilitate extraction of fragments passed to the lower ureter**.** Retrograde access to the upper urinary tract is obtained under video guidance with semi rigid Carl Storz ureterscope measures: 9.5 French, distal tip: 8 French. Visually identifying the stone as it is being irrigated with ordinary saline Irrigation was pumped manually with no pressure or any device and sporadically during the operation to ensure a clean ureteroscopic vision. Pneumatic lithotripsy [Swiss LithoClast] was used to fracture stones in group I. Bursts of compressed air were fired at the head of a metal probe at a prevalence of 12 cycles per second, propelling the metal projectile in the LithoClast's headpiece. A foot pedal was used to turn on the LithoClast while the probe tip was pressed up to the stone. The diameter of the probe is 1.2 mm. pressure was set at 2 bars, with both single and continuously pulses. Endoscopic lithotripsy using an Auriga 30 Ho: YAG LASER was utilized in group II to shatter the stone. Stones were dusted and allowed to naturally clean using lasers with application powers ranging from 2.5 watts [0.5 J at 5 Hz] to 10 watts [1.0 J at 10 Hz],

At the End of procedure: Retrograde study was done in some cases to show if there was a residual proximally migrated stone or extravasation. A JJ [6Fr] stent or ureteric catheter was applied if mucosal injury, bleeding, residual fragments were left or if the operation takes long time and migrated stones are dealt with Eswl next two weeks and removed post one month of operation. Stone-free rates or negligible residual stones< 3 millimeters seen on KUB the day following the surgery were considered treatment success rates [6].

Statistical analysis: When comparing two groups using qualitative data, the Chi-square test was applied, and the Fisher exact test was applied in its place when the predicted count in any cell was less than 5. When comparing two groups with quantitative values and a parametric dispersion, an independent t-test was employed, and when comparing two groups with quantitative data and a non-parametric distribution, a Mann-Whitney test was employed. The allowable margin of error was set at 5%, while the confidence interval was set at 95%. P< 0.05 indicates significance.

RESULTS

A total of 60 patients with upper ureteral calculi; 30 cases were treated with pneumatic lithotripsy [Group I] and 30 cases with HO: YAG laser lithotripsy [Group II] using semi rigid ureterscope.

In group [I], 25 cases [83.3%] were males and 5 cases were females [16.6%] with median age of 38.43 ± 16.51 years. In group [II], 24 cases [80%] were males and 6 cases [20%] were females with mean age of 40.57 ± 15.45 years. There was no statistically substantial variance in both researched groups regarding to the demographic data. In pneumatic group, stone size ranged from 6-18 mm with mean value of 9.70 ± 4.41 mm and in laser group, it ranged from 6-17 mm with mean value of 9.83 ± 2.55 mm. Right side laterality was 13 patients [43.3%] in pneumatic group and 15 patients [50.0%] in laser Group. Left side laterality was 17 patients [56.7%] in pneumatic group and 15 patients [50.0%] in laser Group. There was no substantial variance in both groups as regard size & laterality of stone [table1].

The mean operative time was 27.83± 6.11 min in pneumatic group, while it was 24.47± 5.08 min in laser group. There was statistically substantial reduce in operative time in laser group in comparison to pneumatic group [P=0.024]. The hospital stay in pneumatic group ranged from 1-2 days with mean value [1.06 ± 0.44], while in laser group ranged from 1-2 days with mean value [1.125 ± 0.59]. There was no statistical substantial variance between the two researched groups according to hospital stay [P=0.389]. The mean fluid irrigated volume ranged from 3.2-7.1 L in pneumatic group with mean value of 5.2± 1.14 L, while it was 2.6-6 L with mean value of 4.45± 0.87 L in laser group with statistically significant decrease of fluid irrigated in laser group p =0.001 [table2].

In pneumatic group, DJ applied in 30 cases [100%], and in laser group DJ applied in 17cases [56.7%] and ureteric catheter in 13 cases [43.3%]. So, there was statistically substantial increase DJ Stenting in pneumatic group in comparison to laser group [table 3].

The Stone free rate: In group [I] stone free rate after calculus disintegration was 21[70.0%] and significant residual [>3mm] was 9[30.0%], 8 cases of them migrated upward due to bleeding intra-operative with stone retain. In group [II] stone free rate after calculus disintegration was 28[93.3%] and significant residual stones [>3mm] was 2[6.7%] that migrated upward. There was no statistically substantial variation in both groups in stone –free rate [P > 0.059], while there was a significant different as related to residual stones] P =0.038] as shown in table [3].

As regard intraoperative complication, mucosal injury in 3 cases [10%], failed procedure in 1 case [3.3] with stone retain that was treated with R-URS and one case[3.3] of bleeding in pneumatic group, while bleeding in two cases [6.6] in laser group with no substantial variation in both groups [p-value = 0.124]. Regarding postoperative complication, hematuria occurred in 1case [3.3%], and fever in 1 case [3.3%] in pneumatic group, and fever occurred in 2 cases [6.6%] in laser group with no statistical different in studied groups [p-value = 0.3333] [table 4]

For stones <10mm [30 case], the immediate stone free rate was 88.2%vs 100% in pneumatic & laser [p=0.67], and the rate of upward migration was 11.7% vs. 0.0% in pneumatic and laser [p=0.197], and operative time was 27.28 vs. 22.56 min in pneumatic and laser p=0.034 [table 5].

For stones ≥ 10 mm, the immediate stone free rate was 46.1% vs. 88% in pneumatic and laser [p=0.017], the rate of upward migration was 46.1% vs. 11.7% in pneumatic and laser [P=0.015], operative time was 30.6 vs. 27.33 min in pneumatic and laser [P=0.014], and secondary intervention was 53.7% vs. 11.7% in pneumatic and laser p=0.006 [table 6].

Table [1]: Patient demographic data and stone features

Parameter		Pneumatic [30]	Laser [30]	P value
Age	Range Mean ± SD	22-56 38.43 ±16.51	23-65 40.57 ±15.45	0.607
Gender [M-F]		25 [80%] – 5 [20%]	25 [80%] – 5 [20%]	**0.010**
Laterality [RT-LT]		13-17	15-15	0.605
Stone size	Range Mean ± SD	6-18mm [9.70± 4.41]	[6-17] mm [9.83 ±2.55]	0.886

Table [2]: Operative time, hospital stay and fluid irrigated

		Group I Pneumatic group	Group II Laser group	Independent t-test	
				t	P-value
Operative time [min]	Mean ±SD Range	27.83 ± 6.11 25 – 42	24.47 ± 5.08 22 – 39	-2.322	**0.024**
Fluid irrigated [L]	Mean ± SD Range	5.2 L ± 1.14 L [3.2 -7.1] L	4.45 L ± 0.87 L [2.6 -6] L	-4.415	**<0.001**
Hospital stay [days]	Mean ± SD Range	1.06 ± 0.44 1-2 days	1.125 ± 0.59 1-2 days	0.741	0.389

Table [3]: Stenting in both group & Stone free rate

		Pneumatic group		Laser group		Chi square test	
		No	%	No	%	x^2	p value
Stone free rate	Free stone	21	70.%	28	93.3%	3.286	0.059
	Stone migration	8	26.6%	2	6.7%	-6.385	0.038
	Failed procedure	1	3.3%	0	0%		
Stenting	DJ	30	100.%	17	56.7%	16.596	<0.001
	Ureteric catheter	0	0.0%	13	43.3%		

Table [4]: Complications in both groups

Complication	Group I Pneumatic lithotripsy		Group II Laser lithotripsy	
	No. 30	**%**	**No. 30**	**%**
Intra-Operative				
Mucosal injury	3	10%	0	0.0%
Failed procedure	1	3.3%	0	0.0%
Bleeding	1	3.3%	2	6.6%
Significance X^2 = 3.854 / p-value = 0.124				
Post-Operative				
Hematuria	1	3.3%	0	0.0%
Fever	1	3.3%	2	6.6%
Significance	*X^2 = 3.407 / p-value = 0.3333 NS*			
Significance	*X^2 = 1.886 p-value = 0.079 NS*			

Table [5]: Outcomes in patients with stones<10mm

Stones < 1cm				
Parameter		**Pneumatic group [n=17]**	**Laser group [n=13]**	**P value**
Stone size	Mean Range	7.98 6-9	7.13 6-9	0.687
Stone free rate		15 [88.2%]	13 [100%]	**0.067**
Irrigated volume [liter]		3.6 L - 6.5 L	2.5 L - 4.3 L	**0.021**
Failed procedure		0	0	**0.0**
Operative time [min]		27.28	22.56	**0.034**
Proximal migration		2 [11.7%]	Zero	0.197
Secondary intervention [ESWL or Urs]		2 [11.7%]	Zero	0.197

Table [6]: Outcomes in patients with stones≥10mm

Stone ≥ 1cm				
Parameter		**Pneumatic group [n=13]**	**Laser group [n=17]**	**P value**
Stone size	Mean Range	13.15 10-16	13.63 10-17	0.587
Stone free rate		6 [46.1%]	15 [88%]	**0.017**
Irrigated volume [liter]		3.9 L-7 L	2.8 L-4.9 L	**0.043**
Failed procedure		1 [7.6%]	0	**0.001**
Operative time [min]		30.6	27.33	**0.014**
Proximal migration		6 [46.1%]	2 [11.7%]	**0.015**
Secondary intervention [ESWL or Urs]		7 [53.7%]	2 [11.7%]	**0.006**

DISCUSSION

As a result of advancements in endoscope design and downsizing, surgeons may now reach calculi throughout the collecting system, which is regarded as the gold standard for the treatment of ureteral stones [7]. Using endoscope, a remarkable 95 percent of patients were stone-free after a single surgery. In situ lithotripsy allows for the breakdown of stones using a rigid ureterscope. Ultrasonic lithotripsy, electrohydraulic lithotripsy, pneumatic lithotripsy, and laser lithotripsy comprise the spectrum of lithotripters. In the majority of urology facilities, pneumatic and holmium: YAG laser lithotripsies are routinely utilized, and both have shown satisfactory results [8].

Compared to ultrasonic and pneumatic lithotripters, the holmium laser is one of the safest, most efficient, and most adaptable intracorporeal lithotripters, and has become one of the greatest frequently acknowledged for this goal. It has a broad variety of endoscopic uses and has shown efficacy in dissolving stones of all types [9].

Flexible fibers with a diameter range of 200 to 560 m are used to transmit the holmium: YAG laser. Holmium: YAG laser pulses cause a plasma bubble to develop that works on stone without retropulsion, producing the thermal effect. The laser ablation zone of thermal damage varies in size from 0.5 to 1.0 mm [10].

So long as the lithotripsy is carried out under direct view, ureter damage is unlikely to occur afterwards. When compared to other lithotripters, laser lithotripters often cause less harm to the urothelial mucosa. A pneumatic jack-hammer-like device is used in LithoClast lithotripsy to break up calculi. The probe is struck by a tiny bullet that is propelled by compressed air, which causes the probe to oscillate back and forth at a rate of 12 cycles per second. As the probe tips strike the stone repeatedly, fragmentation occurs [11].

Ballistic lithotripsy has the benefits of being very inexpensive and low-maintenance. The rigidity of the technology, which necessitates ureteroscopes or nephroscopes with straight functional channels and a comparatively high rate of stone retropulsion, is one of the drawbacks of ballistic devices. In addition, LithoClast lithotripsy splits the calculi into many pieces that must be collected and eliminated by dormia basket or forceps [5].

This research compares the effectiveness of laser and pneumatic lithotripsy in treating patients with upper ureteric calculi regarding the percentage of patients who remain stone-free, hospital stays, surgical times, and complications.

In our research, the mean operative time was lengthier in pneumatic group [27.83 ± 6.11] than laser group [24.47 ± 5.08] [p=0.024]. In agreement with our results, in a study by **Jeon and associates** [12], operative time was lengthier in pneumatic group. They explained that in pneumatic lithotripsy, the urologist has to change position of the ureterscope to reach the mobile stones. Also, pneumatic lithotripsy disintegrates calculi into multiple fragments that must be collected in a basket and eliminated. **Mahmood *et al.*** [13] showed that there was statistically substantial variation between both groups as regard to operative time, which was higher in Pneumatic group [60±40 min] than laser group [40±20 min; p=0.003] that agree with our results. **Galeti *et al.*** [9] reported that operative time was 39.67 min for pneumatic group vs. 48.24 min in laser group with p. value 0.05. They explain prolonged operative time for laser due to rapid flashes of light by light of laser that may impaired stone visualization and targeting. **Koju *et al*.** [14] showed prolonged operative time in pneumatic lithotripsy than laser lithotripsy [14.7 ± 4.77 min vs. 13.31 ± 3.24 with p value 0.014] and this result is better than our result as the stone size is > 1cm. **Trivedi *et al*.** [15] found the total operative time was 29.12±10.83 vs. 28.44±7.49 min for pneumatic vs laser lithotripsy [p value 0.719].

Our work revealed that we used DJ stent for all patient in pneumatic group and 17 patients in laser group and we insert ureteric catheter in 13 patients in laser group, there was statistically significant increase DJ fixation in pneumatic compared to laser [p <0.001]. **Mahmood *et al*.** [13] showed that there was statistically substantial variation between both groups as DJ app Stenting was higher in Pneumatic group, which agree with our study [62% for pneumatic group vs. 37.9 in laser group; p <0.005]. **Trivedi *et al*.** [15] put DJ stents in 88% and 94% of patients with pneumatic and laser lithotripsy [p. 0.217]. **Rashid *et al*.** [16] used DJ stent in 100% of patient with pneumatic lithotripsy and 85% for laser lithotripsy [p <0.005]. Also, our results were in accordance with **Denstedt *et al*.** [17] and **Foreman *et al*.** [18] who noted that as long as the treatment is straight-forward, regular stenting after ureteroscopic intracorporeal lithotripsy with the holmium laser is not necessary. **Koju *et al*.** [14] showed that in the PL group, DJ stenting was more in PL group [87.62%] but in laser lithotripsy it was 69.52%; p<0.001.

In our study upward stone migration was observed among 8 cases [26.6%] in Pneumatic group and 2 cases [6.7%] in laser group [p=0.029]. Stone migration was significantly high in stone ≥1cm. In LL group, there was two case of stone ≥1cm of upward migration. In PL group, there were 8 cases [2 cases in stone <1cm and 6 cases in stone ≥1cm] of stone migration. **Mahmood *et al*.** [13] showed that there was statistically substantial variation between both groups regarding migration of stone, which was 10% vs. 2%; greater in Pneumatic group which was similar to our results; they also suggested elevation of the table to prevent stone migration. **Bhandari *et al*.** [19] reported that 10% of the pneumatic group and 6% of the laser group had retrograde stone migrating. **Rashid *et al*.** [16] reported 14 cases [40%] of upward stone migration in pneumatic group vs. two cases [5.7%] in laser group [p <0.05]. **Koju *et al*.** [14] showed that; in situations when the stone was bigger than 12 mm, stone migration was seen. One case of stone migration [0.095%] in the laser lithotripsy group. There were 25 events of stone migration [23.81%] in the PL group [P=0.001]. **Chen *et al*.** [20] showed that in the pneumatic group, but not in the laser group, patients with upward stone migrating had considerably bigger and more burdensome stones than those without upward migrating. **Razaghi *et al*.** [21] reported stone migration is 14.03% [8/56] with pneumatic lithotripsy and 0% in laser lithotripsy. They explain frequent stone migration with pneumatic lithotripsy due to repeated impact of tip of the probe [12 cucle per second] to the stone to disintegrate it, so it may cause upward stone migration and they considerd stone migration as the main cause of failure of uretroscopic lithotripsy.

In contrast to our findings, **Manohar *et al*.** [22] found no discernible variation in stone migration rates between both groups. In which the author claims that even while using a pneumatic lithotripsy, surgical expertise and technological improvement decreased the incidence of stone migration.

Our study revealed the mean Fluid irrigated volume [saline] was 5.2± 1.14 L in pneumatic group and 4.45± 0.87 L in laser group with p value <0.001.

Our study revealed no statistically substantial variation between Laser or pneumatic among hospital stay. Hospital stay ranged from 1-2 days with mean value [1.06 ± 0.44] in pneumatic group and in laser group ranged 1-2 days with mean value [1.125 ± 0.59]; P value =0.389. **Koju *et al*.** [14] showed that there was no substantial variation in hospital stay which is similar to our results, they reported the hospital stay was 1.01±01 days in laser group and 1.08± 0.6 days for pneumatic group [p value <0.247]. **Trivedi *et al*.** [15] reported that the hospital stay was 2.01±0.44 days in pneumatic group and 1.8±0.5 days for laser group with no significant difference in hospital stay which is similar to our results [p value <0.78]. **Razaghi *et al*.** [21] reported no significant difference between pneumatic and laser group in hospital stay so it was 25.3±3.1 hours and 24.4±3.2 hours in pneumatic and laser lithotripsy [p=0.89].

Our study revealed higher incidence of immediate stone free rate in laser group than pneumatic group [93.3% vs. 70%] respectively [p=0.059]. There are 9 cases [29.9%] of residual stone in pneumatic group; 8 cases due to stone migration and one case due to procedure failure, contrary to only 2 cases [6.7%] in laser group due to stone migration [p=0.0385], the retained stone were treated by ESWL or reuretroscopy. **Trivedi *et al*.** [15] showed that there was no statistically significant in the immediate stone free rate between pneumatic group and in laser group; 100%in pneumatic group, and 98% in laser group with mean stone size 1 cm. These results is better than our result which may due to bigger stone size in our laser study. **Rashid *et al*.** [16] found the immediate stone free rate 94.2% for laser group and 60 % for pneumatic group with statistically significant difference [p <0.05] for upper ureteric stone 8-10 mm. **Koju *et al*.** [14] found the immediate stone free rate 99.05% for laser group and 76.99% for pneumatic group with statistically significant difference [p <0.001]. **Galeti *et al*.** [9] studied the immediate stone free rate between pneumatic group and laser group; in pneumatic group, it was 84% and in laser group 94% [p <0.05] which is comparable to our result. **Razaghi *et al*.** [21] reported immediate stone free rate of pneumatic group 85.7% and 100% for laser group for ureteric stone <1cm [p <0.001].

However, **Mahmood *et al*.** [13] reported that immediate Stone-free rates was 88% in patients treated with laser therapy and it was 62% in patients treated with pneumatic therapy. This outcome was statistically significant p=0.001.

For stone < 1cm, the stone free rate was 88.8% for pneumatic group and 100% for laser group [P value 0.067], operative time was 27.28 min for pneumatic group and 22.56 min for laser group with p value 0.034, upward stone migration was 11.7% for pneumatic group vs. zero for laser group with p value 0.197, secondary intervention was done either by ESWL or Ureteroscopy to 11.7% in pneumatic group vs. 0% in laser group with p value 0.197.

For stone ≥ 1cm, the stone free rate was 46.1% in pneumatic group and 88% in laser group [P. 0.017], operative time was 30.6 min for pneumatic group and 27.33 min for laser group with p 0.014, upward stone migration was 46.1% for pneumatic group vs 11.7% for laser group p 0.015, failed procedure in pneumatic [bleeding] and 0% in laser, secondary intervention was done either by ESWL or Ureteroscopy to 53.7% in pneumatic group vs 11.7% in laser group with p value 0.006.

No major complications were concluded in our study like ureteral perforation, avulsion, sepsis, urinoma or severe hematuria requiring treatment. Minor complications observed was mucosal injury in 3 cases [10%], failed procedure in one case [3.3] with stone retain and one case [3.3] of bleeding in pneumatic group, while bleeding in two cases [6.6] in laser group with no significant different in both groups [p value = 0.124].

Postoperative complication, hematuria occurred in 1case [3.3%] and fever in 1 case [3.3%] in pneumatic group and fever occurred in 2 cases [6.6%] in laser group with no statistical different in studied groups [p-value = 0.079], these complications were treated conservatively. **Trivedi *et al*.** [15] detected 6 cases [12%] of hematuria in both pneumatic and laser lithotripsy, fever in one case [2%] in both pneumatic and laser group and mucosal tear in one case with laser while 3 cases [6%] in pneumatic with no significant difference between laser or pneumatic [p= 0.279]. **Koju *et al*.** [14] found two cases of complication during laser group [1.9%] one case of fever and another one of mucosal tear while in pneumatic group 10 cases [9.52%], 5 cases with fever and another 5 cases with hematuria and with statistically significant difference between laser and pneumatic among complication p value<0.017. **Mahmood *et al*.** [13] detected mucosal injury in 2% in pneumatic vs 6% in laser, ureteral perforation in 4% of pneumatic & 0% in laser and postoperative fever in 8% in pneumatic vs 4% in laser. Total complication in pneumatic and laser was 8% & 32% P value 0.003. While hematuria was found more frequently in the pneumatic group patients [14%] in comparison to laser group patients [2%] P value= 0.022. **Razaghi *et al*.** [21] found complication like mucosal damage in two cases [3.6%], post-operative fever in one [1.8%] in laser group and mucosal damage one 1.8%], fever in 2 cases [3.6%] in pneumatic group.

The drawbacks of our study that conducted in limited number of cases, the trial design did not include stone density, and short follow-up period. So, we recommend conducting further studies on larger number of patients to give it higher power, and other studies evaluated the two methods as regard to stone density. Also, long term follow-up is recommended to judge the long-term complications of both methods as regard stricture ureter.

Conclusions: Laser and pneumatic litho-tripsy are safe and effective in the treatment of upper ureteric stone; however, laser lithotripsy has a better stone free rate, less operative time and less stone migration than pneumatic lithotripsy.

Conflict of interest: None to be declared.

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