



Investigating Frequency of Urinary Stones and Predicting Success Rate of Extracorporeal Lithotripsy Instruments in Public Hospitals in Western Iran

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ABSTRACT

Background: The present study was aimed to determine the frequency of urinary tract stones and estimate success rate of ESWL procedure in three general hospitals in Lorestan province, Iran.

Materials and Methods: In this cross-sectional study, a total of 336 patients referring to the three lithotripsy wards for lithotripsy were included. The lithotripters: PIZOLIT-3300WOLF, SLKMODULITH-STORZ, GENEMED-190 were used in Shafa, Tohid and Shohada Ashayer hospitals, respectively. The Chi-square test was applied to evaluate the univariate association between independent variables and outcome. $P < 0.05$ was considered to be statistically significant.

Results: The results showed that the highest success rate was observed by WOLF lithotripter in Shafa hospital with success rate of 72%. The perfect success rate for the ureter stones was 40%, and the relative success and failure rates were equal to 32% and 26%, respectively.

Conclusion: Although three lithotripters with different specifications were included in this study, there is no significant differences in perfect and relative success rate. In addition, the results showed that the most success rate was obtained in stones lesser than 10 mm sizes and bigger than 10 mm the rate of success will be reduced.

Keywords: Urinary Stones, Extracorporeal Lithotripsy, Lorestan, Iran

HOW TO CITE THIS ARTICLE: Haniyeh Mobarak Salari, Maryam Beyranvand, Mehrdad Gholami, Investigating Frequency of Urinary Stones and Predicting Success Rate of Extracorporeal Lithotripsy Instruments in Public Hospitals in Western Iran, Entomol Appl Sci Lett, 2018, 5 (1):47-50,

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Received: 16/11/2017

Accepted: 19/02/2018

INTRODUCTION

Formation of stones in the urinary system depends on various factors including social and economic factors, genetic factors, nutrition, drugs, as well as physiologic and anatomical abnormalities. There are some specific components within the body that begin to form crystals in case of going beyond their saturation state; subsequently, these crystals grow, attach to each other, and eventually form stones. The kidney stones are commonly composed of 70-80% calcium, 5-10% calcium phosphate, 30-45% calcium oxalate/phosphate, 20-30% calcium oxalate, 15-20% struvite (NH₄) MgPO₄ (H₂O), 5-10% urate and uric acid, and 1-3% cysteine stones. The stones may be formed in all parts of the urinary tract. There are various methods for treatment of the urinary stones,

including extracorporeal shock wave lithotripsy (ESWL) [1], percutaneous nephro-lithotomy (PCNL) [2], retrograde intra-renal surgery [3], open surgery, and laparoscopy. The ESWL is a non-invasive method for creating cracks in the stone and eventually crushing it into smaller pieces in order that the small stone pieces can be removed naturally. This method is widely used in patients with urinary stones [4]. Using this non-invasive method, the patient's stones are passed without any surgical intervention. ESWL is the main treatment for kidney stones smaller than 20 mm [5, 6]. The present study was aimed to determine the frequency of urinary tract stones and estimate the success rate of ESWL in Shohada Ashayer, Tohid, and Shafa hospitals in Lorestan province, Iran.

MATERIALS AND METHODS

Lithotripters

The lithotripters and their specification are shown in Table 1.

Lithotripsy method

A full description, urinary tract radiography examinations (abdomen radiography with intravenous injection of the contrast agent), and sonography are taken from the patients referring to the lithotripsy ward in order to specify the number, size, location, radio-opacity, and radio-lucence of the stone(s). Preparing the patient is necessary for lithotripsy procedure. Such preparing includes consumption of laxative drugs and patient's fasting at the day of lithotripsy. Once the patient refers for lithotripsy, the stone's location is determined via fluoroscopy. After adjusting and setting the device on the given stone, the pulses with low energy level and frequency (frequency of 1 and energy level of 25) are started; subsequently, the pulses with higher frequency and energy level (frequency of 2 and energy level of 45, 55, and 65) are applied and continued up to a maximum number of 4000 pulses. After the lithotripsy, the patient refers for re-visiting after two weeks. With regard to the KUB examination or sonography, the success rate is estimated after the first session up to the third session.

The success, relative and failure criteria

Complete removal of the stones from kidneys, ureter, and bladder is considered as a perfect success, while presence of the remaining stones smaller than 4 mm is regarded as a relative success. In case of stones bigger than 5 mm, lithotripsy is performed again up to two other sessions. If the stone is not broken up and crushed after three sessions, the case will be considered as failure. The inclusion criteria were the outpatients referring to the lithotripsy ward in the above-mentioned hospitals; on the other hand, the only exclusion criterion was the patient's non-cooperation for continuing the lithotripsy procedure.

Statistical analysis

The analytical and descriptive statistics were carried out using SPSS 24.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics were showed in terms of percent (for categorical) and mean (SD) (for continuous) variables. The Chi-square test was applied to evaluate the univariate association between independent variables and outcome. $P < 0.05$ was considered to be statistically significant.

RESULTS

A total of 336 patients referring to the lithotripsy wards in Shafa, Tohid, and Shohada Ashayer hospitals for lithotripsy were included in this study. Among the patients, 223 were male (66.4%) and 113 were female (33.6%).

Out of 468 stones in three hospitals, 233 (49.7%) were at the calyx location, so that 69 stones (14.7%) were in the upper calyx, 75 (16%) in the middle calyx, and 89 (19%) in the lower calyx. Furthermore, 67 stones (14.3%) were found in the renal pelvis, 38 (8.1%) in the ureter-pelvis junction, 50 (10.6%) in the upper ureter, 48 (10.2%) in the middle ureter, and 25 (34.5%) in the lower ureter; also, 7 stones (1.5%) were observed in the bladder (Table 2). The findings demonstrated that the highest average number of stones was observed in Shafa hospital (63.1%); while the highest average size of stones was reported in Tohid hospital (26.1%).

The perfect and relative success, and also failure rates based on the anatomical location was shown in Table 2. The perfect success rate for the ureter stones was 40%, and the relative success and failure rates were equal to 32% and 26%, respectively (Table 2). The success rate of ESWL method in the aforementioned hospitals is demonstrated in Table 3. The results showed that the highest success rate was obtained by WOLF lithotripter in Shafa hospital with success rate of 72%.

Table 1. The lithotripters and their specification

Hospital	Lithotripter	Wave generation Mechanism	Focal distance	Connection mechanism	Imaging Devices	
					Fluoroscopy	Sonography
Shafa	Pizolit-3300 Wolf	piezoelectric	0.5 mm	water-coupling	Medison	ALOKA 1000
Shahada	SLK Modulith-	electromagnetic	2.0 mm	water-coupling	GE-OEC	ALOKA

Ashayer	Storz				7700	1000
Tohid	Genomed-190	electrohydraulic	6.0 mm	water-coupling	TAMSON	SIUICTS-5000

Table 2. Number of stones and success rate based on anatomical locations

Anatomical location	NO. (%)	Perfect Success (%)	Relative success (%)	Failure (%)
Upper calyx	69 (14.7)	38.9	44.4	16.7
Middle calyx	75 (16)	30.2	37.7	32.1
Lower calyx	89 (19)	28.9	7.2	44.4
Renal pelvis	67 (14.3)	37.1	31.4	31.4
Ureter-pelvis	38 (8.1)	19	61.5	33.3
Upper ureter	50(10.7)	39	31.7	29.3
Middle ureter	48(10.2)	3.3	8.5	23.9
Lower ureter	25(5.3)	28.6	9.4	28.6
Bladder	7(1.5)	-	-	-
Whole of U-S	468(100)	40	32	26

Table 3. The success and failure rates in different hospitals

Hospitals	Success rate			Failure
	Perfect	Relative	Total	
Shohada Ashayer	55.35%	16.96%	71%	27.67%
Shafa	26.75%	49.1%	72%	23.21%
Tohid	28.57%	58.03%	70%	12.5%

DISCUSSION

Lithotripsy is considered as one of the most important therapeutic procedures which used to remedy the wide range of the kidney stones and stones in other organs. The ESWL method has been established in the early 1980s; which rapidly switched surgery as the treatment of option for larger kidney stones. ESWL is a safer and easier procedure to recover from than other aggressive procedures. Here we aimed to determine the frequency of urinary tract stones and estimate success rate of ESWL in some general hospitals from Lorestan province, Iran.

In order to compare the hospitals with each other, by adjusting the effect of number and size of the stones, it was found out that the hospitals affected the success rate of lithotripsy ($P < 0.001$). The success rate of ESWL method in Shahada Ashayer (Table 3) was observed equal to 71% (perfect success rate of 55% and relative success rate of 16%); while, the success rate of this method in Shafa and Tohid hospitals was obtained equal to 72% (perfect success rate of 23% and relative success rate of 49%) and 70% (perfect success rate of 12% and relative success rate of 58%), respectively. Although the highest success rate of ESWL procedure was observed by WOLF lithotripter in Shafa hospital; however, there is no significant difference in success rate among studied hospitals. As shown in Table 2, it can be said that the ESWL method

had the highest success rate for the upper ureter stones (39%) and upper calyx stones (38.9%); on the other hand, the highest failure rate was related to the lower calyx stones (44.4%). Maliheh Keshvari et al. (2010) obtained the probability of stone removal equal to 56% [7]; besides, in the study by Peschel, the probability of stone removal by ESWL method was obtained equal to 97% [8]. Furthermore, an ANOVA test was performed to compare the average stone sizes, which indicated a significant difference between the average stone sizes in different hospitals ($P = 0.08$).

The average stone size in Shafa, Shohada Ashayer, and Tohid hospitals was equal to 9.3, 11.9, and 12.2 mm, respectively. Regarding the fact that Shafa and Tohid hospitals had the lowest and highest average stone sizes, respectively, their success rate was justifiable.

Since determination of the stones' exact location was one of the effective factors affecting the success rate, and also the focal distance in the fluoroscopy device had direct effect on this rate, the obtained results were justifiable because the fluoroscopy device in Shohada Ashayer hospital had the shortest focal distance (0.2 mm) compared to the two other hospitals.

In the study conducted by Saedi et al. (2012), no relationship was observed between age and gender of the patient and success rate of ESWL;

while, there was a statistical relationship between the stone volume (size) and success rate of the ESWL method, so that the higher the stone size, the higher the success rate [9]. In the present study, the chi-square test showed that there was no significant relationship between the success rate and gender ($P=0.13$); besides, ANOVA test indicated no significant difference between the average age of the patients in the studied hospitals ($P=0.52$).

In the study conducted by Holander et al. (1993) using Siemens and Dornier instruments, the stone clearance rate in case of the stones bigger than 15 mm was nearly 70%; of course, this success rate was related to the pelvis and upper calyces since the stone clearance rate in middle and lower calyces was lower than that in similar stones in pelvis and upper calyx [10]. Chaussy et al. (1984) reported the success rate of 91% for stones smaller than 2 cm [11]. However, in the present study, the perfect success, relative success, and failure rates of the ESWL method for stone with size of 10 mm and smaller were equal to 47%, 39%, and 13%, respectively; while, for stones with size of 10 mm and bigger, the values were obtained equal to 36%, 31%, and 31%, respectively.

CONCLUSION

Although three lithotripters with different specifications were included in this study, but there are no significant differences in perfect and relative success rate. In addition, the results showed that the most success was obtained in stones lesser than 10 mm sizes and in bigger than 10 mm, the rate of success will be reduced.

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