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Stone-free Rate of Ultrasound-assisted and Fluoroscopy-guided Extracorporeal Shockwave Lithotripsy for Radiopaque Renal Stones

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ABSTRACT

Background: Extracorporeal shock wave lithotripsy (ESWL) has been a widely accepted method for treating urinary stones since the early 1980s. ESWL is the preferred non-invasive treatment for renal stones that are smaller than 1.5 cm. Ultrasound and fluoroscopy are used during ESWL operations to visualize the fragmentation. **Objective:** To determine the Stone-free rate of ultrasound-assisted and fluoroscopy-guided extracorporeal shockwave lithotripsy for radiopaque renal stones. **Methodology:** A prospective cohort study was conducted at the Sindh Institute of Urology and Transplantation from 25th February to 25th August 2022, including 75 participants per group with renal stones <1.5 cm, radio-opaque kidney stones, and consented patients. Both groups were treated using identical lithotripters with ultrasound and fluoroscopy for stone localization. Post-lithotripsy, X-ray or ultrasound assessed stone clearance. Frequency and percentages were calculated for variables like age, gender, and stone-free rates. Mean values and deviations were computed. The Chi-Square test analysed categorical variables. Paired sample statistical analysis evaluated differences in stone size and clearance, with p-values <0.05 deemed statistically significant. **Results:** Within group A, 53 patients (70.7%) exhibited no stones, whereas in group B, 45 patients (60%) were devoid of stones. These findings suggest that group A surpassed group B in terms of achieving stone-free statuses. **Conclusion:** Our research findings indicate that ultrasound-assisted extracorporeal shockwave lithotripsy achieved a stone-free rate of 70.7%, surpassing the stone-free rate of 60% achieved by fluoroscopy-guided extracorporeal shockwave lithotripsy for radiopaque renal stones.

INTRODUCTION

Renal calculi, typically referred to as kidney stones, are a major worldwide health issue, impacting millions of people. [1]. Extracorporeal Shockwave lithotripsy(ESWL) is a reliable and effective method for managing renal calculi [2]. ESWL does not require the use of general anesthesia and has a low complication. The success rate is contingent upon multiple factors, including the treatment protocol and the proficiency of the operator [3]. In order to attain the highest level of accuracy in directing the shock waves, it is crucial to carefully envision the stone. This is accomplished via ultrasound (ultrasonography) or fluoroscopy (x-ray) [4]. The non-invasive nature of ESWL has rapidly generated its appeal as a viable alternative to invasive procedures [5]. Nevertheless, ESWL resulting in transient haemorrhages, the secretion of cytokines, and other inflammatory cellular mediators [6]. The European association of urology and the American urological association both endorse ESWL as the preferred treatment for small to moderate renal stones. Nevertheless, the therapy has specific constraints that can indicate inadequate treatment effectiveness, such as a steep and narrow infundibulum, elongated lower pole calyx, and stones resistant to shockwaves [7,8]. In order to improve the efficiency of ESWL, it is possible to focus the energy of the shock waves more accurately on the specific stone being targeted throughout the procedure by employing ultrasonography and fluoroscopy as alternative techniques. The stone-free rate differs among the groups, with 42% in the fluoroscopy-guided group and 52% in the ultrasound-assisted group [9]. The study's main objective is to ascertain the efficacy (stone-free rate) of these methods in disintegrating kidney stones to a size that can be cleared by naturally expelled. Furthermore, the article may investigate variables that impact the success rate, such as the size of the stone in both groups. To my understanding, there is a lack of local literature that directly compares the success rate of radio opaque kidney stones between ultrasound-assisted and fluoroscopy-guided extracorporeal shockwave lithotripsy.

METHODOLOGY

A prospective cohort study was carried out at the Sindh Institute of Urology and Transplantation from 25th February to 25th August 2022. Based on the preceding calculation, it is estimated to have a sample size of 75 in each group, with a power of 80% and a significance level of 5% [10]. The sample size was calculated using the WHO calculator. The sample method employed was consecutive non-probability sampling. The inclusion criteria for the study were patients of both sexes, aged 15 years or older, who had renal stones smaller than 1.5 cm in size and radio-opaque kidney stones, and who provided consent to participate in the study. Patients with kidney stones necessitating surgical intervention, located at lower calyx, congenital abnormalities, and urinary diversion procedures were not included in the study. The study was started after getting approval from the hospital ethical committee. Informed consent from patients were taken. Participants were assigned to either the US group or the FS group by consecutive non probability technique at outpatient department. The data was collected utilising a Performa. An identical group of urologists and technologists conducted all shock wave lithotripsy procedures as outpatient treatments. The patient was instructed to recline. Both groups used Modulith SLX-F2 lithotripters and received 3000 shock waves in a single session. The researchers utilised ultrasonography (ALOKA PROSOUND STORZ SWITZERLAND) as a visualisation modality to follow the position of both the stone and the patient during the setup. The fluoroscopy group only employed fluoroscopy for stone placement, which was verified and modified every 400 shockwaves. Both groups were given identical moisturising gel. An analgesic was supplied during ESWL to alleviate pain. Two weeks after undergoing Extracorporeal Shock Wave Lithotripsy (ESWL), the patients underwent evaluation using either plain X-ray or ultrasound imaging of the kidneys. The data was entered and analysed using SPSS version 21. The frequency and percentage were determined for continuous variables such as age, gender and stone free rate. The stratification technique utilised the stone free rate to stone size in both groups. The Chi-Square test was used to compare groups based on the stone free rate. A paired sample statistical analysis was performed to evaluate stone size and stone-free status between two groups (Group A and Group B). Mean values, standard deviations, standard errors, and p-values were computed to evaluate differences. A P value below 0.05 was considered statistically significant. The results were presented in the form of tables.

RESULTS

The study had 150 patients divided into two groups: group B and group A, each receiving fluoroscopy assisted and ultrasound assisted procedures, respectively. Group A and B predominantly consist of individuals aged between 46 and 69 years. Likewise, the number of male participants exceeds that of female participants. (Table 1)

Table 1

Age Distribution/ Gender Distribution

Groups	Age		
	15 to 30 years	31 to 45 Years	46 to 69 years

A(Ultrasound)	21(28.0%)	17(22.7%)	37(49.3%)
B(Fluoroscopy)	18(24.0%)	25(33.3%)	32(42.7%)
Groups	**Gender**		
	Male	**Female**	
A(Ultrasound)	51(68.0%)	24(32.0%)	
B(Fluoroscopy)	49(65.3%)	26(34.7%)	

In group A, 53 patients (70.7%) were free of stones, while in group B, 45 patients (60%) were free of stones. This indicates that group A outperformed group B in terms of stone-free rates. (table 2)

Table 2

Stone Free After ESWL in Both Groups

Stone free Group B	Frequency (percent)
Yes	45(60%)
No	30(40%)
Stone free Group A	**Frequency (percent)**
Yes	53(70.7%)
No	22(29.3%)

Twenty-nine patients had no stones in group A, ranging in size from 0.5 to 1 cm, while twenty-four patients had stone free ranging in size from 1 to 1.5 cm. (table 3).

Table 3

Stone Free Patients in Group A with Reference to Stone Size

Stone free	Stone size		p-value
	0.5-1cm	1-1.5cm	
yes	29	24	.477
no	14	8	

Twenty-two patients had no stones in group B, ranging in size from 0.5 to 1 cm, while twenty-three patients had stone free ranging in size from 1 to 1.5 cm. (table 4)

Table 4

Stone Free Patients in Group B with Refrence to Stone Size

Stone size	Stone free		p-value
	yes	no	
0.5-1cm	22	13	.637
1cm to 1.5cm	23	17	

Table 5

Comparative Analysis of Stone Size and Stone-Free Outcomes Between Groups A and B

Pair Measures		Mean	N	Std. Deviation	Std. Error Mean	p-value
Pair 1	stone size (groupA)	1.43	75	.498	.057	0.172
	Stone size (groupB)	1.5333	75	.50225	.05799	
Pair 2	Stone free (groupA)	1.55	75	.501	.058	0.001
	Stone free (group B)	1.7600	75	.42996	.04965	

The paired samples analysis examines variations in stone size and stone-free status between two conditions. The mean stone size for Pair 1 increased somewhat from 1.43 (Group A) to 1.53 (Group B), although the change was not statistically significant (p = 0.172), indicating negligible influence on stone size. In Pair 2, the mean for stone-free status significantly increased from 1.55 (Group A) to 1.76 Group B), with a p-value of 0.001. This signifies a significant enhancement in attaining a stone-free state, underscoring the efficacy of interventions in stone removal, despite the stone size remaining comparatively stable. Table 5

DISCUSSION

It is well acknowledged in the scientific community that the selection of therapy for renal and ureteral stones should give priority to the location and size of the stones [11]. Recent research suggests that the efficacy of ESWL in treating kidney stones varies between 47% and 92%. The outcome suggests improved identification and precise aiming of stones with the aid of real-time ultrasonography, resulting in more effective breaking down of stones [12]. An investigation conducted by Hassan et al. (2020) assessed the results of (ESWL) when directed by either ultrasonography (US) or fluoroscopy (FS). The results indicated that the selection of imaging modality had no substantial impact on the overall clinical results in relation to SFR [13]. In contrast, our study revealed that ultrasound-guided endoscopic (ESWL) yielded superior outcomes compared to fluoroscopic guided ESWL. Another study predicts that Stone size and age are the most significant predictors of ESWL outcome [12]. In contrast to this study, the present study did not find any statistically significant differences in size between the two groups, because we did not include lower calyceal renal stone in our study. Similarly, Goren et al. [14] conducted a study to evaluate the outcomes and radiation exposure in pediatric patients with cystine stones. The researcher discovered that Ultrasound ESWL exhibited higher efficiency and involved reduced doses of ionizing radiation when used on pediatric patients. In addition, Ultrasound-guided SWL offers better visibility of cystine stones, which are slightly radiopaque, compared to a fluoroscope. Similarly, in this study, we found that ultrasound-assisted extracorporeal shockwave lithotripsy had a higher incidence of completely removing radiopaque kidney stones (70.7%) compared to fluoroscopy-guided extracorporeal shockwave lithotripsy (60%). The data indicate that group A achieved superior stone-free rates in comparison to group B probably because of real time monitoring with ultrasound during the treatment.

There were various limitations in the current study that require attention. The study's prospective design with a short follow-up period hampered the control of biases, such as stone composition and anatomic characteristics. Furthermore, there was no documentation of radiation exposure except than the self-reported choice of the technicians. Further investigation and a substantial sample size are required to validate the findings of this study.

CONCLUSION

Our research findings indicate that ultrasound-assisted extracorporeal shockwave lithotripsy yielded a stone-free rate of 70.7%, surpassing the 60% stone-free rate achieved by fluoroscopy-guided extracorporeal shockwave lithotripsy for radiopaque renal stones.

Patient's Consent

Informed consent was obtained by all the patients who have participated in the study beforehand. Consent was also obtained to use their data for research purposes.

REFERENCES

1. Stamatelou, K., & Goldfarb, D. S. (2023). Epidemiology of kidney stones. Healthcare, 11(3), 424. https://doi.org/10.3390/healthcare11030424
2. Yuan, S., Velmurugan, R., & Bharathi, S. P. (2024). Comparative analysis of renal calculi treatment via different extracorporeal shock wave lithotripsy (ESWL) pathways. International Urology and Nephrology, 56(9), 2887-2895. https://doi.org/10.1007/s11255-024-04025-5
3. Hegazy, A. S., Abdelfattah, D. M., & Hassan, H. N. (2020). Ultrasound guided extracorporeal shock wave lithotripsy (SONO ESWL) versus fluoroscopy guided ESWL in patients with radiopaque renal stones; A comparative randomized study. QJM: An International Journal of Medicine, 113(Supplement_1). https://doi.org/10.1093/qjmed/hcaa070.013
4. Yayik, A. M., Ahiskalioglu, A., Alici, H. A., Celik, E. C., Cesur, S., Ahiskalioglu, E. O., Demirdogen, S. O., Karaca, O., & Adanur, S. (2019). Less painful ESWL with ultrasound-guided quadratus lumborum block: A prospective randomized controlled study. Scandinavian Journal of Urology, 53(6), 411-416. https://doi.org/10.1080/21681805.2019.1658636
5. Dogan, S., & Ceylan, C. (2021). The effect of music on state anxiety in patients undergoing extracorporeal shockwave lithotripsy. International Journal of Clinical Practice, 75(8). https://doi.org/10.1111/ijcp.14293
6. Tawfick, A., Matboli, M., Shamloul, S., Agwa, S. H., Saad, M., Shaker, H., Selim, M. M., Salim, M. S., Radwan, A., Shorbagy, A. A., & Mousa, W. (2022). Predictive urinary RNA biomarkers of kidney injury after extracorporeal shock wave lithotripsy. World Journal of Urology, 40(6), 1561-1567. https://doi.org/10.1007/s00345-022-03996-3
7. Türk, C., Petřík, A., Sarica, K., Seitz, C., Skolarikos, A., Straub, M., & Knoll, T. (2016). EAU guidelines on interventional treatment for urolithiasis. European Urology, 69(3), 475-482.

https://doi.org/10.1016/j.eururo.2015.07.041

8. Pradère, B., Doizi, S., Proietti, S., Brachlow, J., & Traxer, O. (2018). Evaluation of guidelines for surgical management of urolithiasis. Journal of Urology, 199(5), 1267-1271. https://doi.org/10.1016/j.juro.2017.11.111

9. Hassanpour, N., Panahi, F., Naserpour, F., Karami, V., Fatahi, J., & Gholami, M. (2018). A study on radiation dose received by patients during extracorporeal shock wave lithotripsy. *Arch Iran Med*, *21*(12), 585-588. http://eprints.lums.ac.ir/id/eprint/1621

10. Van Besien, J., Uvin, P., Hermie, I., Tailly, T., & Merckx, L. (2017). Ultrasonography is not inferior to fluoroscopy to guide extracorporeal shock waves during treatment of renal and upper ureteric calculi: A randomized prospective study. *BioMed Research International*, *2017*, 1-7. https://doi.org/10.1155/2017/7802672

11. Oliveira, B., Teixeira, B., Magalhães, M., Vinagre, N., Cavadas, V., & Fraga, A. (2024). Extracorporeal shock wave lithotripsy: Retrospective study on possible predictors of treatment success and revisiting the role of non-contrast-enhanced computer tomography in kidney and ureteral stone disease. https://doi.org/10.21203/rs.3.rs-4124036/v1

12. Chang, T., Lin, W., Tsai, W., Chiang, P., Chen, M., Tseng, J., & Chiu, A. W. (2020). Comparison of ultrasound-assisted and pure fluoroscopy-guided extracorporeal shockwave lithotripsy for renal stones. *BMC Urology*, *20*(1). https://doi.org/10.1186/s12894-020-00756-6

13. Hegazy, A. S., Abdelfattah, D. M., & Hassan, H. N. (2020). Ultrasound guided extracorporeal shock wave lithotripsy (SONO ESWL) versus fluoroscopy guided ESWL in patients with radiopaque renal stones; A comparative randomized study. *QJM: An International Journal of Medicine*, *113*(Supplement_1). https://doi.org/10.1093/qjmed/hcaa070.013

14. Goren, M. R., Goren, V., & Ozer, C. (2016). Ultrasound-guided shockwave lithotripsy reduces radiation exposure and has better outcomes for pediatric cystine stones. *Urologia Internationalis*, *98*(4), 429-435. https://doi.org/10.1159/000446220