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Enhancing Stone Clearance: The role of Tamsulosin as an adjunct to Extracorporeal Shock Wave Lithotripsy.

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Abstract

Background: Urolithiasis affects 12% of the global population and is commonly treated with extracorporeal shock wave lithotripsy (ESWL) due to its efficacy, noninvasiveness, and low morbidity. Factors influencing renal stone clearance include ureteral dynamics, fragmentation efficiency, and calyceal anatomy. The use of alpha-blockers post-ESWL is hypothesized to improve stone clearance rates.

Methodology: A prospective cohort study was conducted at Sindh Institute of Urology and Transplantation (SIUT) from June 6, 2018, to December 5, 2018. The study enrolled 120 individuals aged 18–70 years diagnosed with renal stone disease, with stone sizes ranging from 0.5 to 2.0 cm. Patients were randomly assigned to receive either placebo or tamsulosin immediately following ESWL, in addition to standard therapy. Stone clearance rates were assessed over a two-week follow-up period.

Results: Among the study participants, renal stones were present in 61 (50.83%) patients on the left side and 59 (49.17%) on the right side. Stone clearance rates were significantly higher in the study group (96.6%) compared to the control group (85.0%) (p=0.027).

Conclusion: Administration of alpha-blockers, specifically tamsulosin, following ESWL appears effective in enhancing the expulsion rate of renal stones.

Keywords

Renal Stone Disease, Extracorporeal Shock Wave Lithotripsy, Alpha Blockers, Stone Clearance.

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Introduction

Urolithiasis, affecting approximately 12% of the global population, poses significant challenges in its management and treatment[1]. ESWL has revolutionized the approach to urolithiasis treatment due to its non-invasiveness, efficacy, and minimal side effects[2]. However, the effectiveness of ESWL diminishes as stone size increases, necessitating adjunctive therapies to enhance stone clearance rates[3].

Factors influencing the clearance of renal stones include ureteral dynamics, fragmentation efficiency, and calyceal anatomy[4]. Post-ESWL, ureteral variables like edema and spasm, along with fragment size, critically impact stone passage and patient discomfort. Alpha 1-adrenergic receptors (ARs), particularly the a1A and a1D subtypes found in the human ureter, play a crucial role in modulating ureteral tone and peristalsis[5]. Drugs such as alpha 1-adrenergic antagonists, like tamsulosin, have been investigated to improve stone expulsion rates through their ability to reduce ureteral spasm and enhance fluid dynamics[6].

Tamsulosin, widely used for benign prostatic hyperplasia, has shown promise in promoting stone clearance post-ESWL[7]. Meta-analyses and clinical trials have demonstrated higher stone clearance rates in patients receiving tamsulosin compared to controls, attributed to its effect in reducing intraureteral pressure and enhancing urine transport around the stone[8].

Previous research predominantly focused on tamsulosin's efficacy in ureteric stones, using comparative drugs rather than placebo, limiting broader applicability[9,10]. Given the scarcity of data on alpha blockers in renal calculi post-ESWL, this study aims to evaluate the efficacy of tamsulosin as a monotherapy in enhancing stone clearance rates. Understanding its impact could potentially influence clinical practice by recommending tamsulosin post-lithotripsy if significantly improved stone clearance rates are observed compared to placebo.

The present study seeks to fill gaps in current knowledge regarding adjunctive therapies for renal calculi management post-ESWL, providing valuable insights that may guide treatment protocols and improve outcomes for patients with nephrolithiasis.

Methodology

Study Design

This prospective cohort study was conducted at the urology department of the Sindh Institute of Urology and Transplantation between June 6, and December 5, 2018. The study employed a non-probability consecutive sampling technique to enroll participants.

Setting

The study was conducted at the urology department of the Sindh Institute of Urology and Transplantation, Karachi, Pakistan.

Participants

Participants included individuals of both genders, aged between 18 to 70 years, who provided informed consent. They were diagnosed with renal stones ranging in size from 0.5 to 2.0 cm, confirmed by ultrasound or CT KUB (Kidney, Ureter, Bladder). Exclusion criteria consisted of patients with congenital urogenital anomalies identified on CT KUB and those with pre-procedural renal dysfunction (serum creatinine >1.2 mg/dl).

Variables

In this study, the independent variable investigated was the administration of Tamsulosin post-lithotripsy. Tamsulosin, an alpha blocker, was administered to one group of participants immediately following ESWL (study group), while the control group received standard therapy consisting of placebo medication along with oral diclofenac for pain management. The dependent variables assessed were immediate post-procedural pain intensity and stone clearance rate after two weeks, determined according to predefined criteria. Control variables included age, gender, pre-operative serum creatinine level, size and duration of stone disease, and the side of the kidney affected. These variables were considered

to control for potential confounding factors that might influence the outcomes of interest, ensuring a more rigorous analysis of the effects of Tamsulosin on pain relief and stone clearance in patients with renal stones.

Data Sources/Measurement

Data collection utilized a specialized proforma to record variables such as age, gender, side of kidney, stone characteristics, and outcomes like stone clearance (yes/no). Numeric variables (e.g., age, size of stone) were presented as mean ± standard deviation, while categorical variables (e.g., gender, stone clearance) were reported as frequencies and percentages.

Bias

To minimize selection bias, random assignment of participants into two study groups was achieved using the envelope method (SNOSE protocol). Blinding was implemented in the placebo administration to ensure unbiased reporting of outcomes.

Study Size

A total of 120 patients (60 in each group) were included to achieve a statistical power of 80%, assuming a dropout rate, as determined by a web-based sample size calculator for two proportions with specified confidence intervals.

Quantitative Variables

Numerical variables such as age, serum creatinine levels, size of stones, and duration of stone disease were analyzed using descriptive statistics and compared between groups as appropriate.

Statistical Methods

Data analysis was performed using SPSS version 21.0. The Chi-square test was utilized to compare qualitative variables like stone clearance rates between the study groups. Stratification was applied to control for potential effect modifiers such as age, gender, serum creatinine levels, stone size, duration of stone disease, and kidney side. A significance level of $P \leq 0.05$ was used to determine statistical significance.

Results

Participants

The study included a total of 120 patients, with a mean age of 46.72 ± 12.71 years. The cohort predominantly comprised males (65.83%) compared to females (34.17%). The mean serum creatinine level was 0.90 ± 0.16 mg/dl, and the mean size of renal stones was 1.55 ± 0.68 cm. The average duration of stone disease among participants was 3.63 ± 1.90 months. Stones were most commonly located in the renal pelvis (55.83%), followed by the lower calyx (23.33%), middle calyx (17.50%), and upper calyx (3.33%).

Descriptive Data

Table 1 summarizes the baseline characteristics of the study population, including age, serum creatinine levels, size of stones, duration of stone disease, gender distribution, location of stones, and affected kidney side.

Outcome Data

The primary outcomes assessed were immediate post-procedural pain and stone clearance rate after two weeks. Immediate post-procedural pain management was standardized across both study groups with diclofenac as required. Stone clearance was achieved in 109 patients (90.83%), with 58 patients (96.6%) in the study group (Tamsulosin administration) and 51 patients (85.0%) in the control group (standard therapy). This difference was statistically significant ($p = 0.027$), indicating a higher stone clearance rate in the study group compared to the control group.

Main Results

Table 2 presents the comparison of stone clearance rates between the study and control groups. Stratification by age showed no significant difference in stone clearance rates among patients aged 18-49 years ($p=0.168$). However, patients aged 50-70 years showed a trend towards higher stone clearance in the study group ($p=0.053$). Gender stratification revealed a significantly higher stone clearance rate among males who received Tamsulosin ($p=0.030$), whereas no significant difference was observed among females ($p=0.360$).

Further stratification by the size of stones (0.5-1.0 cm, 1.0-1.5 cm, and 1.5-2.0 cm) indicated no significant differences in stone clearance rates between the study and control groups (p>0.05). However, stratification based on the duration of stone disease (≤3 months vs. >3 months) showed a significant difference in stone clearance rates among patients with ≤3 months of disease duration (p=0.048), favoring the study group.

Table 1: Baseline characteristics (N=120).

Variables		N(%)
Age (years); Mean±SD		46.72±12.71
Creatinine (md/dl); Mean±SD		0.9±0.16
Size of stone (cm); Mean±SD		2.55±0.68
Duration of disease (months); Mean±SD		3.63±1.90
Gender	Male	79(65.83)
	Female	41(34.17)
Location of Stone	Upper Calyx	4(3.33)
	Middle Calyx	21(17.50)
	Lower Calyx	28(23.33)
	Pelvis	67(55.83)
Side Involved	Right	59(49.17)
	Left	61(50.83)

Table 2: Comparison of stone clearance between the groups.

Stone Clearance	Total N(%)	Group Name N(%)		P-value
		Study Group (n=60)	Control Group (n=60)	
Yes	109(90.83)	58(96.6)	51(85.0)	0.027*
No	11(9.17)	02(03.4)	09(15.0)	

Study group - Administered Tamsulosin; Control group - Received standard therapy consisting of placebo medication along with oral diclofenac for pain management.
*p<0.05 is considered significant

Table 3: Comparison of stone clearance rates between study and control groups by demographic and clinical variables.

Variables		Stone Clearance	Group Name N(%)		P-value
			Study Group (n=60)	Control Group (n=60)	
Age Group	18-49 years	Yes	32(53.33)	25(41.67)	0.168
		No	2(3.33)	5(8.33)	
	50-70 years	Yes	26(43.33)	26(43.33)	0.053*
		No	-	4(6.67)	
Gender	Male	Yes	40(66.67)	32(53.33)	0.030*
		No	1(1.67)	6(10.00)	
	Female	Yes	18(30.00)	19(31.67)	0.360
		No	1(1.67)	3(5.00)	

Size of Stone	0.5-1.0 cm	Yes	6(10.00)	6(10.00)	0.335
		No	-	1(1.67)	
	1.0-1.5 cm	Yes	12(20.00)	11(18.33)	0.191
		No	1(1.67)	4(6.67)	
	1.5-2.0 cm	Yes	40(66.67)	34(56.67)	0.140
		No	1(1.67)	4(6.67)	
Duration of Stone Disease	≤3 months	Yes	33(55.00)	23(38.33)	0.048*
		No	1(1.67)	5(8.33)	
	>3 months	Yes	25(41.67)	28(46.67)	0.243
		No	1(1.67)	4(6.67)	

Study group - Administered Tamsulosin; Control group - Received standard therapy consisting of placebo medication along with oral diclofenac for pain management.
*p<0.05 is considered significant

Discussion

The mean age of our study participants was 46.72 ± 12.71 years, with a majority of 79 (65.83%) male patients and 41 (34.17%) female patients. The mean stone size was 1.55 ± 0.68 cm, ranging from 0.5 to 2 cm, reflecting the typical demographic and clinical characteristics observed in similar studies[11,12]. Our findings show a significant difference in stone clearance rates between the study (Tamsulosin) and control groups (standard therapy alone), with 96.6% and 85.0% clearance rates, respectively (p = 0.027). This contrasts with earlier research where expulsion rates post-ESWL did not differ significantly between groups[13-15].

Comparing our results to recent trials examining adjunctive α-blocker therapy, we found consistent trends towards improved stone clearance rates with Tamsulosin use post-ESWL. For instance, a meta-analysis of four trials involving 513 patients demonstrated a significantly higher stone-free rate at four weeks with α-blockers compared to placebo (OR 3.75; 95% CI 2.20-6.39; p < 0.00001)[16]. These findings corroborate our study's conclusion regarding the efficacy of Tamsulosin in enhancing stone expulsion post-ESWL.

The success of ESWL in treating renal calculi, particularly those larger than 2 cm, underscores its non-invasive nature, high success rates, and minimal complications compared to more invasive methods. Factors contributing to better outcomes include optimal shock wave parameters, use of α-blockers, and patient-specific characteristics such as stone size and location[17-19].

Despite the promising results, our study is limited by its single-center design and relatively small sample size. Future research should involve larger-scale, multicenter trials with extended follow-up periods to validate these findings and refine clinical recommendations. Further investigation is warranted to explore the broader implications and long-term benefits of adjunctive α-blocker therapy in conjunction with ESWL.

Conclusion

In conclusion, adjunctive treatment with α-blockers, specifically Tamsulosin, following ESWL appears effective in improving the expulsion rate of renal stones. However, the adoption of Tamsulosin as a standard adjunctive therapy alongside ESWL requires validation through larger confirmatory trials. This approach holds promise for optimizing treatment outcomes and reducing the need for more invasive interventions in managing renal calculi.

Conflicts of Interest

The author(s) declare no conflicts of interest.

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