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EFFICACY AND SAFETY OF EXTRACORPOREAL SHOCK WAVE LITHOTRIPSY IN PEADIATRIC UROLITHIASIS – A SINGLE CENTRE EXPERIENCE

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ABSTRACT

Background: Urolithiasis affects 2-3% of children. We present our experience with extracorporeal Shockwave Lithotripsy (ESWL) as primary therapy in pediatric urolithiasis (PU).
Objective: To assess the outcome of ESWL in PU
Material and methods: During 2009-2016, 58 patients below 18 years were treated with ESWL. Stone localization and size assessment were done by appropriate investigations. Stones in renal and upper ureter were subjected to ESWL. Success was defined as stone-free status or the presence of clinically insignificant residual fragments (CIRF) at the end of 3 months.
Results: The mean age was 11.25± 3.81 (3-17) yrs. The mean stone size was 10.88 (5-40) mm. After ESWL, at 3 months 45(77.58%) patients had no residual stones and 8 patients with CIRF contributing to overall stone-free rate (SFR) of 53(91.5%) patients. Stone <10mm, <1000 HU and upper ureter stones had complete clearance and stones under anesthesia required lesser sessions.
Conclusion: ESWL as primary treatment in PU in stones less than 10mm, <1000HU and located in upper ureter favorably offers good SFR.

KEYWORDS Pediatric urolithiasis, ESWL, stone-free rate.

INTRODUCTION:

Urolithiasis in childhood has frequency of 0.1% to 5% of the child population among various geographic regions [1]. Currently pediatric urolithiasis (PU) has taken increasing attention due to increase in the morbidity and high recurrence rate. ESWL procedure has become more commonly available and has been considered as primary treatment for the non invasive management of PU [2,3]. First report of successful ESWL in children was published by Newman et al [4] in 1986. Thereafter, many reports showed the safety as well as the success of ESWL; however its role in the management of PU has not been fully established. Hence we have conducted a study to assess the efficacy of ESWL as a primary treatment modality for pediatric urolithiasis.

OBJECTIVE:

To assess the outcome of ESWL in pediatric urolithiasis patients

MATERIAL AND METHODS:

It is a retrospective study done in department of Urology in the Institute of Nephro-Urology, Bangalore. Children below 18 years with urolithiasis who were treated with ESWL were included in study, prior to ESWL all children were evaluated with detailed medical history, physical examination and relevant investigations. For stone localization and size assessment, renal ultrasonography, plain X ray or Computed tomography scan were performed.

Eleven patients underwent DJ stenting prior to ESWL, where seven patients were referred from other hospital for ESWL with DJ stenting and 4 patients underwent stenting in our hospital due to infection and acute pain in flank. Patients were managed with antibiotic and analgesic and then subjected to ESWL.

ESWL was performed with patient in supine position for renal and upper ureteric stones and subjected to therapeutic power of 10-12 KV with up to 2000 shocks per session, at 60 shocks/minute using Dornier MEDTEC Delta II lithotripter under real time USG or Fluoroscopy. General anesthesia was required for 18 patients who were 12yrs and less and remaining 40 were subjected to ESWL without anesthesia. The patients were assessed 7 to 10 days after each session with ultrasonography / X ray KUB to assess stone fragmentation and clearance. If further sessions were needed, one such session was held 7 to 10 days later. ESWL success was defined as stone-free status or the presence of CIRF at the end of 3 months.

Plan of analysis / statistical tools

The data was analyzed using SPSS Software. Descriptive statistics like frequencies, percentages and chi-square were calculated. P value < 0.05 was considered as significant.

RESULTS:

Total number of patients was 58 in this study. Demographic data are illustrated in table –1

Table 1: Demographic data;

Variables	Description
Gender	Male: Female = 35:23
Age	Mean: 11.25± 3.81 (Range:3 –17) Yrs
Laterality	Right-35 , Left-23
Stone radiological type	Radio-opaque: 51, Radio-lucent: 07

18 children underwent ESWL under anesthesia and 40 children without anesthesia. Among children who underwent ESWL under anesthesia, correlation between locations of stone with success of ESWL has been illustrated in table-2

Table 2 - Correlation of stone location with ESWL under anesthesia.

SITE	1 SESSION	2 SESSION	3 SESSION	TOTAL
URETER	2	0	0	2
PELVIS	2	2	2	6
LOWER POLE	1	2	0	3
MIDDLE POLE	2	1	0	3
UPPER POLE	2	1	1	4
TOTAL	09	06	03	18

Chi square value: 5.9

Mean session was 1.63 ± 0.510 and p value-0.65 which was not statistically significant however lesser number of children required 3rd session. Remaining 40 patients above 12 yrs were subjected to ESWL without anesthesia and correlation of location of stone with number of ESWL session is illustrated in table 3

Table -3: Correlation of stone location with ESWL without anesthesia.

LOCATION	1 SESSION	2 SESSION	3 SESSION	TOTAL
URETER	5	4	1	10
PELVIS	2	4	3	9
UPPER POLE	2	1	4	7
MID POLE	3	5	1	9
LOWER POLE	1	2	2	5
Total	13	16	11	40

Chi square value: 7.88

Here out of ten children with uretric stones maximum stone was fragmented with single and 2nd session and only 1 child required 3rd session and in renal calculi maximum required 2nd or 3rd session with mean session 2.61± 1.39 and p value -0.44 which is not statistically significant.

Table 4: Comparing Hounsfield units and stone size with ESWL +/- anesthesia

Variables	Anesthesia			Without anesthesia			P value
	1st session	2n dsession	3rd session	1st session	2nd session	3rd session	
Stone size <10mm	8	2	0	12	9	5	0.14
Stone size >10mm	1	4	3	2	7	5	0.99
STONE DENSITY<1000 HU	9	5	0	13	16	05	0.14
STONE DENSITY>1000 HU	0	1	3	1	1	4	0.33

Here in above table when we compare both the groups, number of sessions required under anesthesia group was lesser than compared to without anesthesia with P value -0.016 which is statistically significant and other variables where lesser number of session required for stone size <10mm and HU <1000 however statistically it is not significant

Table 5: Correlation of number of shockwaves, session of ESWL and duration of ESWL with and without anesthesia:

Character	With Anesthesia	Without Anesthesia	P value
Shock waves	2550± 146.67	3800± 161.56	0.03
Session	1.63± 0.50	2.61± 1.39	0.02
Duration of ESW(min)	61.38± 2.9	82.12± 3.6	0.04

Here comparing these variables shockwaves, number of session and duration of ESWL was lesser in anesthesia group compared without anesthesia and was statistically significant.

Follow up:

Table 6: Status of stone after 3 months among study subjects

Status of stone	Frequency	Percent
Cleared	45	77.6
CIRF <4mm	8	13.7
not cleared	5	08.7
Total	58	100.0

In our study we found that 45(77.6%) children had no residual stone after 3 months and 8 children had CIRF (<4mm) and overall stone free rates 91.5%. In 5 children fragmented stones were not cleared and required additional procedure.

In our study only 11(18.91%) children developed complication and 47 children did not have any complication. Among these, 4 patients had mild /transient hematuria and 6 patients had pain which were managed conservatively. One patient developed Steinstrasse and underwent URSL during follow up. Regarding additional procedure, 53 did not required any procedure and 1 child required PCNL where ESWL failed to fragment stone after 2 sessions and stone size, Hounsfield were 16mm and 1300 HU respectively. Four children required URSL as in 3 children's, stone migrated to mid ureter and caused flank pain and hydronephrosis and in other URSL was done for Steinstrasse. DJ stent was removed after 6 weeks.

DISCUSSION:

First report of ESWL efficacy and safety was given by Chaussy et al in early 1980s,[5] whereas first report of successful ESWL in PU was published in 1986 . The treatment options for urolithiasis in PU are same as those in the adult population, they can be managed with invasive or noninvasive or a combination of treatment modalities. Now ESWL has become the treatment of choice for most renal stones in adults and children. According to the literature 30 to 100 % of children required general anesthesia for ESWL. In our study those less than 12 yrs(31%) required general anesthesia which is similar to **Joon Yeop Jee etal** [6] where less than 7 yrs required general anesthesia and even in Muslumanoglu AY, et al [7] study, children less than 13 yrs required general anesthesia for ESWL .

Stone size has been considered the most important predictor of ESWL success in the PU [8, 9, and 10]. While many studies have showed improved outcomes in stones <10mm compared with larger stones [11, 12, and 13] .Other authors like **Ather et al**. found that bigger stones are associ¬ated with poorer results, requiring more additional procedures, and have a higher complication rate [15]. In our study stone size ranged from 6 to 16 mm (less than 20mm) with mean stone size 10.33mm. Stones with less than 10mm required lesser session and lesser number of shock waves compared to stone size more than 10 mm which was statistically significant.

CT attenuation value has been considered to be an independent predictor of stone-free rates after ESWL therapy. Better stone-free rates are seen for stones with lower attenuation values, with 1,000 HU being suggested as a significant cutoff. For stones that are having >1000 HU, poor success rate has been documented. **Perks AE, et al**[14] **and El-Assmy et al**[15] used the Hounsfield value of the stones and selected HU 1000 as their cut off value. In our study those children with lesser <1000 HU required lesser session and number of shockwaves compared to those with >1000 HU which was statistically significant In our study, the overall success rate of ESWL was 91.5%%.. The **S.N. Wadhwa etal**[16] study showed overall success rate of 83.3%. In **U Seok Jeong et al** [17] study, the overall success rate was 90.7%.

Ureteric stones represent 20 to 30% of stones in children at the initial presentation, but only few series of pediatric ESWL reported the management of ureteric stones. In our series, the incidence of ureteric stones was 20.9% and all 100% were successfully fragmented with lesser number of sessions and lesser number of shock waves. This result is comparable to that reported by Myers et al. [18], who had a stone-free rate of 91%. In N. PIRINCCI1 et al [19] study showed 93.3% of stone clearance for upper ureteric stones by ESWL.

The number of complications reported in the recent literature is small and are usually mild. The more common complications were hematuria, and urinary infection with or without fever. Hematuria is temporary and does not required treatment, while, urinary infection required only appropriate antibiotic treatment in majority of the cases [20] Steinstrasse and ureteral obstruction caused by

stone fragments occurs rarely.

ESWL success was defined as stone-free status or the presence of clinically insignificant residual fragments (CIRF), fragments which are asymptomatic, non infected, and non obstructive fragments smaller than 4 mm at 3 months of follow-up. Fragments < 4 mm are expected to pass spontaneously without further treatment. ESWL failure was defined as the non reduction of the stone size or persistence of stone fragments at 3 months of follow-up . In our study at 3 months, 45 patients had no residual stones and 8 patients with clinically insignificant residual fragments (<4 mm) contributing to overall stone-free rate (SFR) of 53(91.37%) and 5 patients required additional procedure like one child required PCNL and other 4 required URSL as explained earlier.

CONCLUSION: ESWL as primary treatment in PU in stones less than 10mm, <1000HU stones and located in upper ureter favorably offers good SFR. It can be increased by performing under anesthesia and careful patient selection with minimal postoperative complications.
Conflict of interest: None

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