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Treatment of Paediatric Urolithiasis by Extracorporeal Shock Waves Lithotripsy

Yasin Idweini Saed PhD,MD.FEBU

Chairman of Urology-Al Bashir Teaching Hospital, Amman Jordan

Abstract:

Purpose: *We present our experience with the treatment of paediatric urolithiasis by extracorporeal Shock Waves Lithotripsy (ESWL) during a 2.5- year period. In this study, the impact of this technology in the management of paediatric urolithiasis was evaluated.*

Material and methods*: We retrospectively reviewed the records of 40 patients under the age of 16 years in whom urolithiasis was treated using Modulith SLX lithotripter. Age, stone, location and changing patterns of treatment with time were reviewed.*

Results*: Forty paediatric patients underwent 67 sessions of ESWL therapy. The mean age was 7 years (2-16years). Male to female ratio was 21:19. All patients were treated as outpatients by ESWL with sedoanalgesia in 36 cases and 4 cases with intravenous -Pro-Dafalgan (paracetamol) and diclofenac suppository. All patients received between 2500-4000 shocks per session from electromagnetic generator Storz Modulith, SLX lithotripter employing dual imaging. A primary double J ureteral stent was placed in those patients with large burden kidney stones. There were 30 cases of renal stones,2 ureteral stones and 8 bladder stones. An overall success rate in 36 cases (90%) was achieved. Open surgery was performed in 4 cases in which ESWL failed.*

Conclusions*: After using ESWL in urology practice and the development of endourologic devices, fewer patients required open surgery in paediatric urolithiasis*

Keywords: *extracorporeal, shock wave, lithotripsy, children, urolithiasis.*

1. INTRODUCTION

Nephrolithiasis occurs following a complex interaction of environment and heredity. It was noticed that Urinary crystals coalesce and precipitate occur when physical and biochemical conditions disturb a delicate balance of stone-promoting and- inhibiting factors. Unnoticed small urinary stone may pass or appear as sand like sediment in urine. Larger calculi may cause pain or obstruct urinary flow. Since the first patient was treated successfully for kidney stone with ESWL by Chaussy et al in 1980, rapid acceptance and widespread use have made this form of stone therapy the treatment of choice for more than 80 percent of all renal calculi. Worldwide clinical series have documented the efficacy of ESWL for renal and ureteral calculi (1,2,3,4).

ESWL can be performed safely in children as long as certain precautions are taken into account, to ensure a precise focus to protect the lungs. Various studies showed normal renal growth one year after the treatment of some children who underwent lithotripsy (5).

In this study we present our experience in treating paediatric urolithiasis and evaluate the impact of ESWL treatment in our patients.

2. MATERIAL AND METHODS

Forty patients, who underwent 67 sessions of ESWL with Storz Modulith SLK lithotripter, over a 2.5-year period, between May 2003 to November 2005, were examined retrospectively. All patients received 2500-4000 shocks per session from an electromagnetic generator employing dual imaging. Preliminary IVU were used to determine stone position, size, and calyceal anatomy. Male to female ratio was 21:19. Age range:(2-16 years) mean (7 years).

All cases were evaluated via conducting urine analysis, urine culture, coagulation profile, serum createnine level, metabolic study, plain radiography of the urinary tract, intravenous urography and/ or ultrasonography, before ESWL application. There were 30 cases of renal stones,2 ureteral stones and 8 bladder stones. The average stone burden was 19 mm(5-60mm). There were 4 cases of radiolucent stones (one renal and three bladder stones)

3. RESULTS

All patients were treated as outpatients with ESWL using intravenous analgesia or sedation using pharmacologic agents such as midazolam (Dormicum) and ketamine (katalar) in 35 cases, because the age was less than 7 years, and in 5 cases the patients were older, treatment included intravenous prodafalgan and diclofenac suppository. A total of 67 sessions of ESWL were performed, each session was between 2500-4000 shock waves. Thirty cases of renal stones, 2 cases of

ureteral stones and 8 cases of bladder stones underwent ESWL therapy. A primary double J ureteral stent was placed in those patients with large burden kidney stones(7patients) in addition to alkaline citrate therapy to prevent stent encrustation and as a medical alkaline therapy for radiolucent stones of uric acid origin. An overall success rate of 90% was achieved in the whole group. With complete stone clearance after3 months follow- ups Fig.(1-6).

Fig. 1. *KUB: TwoStones Lt kidney* **Fig.2.** *IVU:Hydronephrosis Lt kidney*

Fig.3 *KUB: After ESWL stones cleared* **Fig.4** *IVU: Post ESWL Normal Urogram*

Fig.5 *KUB: Big Bladder Stone* **Fig.6** *KUB: After ESWL stone fragmented*

ESWL failed in 4 patients, thus the latest were treated by open surgery (pyelolithotomy, cystolithotomy of multiple bladder stones, and pyeloplasty (Andersen Hynes with insertion JJ stent) with extraction of two secondary calyceal stones due to congenital pelvi-ureteric junction(PUJ)obstruction).

The changing patterns of treatment are shown in Table 1.Two complications were seen, one of them was impacted stones causing acute retention of urine, after ESWL therapy, and was resolved by catheterization and secondary ESWL of fragmented stone, the other complication was stein Strasse which was resolved by pre- inserted double J and ESWL lithotripsy of fragmented stones, in addition to alkaline citrate therapy to dissolve stones and inhibit stone formation and stent encrustation Fig. (13).

Table 1

Treatment modality		N	%
Open surgery (in those cases of failed ESWL therapy and those associated with PUJ obstruction)	**Pyelolithotomy**	**1**	**2.5%**
	Cystolithotomy	**2**	**5.0%**
	Pyeloplasty and extraction of two stones	**1**	**2.5%**
Endourological Procedure	**Successful E.S.W.L.**	**36**	**90%**
Total		**40**	**100%**

4. DISCUSSION

Recent decades witness an increase in the incidence and prevalence of paediatric urolithiasis which is related to considerable morbidity and high recurrence rates. The reason for such increase is not fully understood, but it has been associated with changes in the climate, diet, genetic inheritance and other environmental factors (7).The goal of surgical stone management is to achieve maximum stone clearance with minimal morbidity from the patient side. The current challenge that facing the urologist in terms of treating patients with upper urinary tract stones is represented by choosing the optimal treatment modality as to the patient and stone characteristics. The majority (about 80% to 85%) of simple renal calculi can be treated satisfactorily with ESWL (8). Several factors that are associated with poor results of ESWL, including large renal calculi(mean22.2mm) stones within dependent or an obstructed portion of the collecting system, and stone composition (mostly calcium oxalate monohydrate and brucite) (9,10). Because the ureter in the child is very distensible, allowing passage of relatively large stone fragments, and the anatomic conditions of the infant body such as the smaller size, as well as the increased peristalsis and

flexibility of the ureter of the child favour ESWL, as the main and standard treatment modality. ESWL is the first line treatment for most renal calculi in children (11). Additionally, because of the small size of the urinary tract in young children, some forms of intervention that are routinely used in adults, such as ureteroscopy and percutaneous procedures must be used more judiciously(12).

There is no strict upper limit of stone burden that can be managed with ESWL in children as carried out in adults; although the larger the burden the less likely it is that success will be achieved with one procedure (13).

Anatomic factors, congenital or acquired, that hinder stone clearance adversely affects the results of ESWL. Congenital anomalies occur, commonly, in the upper urinary tract and virtually any condition affecting drainage to the kidney is associated with an increased rate of stone formation.

Congenital anomalies associated with a higher risk of kidney calculi include ureteropelvic junction obstruction (14), horseshoe kidneys (15) and other ectopic or fusion anomalies as well as calyceal diverticula (16,17).

The dependant nature of lower pole calyces may also affect stone clearance after ESWL, the results of ESWL become poorer in the presence of hydro nephrosis and obstruction (18-21).

Any obstruction distal to the stone remains a contraindication to ESWL in the presence of obstruction and infection (22), therefore, ESWL may result in life threatening urosepsis (23). Furthermore, stone fragments are unlikely to clear and a stone is likely to recur if the concomitant obstruction is not dealt with. The presence of stone at the uretero-pelvic junction may worsen the degree of pre-existing obstruction and potentially exacerbate an already compromised renal unit (24).

Likewise, 68% of 22 paediatric patients who were treated from ureteropelvic junction obstruction associated with renal calculus had recurrent stones at a median follow up of 9 years (16). Thus, in addition to the anatomic obstruction that contributes to calculi formation, underlying metabolic abnormalities are commonly present in patients who suffer uretero-pelvic junction obstruction. Out of the 4 cases, which were treated surgically, one had multiple calyceal stones and concomitant uretero-pelvic junction obstruction (PUJ Obstruction) such case underwent pyeloplasty (Andersen Hynes with JJ stent insertion) and extraction of two stones. There remained another calyceal stone which was successfully treated later by ESWL therapy Fig. (7-12).

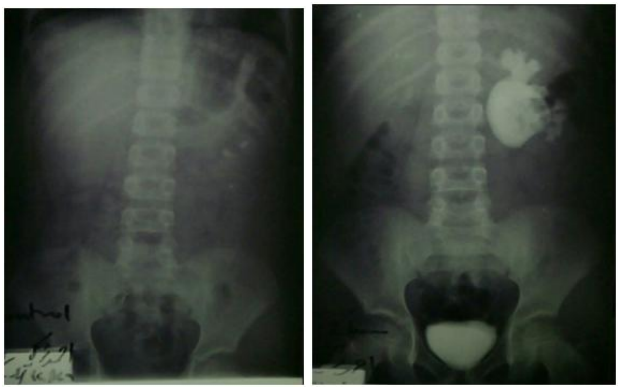

Fig.7 *KUB: secondary stones in Lt kidney* **Fig.8** *IVU: Lt PUJ stenosis*

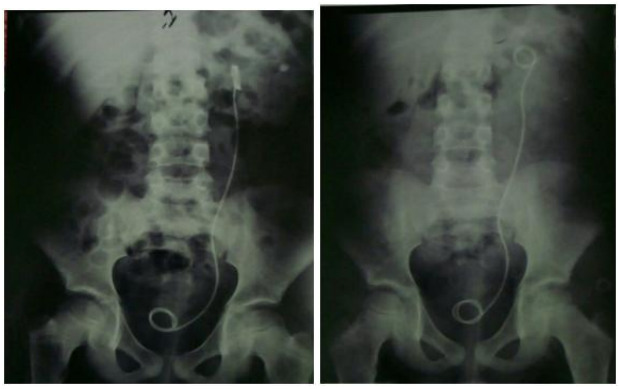

Fig .9 *KUB:post-pyeloplasty JJ in situ +stone* **Fig.10** *post ESWL stone cleared*

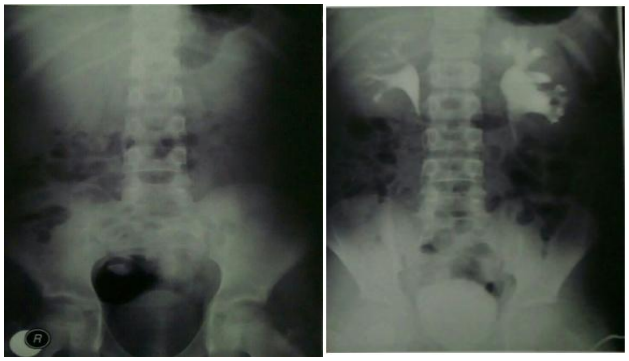

Fig 11 *IVU: post-pyeloplasty+ ESWL: stone cleared* **Fig.12** *IVU post pyeloplasty: Normal urogram*

In our study, an overall success rate of 90% was achieved with complete stone clearance after 3 months follow up. ESWL treatment failed in four patients and needed open surgery. As a complication, post ESWL treatment, we noted a case of impacted male urethral stone, causing acute retention of urine after ESWL of bladder stone, and was resolved by catheterization and secondary ESWL of residual fragments. Another complication was stein Strasse in one patient which resolved by extracorporeal lithotripsy in addition to pre- inserted of double J stent with alkaline citrate medication to prevent stent encrustation (25)Fig.(13).

Fig 13 *KUB: Steine-Strasse: fragmented stones beside JJ stent in Rt side in situ*

Of the cases in which ESWL treatment failed and we treated surgically; one was an eleven-year-old female patient that had undergone three episodes of ESWL treatments of her right (about two cm size) renal stone, but the stone failed to disintegrate. Pyelolithotomy was performed after two weeks of the last episode of ESWL. During the operation, the stone was intact and no evidence of hematoma was seen in the kidney. Postoperative was uneventful and her follow up for 2 years duration was free from stones and symptoms. The composition of her stone was calcium oxalate monohydrate mixed with phosphate. Another two cases of bladder multiple big stones were treated by cystolithotomy, after failure of ESWL therapy. This was due to hardness and composition of the stones. One was associated with multiple kidney stones later treated successfully by ESWL. Follow up was performed for all patients during a period of 3 to 24 months (mean 6 months). All patients were free from stones. We cannot definitively exclude an idiopathic metabolic disease except those cases of uric acid stones for which pharmacological therapy could be indicated to lower the relapse index or fragment re-growth, because citrate therapy that reduced the recurrence of new stones in children and adolescents. Therefore, it worked to. reducing the growth of residual stones resulting from ESWL as well as reduction of stone formation in children suffering hypocitraturia. This is also indicated in the treatment of patients with hyperuricosuria, (26), but a high fluid intake regimen was recommended for every patient.

5. CONCLUSIONS

After using ESWL in urology practice and the development of endourologic devices, fewer patients required open surgery in paediatric urolithiasis. The particular anatomic conditions of the child as the smaller size as well as the increased peristalsis and flexibility of the ureter favour ESWL, as the standard treatment modality in urolithiasis in children. High fluid intake regimen, treatment of underlying metabolic disorders and anatomic obstructive abnormality, should be recommended to lower relapse, index or fragment re- growth issue.

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