

UROLITHIASIS IN CHILDREN

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ABSTRACT

In general, the criteria for the treatment of urolithiasis in children are the same as those for adults. Today, extracorporeal shock wave lithotripsy (ESWL) is the method of choice in the treatment of most pediatric urinary stones. Stone-free rates between 67% and 93% at short-term follow-up, and 57% to 92% at long-term follow-up, have proven the efficacy of ESWL treatment in children. Nevertheless, the demand for auxiliary measures still remains. In order to achieve the most beneficial success rates under low complications, it is advisable to perform this type of ESWL in centers that claim the experience necessary for ESWL and endourological measures in children.

Key words: lithiasis; child; lithotripsy; shock-wave therapy
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INTRODUCTION

Since the introduction of ESWL by Chaussy in 1980, the therapeutic strategy for urolithiasis has completely changed. Nowadays, 96% of all urinary stones can be successfully treated by ESWL. In 1986, Newman et al. (1) presented the first reports on ESWL in children. Since then, numerous further reports have been published on the efficiency and safety of ESWL in children (1-31). In contrast to adults, only 1% to 3% of all urinary stones are detected in children. As a result, profound experience in ESWL treatment in children is demanded at all stone centers. Therefore, the number of patients enrolled in each individual study varies between 1 and 73 (7,24,25,30,32-36). One overall survey has been made with 446 children in over 250 stone centers (25). Very few reports have been published that provide exact statistics on the frequency of auxiliary measures in children (7,25,30,32-34,36).

INTERESTING ASPECTS OF ESWL IN CHILDREN

Calyceal or renal stones with a stone diameter of up to 2cm are an ideal indication for ESWL. More effective disintegration of even larger stones, together with swifter and uncomplicated discharge of larger fragments, can be achieved in children by ESWL. Consequently, ESWL can be indicated for children with a larger stone volume, and the placement of a ureteral stent before or after ESWL is generally unnecessary (9,21,29,34).

In our series of 46 children, staghorn stones were detected in 20%, renal stones with a diameter over 1.5cm in 34%, and calyceal stones with a diameter of 0.3 to 2.0cm in 29% (7,32). Further indications for ESWL in combination with endoscopic measures are proximal and distal ureteral stones that do not pass spontaneously (9,10). However, potential damage of the gonadal tissue in the ovaries caused

by ESWL is still a controversial subject, and ESWL in female infants is considered a contraindication by several authors.

LITHOTRIPTER MODIFICATIONS

In principle, the same ESWL procedure is performed for both children and adults. Specific modifications depend on the age and size of the child, and also on the type of lithotripter in use. With the Dornier HM3, a polystyrene shield was used as lung protection in children smaller than 120cm (14,27-29,34). Today, no additional equipment is demanded for the treatment of infants and small children on 2nd and 3rd generation lithotripters (2,7,20,21,23,25,32,36-38) (Figure-1). The waterbath of the HM3 has been replaced by a multifunctional table that allows better positioning of children, and uncomplicated treatment in supine and prone position. The ultrasound location systems and digital fluoroscopy enable precise

location of the stones at lower radiation exposure. The fluoroscopic screening times in children during treatment for renal stones averages 2.6 minutes, and for ureteral stones 3.0 minutes (25).

The average radiation exposure for children is 106.6 (16 to 415) cGy/cm², and is distinctly lower than 250 cGy/cm² for adults (11). A further attribute of the new lithotripters enables the precise focusing of energy on the stone, thus minimizing potential tissue damage.

ANESTHESIA

Although, nowadays, no general anesthetic is normally administered to adults for ESWL treatment, this is not the case with children. A general anesthetic is demanded in 30% to 100% of children treated by ESWL. However, this demand together with the method of anesthesia varies strongly depending on the age of the child, and on the type of lithotripter in use. The reluctant cooperation of small



Figure 1 - The figure shows a 12 month-old child treated with the Modulith SLK (Storz Medical AG, Kreuzlingen).

infants when awake, makes a general anesthetic advisable in this group (2,3,11,13,14,19,24,25,39). The age limit for analgosedation or no anesthetic use at all for children treated by modern lithotripters varies between 3 years (Piezolith) and 12 years (HM3) (21,29,36,40). In our department, children up to the age of 8 years treated by ESWL were routinely given a general anesthetic or preferably, if possible, analgosedation. Only poor compliance necessitated general anesthetics in older children. General anesthesia was administered to 30 out of 46 children (aged 3 months to 14 years). Sixteen children received analgosedation (aged 14 to 17 years). ESWL was performed with the Lithostar Plus (Siemens AG, Erlangen), the Modulith SL20/SLX, and SLK (Storz Medical AG, Kreuzlingen) (Figure-1).

DISINTEGRATION AND STONE-FREE RATES

In earlier days, the chief aim of stone surgery was to achieve a complete stone-free condition. Although this does not quite apply to ESWL, long-term success depends on the stone-free rate. Complete stone disintegration is achieved in 57% to 97% of cases (1-31), but this is still only a prerequisite for a stone-free condition. In contrast to adults, more effective disintegration by ESWL, and subsequent

swifter and uncomplicated passage of larger fragments, has frequently been observed in children (9,21,32,34). The reasons for this could be that, in general, the dwelling time of stones in children is only short, the shock wave effect is stronger in children, and they also quickly recuperate (34) from this method of treatment. Thirty-seven to 52% of the children were stone free at discharge (7,11,29,32), and the stone-free rate was between 57% and 97% 3 months after ESWL (1-31), Table-1.

AUXILIARY MEASURES

The demand for pre- and post-therapeutic auxiliary measures is lower in infants than in older children or adults (11,21-23,27-29,34,38). Large fragments are often easily discharged by infants, thus making stent insertion unnecessary (36). In principle, the auxiliary measures for urinary diversion in complicated hydronephrosis, e.g. ureteral stent and percutaneous nephrostomy (PCN), together with those for stone removal, e.g., ureterorenoscopy (URS) and percutaneous nephrostolithotomy (PCNL), are usually defined as overall auxiliary measures (14,41). However, a distinction must be made, both for adults and children, between these two groups of auxiliary measures. Curative auxiliary measures aim at a stone-free condition. These comprise lithotripsy and stone

Table 1 - Stone-free-rate and auxiliary measures in different studies.

Study	Number of Patients	Stone-free-rate % after 3-6 Months	Auxiliary Measures %
Nijman et al., 1989	73	79	
Vandeursen et al., 1992	28	90.5	
Moreno et al., 1992	14	71.4	14.28
Zanetti et al., 1993	14	92.85	
Moazam et al., 1994	83	82	
Myers et al., 1995	446	kidney 67.9; ureter 91.1	kidney 36.3 ureter 17.7
Oktay et al., 1998	67	88.6	9
Own series	46	81	adjuvant: 19.6 curative: 8.7

extraction by URS or PCNL, respectively. Those measures with an adjuvant effect attempt to suppress complications to a minimum, and include the insertion of ureteral stents or percutaneous nephrostomies. Curative auxiliary measures are invasive and must be carried out under general anesthetic, in both younger and older children. Adjuvant measures are less invasive and can frequently be performed under analgesedation. Among our young patients, 19.6% were treated by adjuvant auxiliary procedures, and 8.7% by curative auxiliary measures (7,32). Information on auxiliary measures is rarely given in the bibliography – frequency is reported to be 14 to 37% (25,33-35,39). It must be taken into consideration that retrograde auxiliary measures over URS in boys always bear the risk of damage to the urethra, with subsequent urethral strictures. Hence, whenever possible, this procedure should be avoided in the treatment of boys. Advisable is either repeated ESWL or an antegrade procedures over PCNL. In our patient group, URS was demanded only once for a distal ureteral stone in a small boy (Table-1).

COMPLICATIONS

Petechia bleeding at the skin or slight hematuria often arise, whereas severe complications after ESWL are more seldom in children than in adults. The complication rate lies between 6% and 26% (2,3,11,25,29,38). Urinary tract infection, accompanied by a high temperature up to sepsis, is the most common complication that originates from previously existing, persistent urinary tract infection. The complication rate in our series of patients was 8%, and these were all episodes of high temperature from previously existing, persistent urinary tract infection, caused by upper urinary tract obstruction. These complications were all conservatively managed by percutaneous procedures or retrograde ureteral stents plus additional antibiotic therapy (7,32). Very severe complications that can arise in connection with the infantile anatomical structure, e.g., pulmonary contusion, hemoptysis or perirenal hematoma, have only been described in reports on 4 series of patients (2,13,14,27).

LONG-TERM RESULTS

Stone-free rate and stone recurrence rate

Only five reports (8,11,18,29,34) have been made on stone-free rates, between 57% and 92% in a long-term follow-up, between 18 and 46 months after ESWL in children. A general recurrence rate of 2% to 44% has been reported for children after ESWL (18,29,34,42), the residual fragment rate is between 23% and 33% (29,34). In contrast, the recurrence rate in adults is only between 8% and 10%, and residual stone growth averages 22% (41). Complex etiology, a high rate of metabolism disturbances, anatomical changes, and urinary tract infection, are given as reasons for the higher rate of residual stone growth in children (8,42). Seventy-two percent of our small patients were stone-free after an average of 46 months; 5/42 (13.7%) of these developed recurring stones. Residual stone growth progressed in all 9 children who were not stone-free after 3 months. Either urinary tract infection, metabolic disturbance or an anatomical change were detected in those children suffering from stone recurrence or residual stone growth (7,32).

CONCLUSION

Infant stone patients must be followed over a prolonged period in order to assess the safety and effectiveness of the treatment strategy. Sonographic and/or X-ray monitoring of the respective kidney should be performed at least 2 weeks and 3 months after ESWL. Any remaining stubborn residual fragments are then disintegrated in repeated ESWL treatment.

A metaphylaxis for metabolic disturbances and a long-term antibiosis for chronic infection are recommended in an attempt to avoid residual stones. Any existing infrarenal obstruction must first be cleared.

In order to achieve the most beneficial success rates under low complications, it is advisable to perform this type of ESWL in centers that claim the experience necessary for ESWL, and endourological measures in children.

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