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Extracorporeal lithotripsy in children. The efficacy and long-term evaluation of renal parenchyma damage by ^{99m}Tc-DMSA scintigraphy

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A B S T R A C T

Purpose: To determine the effectiveness of extracorporeal shock-wave lithotripsy (ESWL) and possible deleterious effects on renal parenchyma of children subjected to treatment of renal lithiasis, using renal scintigraphy with ^{99m}Tc dimercapto-succunic acid (DMSA).

Patients and methods: From January 2004 to November 2007, 18 children (age 3-10 years) underwent ESWL (Philips-Dornier) for kidney urolithiasis. All patients underwent preoperative evaluation, including physical examination, urine culture, image exams and renal scintigraphy with ^{99m}TC-DMSA. Evaluation after treatment consisted of a clinical examination, blood pressure measurement, urine culture, renal ultrasound and ^{99m}TC-DMSA, repeated at 3, 6 and 12 months, which were compared to the scans obtained before ESWL to determine possible morphological or functional changes.

Results: Success in the stones fragmentation was achieved in all cases – in 9 patients (50%) with one session of ESWL, in 6 (33%) with two sessions and in 3 patients (17%) with 3 sessions of ESWL. Only one patient (5%), after three sessions of ESWL and 6 months of follow-up showed change in size of right kidney with a decrease in tubular function, without hypertension or other major changes. In the other cases, there was absence of hypertension up to 12 months of follow-up, absence of renal hematomas detected by ultrasound or significant renal scars in scintigraphic examinations.

Conclusion: ESWL is effective and safe for treating renal lithiasis in children. Renal parenchyma lesions may occur early after treatment, but these lesions are transients and resolve spontaneously in virtually all cases; generally, there are no irreversible renal lesions associated with ESWL, even after the follow-up period with clinical examination, ultrasound examination and ^{99m}Tc-DMSA scintigraphy.

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Litotricia extracorpórea en niños. Eficacia y evaluación a largo plazo de la lesión del parénquima renal mediante gammagrafía con DMSA-^{99m}Tc

Palabras clave:
Litotricia extracorpórea por ondas de choque
Litotricia en niños
Evaluación a largo plazo
Lesión del parénquima renal
Gammagrafía con DMSA-^{99m}Tc
Eficacia del tratamiento

RESUMEN

Objetivo: Determinar la eficacia de la litotricia extracorpórea por ondas de choque (LEOC) y los posibles efectos nocivos en el parénquima renal de niños sometidos a tratamiento de la litiasis renal mediante gammagrafía renal con ácido dimercaptosuccínico marcado con ^{99m}Tc (DMSA-^{99m}Tc).

Pacientes y métodos: Desde enero de 2004 a noviembre de 2007 se sometió a 18 niños (de 3-10 años) a LEOC (Philips-Dornier) por urolitiasis renal. A todos los pacientes se les realizó una evaluación preoperatoria, que incluyó una exploración física, cultivo de orina, pruebas de imagen y gammagrafía renal con DMSA-^{99m}Tc. La evaluación tras el tratamiento constó de una exploración clínica, determinación de la presión arterial, cultivo de orina, ecografía renal y DMSA-^{99m}Tc, repetidas a los 3, 6 y 12 meses, que se compararon con las exploraciones obtenidas antes de la LEOC para determinar posibles cambios morfológicos o funcionales.

Resultados: Se fragmentaron con éxito los cálculos en todos los casos; en 9 pacientes (50%) con una sesión de LEOC, en 6 (33%) con dos sesiones y en tres pacientes (17%) con tres sesiones de LEOC. Sólo un paciente (5%) mostró un cambio de tamaño del riñón derecho con descenso de la función tubular, sin hipertensión ni otros cambios importantes después de tres sesiones de LEOC y 6 meses de seguimiento. En los demás casos se comprobó la ausencia de hipertensión hasta los 12 meses de seguimiento, de hematomas en la ecografía o de cicatrices renales importantes en las exploraciones gammagráficas.

Conclusión: La LEOC es eficaz y segura para tratar la litiasis renal en niños. Pueden aparecer lesiones del parénquima renal precozmente tras el tratamiento, pero estas lesiones son pasajeras y se resuelven espontáneamente en prácticamente todos los casos. No existen generalmente lesiones renales irreversibles asociadas con la LEOC, ni siquiera después del periodo de seguimiento con exploración clínica y ecográfica y gammagrafía con DMSA-^{99m}Tc.

Introduction

The incidence of urinary stones in children is very low, ranging from 0.1% to 5%, and only accounts for 2-3% of the total population of patients presenting with urolithiasis[1,2]. It is two times more frequent in males; nevertheless, there is an upward trend in incidence, parallel to the increase seen in adults[3]. The etiology of urolithiasis includes birth defects, metabolic susceptibility to stone formation (hypercalciuria) and urinary infection[4-6].

Extracorporeal shock wave lithotripsy (ESWL) has revolutionized treatment of renal lithiasis in children. It is a well-established procedure and is currently considered as first-line treatment for urinary stones in this age group[7-11]. However, there is still controversy on possible deleterious effects on renal parenchyma in the mid- and long-term. Many studies have shown that ESWL is safe and effective in children. Renal changes after ESWL are rare and usually resolve spontaneously[8,11-14].

Objective

To determine the effectiveness of ESWL and possible deleterious effects on renal parenchyma of children subjected to treatment of renal lithiasis by renal scintigraphy with ^{99m}Tc dimercaptosuccinic acid (DMSA).

Patients and methods

From January 2004 to November 2007, 18 children underwent ESWL (Philips-Dornier) for renal lithiasis. Of these, 5 were girls and 13 boys. Their age ranged from 3 to 10 years (mean: 5 years). Thirty renal calculi, mostly pyelic and ranging in size from 8 and 20 mm, were treated. All patients underwent preoperative evaluation, including physical examination, urine culture, imaging tests and renal scintigraphy with ^{99m}Tc-DMSA.

All procedures were performed under general anesthesia and precautions were taken with the lung bases. Pulse intensity ranged from 17 and 20 kV, and the maximum number of shocks was 2,000. Patients received 0.5 mg/kg of furosemide during the session to facilitate as far as possible subsequent elimination of the fragments.

Evaluation after treatment consisted of a clinical examination, blood pressure measurement, urine culture, renal ultrasound and ^{99m}Tc-DMSA, repeated at 3, 6 and 12 months, which were compared to the scans obtained before ESWL to determine possible morphological or functional changes.

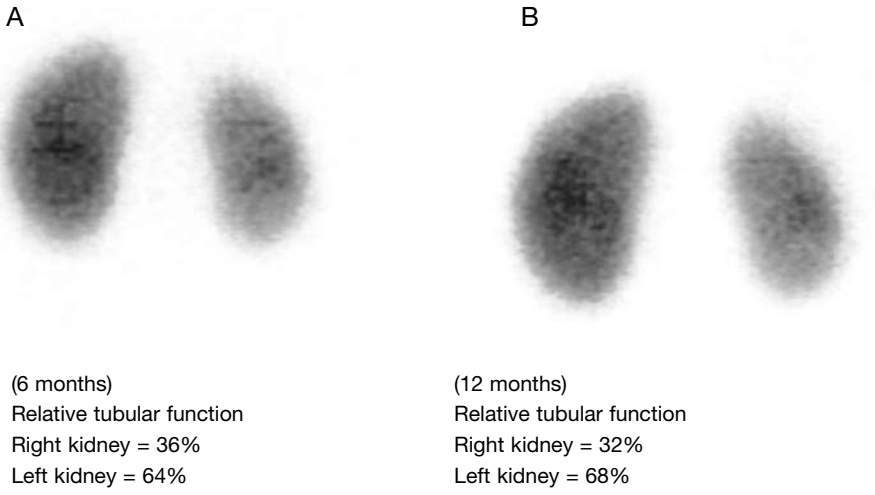

Figure 1 – Renal scintigraphies with 99mTc-DMSA completed at 6 months (A) and 12 months (B) after treatment, showing a change in size of right kidney with decreased tubular function (posterior view). Relative renal function was 45 and 55% in the right and left kidneys, respectively, before the extracorporeal shock wave lithotripsy.

Results

Success in stone fragmentation was achieved in all cases, in 9 patients (50%) with one session of ESWL, in 6 (33%) with two sessions, and in three patients (17%) with three sessions of ESWL.

Analysis of the stones revealed calcium oxalate in 10 patients (56%), struvite in three (17%) and calcium phosphate in 5 (27%).

Placement of a stent was not required in any case, and all patients received prophylactic antibiotic treatment for 7 days from the day following ESWL.

Only one patient (5%), after three sessions of ESWL and 6 months of follow-up, showed a change in size of the right kidney with a decrease tubular function (fig. 1).

No urinary infection was detected in this patient during follow-up. Initial and 3-month follow-up renal scans showed 45% and 55% function in the right and left kidneys, respectively.

This patient did not show hypertension or other significant changes at 12 months of ESWL. In the other cases, there was absence of hypertension up to 12 months of follow-up, absence of renal hematomas detected by ultrasound or significant scars in scintigraphic examinations.

Discussion

This study, which showed absence of renal calculi in 100% of patients after one to three ESWL treatments, confirms the well-established effectiveness of ESWL in the pediatric population. Absence of calculi has been reported in the literature in 75% to 92% of patients after one to three treatments of ESWL[10,14-19].

The number of complications reported after ESWL is low. All were mild and transient, and included hematuria, "steinstrasse", ureteral obstruction, and urinary tract infection with or without fever[10,15,20].

The possible deleterious effects of ESWL on renal parenchyma have been addressed in several studies. Two of them evaluated functional results after ESWL using renal scintigraphy with ^{99m}Tc-pentetic acid (DPTA). In a study in 50 patients Goel et al noted that the mean ipsilateral glomerular filtration rate (GFR) of the treated kidneys did not significantly change in long-term follow up, and that the acute changes after ESWL in a few patients resolved spontaneously[16]. In another study, Vlajkovic et al showed decreased GFR immediately after ESWL, but it returned to baseline values three months later[14].

However, renal scintigraphy with ^{99m}Tc-DMSA appears to be the best method to assess the long-term functional or morphological parenchymal sequelae of ESWL[21]. Several studies have assessed the potential long-term effects of ESWL in renal parenchyma of children using ^{99m}Tc-DMSA scintigraphy.

Traxer et al conducted three studies and demonstrated that no episodes of hypertension or parenchymal lesions attributable to the ESWL[12,22,23] were seen in long-term follow-up (after 6 months to 8 years). Other studies confirmed these results[8,13,18].

In an initial study, Lootmann et al evaluated 17 children with 31 calculi treated with ESWL, of which 8 were subjected to preoperative DMSA and 7 to DMSA at 6 or more months of the last session. Four of the last 7 patients were normal, but the other three groups had loss of function and a heterogeneous uptake in the treated side. Blood pressure remained normal in all patients[24]. In other studies by the same authors, no parenchymal scars acquired at least 6 months after treatment of ESWL were identified, nor were

changes in blood pressure observed. The authors concluded that renal parenchyma damage associated with ESWL does not appear to cause long-term lesions identifiable by renal scintigraphy with DMSA[8,21,25].

In another study of 35 children subjected to radioisotope renography, a transient decrease in renal function was found in the early follow-up period (0-3 months), with a return to normal ranges after this period. No statistically significant changes in blood pressure were noted[26].

Our experience confirms these reports. Stone fragmentation was performed successfully in all cases. Only one patient (5%), after three sessions of ESWL and 6 months of follow-up, showed a change in size of the right kidney with a decrease tubular function. This patient did not show hypertension or other significant changes at 12 months of ESWL. In no other patients was hypertension observed or renal hematomas detected by ultrasound or significant scars in scintigraphic examinations.

Conclusions

According to our study and earlier published reports, ESWL is effective and safe for treating renal lithiasis in children. Renal parenchyma lesions may occur early after treatment, but these lesions are transient and resolve spontaneously in virtually all cases. Although ESWL is not free from complications in children (in this series they occurred in 5% of cases), it is not associated with irreversible renal lesions, even after the period of follow-up with clinical examination, ultrasound examination and with ^{99m}Tc-DMSA scintigraphy.

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