

## COMPARATIVE STUDY BETWEEN INTRAVENOUS UROGRAPHY AND RENAL SCINTIGRAPHY WITH DMSA FOR THE DIAGNOSIS OF RENAL SCARS IN CHILDREN WITH VESICoureTERAL REFLUX

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### ABSTRACT

**Purpose:** To assess the value of intravenous urography (IVU) in detecting and grading the renal scar, comparing its results with those of scintigraphy with dimercaptosuccinic acid (DMSA).

**Materials and Methods:** The study included 43 children investigated by DMSA and IVU, who had vesicoureteral reflux diagnosed and classified through voiding cystourethrography.

**Results:** Among the kidneys with reflux, there was agreement between the results of DMSA and IVU concerning the presence and the absence of scars in 82.4% of the cases. Based on the results obtained, IVU would have a sensitivity of 66.6%, specificity of 94.4%; accuracy of 82.5%; positive predictive value (PPV) of 90% and negative predictive value (NPV) of 79%, when compared with DMSA results. Our data also confirm the close relation between the reflux grade and the presence of renal scar, since 75% of the kidneys with grade IV and V reflux presented scars. In relation to the grading of nephropathy, in 78% of patients the classification of the scar by both methods was identical. The highest disagreement was verified in the group with segmental scar on DMSA, where 41.6% of the kidneys were classified as normal on IVU.

**Conclusion:** The data obtained confirm that the scintigraphy with DMSA is essential in the investigation of patients with renal scar, and cannot be replaced by IVU, due to its low sensitivity and lower ability of satisfactory grading.

**Key words:** kidney; scar; scintigraphy; Dmsa; urography

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### INTRODUCTION

The detection of renal scar has been of great interest in pediatric urology due to its clinical significance. The emphasis given to this condition lies in the fact that it is a frequent cause of systemic arterial hypertension and chronic renal failure in the pediatric population (1,2).

Renal scarring occurs most frequently in patients with pyelonephritis (3) and is, generally, associated to vesicoureteral reflux (4). It is well established that the risk of developing a renal scar increases

accordingly to the degree of reflux (5,6). These data warrant the need of diagnosing the renal scar, what is currently performed by scintigraphy with dimercaptosuccinic acid (DMSA), regarded as the best current method for detecting such condition (3,7-9).

As much as detecting, it is important to classify the intensity of the renal lesion (focal or generalized), due not only to its implications in prognosis, but also to help to elucidate its etiological factors (10), a goal that is also satisfactorily achieved by using the scintigraphy with DMSA.

Even though the scintigraphy allows identifying the presence and the intensity of the scar, in addition to quantifying the renal function (8), some authors consider the intravenous urography (IVU) a fundamental part of the investigation for such patients (11). Moreover, in our setting, many clinicians continue to use the IVU as a diagnostic method for renal scar. Not rarely children with vesicoureteral reflux are referred to the specialist with the urographic study already done. The present study aims to assess the value of IVU for detection of renal scar, comparing its results with those of DMSA.

**MATERIALS AND METHODS**

We retrospectively studied 43 children who presented vesicoureteral reflux between the years of 1986 and 1999, who were assessed by scintigraphy with DMSA and intravenous urography. Among the patients, 10 were boys and 33 were girls, with ages ranging from 3 months to 9 years. The median age for the group under study was 3.3 years.

Only the renal units with reflux were included in the analysis. The reflux was initially studied by voiding cystourethrography. IVUs and scintigraphies were obtained in different services (radiology and nuclear medicine, respectively), so that the physician who assessed the scintigraphy had no knowledge about IVU data and vice-versa.

IVU was performed following the intravenous administration of iodinated contrast material with calculation of dose based in the child's age and weight (2 ml/kg). Nephrotomographic views were obtained (acquired 1 minute after the contrast injection) in the majority of examinations, in addition to films within 5, 15 and 25 minutes. The renal scar was classified as focal or generalized. The focal scar reached only segments of poles or the medial portion of the kidney (focal defect of radioisotope distribution), and the generalized one represented a diffuse involvement, with global decrease in renal function (less than 40% of the relative renal function) (10). Contracted kidneys were included in the category of generalized scar, with function below 20%.

The statistical analysis was performed by obtaining sensitivity, specificity, accuracy, positive pre-

dictive value (PPV) and negative predictive value (NPV) for IVU, comparing with the results of scintigraphy (12).

**RESULTS**

Among a total of 86 renal units studied, 63 presented reflux. The correlation between the results of IVU and DMSA concerning the detection of renal scar is demonstrated in Table-1.

There was agreement between the results of both methods in 82.4% of cases. IVU detected 18 of 27 kidneys with scars in DMSA. However, when DMSA was negative (n = 36), IVU was concordant in 34 cases. Based on the data on Table-1, we can state that, when compared with DMSA, IVU had a sensitivity of 66.6%, specificity of 94.4 %, accuracy of 82.5%, PPV of 90%, and NPV of 79%.

Table-2 correlates the grades of reflux with the presence of renal scar in DMSA. Among the 32 kidneys with reflux between grades I to III, 25% presented a scar. On the other hand, in the 28 kidneys associated with homolateral grade IV or V reflux, 75%

*Table 1 – Detection of renal scarring by scintigraphy with DMSA and intravenous urography (IVU).*

Scarring by DMSA			
Scarring by IVU	Present	Absent	Total
Present	18	2	20
Absent	9	34	43
Total	27	36	63

*Table 2 – Correlation between the grade of vesicoureteral reflux and the presence of renal scarring by DMSA.*

Grade of Reflux	With Scarring	Without Scarring	Total
I	-	3	3
II	4	8	12
III	4	13	17
IV	15	7	22
V	6	-	6
Total	29	31	60

**Table 3** – Classification of renal scarring: comparison between scintigraphy with DMSA and intravenous urography.

DMSA	Intravenous Urography			Total
	Generalized Scarring	Segmental Scarring	Normal Exam	
Generalized Scarring	9	0	2	11
Segmental Scarring	1	6	5	12
Normal Exam	1	0	34	35
Total	11	6	41	58

had a scar. From this analysis, 3 kidneys were excluded where there was associated reflux, but with no reporting on its grade.

A comparison between the findings of DMSA and IVU were also performed concerning the classification of the renal scar (Table-3). In 5 patients, this evaluation was not possible due to incomplete data in the medical records and the impossibility of re-viewing the exams. In 78% of patients, the classification of the scar by the 2 methods was identical. The higher disagreement was verified in the group with segmental scar by DMSA, in which 41.6% of kidneys were classified as normal by IVU. Among the 11 cases of generalized scar by DMSA, IVU was concordant in 9 (90%).

**DISCUSSION**

Vesicoureteral reflux, due to its importance and high frequency in pediatric urology, has been the subject of several studies. Among its consequences, the renal scar stands out, being an important cause of chronic renal failure and systemic arterial hypertension in children, occurring between 10 and 20% of patients with urinary infection, respectively (1,13). Several conditions can lead to the development of renal scarring, whether congenital or acquired (3). Nevertheless, it is widely known that the vesicoureteral reflux, especially from grade III on, would be an alteration more commonly associated to pyelonephritis in children (5,6), and this, in turn, would result in the appearance of renal scars in the majority of patients (3).

Some diagnostic methods such as ultrasonography have been used as a method for detecting renal scarring. We recently assessed the value of ultrasonog-

raphy for this purpose, comparing it to renal scintigraphy with DMSA (12). In one analysis of 41 patients, the positive predictive value, negative predictive value, sensitivity and specificity of ultrasonography when compared to scintigraphy were 87.5%, 61%, 66% and 84%, respectively. These data show that, though the ultrasonography has a good accuracy for diagnosis of renal scar, its role in the detection of focal lesions is restricted. We performed then a similar study observing the value of intravenous urography.

Until recently, IVU was the method of choice for assessing renal scar. Inclusively, the main prospective randomized studies, that have guided the treatment of vesicoureteral reflux, used IVU as the method for evaluating the scar (14-16). However, today, the scintigraphy with DMSA is considered the best method for detecting cicatricial renal lesions, due to its high sensitivity and specificity, in addition to enabling the classification of the renal scar in focal or generalized, as well as assessing renal function (7-9,17,18).

Nevertheless, some authors believe that performing an IVU is indispensable for patients in risk of presenting cicatricial renal lesions, reasoning that this study would be more complete for assessing the anatomy of the upper urinary tract and would provide more reliable measures of the kidney and the scar for follow-up (11).

We found a percentage of agreement between the results of both methods of 82% in relation to detection of renal scarring, corroborating the data from Mc Lorie et al. who evidenced an agreement of 80% (19). However, the same study claims that IVU would have sensitivity and specificity of 84% and 83% respectively. In another study conducted by Elison et

al. (20), it was noted that despite DMSA having detected more cortical abnormalities than IVU, such difference was not statistically significant. Our data show that IVU has a good specificity (94.4%) for detecting renal scar in patients with reflux, but it presents a low sensitivity, since it failed to detect 33.3% of kidneys having scars proved by DMSA.

Some authors stress the importance of correctly classifying the nephropathy, since this data can help to determine if the scar is congenital (found mainly in cases of generalized scarring) or acquired (focal scar), in addition to having implications in the prognosis (10). Some studies claim that IVU would detect more serious or advanced cases of renal scarring only, being unable to identify other cases (21-23). According to the study conducted by Goonasekere et al. (1), there was agreement in only 50% in the grading of renal scar assigned by IVU when compared to DMSA. However, in the study conducted by Whitear et al. (24), in cases that presented alterations in the DMSA, with IVU without abnormalities, focal defects were predominantly demonstrated. Our data also show that IVU allows the detection of most kidneys with generalized scarring, but proved to be unable to identify 41.6% of the kidneys with segmental scar. Thus, one can conclude that this group would be responsible for the method's low sensitivity, in addition to confirming the hypothesis that this is not the ideal exam for classifying renal scarring (22). The main explanation for this fact is that excretory urography makes renal planigraphic sections (renal anteroposterior assessment in a 10 to 50° arch) according to the desired thickness of the section. Ideally, a better study of the renal parenchyma concerning the presence of focal scarring would be achieved if we obtained nephrotomographic sections with 10, 20, 30, 40 and 50° in a period of 1 to 5 minutes following the injection of intravenous contrast. However, in addition to being little practical, it would exaggeratedly irradiate to the child. Therefore, whenever the excretory urography is normal, the performance of renal scintigraphy is mandatory.

In conclusion, our data show that when IVU demonstrates a renal scar there is a high percentage of confirmation by DMSA. However when IVU is negative, the renal scarring cannot be ruled out, since focal lesions can be identified by scintigraphy. Our

study did not assess IVU in association with ultrasonography, which could increase the sensitivity for detection of renal scarring.

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