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# Abnormal Renal Scans and Decreased Early Resolution of Low Grade Vesicoureteral Reflux

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**Purpose:** Limited studies suggest a relationship between scarring on renal scan and failure to resolve vesicoureteral reflux. We evaluated the impact of abnormal renal scans on early vesicoureteral reflux resolution.

**Materials and Methods:** The medical records and renal scans were reviewed of children diagnosed with primary reflux between 1988 and 2004. We defined an abnormal renal scan as renal scarring or relative renal function 40% or less. Reflux resolution was noted 1 and 2 years after diagnosis.

**Results:** Renal scan data were available on 161 children with vesicoureteral reflux, including 127 girls and 34 boys. Relative renal function was 15% or less in 7 children, 16% to 35% in 14, 36% to 40% in 18 and greater than 40% in 122. Of the 161 patients 79 (43%) had an abnormal renal scan, including 37% with grades 1 to 3 reflux. The rate of 2-year reflux resolution in the abnormal and normal renal scan groups was 13% vs 53%. Of children with grades II and III reflux those with an abnormal renal scan were less likely to have reflux resolution compared to those with normal renal scans (23% vs 55% and 4% vs 41, respectively,  $p < 0.05$ ). The same relationship was present at 1 year for grades 2 and 3 (18% vs 49% and 4% vs 30, respectively,  $p < 0.05$ ).

**Conclusions:** Abnormal renal scans are an important independent predictor of early failure to resolve vesicoureteral reflux. An abnormal renal scan should be considered when counseling families about the likelihood of early reflux resolution. Performing a renal scan may be indicated in select patients.

*Key Words:* kidney, vesico-ureteral reflux, urination disorders, radionuclide imaging

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Vesicoureteral reflux is associated with renal parenchymal abnormalities, which may be congenital or secondary to inflammatory damage associated with UTIs.<sup>1</sup> Providing an accurate estimate of the likelihood of spontaneous reflux resolution is important for counseling regarding VUR management. Treatment guidelines have attempted to identify clinical factors that affect the likelihood of VUR resolution, including patient age and reflux grade.<sup>2</sup> Previous published reports from our institution have identified several additional clinical factors that are predictive of early VUR resolution, including laterality, ureteral duplication, bladder volume at reflux onset, reflux with filling or voiding, history of prenatal hydronephrosis or voiding dysfunction.<sup>3,4</sup>

In the assessment of UTI and/or hydronephrosis the renal scan (renal scintigraphy) is a tool commonly used by urologists to evaluate obstruction, renal scars (photopenic defects) and RRF.<sup>5</sup> Mingin et al reported that children with grades 3 to 5 reflux and an abnormal renal scan are at increased risk for breakthrough UTI.<sup>6</sup> Despite an often quoted relationship actual data on whether renal scan data can be used to predict reflux resolution are limited and focused primarily on high grade reflux.<sup>7-11</sup> We performed a retrospective study of a large series of children who had a renal scan performed as part of their evaluation

for VUR. The primary objective was to evaluate the impact of an abnormal renal scan on early VUR resolution in a large series of children, including those with lower grade reflux.

## MATERIALS AND METHODS

After receiving institutional review board approval the medical records of patients from 1988 to 2004 were reviewed to identify children with primary reflux who underwent renal scintigraphy as part of their initial evaluation. The degree of reflux was graded using voiding cystography according to the International Reflux Study classification.<sup>2</sup> Reflux grade in children with bilateral reflux was categorized by the side with the highest grade. Patients were excluded from study if they were older than 18 years, had neurogenic bladder, myelomeningocele, posterior urethral valves, bladder exstrophy, ureterocele, ectopic ureter or megaureter, or clinical followup was not available. Voiding dysfunction was defined as increased incontinence episodes more than expected for age or the prescription of anticholinergic medicine for overactive bladder symptoms. Ureteral duplication was assessed based on VCUG and ultrasound findings.

Renal scans and radiology reports were reviewed to identify renal scars and document RRF in the refluxing kidney. Renal scans were done during outpatient clinical urological evaluation and not at the time of initial UTI. In cases of bilateral reflux the lower RRF was used. We defined an abnormal renal scan as RRF 40% or less or renal scarring based on the finding of photopenic defects.

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Study received institutional review board approval.

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TABLE 1. Demographic and clinical variables in children with and without abnormal renal scans

Variable	Overall	Renal Scan		p Value
		Normal	Abnormal	
No. pts	161	91	70	
No. girls (%)	127 (79)	76 (84)	51 (63)	0.15
Age at diagnosis:				0.89
Mean $\pm$ SD	2.3 $\pm$ 2.2	2.2 $\pm$ 2.3	2.4 $\pm$ 2.2	
Median	1.5	1.3	1.9	
No. presenting symptoms (%):				0.74
Febrile UTI	87 (54)	48 (53)	39 (56)	
Nonfebrile UTI	39 (24)	27 (30)	12 (17)	
Prenatal hydronephrosis	27 (17)	11 (12)	16 (23)	
Other	8 (5)	5 (6)	3 (4)	
No. voiding dysfunction (%)	21 (13)	11 (12)	10 (14)	0.86
No. ureteral duplication (%)	14 (9)	3 (3)	11 (16)	0.01
No. initial reflux grade (%):				<0.001
1	18 (11)	12 (13)	6 (9)	
2	73 (45)	51 (57)	22 (31)	
3	51 (32)	27 (30)	24 (34)	
4/5	19 (12)	1 (1)	18 (26)	
No. bilat reflux (%)	80 (50)	43 (46)	37 (53)	0.59
% Resolved				
At 1 yr	29.8	44.4	11.4	<0.001
At 2 yrs	35.4	52.7	12.9	<0.001

The primary outcome was spontaneous reflux resolution, which was noted as resolved or unresolved at 1 and 2 years after diagnosis. Children were followed with VCUG, typically at 1-year followup intervals, and maintained on prophylactic antibiotics until resolution. Children with resolution on VCUG did not undergo repeat VCUG unless febrile UTI developed. Cases of bilateral reflux were not considered resolved until each ureter demonstrated reflux resolution. Any surgical correction, endoscopic treatment or ureteral reimplantation was classified as failure to resolve and those charts were reviewed to identify the indication for surgery.

Demographic and clinical variables were compared between patients who did and did not have reflux resolution. The Fisher exact and chi-square tests were used to compare categorical variables and the 2-sample t and Wilcoxon rank sum tests were used to compare continuous and ordinal variables. To test for the association between renal scan data and resolution independent of grade, resolution was compared between children with the same reflux grade while stratifying for reflux grade. SigmaStat®, version 3.5 was used when applicable to assess statistical results with  $p < 0.05$  considered significant.

## RESULTS

A total of 206 patients met clinical study inclusion criteria and a renal scan was available on 161 (78%). Renal scan type was glucoheptonate in 67, MAG3 in 54, DMSA in 43 and DTPA in 32. Combination scans were performed in 35 children. On renal scan RRF was less than 16% in 7 children, 16% to 35% in 14, 36% to 40% in 18 and greater than 40% in 122. RRF was 40% or less in 39 of 161 children. Renal scars were identified in an additional 31 children with normal (greater than 40%) RRF. When an abnormal renal scan was defined as decreased RRF in a refluxing kidney or renal scars, 70 children (43.5%) had abnormal and 91 had normal renal scans.

Table 1 shows demographics and clinical variables for all children in the study stratified based on normal vs abnormal renal scan. Of boys and girls 56% and 40%, respectively, had

abnormal renal scans but the trend toward abnormal renal scans in boys was not statistically significant ( $p = 0.15$ ). With respect to presenting symptoms the incidence of abnormal renal scans was 44.8% for febrile UTIs (39 of 87 children), 30.8% for nonfebrile UTIs (12 of 39) and 59.3% for prenatal hydronephrosis (16 of 27). A similar incidence of children had voiding dysfunction in the normal and abnormal renal scan groups (12% and 14%, respectively,  $p = 0.86$ ). An abnormal renal scan was present in 11 of 14 children (78.6%) with ureteral duplication vs 59 of 147 (40.1%) without ureteral duplication ( $p = 0.01$ ). Abnormal renal scans were more prevalent at higher reflux grades ( $p < 0.001$ ). Table 2 shows the incidence of an abnormal renal scan for a given reflux grade. Renal scan was abnormal in 51% of DMSA, 47% of DTPA, 43% of MAG3 and 39% of glucoheptonate renal scans. However, there was no statistically significant relationship between the type of renal scan and the prevalence of abnormal renal scans ( $p = 0.62$ ).

Overall the VUR spontaneous resolution rate was 29.8% at 1 year and 35.4% at 2 years (table 1). A total of 33 children (21%) underwent corrective reflux surgery within 2 years of diagnosis, 57 achieved reflux resolution without surgery and in 71 reflux did not resolve. In the 33 children who underwent corrective reflux surgery mean time to surgical intervention was 10.0 months. Reasons for surgical intervention were symptomatic breakthrough UTI in 24 children and multifactorial in 9, that is physician/parental preference or antibiotic intolerance.

TABLE 2. Patients with abnormal renal scan by grade

Grade	% Pts
Overall	43.5
1	33.3
2	30.1
3	47.1
4/5	94.7

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