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Design. We reviewed 352 admissions of children under 10 years old whose discharge diagnoses indicated UTIs. These admissions occurred over a 27-month period between October 1994 and December 1996 at the Children’s Hospital of Austin, Texas. We identified 213 patients with confirmed UTIs and no other previously defined urinary tract pathology. These patients were divided into 2 groups according to whether they had a VCUG scheduled to be performed either within 1 week after the diagnosis of a UTI (the early group), or later than 1 week after the diagnosis (the late group). We compared the presence and severity of reflux in the 2 groups as well as the proportion of scheduled VCUGs that were actually performed.

Results. Reflux was present in 19% of the patients studied within 1 week after UTI (95% confidence interval [CI]: 12.9–26.4) and in 18% of those studied after 1 week (95% CI: 6.7–34.5). This difference was not statistically significant ($\chi^2 = 0.034; DF = 1$). However there was a substantial difference between the 2 groups with regard to the number of scheduled VCUGs actually performed. Whereas 100% of the scheduled VCUGs in the early group were performed, only 48% (95% CI: 35.9–60.1) of those scheduled in the late group were performed. This difference is statistically significant ($\chi^2 = 89.6; DF = 1$).

Conclusions. In the hospitalized children who underwent VCUGs within a week after diagnosis of UTI, the presence of reflux is not significantly different from those studied later. Furthermore, late scheduling of VCUGs resulted in failure to perform the procedure in more than half of the patients. Some of the patients who were not evaluated would be expected to have vesicoureteral reflux and thus be at risk for chronic renal disease. Therefore, the traditional recommendation to perform the VCUG at 3 to 6 weeks after the diagnosis of UTI should be reconsidered, especially for hospitalized children.

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were performed either at the Children’s Hospital of Austin or at 1 outpatient-imaging center. Reflux was graded using the international system of radiographic grading of VUR.10

Of 352 admissions, 139 were excluded from the study. Table 1 shows the numbers of patients excluded and the reasons for their exclusion. The remaining 213 patients were divided into 2 groups according to the timing of the VCUG. The early group consisted of those patients who were scheduled to have VCUGs performed within 7 days after the diagnosis of UTI. The late group consisted of those patients who were scheduled to have VCUGs performed >7 days after the diagnosis of UTI. If there was no evidence that the VCUG was performed at the hospital, records from the only radiology group in the area were reviewed. Results were also pursued by contacting the primary care providers of the patients.

RESULTS

Reflex was present in 19% (95% confidence interval [CI]: 12.9–26.4) of the patients studied within 1 week after UTI and in 18% (95% CI: 6.7–34.5) of those studied after 1 week (Table 2). This difference was not statistically significant ($\chi^2 = .034; DF = 1; P = .854$). Further breakdown of the late group showed that reflex was present in 20% of patients studied at 1 to 3 weeks and in 17% of those studied after 3 weeks.

Of the 213 patients scheduled for VCUGs, 142 were in the early group, and 71 were in the late group (Table 3). Whereas 100% of the scheduled VCUGs in the early group were performed, only 48% (95% CI: 35.9–60.1) of those scheduled in the late group were performed. This difference was statistically significant ($\chi^2 = 89.6; DF = 1; P < .001$). Of the 37 patients who did not get VCUGs, 34 (92%) were under the care of physicians in private practice.

Table 4 shows the distribution of grades of reflux in the 2 groups. Although there were only 6 patients with reflux in the late group, it is notable that the percentages in Table 4 are very similar (Fisher’s exact test; $P = 1.0$). For example, grade 3 reflux was present in 48% of patients in the early group and in 50% of patients in the late group; grade 2 reflux was present in 29% of patients in the early group compared with 33% of patients in the late group.

The 2 groups were similar with regard to age. The median ages in the early versus late groups were 7 weeks and 10.5 weeks, respectively. This difference is not statistically significant (Mann-Whitney U test; $P = .147$). In contrast, the percentage of females was 74% (95% CI: 55.6–87.1) in the late group compared with 52% (95% CI: 43.6–60.6) in the early group. This difference was statistically significant ($\chi^2 = 5.113; DF = 1; P = .024$).

Table 5 contains further breakdown of the timing intervals in the late group. The majority of patients in the late group (72%) had their VCUGs performed at greater than 3 weeks; 50% had their VCUGs performed at greater than 4 weeks.

DISCUSSION

VUR is the most common anomaly of the urinary tract in childhood.11 It is important to detect reflux in a patient with a UTI because reflux predisposes to pyelonephritis by facilitating the ascent of infected urine to the kidneys12,13 and because children with reflux are at increased risk for renal scarring.14 The presence of scarring and reflux together, or either of them with subsequent UTIs, is associated with an increased risk of progressive renal damage.15 Many authorities recommend evaluation of infants and young children with pyelonephritis for VUR.16,17

However, the time to evaluate children with UTI by performing a VCUG is not clear. The traditional recommendation to wait 3 to 6 weeks after the infection has been based on the belief that acute infection leads to transient reflux. In the past, it has been theorized that acute inflammation may cause obstruction and result in reflux18 or that infection per se results in reflux.19 More recent work, however, suggests that VUR is a primary phenomenon attributable to incompetence of the ureterovesical junction and not secondary to either obstruction or infection.20 If VUR is a primary phenomenon, it should not matter how long the interval is between diagnosis of a UTI and performance of the VCUG.

Only 1 previous study has examined the association between reflux and the interval between a UTI and the VCUG.21 No relationship was found between the presence or severity of VUR and the timing of the VCUG when the VCUG was performed later than 1 week. However, this study examined only 2 patients whose VCUGs were performed in the first week after the diagnosis of UTI.

In our study, there was no significant difference in the presence of reflux whether the VCUG was performed within 1 week or later. In addition, the 2 groups had similar grades of reflux. Our results indicate that early performance of VCUG does not lead
to an overestimation of the presence or grade of reflux. In contrast, waiting to perform the VCUG has substantial risks. Waiting >1 week to schedule the VCUG resulted in more than half of the scheduled VCUGs never being performed. Loss of follow-up of patients (some of whom will have reflux and will, therefore, be at high risk for further UTIs and chronic renal disease) is unjustified if waiting does not increase the accuracy of the VCUG results.

Because this study was retrospective, the timing of the VCUG was not determined randomly but by the judgment of individual clinicians. Some physicians provided feedback that many children who had been scheduled for VCUGs at the traditional 3 to 6 weeks after a UTI did not have studies performed and failed to appear for follow-up appointments. This feedback led hospital-based physicians caring for mostly indigent patients to perform VCUGs before discharge in many cases. Of the 37 patients who were scheduled for VCUGs after discharge but who failed to have VCUGs performed, 34 (92%) were under the care of physicians in private practice. Because private practice patients generally have more resources to return for follow-up studies, it seems unlikely that ability to obtain transportation or to keep follow-up appointments confounded these results.

There was no statistically significant difference in age between the patients studied early and those studied late, so age is unlikely to be a confounding factor in this study. However, with regard to gender, there was a statistically significant difference between the 2 groups. The proportion of females in the late group was higher than that in the early group. Nonetheless, previous work has shown that the likelihood of finding reflux in children with UTIs is the same in both genders. Therefore, gender is not likely to be a confounding factor. There is some possibility of type II error in our results because the number of patients with reflux in the late group was small.

All the patients in this study were hospitalized with UTI, whereas most children with UTI are treated as outpatients. Patients with UTI who are hospitalized are generally sicker than are those who are not. Therefore, it may not be appropriate to extrapolate these results to outpatients. However, a previous study that did include outpatients found no relationship between the presence or severity of reflux and the timing of the VCUG when the VCUG was performed after 1 week. A prospective, randomized outpatient study is desirable.

**CONCLUSION**

The traditional recommendation to perform a VCUG 3 to 6 weeks after a UTI should be reconsidered in hospitalized children. Because there is no evidence that waiting has an advantage and because waiting is associated with failure to perform the VCUG, a hospitalized patient with a UTI should have a VCUG performed before discharge.

**ACKNOWLEDGMENTS**

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**REFERENCES**


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**TABLE 4.** Distribution of Grades of Reflux

<table>
<thead>
<tr>
<th>Grade</th>
<th>Early Group (VCUG ≤ 1 Week; n = 27)</th>
<th>Late Group (VCUG &gt; 1 Week; n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>2 (7%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Grade 2</td>
<td>4 (15%)</td>
<td>4 (67%)</td>
</tr>
<tr>
<td>Grade 3</td>
<td>13 (48%)</td>
<td>3 (50%)</td>
</tr>
<tr>
<td>Grade 4</td>
<td>2 (7%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>27 (100%)</td>
<td>6 (100%)</td>
</tr>
</tbody>
</table>

Fisher’s exact test; *P* = 1.00.

**TABLE 5.** Time Intervals Between UTI and VCUG

<table>
<thead>
<tr>
<th>Interval</th>
<th>Early Group (VCUG ≤ 1 Week; n = 142)</th>
<th>Late Group (VCUG &gt; 1 Week; n = 34)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–7 d</td>
<td>142 (100%)</td>
<td>34 (100%)</td>
</tr>
<tr>
<td>8–14 d</td>
<td>4 (12%)</td>
<td>2 (6%)</td>
</tr>
<tr>
<td>15–21 d</td>
<td>6 (18%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>22–28 d</td>
<td>7 (20%)</td>
<td>5 (15%)</td>
</tr>
<tr>
<td>≥ 28 d</td>
<td>17 (50%)</td>
<td>6 (18%)</td>
</tr>
<tr>
<td>Total</td>
<td>142 (100%)</td>
<td>34 (100%)</td>
</tr>
</tbody>
</table>


Voiding Cystourethrograms and Urinary Tract Infections: How Long to Wait?
Anu McDonald, Maria Scranton, Robert Gillespie, Vandana Mahajan and George A. Edwards

Pediatrics 2000;105;e50

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