

Voiding Cystourethrograms and Urinary Tract Infections: How Long to Wait?

Anu McDonald, MD; Maria Scranton, MD; Robert Gillespie, MD; Vandana Mahajan, MD; and George A. Edwards, MD

ABSTRACT. *Objectives.* Many authorities recommend an interval of at least 3 to 6 weeks after a urinary tract infection (UTI) before performing a voiding cystourethrogram (VCUG). However, such an interval may reduce the likelihood of completing the procedure. This study was performed to investigate whether the length of the interval between a UTI and the performance of the VCUG influences the presence or severity of reflux, and whether it influences the likelihood of actually having the study performed.

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 ($\chi^2 = .034$; $DF = 1$). 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. *Pediatrics* 2000;105(4). URL: <http://www.pediatrics.org/cgi/content/full/105/4/e50>; *urinary tract in-*

fection, pyelonephritis, voiding cystourethrogram, vesicoureteral reflux.

ABBREVIATIONS. UTI, urinary tract infection; VUR, vesicoureteral reflux; VCUG, voiding cystourethrogram; CI, confidence interval.

Urinary tract infection (UTI) is a common problem in children, which occurs in up to 5% of girls and 1% to 2% of boys.¹ Vesicoureteral reflux (VUR) is present in 25% to 40% of children with acute pyelonephritis.² The combination of VUR and UTI may predispose children to pyelonephritis, renal scarring, hypertension, and chronic renal disease.³ To evaluate for reflux most authorities recommend a voiding cystourethrogram (VCUG) on all males and younger females 3 to 6 weeks after the first UTI.^{4–6} It has been hypothesized that there may be transient reflux immediately after a UTI secondary to inflammatory changes at the ureterovesical junction.⁷ If this reasoning is correct, then reflux should occur more commonly when the VCUG is performed earlier than when it is performed later. It has also been suggested that acute infection may cause ureteral dilatation, which may falsely overestimate the grade of reflux.^{8,9} If so, one should find higher grades of reflux in children with VCUG performed earlier compared with later.

There is a potential risk of waiting 3 to 6 weeks before performing the VCUG. During the 3- to 6-week interval, patients who may have VUR and be at risk for chronic renal disease may fail to show up for the scheduled VCUG and thus risk loss of follow-up. We analyzed patients' records at the Children's Hospital of Austin to evaluate whether the timing of VCUG after UTI influenced the presence or severity of VUR and whether the timing of VCUG influenced the likelihood of completion of this study.

METHODS

We performed a retrospective chart review of 352 admissions whose discharge diagnoses indicated UTI at the Children's Hospital of Austin over a 27-month period from October 1994 to December 1996. Patients included both males and females <10 years old. For inclusion in the study, patients had to have a documented UTI and a scheduled VCUG. A UTI was defined as growth of a potential urinary pathogen at any concentration if urine was obtained by bladder tap, growth of greater than 1000 colony-forming units/mL if urine was obtained by catheterization, or growth of greater than 100 000 colony-forming units/mL if urine was obtained by clean catch voiding. Patients whose urine was obtained by a urine collection bag were excluded. VCUGs

From the Department of Pediatrics, Central Texas Medical Foundation, Children's Hospital of Austin, Austin, Texas.

Received for publication May 4, 1999; accepted Nov 19, 1999.

Reprint requests to (G.A.E.) Department of Pediatrics, Children's Hospital of Austin, 601 E 15th St, Austin, TX 78701. E-mail: gaedwards@seton.org. PEDIATRICS (ISSN 0031 4005). Copyright © 2000 by the American Academy of Pediatrics.

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

Reflux 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 reflux 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

TABLE 1. Exclusion Criteria

Failed to meet UTI criteria	30 (21%)
Diagnosis not supported in chart	26 (19%)
Previous hospitalization for UTI	27 (19%)
Other genitourinary anomalies	23 (17%)
Previous history of reflux	15 (11%)
No VCUG scheduled	8 (6%)
Other	10 (7%)
Total	139 (100%)

TABLE 2. Reflux and Timing of VCUG

	Early Group (VCUG ≤ 1 Week; $n = 142$)	Late Group (VCUG > 1 Week; $n = 34$)
Reflux	27 (19%) 95% CI: 12.9–26.4	6 (18%) 95% CI: 6.7–34.5
No reflux	115 (82%)	28 (81%)
Total	142 (100%)	34 (100%)

$\chi^2 = .034$; $DF = 1$; $P = .854$.

TABLE 3. Performance of Scheduled VCUG

	Early Group (VCUG ≤ 1 Week; $n = 142$)	Late Group (VCUG > 1 Week; $n = 71$)
VCUG performed	142 (100%)	34 (48%) 95% CI: 35.9–60.1
VCUG not performed	0 (0%)	37 (52%)
Total scheduled	142 (100%)	71 (100%)

$\chi^2 = 89.6$; $DF = 1$; $P < .001$.

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 kidneys^{12,13} 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

TABLE 4. Distribution of Grades of Reflux

	Early Group (VCUG \leq 1 Week; n = 27)	Late Group (VCUG >1 Week; n = 6)
Grade 1	1 (4%)	0 (0%)
Grade 2	7 (26%)	2 (33%)
Grade 3	13 (48%)	3 (50%)
Grade 4	4 (15%)	1 (17%)
Grade 5	2 (7%)	0 (0%)
Total	27 (100%)	6 (100%)

Fisher's exact test; $P = 1.000$.

TABLE 5. Time Intervals Between UTI and VCUG

	Early Group (VCUG \leq 1 Week; n = 142)	Late Group (VCUG >1 Week; n = 34)
0-7 d	142 (100%)	
8-14 d		4 (12%)
15-21 d		6 (18%)
22-28 d		7 (20%)
>28 d		17 (50%)
Total	142 (100%)	34 (100%)

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 work²² 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 study²¹ 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

We thank Charlotte Payton Ross, research coordinator, Central Texas Medical Foundation, for her assistance in data entry and administrative support and Dr Betsy Greenberg for statistical assistance. We also thank Dr Vaishalee Jambaulikar and Dr Nelson Spinetti for their assistance in collecting the data.

REFERENCES

1. Syed A, Swedlund S. Evaluation and treatment of urinary tract infections in children. *Am Fam Physician*. 1998;57:1573-1580
2. Hellerstein S. Urinary tract infections: old and new concepts. *Pediatr Clin North Am*. 1995;42:1433-1457
3. Holland N, Jackson E, Kazee M, Conrad G, Ryo U. Relation of urinary tract infection and vesicoureteral reflux to scars: follow up of thirty-eight patients. *J Pediatr*. 1990;116:S65-S71
4. Avery M, Mandell J, Simmons C, Harmon W, First L. Genitourinary tract infections. In: Avery M, First L, eds. *Pediatric Medicine*. Baltimore, MD: Williams & Wilkins; 1989:611-614
5. Gonzalez R. Urologic disorders in infants and children. In: Behrman R, Kliegman R, Arvin A, eds. *Nelson Textbook of Pediatrics*. 15th ed. Philadelphia, PA: WB Saunders Co; 1996:1527-1553
6. Gordon I. Imaging the kidneys and urinary tract. In: Holliday M, Barratt M, Avner E, eds. *Pediatric Nephrology*. 3rd ed. Baltimore, MD: Williams & Wilkins; 1994:421-437
7. Hellerstein S. Classification of patients with urinary tract infections. In: *Urinary Tract Infections in Children*. Chicago, IL: Yearbook Medical Publishers, Inc; 1982:15-29
8. Rushton G, Belman B. Vesicoureteral reflux and renal scarring. In: Holliday M, Barratt M, Avner E, eds. *Pediatric Nephrology*. 3rd ed. Baltimore, MD: Williams & Wilkins; 1994:963-986
9. Hellstrom M, Jodal U, Marild S, Wettergren B. Ureteral dilatation in children with febrile urinary tract infection or bacteriuria. *AJR Am J Roentgenol*. 1987;148:483-486
10. International Reflux Study in Children. International system of radiographic grading of vesicoureteral reflux. *Pediatr Radiol*. 1985;15:105-109
11. Andrich M, Massoud M. Diagnostic imaging in the evaluation of first time urinary tract infection in infants and young children. *Pediatrics*. 1992;90:436-441
12. Blickman J, Taylor G, Lebowitz R. Voiding cystourethrography: the initial radiologic study in children with urinary tract infection. *Radiology*. 1985;156:659-662
13. Stephens F. Urologic aspects of recurrent urinary tract infection in children. *J Pediatr*. 1972;80:725-737
14. Rushton G. Genitourinary infections. In: Kelalis P, King L, Belman B, eds. *Clinical Pediatric Urology*. 3rd ed. Philadelphia, PA: Harcourt Brace Jovanovich, Inc; 1992:286-363
15. Merrick M, Notghi A, Chalmers N, Wilkinson A, Uttley W. Long

- term follow up to determine the prognostic value of imaging after urinary tract infections. Part 2: scarring. *Arch Dis Child*. 1995;72:393–396
16. Harmon W, Mandell J. Urinary tract infections. In: Avery M, First L, eds. *Pediatric Medicine*. 2nd ed. Baltimore, MD. Williams & Wilkins; 1994:685–688
 17. Roth D, Gonzales E. Urinary tract infection. In: Oski F, DeAngelis C, Feigin R, McMillan J, Warshaw J, eds. *Principles and Practice of Pediatrics*. 2nd ed. Philadelphia, PA: JB Lippincott Co; 1994:1770–1772
 18. Burns E, Pratt A, Hendon R. Management of bladder neck obstruction in children. *JAMA*. 1955;157:570–574
 19. King L, Surinan M, Wendel R, Burden J. Vesicoureteral reflux: a classification based on cause and the results of treatment. *JAMA*. 1968;203:169–174
 20. Gross GW, Lebowitz RL. Infection does not cause reflux. *Am J Radiol*. 1981;137:929–932
 21. Craig J, Knight J, Sureshkumar P, Lam A, Onikul E, Roy P. Vesicoureteral reflux and timing of micturating cystourethrography after urinary tract infection. *Arch Dis Child*. 1997;76:275–277
 22. Horowitz M, Glassberg K. Vesicoureteral reflux. In: O'Donnell B, Koff S, eds. *Pediatric Urology*. 3rd ed. Oxford, UK: Butterworth-Heinemann; 1997:440–455

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

DOI: 10.1542/peds.105.4.e50

Updated Information & Services

including high resolution figures, can be found at:
<http://pediatrics.aappublications.org/content/105/4/e50>

References

This article cites 13 articles, 3 of which you can access for free at:
<http://pediatrics.aappublications.org/content/105/4/e50#BIBL>

Subspecialty Collections

This article, along with others on similar topics, appears in the following collection(s):

Urology

http://www.aappublications.org/cgi/collection/urology_sub

Letter from the President

http://www.aappublications.org/cgi/collection/letter_from_the_president

Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:

<http://www.aappublications.org/site/misc/Permissions.xhtml>

Reprints

Information about ordering reprints can be found online:

<http://www.aappublications.org/site/misc/reprints.xhtml>

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

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

DOI: 10.1542/peds.105.4.e50

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/105/4/e50>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since 1948. Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2000 by the American Academy of Pediatrics. All rights reserved. Print ISSN: 1073-0397.

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

