Research Roundtable Summary

25

TWENTY-FIFTH

in a Series of Seminars

on MCHB-funded

Research Projects

Emergency Department Screening for UTI in Febrile Children

June 10, 1999 • Parklawn Building, Chesapeake Conference Room

Kathy Shaw, M.D.

Professor of Pediatrics, University of Pennsylvania School of Medicine

Reactor

Alejandro Hoberman, M.D.

Associate Professor of Pediatrics, University of Pittsburgh School of Medicine

Moderator

Rita A. Haggerty

Public Health Analyst
Maternal and Child Health Bureau

U.S. Department of Health and Human Services
HRSA
Health Resources and Services Administration
Maternal and Child Health Bureau

This series is sponsored by the Maternal and Child Health Bureau and coordinated by the National Center for Education in Maternal and Child Health (NCEMCH). This publication was produced by NCEMCH under its cooperative agreement (MCU-119301) with the Maternal and Child Health Bureau, Health Resources and Services Administration, U.S. Department of Health and Human Services. For more information, please contact Jolene Bertness, NCEMCH, (703) 524-7802.

Research Roundtable #25 Summary

Emergency Department Screening for UTI in Febrile Children

About This Series

The Research Roundtable Series, sponsored by the Maternal and Child Health Bureau (MCHB), disseminates the results of MCHB-funded research to policymakers, researchers, and practitioners in the public and private sectors. The results of these projects influence future service, research, and policy development. The Research Roundtable sessions provide an opportunity for researchers to discuss their findings with policymakers, MCH program directors, service providers, and other health professionals.

The MCHB Research Program is directed by Dr. Gontran Lamberty and administered through the Division of Systems, Education and Analysis, MCHB, Health Resources and Services Administration (HRSA), U.S. Department of Health and Human Services. The purpose of the research program is to support applied research relating to maternal and child health services that shows promise of substantial contribution to the advancement of these services.

Presentation of Research and Relevant Findings

Statement of the Problem

The high prevalence and significant morbidity of urinary tract infection (UTI) in young children make evaluation of the febrile child in the emergency department (ED) for UTI an important issue. Nuclear scans suggest that 68 percent to 78 percent of febrile young children with UTI have pyelonephritis, putting them at risk for scarring and long-term sequelae of hypertension and renal failure.[1,2] It has therefore been advocated that clinicians adopt a low threshold for screening for UTI, even in children whose fever might be due to an alternative source, such as viral illness or upper respiratory infection.[3,4]

Little reliable information exists about the prevalence of UTI among febrile pediatric ED patients, and there is much debate about the most appropriate clinical and laboratory criteria for diagnosing UTI in the ED.[5–7] Reliable screening tests for UTI and clinical predictors are needed to help clinicians identify which febrile young children in the ED are at high risk for UTI. This information, along with an analysis of cost-effectiveness, will help guide individual ED practitioners, institutional providers, and policymakers in their decision making.

Research Questions

This study considered the following questions: (1) What is the prevalence of UTI among febrile boys younger than 1 year and girls younger than 4 years in a high-volume pediatric ED? (2) What are the sensitivity, specificity, and predictive values of rapid screening tests for UTI? (3) Can clinical predictors be identified and a clinical predictive model be used to stratify febrile

young children without a documented source of fever in the ED for risk of UTI? (4) What is the cost-effectiveness of alternative management strategies for screening for suspected UTI in the evaluation of febrile young children in the ED?

Population Description and Sampling Plan

A prospective cross-sectional concordance study of all febrile babies younger than 1 year of age and girls 1 to 4 years of age, excluding those with a documented source of fever, was conducted in the ED of The Children's Hospital of Philadelphia during a 12-month period to determine the prevalence of UTI and the sensitivity, specificity, and predictive values of rapid screening tests for UTI. From 1995 to 1996, 4,095 febrile children were eligible for the study, and 76 percent (3,130) had urine cultures obtained. Urine cultures were obtained for only 60 percent of the 1,181 febrile girls older than age 2 years compared with 83 percent of the 2,914 babies younger than age 2.

Research Findings

Overall UTI prevalence in febrile babies younger than age 2 in the ED was 3.3 percent (95% confidence intervals [CI] = 2.6, 4.0). The highest prevalence rate occurred in white girls: 16.1 percent (95% CI = 10.6, 21.6). A laboratory study should be conducted to test the hypothesis that racial differences may be due to differences in blood group antigens on the surface of uroepithelial cells that may affect E. coli adherence.

Sensitivity, specificity, and predictive values of the screening tests for UTI were determined at different definitions of a positive result. The enhanced urinalysis was most sensitive at predicting UTI (94 percent [95% CI = 83, 99]) but had lower specificity (84 percent [95% CI = 82, 86]) and lower positive predictive value than the urine dipstick or Gram's stain.

Using only those factors with good reliability and reproducibility, regression analysis revealed five clinical predictors and factors independently associated with UTI in febrile girls younger than 2 years: race, temperature of 39°C or higher, age younger than 1 year, fever history 2 days or more, and absence of an alternative source for the fever. This model had an area under the curve of 0.79, and the presence of any two factors predicted UTI with a sensitivity of 95 percent and a specificity of 31 percent.

A model with four predictive factors was identified for boys younger than 1 year: age younger than 6 months, being uncircumcised, absence of an alternative source of fever, and temperature of 39°C or higher. This model had an area under the curve of 0.84, and the presence of any one risk factor predicted UTI with a sensitivity of 1.00 and a false-positive rate of 0.47.

Finally, we compared the cost-effectiveness of several alternative management strategies for diagnosing and treating UTI in febrile young children. For girls, the most cost-effective strategy was to apply the following clinical decision rule: to send culture on all girls with two or more risk factors and to conduct no further testing in those with one risk factor or none. In the baseline analysis—meant to apply to an ED setting where loss to follow-up occurs—this strategy would have resulted in the treatment of 3,640 children with UTI, or 88 percent of all the children with UTI expected in the cohort, at an average cost of $865 per UTI treated.

In an office practice setting, where loss to follow-up is not a problem, the clinical rule–only strategy leads to successful treatment of 94 percent of all UTIs at a cost of $850 per UTI. For boys, use of the clinical prediction rule to identify children needing culture (any of four risk factors present) leads to successful treatment of almost 90 percent of the UTIs expected in the cohort, at an average cost of $955 per case treated.

Reactor Response

How to best evaluate and manage infants and young children who have a fever with no apparent source is controversial. Although universal immunization has substantially reduced the frequency of invasive bacterial infections in early childhood, febrile infants and young children can still contract a urinary tract infection (UTI). UTI remains the most common serious bacterial illness among febrile infants and young children. If it is not appropriately evaluated and managed, it can contribute to permanent renal damage.

The findings of the study by Dr. Shaw, of Children's Hospital of Philadelphia, are remarkably similar to those of an initial study we conducted at Children's Hospital of Pittsburgh. We reported the overall prevalence of UTIs in febrile infants as 5.3 percent, a percentage just slightly higher than Dr. Shaw's. Both studies found UTIs to be considerably more common among white female infants and young children with high fever than among infants and young children in general.

In Dr. Shaw's study, which compares enhanced and dipstick urinalyses (UA) as screening tests for UTI, assessments were made daily rather than on fresh specimens. (The enhanced technique has been validated when used on fresh specimens, not on refrigerated specimens.) This difference might account for some of the differences in the two studies' results, given that white blood cells have been reported to lyse, depending on the urinary pH in refrigerated specimens. In spite of this methodological limitation, the enhanced UA performed as the most sensitive (94 percent) test, and at the most specific definitions it had the highest positive predictive value (80 percent) for identifying children with positive urine cultures. When dipstick UA was used, approximately 20 percent of patients who tested negative came up positive later, when culture results became available. This meant that a health professional had to attempt to contact parents, which can be difficult in the case of parents who use hospital emergency rooms for primary care. It is unclear how contaminants were accounted for in the study.

Dr. Shaw's study examines costs associated with the evaluation and management of fever in infants and young children, including the cost of reagents and controls, technicians' salaries and fringes, kits, time required to perform tests, and instrument depreciation. No information was provided about return visits, delays in treatment that led to an increased incidence of long-term morbidity (renal scarring), or costs of unnecessary treatment. For example, if hospitalization costs for the hypothetical cohort of 1,000 children had been accounted for, the cost of performing the dipstick UA screening test would have increased by $50 to $100 per patient, because the dipstick UA screening test is not as reliable as the enhanced test, and use of the latter thus results in a higher percentage of children being hospitalized. Valid indicators of screening effectiveness should have included (1) the proportion of children with true UTIs who were successfully brought to treatment, and (2) the length of time between initial presentation and the start of definitive treatment. These measures were not provided, and no long-term outcomes—the incidence of reinfections and the incidence and extent of renal scarring—were reported.

Dr. Shaw's project also includes the development of clinical predictor rules to identify infants and young children with UTIs. The presence of at least two predictors (white female, temperature $\geq 39°C$, age < 1 year, history of at least 2 days of fever, and absence of an alternative source of fever) had acceptable accuracy in identifying children with UTIs. However, predictor rules were tested in the same population in which they were derived. In general, these rules fail to perform as well when applied to a different population. Therefore it seems reasonable to recommend validation of the prediction rules in another subset of patients.

In summary, Dr. Shaw's study adds to an impressive body of information gathered on UTI in infants and young children. This body of information has resulted in an increased awareness of UTI, more aggressive and earlier screening leading to prompt treatment, and reduced long-term morbidity.

References

1. Benador D, Benador N, Slosman DO, Nussle D, Mermillod B, Girardin E. Cortical scintigraphy in the evaluation of renal parenchymal changes in children with pyelonephritis. *Journal of Pediatrics* 124:17–20.

2. Winberg J. 1992. Commentary: progressive renal damage from infection with or without reflux. *Journal of Urology* 148:1733–1734.

3. Hoberman A, Han-Pu C, Keller DM, Hickey R, Davis HW, Ellis D. 1993. Prevalence of urinary tract infection in febrile infants. *Journal of Pediatrics* 123:17–23.

4. Baraff LJ, Bass JW, Fleisher GR, et al. 1993. Practice guideline for the management of infants and children 0 to 36 months of age with fever without source. *Annals of Emergency Medicine* 22(7):1198–1210.

5. Hoberman A, Wald ER, Reynolds EA, Penchansky L, Charron M. 1994. Pyuria and bacteriuria in urine specimens obtained by catheter from young children with fever. *Journal of Pediatrics* 124(4):513–519.

6. Landau D, Turner ME, Brennan J, Majd M. 1994. The value of urinalysis in differentiating acute pyelonephritis from lower urinary tract infection in febrile infants. *Pediatric Infectious Disease Journal* 13(9):777–781.

7. Hoberman A, Wald ER, Reynolds EA, Penchansky L, Charron M. 1996. Is urine culture necessary to rule out urinary tract infection in young febrile children? *Pediatric Infectious Disease Journal* 15(4):304–309.

NCEMCH

National Center for Education in Maternal and Child Health

Georgetown University