

# The Frequency and Natural History of Urinary Tract Infection in School Children\*

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This presentation reviews briefly investigations of the epidemiology and natural history of urinary tract infections in school children conducted during the past four years in Central Virginia. The results of this work will be summarized and their implications discussed.

## Urine Culture Methods

The clean-voided, quantitative pour-plate urine culture was performed throughout. Cases were defined as children with three consecutive positive cultures (criterion  $1 \times 10^5$  bacteria per ml). Almost all cases were confirmed by culture of urine obtained by catheter at the time of the urologic study. *E. coli* were serotyped according to their O and H antigens.

## The Population

Following a pilot study of 3,057 children in Waynesboro, Virginia, in 1959, full scale surveys of school children in Charlottesville-Albemarle County, Virginia, were conducted in 1960-61 and 1962-63. Participation was 85% in the pilot study and 90% of all children enrolled in school in the full scale surveys. Altogether, more than 20,000 cultures have been performed on specimens from 16,000 per-

sons. A prospective study of a cohort of girls begun when they first enrolled in school is still underway.

## Frequency of Bacteriuria

The prevalence of bacteriuria was 1.2% in school-aged girls and 0.04% in school-aged boys. Prevalence was about the same in Negro and white girls, equally distributed in urban and rural areas and constant in all three studies. The prevalence of silent bacteriuria was significantly higher in older Negro girls (15-19) than in white girls or younger Negro girls. Incidence of silent bacteriuria over a two-year period was 0.7% and the same in whites and Negroes. Incidence of overt urinary tract infection in school girls during the same period was 3.6% and higher in white than Negroes (5.3% and 1.1% respectively).

## Characteristics of Cases

One hundred and twenty two bacteriuric children were discovered in these surveys. Pyuria (four or more WBC/hpf) was present in almost 50%; past history of overt infection was reported by almost one third; and 40% had symptoms, usually referable to the lower urinary tract. Urologic studies (IVP and cystogram) were performed in 107 cases. Intravenous pyelograms revealed some abnormality in 22; caliectasis was present in 14; and 4 had reduplication of the collecting system. Cystograms revealed some ab-

normality in 40 children including reflux in 20, large bladder in 11, small bladder in 5 and trabeculation in 13. Lesions detected on IVP and cystogram were significantly ( $P < .05$ ) more frequent in white than Negroes. Pyuria, past history of infection and symptoms were not reliable indicators of the presence or absence of abnormalities later found on urologic study.

## Therapy and Recurrence

Most cases were initially treated with sulfonamides for a period of two weeks. Recurrences were first treated with a second course of sulfonamide and, if frequent, with tetracycline, nitrofurantoin or other appropriate drugs. Recurrences were frequent. For example, at the end of one year, 65% of white girls had at least one recurrence. The recurrence rate in Negro girls (18.2%) was significantly lower than in whites ( $P < .01$ ) at one year. Recurrences were analysed as being due to endogenous relapse (recurrence of the same *E. coli* serotype or same bacterial species other than *E. coli*) or to reinfection (appearance of a new *E. coli* serotype or a new species in the urine). Most recurrences (about 80%) were thought to be due to reinfection rather than to endogenous relapse, and possibly related to inadequate therapy. This indicates that this population with cases of bacteriuria is distinctly different from the general population of school children in which bacteriuria is

\* Presented at the Second Annual Kidney Symposium, Virginia Chapter, National Kidney Disease Foundation, Richmond, October 16, 1964.

relatively rare. One possible implication is that females who develop pyelonephritis during the reproductive years emerge from this group of children with frequently recurrent bacteriuria.

Frequency of recurrences could not be related to the previous findings of caliectasis, reflux or trabeculation on urologic study, suggesting that the entrance and persistence of bacteria in the urine is not related to these abnormalities. This does not necessarily indicate that structural abnormalities may not be important in the genesis of infection of the upper urinary tract once bacteriuria is established.

#### Antibody Response to Infection

All children studied over the age of two had circulating antibodies to a wide variety of *E. coli* O antigens including those most commonly found in children (reported by us) and adults (reported by others). The common types of *E. coli* are 0, 1, 2, 4, 6, 7, and 75. Enteropathic *E. coli* were not found in urinary tract infections. A rise of antibody titer in association with bacteriuria was rarely observed in the current series of cases and persistence of constant antibody titers for many months was commonly observed.

#### Summary

This brief summary of our studies of urinary tract infection in school children indicates that bacteriuria is frequent enough among girls to make surveys of this type quite practical both as a community effort and an office practice. The ultimate significance of bacteriuria is unknown, but about 10% of the cases found had important urologic lesions (including the megacystis syndrome) which would not have been detected if these studies had not been conducted. Long term follow-up of cases, now underway, may help to determine the true significance of bacteriuria.

#### Acknowledgement

The studies reported were conducted in coöperation with Dr. Albert Paquin, Jr., professor of urology, University of Virginia School of Medicine.

#### The Scholar as a Teacher

"... I hold that no teacher—no matter how skilled—can so well present a subject as when he himself is working in that field. It is a truism that a member of a university community of scholars must himself be engaged in scholarly work. There is nothing like the combination of clinical problems at the bedside and dirty hands in the laboratory to teach the teacher. A prime prerequisite for scholarly work is a curious and inquiring mind. Attempting to answer any single question in depth soon disciplines omnivorous curiosity. Many problems can be approached only by carefully planned and slowly developed data, and no problem is solved until it is formulated and worked out and the data analyzed and published. 'Publish or perish' is more than a scoffer's jibe. The investigator who does not publish his results has not completed his research problem, made full use of his data, or justified the financial support intended to increase available human knowledge. 'Reading maketh a full man; conference a ready man; and writing an exact man.' And I mean writing for professional journals—not for the lay press. It is also true that when a problem presents itself on the ward or in the clinic, nothing is more apt than Claude Bernard's aphorism, now 99 years old, that 'chance favors the prepared mind' (Bernard, C. *Introduction a l'Étude de la Médecine Expérimentale*. Paris: Baillière, 1865).

"The exact influence of research on teaching is, of course, hard to assess. Certainly enthusiasm is an important teaching instrument, and the person intensely engaged in work on a subject about which he is teaching is the best possible person to create an enthusiastic reception on the part of the student. To my mind, a scholar who is himself working on the subject which he teaches is also the person most aware of the pitfalls, dubieties, uncertainties and qualifications involved. Such caution should contrast greatly with the glib veneer of the nonscholar. Glib over-

simplification may sell soap, but it should not be the tool of the scholar. In the academic community, teaching is not a popularity contest and the teacher must aim at clarification rather than simplification. Who knows better the limitations of knowledge than the man who is himself striving to extend the frontiers of that knowledge?"

Gilbert S. Gordon, M.D.,  
Credo, *Postgraduate Medicine* 36: 630-633, 1964.