General Practice Observed

Incidence and outcome of symptomatic urinary tract infection in children

J A DICKINSON

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Summary and conclusions

The incidence of symptomatic urinary tract infection in 2879 children aged under 15 years was studied over 18 months in a single general practice. Infection was diagnosed if bacterial counts in three consecutive samples exceeded 100 000/ml. The incidence of urinary tract infection was 1.7 per 1000 boys at risk per year and 3.1 per 1000 girls. These values are lower than those of comparable studies, possibly because of the stricter diagnostic criterion used in the study. Urinary pus cell counts were also carried out and sometimes found to be misleading. Of the 14 children found to have an infection, three had a radiological abnormality. Five of the children had a recurrence of infection within the first two years, and one an asymptomatic bacteriuria seven years after diagnosis. Only six out of 34 children presenting with dysuria had infected urine, and an association was discovered between abacterial dysuria (or the urethral syndrome) in the remainder and a concurrent upper respiratory tract infection.

All children should undergo radiological investigation after their first confirmed infection. Diagnosis and management could be improved by providing all general practitioners with a semiquantitative method of urine culture such as the dip slide.

Introduction

The potentially harmful effect of recurrent urinary tract infections on the growing kidney was shown radiologically by Hodson and Wilson in 1965, so early and accurate diagnosis is important. Several workers have reported on the prevalence of bacteriuria in schoolchildren, although the incidence of childhood symptomatic infection in general practice has been less well documented and criteria for diagnosis are often imprecise. Brooks and Houston based their diagnosis on a positive reaction to dip-slide culture, but with the exception of Mond et al, the yardstick of three consecutive cultures yielding over 100 000 bacteria/ml together with confirmatory pus cell counts has not been used.

Patients and methods

The semi-rural practice has five principals and is situated in South Humberside. The patients are predominantly from the Registrar General's social classes III, IV, and V. The number of children in the practice aged 14 or under during the 18-month survey was 2879 (1446 boys, 1433 girls). Children presenting with symptoms suggesting a urinary tract infection were all seen by me for diagnosis and management. The figure shows a referral form.

Urinary collection—No skin preparation was used on children under 2 years old. The remainder had their genitals washed with sterile water. A clean midstream urine specimen was obtained whenever possible, otherwise sterile Hollister urine collecting bags were used. Bag samples that yielded positive results on culture were checked against specimens obtained by suprapubic aspiration.

Analysis and diagnosis—Infection was diagnosed when bacterial counts in three consecutive specimens equalled or exceeded 100 000 of the same organism per ml in pure culture. I carried out the first two cultures in the surgery using the filter-paper strip technique described by Leigh and Williams and the local laboratory performed a third confirmatory bacterial count and sensitivity tests and identified the organism. Specimens were taken from home to the surgery or laboratory in a vacuum flask packed with ice. I carried out a urinary

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Name: ____________________________ Sex: ___  Date: __________
Address: ____________________________ Years: __  Months: ______

Presenting symptoms (please tick)

- Loin pain
- Abdominal pain
- Frequency
- Fever
- Enuresis
- Convulsions
- Haematuria
- Vomiting
- Irritability
- Offensive urine
- Chronic constipation

Has patient had an antibiotic in last 7 days?  Yes / No
Has patient had a respiratory infection in last 7 days?  Yes / No

Names and ages of siblings

(1) ____________________________ (3) ____________________________ (5) ____________________________
(2) ____________________________ (4) ____________________________ (6) ____________________________

Method of urine collection

Bag/MSU

H MSU contamination  Yes / No

Results

<table>
<thead>
<tr>
<th>pH</th>
<th>CC</th>
<th>BC</th>
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<td>8</td>
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</tbody>
</table>

Details of treatment

Investigations

Sibling morbidity

Referral form for children presenting with symptoms of urinary tract infection.

MSU = Midstream urine specimen. CC = Cell count. BC = Bacterial count.
white cell count on all specimens using an improved Neubauer counting chamber.

Management—The initial infection was treated with a 14-day course of an appropriate antibiotic, usually sulphonamide or ampicillin. Children with recurring infections received long-term antibiotic treatment. All the patients were referred to hospital for assessment, and most underwent radiological investigations. I followed up all patients regularly, at first monthly, then at longer intervals until they had been free of infection for at least two years. All the patients were recalled a mean of seven years after diagnosis. Samples were taken from siblings of all patients for urine culture.

Results

Incidence—During 18 months 156 children were investigated, 14 of whom were found to have an infection. Table I shows the incidence according to age and sex, expressed as the patient consulting rate per 1000 at risk per year. The girl:boy ratio was 2:1.

TABLE I—Yearly rates (consulting rate/1000 children at risk) of symptomatic urinary tract infections, according to age and sex

<table>
<thead>
<tr>
<th>Age (years):</th>
<th>0–2</th>
<th>2–14</th>
<th>Combined incidence (0–14 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>2.0</td>
<td>1.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Girls</td>
<td>0</td>
<td>3.8</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Presenting symptoms—Of the 14 children with infected urine, two boys and four girls presented with dysuria and frequency; two girls and one boy with abdominal pain; one boy and one girl with enuresis; one girl with loin pain; one girl with haematuria; and one boy with failure to thrive.

Organisms isolated—Urine samples in 10 of the children (nine girls and one boy) yielded a growth of Escherichia coli; Proteus sp in three boys; coagulase-negative staphylococcus in one boy.

Urinary white cell count—In 23 of the 142 urine samples without detectable bacterial contamination (six boys and 17 girls) pus cell counts exceeded 10,000/ml, five of which yielded 170–1000 cells/ml. Counts were carried out on two samples from each of 13 children with bacteriuria. One contained no pus cells, 12 20,1000-ml, and 13 exceeded 1000/ml.

Recent or concurrent infections—Of the 14 children with a urinary tract infection, three had had an upper respiratory tract infection within the previous week. Six children (five girls and one boy) had a history suggesting a previous urinary tract infection, and of these, all but one girl relapsed after treatment.

Radiological abnormalities—Three children had a radiological abnormality. A male neonate with Fallot's tetralogy was found to have only one kidney, which had a dilated pelvis. In another 6-year-old boy, with a long history of infection, pyelonephritic changes were seen in the left kidney, while evidence of bilateral pyelitis was found in a girl aged 11.

Recurrence—Within the first two years four girls and one boy had recurrent infections. Ten of the children were reviewed six to eight years after diagnosis. Evidence of infection was found in one girl. A review of all the medical records disclosed only one possible but unconfirmed urinary infection.

Siblings—The 14 children with urinary infection had 31 siblings. Urine samples from 29 (19 girls and 10 boys) were examined, but no evidence of infection was found.

Discussion

Mond et al.12 found that the yearly incidence of childhood urinary tract infection in a single practice was 1–4%. He screened all patients under 13 years of age on three occasions. Four of his patients had an asymptomatic infection and one presented with abdominal pain. Screening programmes for infection have shown that symptoms of infection are often ignored. Meadow et al.12 found that in all but one out of 10 schoolgirls symptoms of bacteriuria were clearly referable to the urinary tract. My report concerned the incidence of symptomatic urinary tract infection in children brought to the doctor. Loudon and Greenhalgh13 carried out a similar investigation in which evidence of infection was accepted as an unspecified degree of pyuria and a "positive culture." They found a yearly consulting rate for children up to 14 of 2.3 per 1000 boys at risk, and 10.8 per 1000 girls, and a girl:boy ratio of 4:1. Fry et al.14 who based their results on similar criteria, found a yearly incidence of 21 per 1000 girls, 70 per 1000 boys, and a girl:boy ratio of 3:1.

In Brooks and Houston's study diagnosis was confirmed by a positive result to a dip-slide culture, and yearly incidence was 3.8 per 1000 boys, 7.7 per 1000 girls, and girl:boy ratio of 2:1. My figures of 3.1 per 1000 girls at risk yearly and 1.7 per 1000 boys are much lower, possibly because I used a stricter diagnostic criterion. Table II shows a comparison of findings in children aged 0–14 years in the present series and others.

TABLE II—Comparison of estimated yearly rates of symptomatic urinary tract infection per 1000 children at risk, age 0–14 years

<table>
<thead>
<tr>
<th>Series</th>
<th>Boys</th>
<th>Girls</th>
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<tbody>
<tr>
<td>Loudon and Greenhalgh13</td>
<td>2.3</td>
<td>10.8</td>
</tr>
<tr>
<td>Brooks and Houston15</td>
<td>3.8</td>
<td>7.7</td>
</tr>
<tr>
<td>Present series</td>
<td>1.7</td>
<td>3.1</td>
</tr>
</tbody>
</table>

Nine of the 14 children presented with symptoms referable to the urinary tract. After children with obvious vulvitis or balanitis had been excluded, 34 children presenting with dysuria and frequency underwent investigation and only 6 (18%) were found to have infected urine. Williams16 reported a 24% infection rate in a large-scale study in Australia. This condition of dysuria and frequency with sterile urine has long been recognised in adults and called, perhaps unhelpfully, the "urethral syndrome." Mond et al.17 suggested that it might be caused by urethritis, and found that half of his patients had an excess of pus cells in their urine. Using the criteria of Braude et al.18 for normal urinary white cell counts in childhood, only 7% of my patients had clinically important pyuria. Of the 28 patients with the "urethral syndrome" and a concurrent upper respiratory tract infection compared with 21% of the infected group, and 24% of all patients who underwent investigation (156). An association between children with the "urethral syndrome" and a concurrent upper respiratory tract infection is significant (0.01 > P > 0.001). These findings suggest that some cases of dysuria may be due to the same infective agent as that causing the respiratory infection.

Many paediatricians dismiss plastic-bag collection as valueless for urine culture in babies, and false-positive rates as high as 64% have been recorded.19 The false-positive rate in this series was 6.6%, for 45 specimens. This low incidence of contamination may be due to the type of bags used (Hollister U bags), in which the collected urine is separated from the perineum by a system of valves; the immediate culture or refrigeration of all specimens; and the small number of neonates investigated. I found that the filter-paper strip method of urine culture was easy to perform and interpret. Only small amounts of urine were required. The false-positive rate of 2.1% is higher than that recorded by Leigh and Williams9 (0.7%) but they studied adult patients only.

The results of the urinary pus cell counts show the difficulty in defining the upper limits of normal if this method alone is used to diagnose an infection. If a cell count of 10/ml in uncentrifuged urine had been taken as the upper limit of normal, as suggested by Stansfeld,16 the number of false-positive diagnoses would have been 19 (13.3%) and there would have been one false-negative result (0.6%). If the higher figure of 200 cells/ml, as suggested by Masters and Lewis,14 had been adopted the false-positive cases would have been reduced to two (1.4%), but nine samples (5.7%) with clinically important bacteriuria would have been judged normal. Braude et al.18
proposed different diagnostic criteria according to age, sex, and methods of collection. Diagnosis according to their criteria would have resulted in 15 (10.5\%) false-positives and 6 (3.6\%) false-negatives.

The commonest infecting organism was *E coli*. Proteus infection was found in three boys. A predilection of this organism for the male urinary tract has been described by others.\(^1\)\(^2\) In one boy whose urine was repeatedly found to contain *Staphylococcus albus* pus cell counts in excess of 1500/ml and investigation showed scarring of his left kidney. Urinary infection with this organism has been described elsewhere in general practice.\(^1\)\(^9\)

Only one new case of infection was found in a child under the age of 2 years, most presenting at 3-8 years. This contrasts with results of hospital studies. Both Stansfeld\(^1\) and Smellie et al\(^2\) found the highest incidence in those aged under 1 year. The overall recurrence rate was 35\% within the first two years, but the long-term outlook in this small group, with careful follow-up and treatment, was good.

I thank the Sheffield Regional Board for financial help; my partners for referring patients for inclusion in this study; Dr R J M Bell, paediatric consultant at Scunthorpe General Hospital, for carrying out further investigations; the department of pathology at that hospital for technical help; and Mrs P Parks and Mrs V Laing for secretarial help.

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**Hospital Topics**

**Accuracy of diagnostic content of hospital activity analysis in infectious diseases**

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**Summary and conclusions**

Hospital activity analysis (HAA) was used to identify 2151 patients in whom the diagnostic code fell within the infectious disease categories of the International Classification of Disease. The clinical notes of these patients were examined by a doctor and in 414 (19.2\%) the diagnostic coding was incorrect. Diarrhoea and viral infections were miscoded most often.

The possibility of inaccuracy must be considered when HAA aggregated data are used for planning purposes. Accuracy could be improved if clinicians routinely completed the diagnostic sections of the HAA form.

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**References**


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**Introduction**

Hospital activity analysis (HAA) is a computer-based information system that allows the administrative, personal, and clinical details of patients to be brought together for analysis. The objectives of HAA were outlined by Benjamin. The Department of Health and Social Security made suggestions for its introduction and operation. Rowe and Brewer have described the development and applications of the system. Martini et al studied the accuracy of HAA data in Nottingham and concluded that the HAA system in that area is almost as good as the clinical notes from which it is derived. They also listed the few studies that have been published on the accuracy of HAA.

The HAA system in Wales covers all discharges from hospital, including those from maternity wards. The patients’ notes are used as the source of data. Form HMR 1 serves as the “front sheet” in the patients’ notes and as the input document for the computer. The operative and diagnostic sections are completed when the patient has been discharged. Unless medical staff are interested in data capture, these sections have to be completed by HAA clerks at hospital level. This is a source of potential error because of the difficulty a lay person may have in extracting accurate and relevant information from medical notes. The coding is undertaken at hospital level. Validation exercises on the accuracy of information noted on form HMR 1 are undertaken by the Welsh Office, but unless a medically qualified