

Urinary Pathogens in the Male

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It is accepted that, in the vast majority of cases, the route of infection in the urinary tract is ascending, and there is considerable evidence that in the female the infecting organisms originate in the bowel (Grüneberg, 1969). There is, as yet, insufficient understanding of the factors which determine the ability of a particular organism to establish itself in the urinary tract; in the case of *Escherichia coli*, the commonest urinary pathogen, it seems likely that the antigenic character of the organism and host factors each play a part. Much attention has been paid to the elucidation of this problem in the female, but the pathogenicity of bacteria in the male urinary tract has been studied less.

In 1971-72 we noticed the frequency of *Proteus* species as the infecting organisms in urinary infection in boys, in marked contrast to the predominance of *Escherichia coli* in girls. The incidence of *Proteus* infection in boys was also noticed by Bergström (1972) and Mann (1972).

We report some bacteriological data which suggest a possible explanation of this phenomenon.

Methods

The mid-stream urine (M.S.U.) specimens from children aged 1 to 12 years were cultured on cysteine lactose electrolyte deficient (CLED) agar at the request of their general practitioners for diagnostic, not screening, purposes. The laboratory provides instruction sheets, good collection and refrigeration facilities and dip-inoculation spoons (Mackey and Sandys, 1965) for use by patients at a distance. The quality of specimens received is good. The M.S.U.s from adult males with symptomatic urinary infection were received from practitioners and from hospital out-patient departments. 10^5 organisms/ml in pure culture was accepted as the criterion of urinary infection.

Swabs from the preputial sac (meatal area in circumcised boys) and from the perineal area were taken from 49 boys aged 2 to 12 years known to have had proven urinary infection, by a nurse in a hospital clinic. At the time the swabs were taken the urinary infection had been successfully treated. Preputial swabs were also taken from 51 boys in a control group by a nurse in a general practitioner's surgery. The boys in the control group were carefully matched for age and social class, had no history of urinary symptoms or evidence of urinary infection in the past, and had not received antibiotics within the previous week. None of the boys in either group had any evidence of balanitis; 4 boys in each group had been circumcised.

Results

From May 1974 to February 1975 inclusive, 52 episodes of urinary infection were diagnosed in 46 boys. Table I compares the infecting organisms with those in 223 episodes of infection in 191 girls during the same period. The difference in the relative number of *Proteus* to *E. coli* and coliform infections in the 2 sexes is highly significant. ($\chi^2 = 55.2 P = <0.001$) (Table I).

In addition, 43 M.S.U.s from 34 boys, and 48 M.S.U.s from 40 girls yielded a pure culture of 10^4 organisms/ml (Table II.)

Table III compares the organisms isolated from the preputial swabs of the boys in the urinary infection and control groups.

Table IV shows the organisms isolated from the perineal swabs of the boys in the urinary infection group. *Proteus* was isolated from only 1 boy.

In the light of these observations, an analysis was made of the organisms causing symptomatic urinary infection in adult males during 16 weeks from 1st December 1974. No postoperative or instrumented patients were included. Table V shows the infecting organisms. The difference in the relative incidence of *Proteus* and *E. coli* and coliform infections in the men under and over 60 years of age is significant. ($\chi^2 = 8.5 P = <0.01$). The difference between the boys of 1 to 12 years, and the men of 14 to 60 years is highly significant. ($\chi^2 = 21.65 P = <0.001$).

Table I

Organisms Causing Urinary Infection in Boys and Girls aged 1 to 12 Years inclusive. May 1974 to February 1975

Organism	Boys		Girls	
	No.	%	No.	%
<i>Esch. coli</i> and other coliforms	27	52	198	89
<i>Proteus</i> spp.	23	44	11	5
Coagulase negative staphylococci	2	4	7	6
<i>Staphylococcus aureus</i>	0		1	
<i>Streptococcus faecalis</i>	0		4	
Other streptococci	0		2	
Total	52	100	223	100

Table II

Organisms Isolated in Pure Culture of 10^4 /ml in Boys and Girls

Organism	Boys		Girls	
	No.	%	No.	%
<i>Esch. coli</i> and other coliforms	11	25	38	80
<i>Proteus</i> spp.	27	63	4	8
<i>Pseudomonas</i> spp.	0	12	2	12
<i>Streptococcus faecalis</i>	5		3	
<i>Staphylococcus aureus</i>	0		1	
Total	43	100	48	100

Discussion

Some preliminary conclusions can be drawn from these findings. It is well recognised that the organisms causing urinary infection in females are derived from the bowel and the proximity of the short urethra to the anal area facilitates ascending infection. The finding that swabs from the perineal area of boys known to have had urinary infection rarely yielded Gram-negative organisms suggests that the focus of infection in males is elsewhere. Swabs from the preputial sac yielded

Table III

Comparison of Preputial Flora in 49 Boys in the Urinary Infection Group and 51 Controls

Organisms	Urinary Infection Group 49 boys		Controls 51 boys	
	2-5 yrs	6-12 yrs	2-5 yrs	6-12 yrs
Gram-negative organisms in pure culture	0	4*	0	0
Mixed culture including Gram-negative organisms	10	11	5	0
Gram-positive organisms	11	12	11	17
No growth	0	1	3	15
Total	21	28	19	32

* *Proteus* 3, *Pseudomonas* 1.

Table IV

Organisms Isolated from Perineal Swabs from 49 Boys in the Urinary Infection Group.

Organism	No.	%
Mixed culture including Gram-negative organisms*	8	16
Gram-positive organisms	33	68
No growth	8	16
Total	49	100

* *Proteus* 1, *E. coli* and coliform 7.

Table V

Organisms Isolated from 95 Adult Males with Symptomatic Urinary Infection. December 1974 to March 1975

Organism	14-60 yrs		> 60 yrs	
	No.	%	No.	%
<i>Esch. coli</i> and other coliforms	63	88	12	52
<i>Proteus</i> spp.	5	7	7	30
<i>Pseudomonas</i> spp.	0	5	1	18
Coagulase-negative staphylococci	3		0	
<i>Streptococcus faecalis</i>	1		1	
Other streptococci	0		2	
Total	72		100	

Gram-negative organisms in 25 (51%) of the boys who had had urinary infection, *Proteus* predominating over other organisms in a ratio of nearly 2 : 1. These boys were distributed over the whole age range. In marked contrast, Gram-negative organisms were isolated from the preputial swabs of only 5 boys (10%) in the control group and all were under 6 years of age. It seems, therefore, that Gram-negative organisms are established in the preputial sac of only a small minority

of boys and that they tend to disappear after the age of 5, presumably as a result of better hygiene and full retractability of the foreskin. They may, however, persist in some boys and provide a focus of ascending infection. A pure culture of 10^4 organisms/ml was found in 43 M.S.U.s from 34 boys aged 1 to 12 years with symptoms of urinary infection (Table II). This observation and the finding that the preputial swabs yielded pure cultures in only 4 boys in the urinary infection group (Table III) suggests that these organisms may reside in the urethra or prostatic ducts. *Proteus* species predominated markedly over other Gram-negative organisms in the 10^4 cultures from boys, and also caused a significantly greater proportion of symptomatic infections in boys than in girls or in adult males below the age of 60 years.

This evidence, therefore, suggests that *Proteus* can become established in the urethra or preputial sac of pre-pubertal males, and that, at puberty, the situation alters. After the age of 60 years the proportion of *Proteus* infections appears to increase again. It seems possible that this phenomenon is related to prostatic secretion (Stamey *et al.*, 1968) and it merits further study.

Summary

Evidence is presented that the pathogens causing urinary infection in boys differ significantly from those causing infection in girls and in adult males. Studies of the prepuce flora in boys known to have had urinary infection and in matched controls suggest that the focus of infection is in the preputial sac or urethra, rather than the bowel as in girls. It is suggested that the difference in infecting organisms in boys and in adult males may be related to prostatic secretion.

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