

## Urinary tract infection in young women, with special reference to *Staphylococcus saprophyticus*

W. A. GILLESPIE, MARGARET A. SELLIN, PATRICIA GILL, MARY STEPHENS, L. A. TUCKWELL, AND A. L. HILTON

From the Departments of Microbiology and Venereology, Bristol Royal Infirmary, Bristol BS2 8HW, UK

**SUMMARY** Acute urinary tract infections in young women attending a clinic for sexually transmitted diseases were caused by the same bacteria, in the same proportions, as those that caused infections in women students. *Staphylococcus saprophyticus* biotype 3 (formerly called *Micrococcus* subgroup 3) was the commonest organism after coliform bacilli and caused about 30% of the infections. It was uncommon in women over 25 years of age and rarely caused asymptomatic bacteriuria in pregnancy. Most infections, irrespective of the causative organism, started soon after sexual intercourse, but neither the staphylococci nor the other organisms were associated with promiscuity, as judged by numbers of sexual partners or the incidence of sexually transmitted diseases. There was no evidence that the staphylococci were sexually transmitted. The reasons for the virulence of *Staph. saprophyticus* and its predilection for the urinary tract of young women remain unknown.

In previous, prospective studies of urinary infection in otherwise healthy young women in Bristol (nurses and students) only three causative organisms were identified (Kerr, 1973; Sellin *et al.*, 1975). About 60% of the infections were caused by *Escherichia coli*, 30% by a micrococcus biotype, and all the remaining 10% by *Proteus mirabilis*. The micrococcus, characterised by novobiocin-resistance and belonging to subgroup 3 of Baird-Parker (1963, 1965), has been reclassified as a staphylococcus on the basis of its DNA base ratio and is now named *Staphylococcus saprophyticus* biotype 3 (Buchanan and Gibbons, 1974).

Little is known about the pathogenesis of primary staphylococcal urinary infection. The organisms are rarely found in the external genital area or urethra of uninfected young women or in faeces. One possible route of infection might be by transmission from men during sexual intercourse. Staphylococcal urinary infections often follow intercourse, although admittedly they do not differ in this respect from coliform infections in women of similar ages. Nevertheless, the possibility of sexual transmission should be further investigated, and to do so we studied women attending a clinic for sexually transmitted diseases in order to determine whether urinary infections were related to promiscuity. For com-

parison we also studied the organisms causing asymptomatic bacteriuria in pregnancy; and we continued to identify the organisms causing urinary infection in women students.

### Patients and methods

Fresh midstream urine from women with dysuria who attended the department of venereology during 1974 and 1975 was examined microscopically and by quantitative culture (Sellin *et al.*, 1975). A dip-inoculum culture method with MacConkey and CLED medium (Mackey and Sandys, 1966) was used to detect significant bacteriuria (viable counts more than  $10^5$ /ml) in pregnant women at the antenatal clinic of the Bristol Maternity Hospital between 1 June 1976 and 30 June 1977. The same method was used to diagnose urinary infection in women students with dysuria who attended the University Health Centre between 1 October 1975 and 31 May 1977.

All micrococaceae were tested for novobiocin resistance and identified by Baird-Parker's (1963) method. Lactose-fermenting Gram-negative bacilli isolated from patients in the venereology and antenatal departments were recorded as coliform bacilli. Those from students were further identified and, as before, all were found to be *E. coli*.

Table 1 Causes of urinary tract infection in women in relation to age (years)

Organism	Students and nurses 1971-4* aged under 26	Students 1975-7 aged under 26	Venereology dept. patients 1974-5 aged:		Bacteriuria in antenatal patients 1976-7 aged:	
			Under 26	26 and over	Under 26	26 and over
Coliform bacilli	65 (63%)	36 (64%)	54 (63%)	34 (90%)	25	22
<i>Staph. saprophyticus</i> biotype 3	29 (28%)	17 (30%)	24 (28%)	2† (5%)	0	2‡
Proteus	9 (9%)	3 (6%)	8 (9%)	2 (5%)	0	0
Total	103	56	86	38	25	24

\*Sellin *et al.* (1975).

†Aged 26 and 28.

‡Aged 26 and 29.

Table 2 Urinary infection and sexually transmitted disease in patients under 26 years old

Organism	Patients with urinary infection in 1975	Attacks of sexually transmitted diseases*						
		No. previously			No. in 1975			Total
		G	T	H	G	T	H	
Coliform bacilli	25	8	5	2	3	2	0	20
<i>Staph. saprophyticus</i> biotype 3	14	4	3	0	3	2	0	12
Proteus	7	3	1	0	0	2	1	7

\*Some patients had more than one attack.

G = gonorrhoea. T = trichomoniasis. H = herpes.

## Results

A total of 124 patients at the department of venereology were found to have urinary infection with pyuria and colony counts above  $10^5$ /ml. The only causative organisms, as in the students and nurses, were coliform bacilli, *Staph. saprophyticus* biotype 3, and proteus. Symptoms of infection and pyuria were similar irrespective of the causative organism. In patients under 26 years of age nearly one-third of the infections were staphylococcal, a proportion that was virtually the same as in nurses and students. Staphylococcal infections were uncommon in older women (Table 1).

As in the nurses and students whom we had investigated previously, most infections in the venereology department patients started less than seven days after intercourse irrespective of the causative organism. Most patients were taking a contraceptive pill, but a few infections by each organism occurred in patients who used other contraceptive methods or none. In a further investigation of the patients who were seen in the department of venereology in 1975 no association was found between staphylococci or

other causative organisms of urinary infection and promiscuity as indicated by the incidence of sexually transmitted diseases (Table 2) or the numbers of sexual partners (Table 3).

The bacteriology of asymptomatic bacteriuria in pregnancy was different from that of overt infection in that staphylococci were uncommon (Table 1).

## Discussion

Pereira (1962) and Mitchell (1964, 1968) established one variety of coagulase-negative staphylococcus as a primary pathogen of the normal female urinary tract. This organism, subsequently named *Micrococcus* subgroup 3 and now renamed *Staphylococcus saprophyticus* biotype 3 (Buchanan and Gibbons, 1974), has been shown by several workers to be a common cause of primary urinary infection in young women (Mabeck, 1969; Kerr, 1973; Maskell, 1974; Meers, 1974; Sellin *et al.*, 1975). Other biotypes of *Staph. saprophyticus* occasionally cause urinary infection (Peard *et al.*, 1977). We have recently isolated biotype 2 from two infections not in this series. However, in our experience, *Staph. saprophyticus* (or *Micrococcus* subgroup 3) is still regarded as a contaminant by some practitioners, and consequently the infections may not be correctly treated. This is probably because other coagulase-negative staphylococci are indeed common contaminants in urine (although they may cause infection of an abnormal urinary tract), and also because staphylococcal (or micrococcal) infections have not been prominent in several previous surveys of primary

Table 3 Urinary infection in patients under 26 years old in relation to number of sexual partners

Organism	Patients with urinary infection in 1975			No. of sexual partners		
	No.	One	More than one	No.	One	More than one
Coliform	25	15	10			
<i>Staph. saprophyticus</i> biotype 3	14	9	5			
Proteus	7	4	3			

urinary infection in women—no doubt because most surveys have included women of all ages and primary staphylococcal infections are uncommon above the age of 25.

The pathogenesis of *E. coli* urinary infection is not fully understood but it is known that the organisms usually originate from the patient's intestine. Much less is known about the origin of *Staph. saprophyticus* infections or why they are common only in young women. In unpublished studies we failed to isolate this species from faeces of 32 healthy young women, using selective medium. However, Pead and Maskell (1977), using similar medium, isolated the staphylococci from rectal swabs from 15 out of 156 women. The staphylococcal urinary infections cannot be explained by the predominance of *Staph. saprophyticus* among the organisms that colonise the normal urethra or periurethral area. This organism was found only rarely and in small numbers in these sites in uninfected young women, where it was greatly outnumbered by other, non-pathogenic micrococcaceae (Sellin *et al.*, 1975). Although present on the skin, *Staph. saprophyticus* is not predominant there (Kloos and Musselwhite, 1975; Namavar *et al.*, 1977).

No evidence has yet been found that *Staph. saprophyticus* infection follows transmission from men during sexual intercourse. Although staphylococcal urinary infections often followed intercourse they did not differ in that respect from coliform infections in women of similar age, and staphylococcal infections were relatively no more common in promiscuous than in other sexually active women. These negative findings are in line with the rarity of *Staph. saprophyticus* biotype 3 in the urethra or prepuce of young men (Sellin *et al.*, 1975) and with the fact that it can cause infection in children (Hermansson *et al.*, 1974; Pead *et al.*, 1977).

The conclusion therefore seems unavoidable that *Staph. saprophyticus* biotype 3 differs from other micrococcaceae in being more virulent for the urinary tract of young women, but the reason remains obscure. It cannot be explained by the urease activity of the organisms (Sellin *et al.*, 1975) or by their ability to grow rapidly in urine (Anderson *et al.*, 1976). Our attempts to demonstrate adherence of *Staph. saprophyticus* to bladder epithelial cells, as reported by Edén *et al.* (1976) with some strains of *E. coli.*, have so far been negative.

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