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Antibiotic sensitivities of urinary pathogens isolated from patients in Liverpool, 1984–5

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SUMMARY

Urinary pathogens isolated from patients in general practice, an antenatal clinic and several hospitals in Liverpool during 1984–5 have been tested for antibiotic sensitivities. The proportion of sensitive organisms varied from antimicrobial to antimicrobial and from institution to institution. Isolates from all institutions showed high rates of sensitivity to cephradine, nalidixic acid and nitrofurantoin, and somewhat lower rates to trimethoprim. Significantly lower sensitivities were found to ampicillin and sulphamethoxazole indicating that neither ampicillin nor a sulphonamide is suitable for initial choice on a 'best guess' basis in the situation studied. In general, the organisms derived from the antenatal patients showed the highest rates of sensitivity and those isolated from patients in geriatric hospitals the lowest.

INTRODUCTION

It has been well documented that the organisms causing urinary infection are either different or isolated in different proportions in hospital and domiciliary practice (Brumfitt & Hamilton-Miller, 1977). Furthermore, these organisms and their antibiotic sensitivities vary from place to place and from time to time with considerable repercussion on the choice of treatment (Gruneberg, 1976, 1980, 1984). In 1971 the results of a multicentric study (McAllister *et al.* 1971) included the sensitivities of urinary isolates in Liverpool. We report new data on the sensitivities of urinary pathogens isolated in general practice (GP) and several hospitals in Liverpool in 1984–5.

PATIENTS AND METHODS

Urinary pathogens reported in this study were isolated from specimens sent to the Department of Pathology at Sefton General Hospital (SGH) from June 1984 to May 1985. Samples of urine were received from general practitioners (37%), Liverpool Maternity Hospital (LMH) with antenatal clinic (ANC) and Liverpool Women's Hospital (LWH) (39%) and several non-acute hospitals (NAH) (24%). The latter includes SGH, Mossley Hill Hospital (MHH), Princes Park Hospital (PPH) and Stapley Hospital. All these hospitals treat geriatric and psycho-geriatric patients. SGH also caters for psychiatric and chronic renal patients. The great

majority (over 90%) of specimens came from female patients. This is in part because more than a third of specimens derived from LMH and LWH and in part, because the samples sent by other groups came mostly from females (89% of specimens from GP, 86% from NAH).

The age of patients giving specimens varied from group to group. Seventy-two per cent of expectant mothers (ANC) were under 30 (100% under 40), whilst 72% of the patients from LMH and LWH were under 40. This contrasts with SGH where 65% of patients were over 60 and with the geriatric hospitals (MHH, PPH and Stapley) where 98% of patients were over 60 (59% over 80). In general practice, however, the age of patients was more or less evenly distributed, 53% being under 40.

Urine samples were allocated in sterile universal bottles and refrigerated at 4–6 °C until examined by the laboratory, usually within 6 h. Standard methods and media were used (Stokes & Ridgeway, 1980) for isolation, identification and determination of numbers of organisms present. However, organisms other than typical coliforms were identified by API 20E strips. Antibacterial sensitivities were determined by Stoke's method (Stokes & Ridgeway, 1980) slightly modified as Mastring-S instead of discs were used on Oxoid Diagnostic Sensitivity Test Agar with *Escherichia coli* NCTC 10418 as the control organism.

Difference in the sensitivity of urinary pathogens to various antimicrobials and differences in the sensitivity of isolates from different sources were checked for significance by the χ^2 test.

RESULTS

A total of 1749 urinary isolates were identified and their sensitivities determined. The types and numbers of organisms isolated from specimens received from various institutions are presented in Table 1. The proportions of all isolates from each source varied from institution to institution, *E. coli* being the most commonly isolated. Higher proportions of the latter were found in specimens received from ANC and GP than in specimens received from NAH or LMH and LWH. However, as can be seen from Table 1, the proportions of other types of organisms varied, e.g. klebsiella and other coliforms as well as enterococci and other streptococci were more common in specimens received from NAH or LMH and LWH.

Sensitivities to antimicrobials of all urinary pathogens except pseudomonas are compiled and presented in Table 2 in parallel with the sensitivities of *E. coli*.

It can be seen that the proportions of sensitive organisms varied from antimicrobial to antimicrobial and also from institution to institution. However, there were no significant differences in sensitivities of isolates from GP or from LMH and LWH ($P > 0{\cdot}50$). Isolates from all institutions showed high rates of sensitivity to nalidixic acid, nitrofurantoin and cephradine. With the exception of pathogens isolated from specimens derived from NAH, the organisms were sensitive in high proportions to trimethoprim. Sensitivity rates to ampicillin were found to be significantly lower when compared with sensitivities to nalidixic acid ($P < 0{\cdot}02$) and cephradine ($P < 0{\cdot}05$). However, when sensitivities to ampicillin were compared with sensitivities to nitrofurantoin and trimethoprim the differences were not statistically significant ($0{\cdot}50 > P > 0{\cdot}10$ for nitrofurantoin and $P > 50$ for

Table 1. *Urinary pathogens isolated from patients treated in various medical institutions in Liverpool, 1984–5*

	General practice		Antenatal clinic		Liverpool Maternity and Women's hospitals		Non-acute hospitals	
Organism	No.	%	No.	%	No.	%	No.	%
Escherichia coli	498	77·8	73	85·0	384	64·1	274	64·6
Proteus mirabilis	45	7·0	0	0	40	6·8	32	7·5
Klebsiella–Enterobacter spp.	32	5·0	6	7·0	54	9·0	39	9·2
Other coliforms	9	1·4	3	3·5	28	4·7	27	6·4
Staphylococci	42	6·6	2	2·5	29	4·8	10	2·4
Enterococci	8	1·3	1	1·0	44	7·3	24	5·7
Other streptococci	0	0	0	0	20	3·3	10	2·3
Pseudomonas aeruginosa	6	0·9	1	1·0	0	0	0	1·9
Total	640	100·0	86	100·0	599	100·0	424	100·0

Table 2. *Percentage of urinary pathogens sensitive to various antimicrobials*

Source of specimens, Liverpool 1984–5

	General practice		Antenatal clinic		Liverpool Maternity and Women's hospitals		Non-acute hospitals	
Drug	All isolates	*E. coli*	All isolates	*E. coli*	All isolates	*E.coli*	All isolates	*E. coli*
Amplicillin	62	59	72	71	62	59	49	47
Nalidixic Acid	88	98	97	100	85	98	89	96
Nitrofurantoin	88	96	100	100	86	97	79	94
Sulphamethoxazole	59	57	79	81	58	58	42	42
Trimethoprim	84	86	97	97	85	88	67	70
Cephradine	93	99	100	100	86	98	86	95

trimethoprim). Significantly lower sensitivity rates were found to sulphamethoxazole when compared to trimethoprim ($P = 0{\cdot}05$) or nalidixic acid, nitrofurantoin and cephradine ($P = 0{\cdot}001$).

It can be seen from Table 2 that sensitivity rates of *E. coli* were similar to the sensitivity rates shown by all isolates. As *E. coli* was the commonest pathogen isolated it appears that this organism is overall responsible for the pattern of sensitivity presented in Table 2.

DISCUSSION

Differences in the species distribution found in various institutions in Liverpool (Table 1) are in accordance with the reported differences in general practice and in hospital (McAllister *et al.* 1971, Grüneberg, 1976, Brumfitt & Hamilton-Miller, 1977). In the present study these differences are particularly emphasized between ANC (young and healthy pregnant women as outpatients) and other institutions

except GP (sick or geriatric sick patients). Thus, for instance, *E. coli* was responsible for 85% of infections in women attending ANC but for only 64% of hospital urinary infection.

The differences in the species distribution are in part responsible for the differences in antibiotic sensitivity of the urinary pathogens in the situations studied (Table 2). Thus, lower rates of sensitivity to nalidixic acid of organisms derived from LMH and LWH are due to a higher proportion of Gram-positive urinary pathogens isolated in these settings. Or, lower rates of sensitivity to nitrofurantoin of organisms isolated from specimens received from NAH can be explained by a higher proportion of *Proteus mirabilis* and other members of this genus (included under 'other coliforms') isolated from these specimens (Table 1). Nevertheless, when organisms of the same species are compared (e.g. *E. coli*, Table 2) there are still differences in antibiotic sensitivities in various situations, the lowest rates of sensitivity being in NAH.

There is little data on the sensitivities of urinary pathogens isolated from patients in Liverpool. However, the results of the multicentric study published more than a decade ago (McAllister *et al.* 1971) included some interesting findings from Liverpool. It was reported that at the time *E. coli* isolated from outpatients in Liverpool showed rather low rates of sensitivity to ampicillin and sulphonamide (75 and 72% respectively). This was explained by the fact that Liverpool outpatients contained a high proportion of chronic urological cases requiring frequent hospital care. However, the specimens were derived from one hospital only (Royal Infirmary) and some minor variations in sensitivity from one hospital to another should be anticipated (Percival, 1985, personal communication). When the above finding is compared to the results of the present study (59% of strains isolated in GP, LMH and LWH are sensitive to ampicillin and 57% to sulphamethoxazole) it appears that a significant decline in sensitivity occurred in Liverpool during the last decade. A similar drop in sensitivity of urinary *E. coli* from general practice for a period of 12 years was reported in London (Grüneberg, 1984). However, the latter decline was at different levels (91·4 to 77·7% for ampicillin, 77·3 to 70·9% for sulphonamide) suggesting again lower rates of sensitivity of at least *E. coli* to ampicillin and sulphamethoxazole in Liverpool.

The rational chemotherapy of urinary infection depends on many factors, the antibiotic sensitivity of urinary pathogens being one of the most important (Brumfitt & Hamilton-Miller, 1977). Although the choice of antibiotic should be made after the sensitivities of the causative organisms have been determined in the laboratory, in some circumstances, such as in the acute case, treatment must be started on a 'best guess' (McAllister *et al.* 1971, Grüneberg, 1976). Then general information on the sensitivities of urinary pathogens based on bacteriological statistics, may serve as an aid to the choice of treatment. So, in previous studies the antimicrobials have been either arranged in tables (McAllister *et al.* 1971) or ranked (Grüneberg, 1976, 1980, 1984) in order of *in vitro* effectiveness. Following our results on the sensitivities of urinary pathogens isolated in Liverpool (Table 2) the antimicrobials can be recorded in decreasing order of effectiveness as follows: in GP and ANC: cephradine, nalidixic acid or nitrofurantoin, trimethoprim, ampicillin, sulphamethoxazole; in LMH and LWH: cephradine or nitrofurantoin, nalidixic acid or trimethoprim, ampicillin, sulphamethoxazole; in

NAH: nalidixic acid, cephradine, nitrofurantoin, trimethoprim, ampicillin, sulphamethoxazole. The overall highest rank of cephradine probably reflects a rare administration of cephalosporins in the institutions studied: the present laboratory reports cephradine only when isolates are resistant to ampicillin (e.g. klebsiella). Other antimicrobials tested routinely are reported regularly. Nevertheless, a very high rank of nalidixic acid and nitrofurantoin is not surprising and our finding confirms that these antimicrobials (resistance to which is not plasmid mediated) have maintained their activities. Although trimethoprim is ranked behind the three antimicrobials above, it will continue to be a very useful drug. It has recently been shown that trimethoprim can replace co-trimoxazole not only in uncomplicated urinary infections, but also in more difficult recurrent urinary infections (Brumfitt *et al.* 1982). Ampicillin and sulphamethoxazole are at the end of the list and sensitive organisms are too few in number to use either ampicillin or a sulphonamide as initial choice without laboratory information on sensitivity of isolates.

It can be seen from this study that, despite a high rate of sensitivity of urinary pathogens to a number of antimicrobials, some deterioration does occur in various situations and therefore there is a need for review of the sensitivities from time to time.

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