The antibiogram and the distribution of *Proteus* organisms isolated from urinary tracts

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Introduction

THE EMERGENCE of bacteria highly resistant to a multiplicity of drugs has become one of the most important factors which determines the clinical application of chemotherapeutic agents. The frequency of occurrence of bacteria resistant to more than one drug is causing concern to the clinicians. In urinary tract infections, gram negative bacilli are mainly the chief offenders and bacteria resistant to more than one drug are very frequently isolated. (Yorio et al 1967).

The genus *Proteus* is very frequently associated with urinary tract infections and the fact that they are usually more resistant to the drugs normally employed is making it quite difficult to handle such bacterial infections. (Huang and Chuo 1968). The marked differences in the response of the various species of *Proteus* to the various drugs has been reported by Barber and Waterworth (1964). This report is to give an idea of the distribution of the various species of *Proteus* organisms isolated from patients who had, or were suspected of having urinary tract infections in the teaching hospital and also at the same time to discuss the nature of the drug resistant pattern and the extent of the spread of the multiple resistant strains of the organism.

Materials and Methods

Sources of strains

The 302 strains of *Proteus* organisms were isolated from clinical specimens of urines from the teaching hospital during routine examination. Gram negative bacilli showing swarming on blood agar and urease positive were picked up and subcultured on the MaConkey's agar. Individual colonies on MaConkey's agar were then inoculated into the various sugar media given in Table I. Peptone water, gelatine and phenylalanine deaminase test medium were also inoculated. Identification of the organisms is based on the method of Edwards and Erwing (1962).

Drug sensitivity tests

These were done by the discs plate method of Isenberg (1964). Five ml of a four to five hours' broth culture of the organism were used to flood nutrient agar plates. Excess fluid was removed by Pasteur pipettes and dried. Various discs, impregnated with drugs obtained commercially, were placed on the nutrient agar plates. Plates were incubated at 37°C overnight.

Results and Discussion

Table I shows the distribution of species of

TABLE I – BIOCHEMICAL TESTS USED FOR THE IDENTIFICATION OF PROTEUS SPECIES

Species	P. mirabilis	P. vulgaris	P. rettgeri	P. morganii
Glucose	+	+	+	+
Sucrose	+	+	+	–
Lactose	–	–	–	–
Maltose	–	+	–	–
Mannitol	–	–	+	–
Indole	–	+	+	+
Gelatin	+	+	–	–
Phenylalanine	+	+	+	+
Urease	+	+	+	+
No. of strains tested	290	7	3	2
Strains in %	96.3%	2.3%	0.9%	0.6%

TABLE II – DRUG RESISTANT PATTERN OF *PROTEUS* ORGANISMS

Organisms	No. of strains tested	No. of strains resistant to										
		P.	AMP.	S.	T.	CL.	K.	CR.	Ni.	SU.	NA.	NE.
P. mirabilis	290	115	28	31	118	6	33	18	117	191	12	25
P. vulgaris	7	5	3	0	6	0	0	3	2	7	0	0
P. rettgeri	3	3	2	2	3	2	2	3	3	3	0	1
P. morganii	2	2	1	1	2	0	0	2	1	2	0	0

P = Penicillin Amp = Ampicillin S = Streptomycin T = Tetracyclin
CL = Chloromycetin K = Kanamycin Su = Sulphatriad Ni = Nitrofurantoin
CR = Cephaloridin NE = Neomycin NA = Nalidixic Acid

TABLE III – MULTIPLE RESISTANCE PATTERN OF *PROTEUS* SPECIES

Organisms	Total No. of strains tested	Resistant to the number of drugs										
		1	2	3	4	5	6	7	8	9	10	11
P. mirabilis	290	17	35	69	54	13	7	10	5	2	1	0
P. vulgaris	7	0	0	2	2	3	0	0	0	0	0	0
P. rettgeri	3	0	0	0	0	0	1	0	1	0	1	0
P. morganii	2	0	0	0	1	0	0	1	0	0	0	0

Proteus organisms isolated from urine specimen. Among the four strains, Proteus mirabilis predominates and it constitutes more than 95% of the total isolates. Proteus mirabilis has been implicated as being one of the most common etiological agents of a majority of human infections caused by the genus *Proteus.* (Martin 1969). The results shown here concorded well with Martin's observation.

The pattern of antibiotic resistance and the extent of the spread of multiple resistant strains of the *Proteus* organisms are shown in Tables II and III. The results in Table II gives an indication of the negative response of the *Proteus* organisms to the following drugs, Penicillin, Tetracyclin, Nitrofurantoin and Sulphatriad. More than 40% of the Proteus mirabilis are resistant to the above mentioned four drugs, but in the case of the other three species not much can be said about them because of the small number of isolates.

The pattern of resistance of the organisms to a multiple of two, three, four and five drugs is given in Table IV. The drugs are Penicillin, Ampicillin, Streptomycin, Tetracyclin, Nitrofurantoin, Nalidixic Acid and Sulphatriad which are used in the treatment of urinary tract infections. As indicated in the table, a high proportion of the organism is showing a com-

TABLE IV – ORGANISMS SHOWING MULTIPLE RESISTANCE TO TWO, THREE, FOUR AND FIVE DRUGS

Organisms	Resistant to the groups of drugs					
	T/Su.	Ni/Su.	P/T/Su.	T/Ni/Su.	P/T/Ni/Su.	P/Amp/T/Ni/Su.
P. mirabilis	22(35)	8(35)	35(69)	25(69)	39(54)	13(13)
P. vulgaris			2(2)		2(2)	3(3)
P. rettgeri	All the three species are resistant to more than 5 drugs.					
P. morganii	–	–	–	–	1(1)	–

Figures in brackets indicates the total number of strains resistant to two, three, four and five drugs respectively as given in Table III.

T/su. = Tetracyclin and Sulphatriad
Ni/Su. = Nitrofurantoin and Sulphatriad
P/T/Su. = Penicillin, Tetracyclin and Sulphatriad
T/Ni/Su. = Tetracyclin, Nitrofurantoin and Sulphatriad
P/T/Ni/Su. = Penicillin, Tetracyclin, Nitrofurantoin and Sulphatriad
P/Amp/T/Ni/Su. = Penicillin, Ampicillin, Tetracyclin, Nitrofurantoin and Sulphatriad.

mon resistance to a combination of Penicillin, Ampicillin, Tetracyclin, Nitrofurantoin and Sulphatriad. Drugs like Penicillin, Tetracyclin, Nitrofurantoin and Sulphatriad are the least effective against the organisms, and this is clearly shown by the results in Tables II and IV.

The resistance of the organisms to one drug could be explained as being due to a process of selection and mutation. In the case of those organisms showing resistance to more than one drug, the selective and mutational process alone could not account for its development. Therefore, the frequency of occurrence of multiple resistant strains of *Proteus* organism may be due to the presence of an 'R' factor. The 'R' factor is an extrachromosomal element which is responsible for the transmission of the multiple resistant determinants from bacterial cells to bacterial cells on contact. The presence of such a factor among bacteria other than the *Proteus* isolated from urine has been reported by several workers. (Yorio et al 1967, Smith and Armor 1966). The nature and the role the 'R' factor played in the transfer of resistant determinants among the Enterobacteriaceae group of organisms except the *Proteus* has been well established and extensively documented. (Watanabe T. 1963, Watanabe T. and Fukoswa T. 1961, Watanabe T. Ogata C. and Sato S. 1964, Datta N. 1965 and Datta N. et al 1965). The result presented here is suggestive of the involvement of the 'R' factor and further work need to be caried out to try to establish the role the 'R' factor plays in the multiple resistant character of the *Proteus* organisms.

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