EVALUATION OF HOSPITAL ACQUIRED PSEUDOMONAS INFECTION IN PARAPLEGIC AND ORTHOPAEDIC CASES

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ABSTRACT

One hundred isolates of *Pseudomonas aeruginosa* from patients of the spinal cord injury and orthopaedic centre were evaluated on the basis of 2 laboratory assays; antibiotic sensitivity and pyocin typing. Antibiotic drug resistance was found in 54 per cent of the isolates. The urinary tract, pressure sores and wound swabs were the most common clinical specimens. Spinal cord injury patients showed a high rate of nosocomial colonisation. Ceftazidime, amikacin, norflox and ciprofloxacin were the most active antimicrobial agents. Gentamicin, carbenicillin and tobramycin showed high resistance. Pyocin typing with 22 strains did yield information to establish a clinico - epidemiological relationship.

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KEYWORDS : Antibiotic sensitivity; Pyocin typing; *Pseudomonas*.

Introduction

Infection remains a major cause of morbidity and mortality amongst patients of spinal cord injuries and orthopaedic cases. *Pseudomonas aeruginosa*, the best known of the non-fermentative, aerobic gram negative bacilli has acquired a sinister clinical reputation as a troublesome pathogen, characteristically prone to antimicrobial resistance [1,2]. Various studies have placed nosocomial *Pseudomonas aeruginosa* infection rate between 10-20 per cent of all in patient infections [3,4]. Hospital acquired mortality due to *Pseudomonas* bacteremia (35.51%) and *Pseudomonas* Pneumonia (70-90%) is high as shown in some studies [5,6]. Epidemiologic issues are often difficult to resolve because of the ubiquitous nature of *P.aeruginosa* in the environment as well as its frequency as a commensal organism in human [7].

This study was carried out to demonstrate prevalence of *Pseudomonas aeruginosa* and to establish an epidemiological relationship between the isolates by pyocin typing and antibiotic susceptibility to anti pseudomonal agents.

Material and Methods

One hundred *Pseudomonas aeruginosa* isolates were studied. They were obtained from clinical specimens like urine, bed-sore/wound swabs, from patients of the spinal cord injury centre and paraplegic home and orthopaedic cases. Twenty isolates of *Pseudomonas* were also evaluated from the environment. These were obtained from surface/throat/nasal swabs of nursing staff and from inert surface like bedpans, catheters, lotions and urine bottles. Sterile swabs moistened in 1 per cent dettol nutrient broth were used for collecting the specimens. After overnight incubation at 37° C, subcultures were made on cetrimide nutrient agar.

Identification of *Pseudomonas aeruginosa* isolates were done

on the basis of morphology, Gram stain, motility, oxidase test, pigment production on King A and King B medium, O-F test, growth at 42° C and arginine dihydrolase test. The antibiotic sensitivity of the isolates were determined by stokes method [10] using NCTC 10662 standard strain of *Pseudomonas aeruginosa* as control organism on Muller-Hinton agar plates. The antibiotic disc strength used were amikacin 30 ug, tobramycin 10 ug, gentamicin 10 ug, carbenicillin 100 ug, polymyxin B 300 units, ceftazidime 10 ug, norfloxacin 30 ug. Pyocin typing was carried out using the scrape and streak method [11]. Twenty two indicator strains were used for the purpose. Mnemonic coding of Al Jumali was used [12] for reporting the pyocin type. Minimum inhibitory concentration (MIC) of gentamicin, tobramycin, amikacin, carbenicillin, ceftazidime, ciprofloxacin and norfloxacin, against *P.aeruginosa* were determined by the agar-dilution method. Both high and low break point concentrations of each antibiotic were used. A fabricated multipoint replicating inoculator was used for carrying out the procedure [13].

Results

The overall isolation of *P.aeruginosa* in the hospital was 22.1 per cent and this increased to 29.9 per cent in the spinal cord injury centre (SCIC) and orthopaedic centre. Fifty isolates of *P.aeruginosa* from each of the above mentioned centres were evaluated. From the SCIC patients 68 per cent of the isolates were from urine samples, while 88 per cent of the isolates in the orthopaedic centre were from wound swabs. Both centres showed high resistance to common antipseudomonal agents at 56 per cent and 57 per cent respectively.

Pyocin typing of the isolates from SCIC showed a distribution within 15 mnemonic patterns (Table 1). Some of the isolates present in SCIC were totally absent from the paraplegic home. Isolates from urine showed a wide variability as compared to the isolates from the wound swabs. The antibiogram pattern of the isolates obtained from the SCIC showed sensitivity to tobramycin, amikacin, norflox, ciprofloxacin and ceftazidime (Table 2). Only four pyocin types showed complete sensitivity while many of the same pyocin types exhibited variable antibiotic sensitivity.

The isolates of *P.aeruginosa* from the orthopaedic centre showed a distribution within 14 pyocin types (Table 3). Many of

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TABLE 1

Spinal cord injury centre (Distribution - Pyocin types (15))

Pyocin type	Total (50) % isolate	Ward SCIC	Location Paraplegic Home	Clinical	Specimens
				Urine	Wound swab
1. 0000100	11 (22%)	10 (90.9%)	1 (9.1%)	81.8%	18.2%
2. 7777777	21 (42%)	8 (38.1%)	13 (61.9%)	47.6%	52.4%
3. 0143000	2 (4%)	2 (100%)	Nil	50%	50%
4. 4303000	2 (4%)	2 (100%)	Nil	100%	Nil
5. 4000400	3 (6%)	Nil	3 (100%)	75%	25%
6. 6753775	2 (4%)	1 (50%)	1 (50%)	100%	Nil
7. Other types (Nine)	9 (18%)	7 (77.8%)	2 (22.2%)	88.8%	11.2%

TABLE 2

Antibiogram pattern (as per Pyocin type) SCIC - paraplegic home

Aeruginocine type	Total isolate	Genta		Tobra		Amik		Carb		Norflox		Cipro		Cefta	
		S	R	S	R	S	R	S	R	S	R	S	R	S	R
1. 0000100	11	7	4	9	2	11	—	9	2	11	—	9	2	11	—
2. 7777777	21	15	6	17	4	21	—	14	7	18	3	16	5	21	—
3. 0143000	2	1	1	2	—	2	—	2	—	2	—	2	—	2	—
4. 4303000	2	2	—	2	—	2	—	2	—	1	1	2	—	2	—
5. 4000400	3	3	—	3	—	3	—	3	—	2	1	3	—	3	—
6. 6753775	2	1	1	2	—	2	—	1	1	1	1	2	—	2	—
7. Other types	9	6	3	6	3	7	2	5	4	6	3	8	1	8	1

the wound swab isolates were not detected in any of the urinary isolates. Ceftazidime, amikacin, ciprofloxacin, norfloxacin and carbenicillin showed high sensitivity amongst most strains (Table 4).

TABLE 3

Orthopaedic centre (Distribution Pyocin type)

Aeruginocine type	% Isolate	Urine	Wound swab
1. 7047574	4%	50%	50%
2. 7777354	30%	20%	80%
3. 0000154	22%	9%	91%
4. 4102200	8%	50%	50%
5. 5777202	10%	20%	80%
6. 7773616	4%	Nil	100%
7. 4430154	6%	Nil	100%
8. 0000000	6%	66.6%	33.4%
9. Other types (five)	10%	Nil	100%

Amongst all the isolates gentamicin, tobramycin and carbenicillin showed high resistance, while amikacin, norfloxacin, ciprofloxacin and ceftazidime showed sensitivity. Analysis of break point concentrations showed amikacin and ceftazidime to be the most active compounds, followed by norfloxacin and ciprofloxacin.

Environmental isolates of *P.aeruginosa* showed a similarity to the clinical isolates from the respective centres. *P.aeruginosa* were isolated from a large number of asymptomatic patients and from those having more than 8 weeks stay in the hospital. Patients with condom drainage were more likely to have infection by *P.aeruginosa* than those without it (Table 5).

Discussion

The increase in isolation of *Pseudomonas aeruginosa* at 29.9 per cent amongst SCIC and Orthopaedic cases corroborates with the study of Mongomerie and Morrow [14]. Although *Pseudomonas* is not a part of the body flora, studies [15] have found high prevalence of colonisation of the urethra, perineum and rectum associated with urinary tract infection in spinal cord injury patients. In the present study asymptomatic patients with *P.aeruginosa* isolates from wound swabs was 54.1 per cent, while colonisation of urinary tract was high at 52.9 per cent. Colonisation is a major reservoir and potential source of *Pseudomonas* infection [16].

Risk factors predisposing patients to *Pseudomonas* colonisation like hospitalisation longer than 8 weeks, condom drainage, severe underlying disease and previous antimicrobial therapy have been reported to be as high as 30-47 per cent [17]. Environmental isolates of *P.aeruginosa* have shown a similar pattern to those shown by Thomas et al [18], whereby a significant percentage of patients are colonised by the most common environmental strains.

The significance of *P.aeruginosa* isolates must always be questioned. Isolation per se is no indicator of significance and recovery of *P.aeruginosa* should not

TABLE 4

Antibiogram pattern (as per Pyocin type) Orthopaedic centre

Aeruginocine type	Total isolate	Genta		Tobra		Amik		Carb		Norflox		Cipro		Cefta	
		S	R	S	R	S	R	S	R	S	R	S	R	S	R
1. 7047574	2	1	1	2	—	2	—	0	1	2	—	2	—	2	—
2. 7777354	15	7	8	10	5	15	—	12	3	13	2	15	—	15	—
3. 0000154	11	9	2	11	—	11	—	10	1	11	—	9	—	2	11
4. 4102200	4	3	1	3	1	4	—	4	—	3	1	3	1	4	—
5. 5777202	5	1	4	3	3	3	2	3	2	2	3	5	—	5	—
6. 7773616	2	1	1	2	—	2	—	2	—	2	—	2	—	2	—
7. 4430154	3	2	1	2	1	2	1	3	—	2	1	2	—	3	—
8. 0000000	3	2	1	2	1	2	1	3	—	1	2	2	—	3	—
9. All other types	3	3	—	3	—	3	—	2	1	2	1	1	2	3	—

TABLE 5

Host factors (*Pseudomonas aeruginosa*)

	SCIC	Ortho
Wound swab (asymptomatic)	56%	52.2%
Urinary tract		
Asymptomatic	53.9%	16.6%
Intermittent catheterization (12/30)	40%	—
Condom drainage	75%	—
Hospital stay 8 weeks	74%	48%
Prosthetic replacement	Nil	4%

automatically merit anti-pseudomonal therapy. Elimination of the organism can be better achieved by careful attention to wound toilet, patient education and hygiene during intermittent urinary catheterisation. Use of specific anti-pseudomonal therapy should be kept for serious infection only.

The simple epidemiological question "Is this isolate of the same strain as that one" can often be resolved by API zone profile, O-sero type, phage type, lysogenic state antibiotic susceptibility and Pyocin type [19,25]. Patients who stayed more than 8 weeks showed isolation from the predominant pyocin type while those recently admitted showed a different typing pattern. Predominance of different pyocin types from urine and wound swabs showed the predilection of the strains in their preference of colonisation/infection sites.

The association between pyocin type and antibiotic sensitivity pattern was evident in both the SCIC and Orthopaedic isolates. The overall antibiotic sensitivity testing showed that nearly 50 per cent of the isolates from SCIC and about 35 per cent of the isolates from the orthopaedic cases were resistant to gentamicin. This was probably due to extensive use of this antibiotic in the hospital leading to cross-resistance amongst the hospital strains of *P. aeruginosa*. On the other hand

restricted use of amikacin and ceftazidime showed high sensitivity pattern in both centres. Similarly increased use of tobramycin, carbenicillin, norfloxacin and ciprofloxacin amongst SCIC patients showed fairly high resistance as compared to orthopaedic cases. Bacterial infections associated with indwelling medical devices often demonstrate an intrinsic resistance to anti-microbial therapies due to formation of biofilms [20]. SCIC patients with indwelling catheters showed higher resistance to various antibiotics probably due to poor penetration of *Pseudomonas aeruginosa* biofilms.

Holmes et al [21] in their study on aminoglycoside resistance in *P. aeruginosa* found the incidence of resistance to antibiotics in clinical isolates related to the period of time each has been used in the hospital environment. Frequent and prolonged use of an antibiotic has resulted in increased resistance amongst the isolates [22,23]. Loss of sensitivity to beta lactams, quinolones and aminoglycoside antibiotics has been described during treatment of infections produced by strains of *Pseudomonas aeruginosa* [24].

Although the orthopaedic and SCIC were adjacent to each other, the pyocin types isolated from both centres were different. This could be because there was no transfer of patients between these centres and the affinity of the different pyocin types for particular patient groups. Judicious use of antibiotics in selected cases only after clinical co-relation will go a long way to reduce the antibiotic pressure on the resident flora and thereby reduce the resistance among them. Only then the mortality and morbidity from this nosocomial pathogen can be averted.

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