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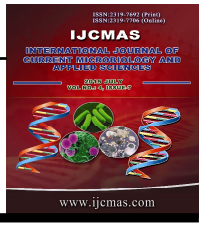

Original Research Article

Characterization of *Pseudomonas aeruginosa* and its Association with Diabetic Foot Ulcer Isolated from a Tertiary Care Hospital in Tamilnadu, India

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A B S T R A C T

Keywords

Pseudomonas aeruginosa, Diabetic foot ulcer, *Escherichia coli*

75 diabetic foot ulcer cases were screened for bacterial pathogens. Out of the104 isolates, majority of them were *Escherichia coli* (25), followed by coagulase positive *Staphylococcus aureus* (18), *Pseudomonas aeruginosa* (18), *Klebsiella* species (11) and others. Out of the 18 *Pseudomonas aeruginosa* isolates from diabetic foot ulcer cases, the majority (9) were in the Wagner's Grade three. About 66% of Pseudomonas aeruginosa were resistant to Cefotaxime, followed by Ceftriaxone (44%), and Ciprofloxacin (44%).The increasing incidence of *Pseudomonas aeruginosa* and its antimicrobial resistance in diabetic foot ulcer is a matter of great concern.

Introduction

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia, resulting from defective insulin secretion, insulin action or both. The prevalence of diabetes is 6.3 % in the general population, 8.7% among persons 20 years of age, and older. Approximately, 15–25% of persons with diabetes will develop a DFU in their lifetimes, as a general case (Grossi *et al.*, 1991).

S. aureus was the most commonly isolated organism, ranging from 23% to 76% of ulcer cases (Diamantopaulos *et al.*, 1998, 2013; Wheat, 1986; Wheat *et al.*, 1986a,b).

High prevalence of common pathogens with antibiotic resistance, and their ever-increasing threat to public health causes a great concern to medical practitioners. This kind of resistance could occur through many varied mechanisms (Beach and Champney, 2014).

The chronic hyperglycemia of diabetes associated with long term damage, dysfunction and failure of various organs, especially the eyes, kidney, nerves, heart and blood vessels. Traditionally type 2 diabetes is common in individuals over the age of 40. It is often associated with obesity, decreased physical activity and heredity (Zimmet *et al.,* 1990, 2001; Eriksson *et al.,* 1991). Recent data from several countries show that type 2 diabetesis increasingly becoming a problem among adolescents, and even among children (Glaser *et al.,* 1997). Diabetic foot ulcer (DFU) is usually multi-factorial, and the bacterial infection would complicate the spectrum of the disease. Infections are usually exogenous, from soil, air and commensals of the skin itself.

The aim of the present research study is to isolate and identify bacterial pathogens from diabetic foot ulcer cases, in samples collected from a reputed diabetic care center in Chennai City, Tamilnadu, India and to analyze the most common drug resistance pattern for *Pseudomonas aeruginosa*.

Material and Methods

75 pus samples in swab were collected from chronic foot ulcer cases attending a private diabetic center in Chennai City, during the period from May 2005 to September 2005, and were transferred to the laboratory, in Carey-Blair transport medium, to analyze for bacterial growth by standard procedures (Mackie and McCartney). Ethical clearance was obtained from the Institutional Ethical Committee, and the necessary signed-consent - letter was obtained from all participants, after explaining the purpose of the study, and the benefit intended for the patients. All the isolates were identified and the antibiotic susceptibility test was performed, according to the method of Kirby-Bauer (1989). The diabetic foot ulcer was graded according to Wagner's classification.

Results and Discussion

Out of the 75 DFU cases, 104 bacterial isolates were obtained. Majority of CFU cases (22.2 %) showed *Escherichia coli* in ulcer, followed by *Pseudomonas aeruginosa* (17.3%), and *Staphylococcus aureus* (17.3%), and other organisms (Table 1). Since *P. aeruginosa* is generally a multi-drug resistant organism (antibiogram), the same was analyzed against routinely-used antibiotics.

Cefotaxime was found to be resistant for 66% of strains (Table 2). However, the Imipenem and piperacillin are highly sensitive for Pseudomonas. Moreover, out of 18 *Pseudomonas aeruginosa* cases, 8.6 % were under Wagner's Grade III ulcer (Table 3).

In the present DFU study, *Escherichia coli* and *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the predominant infections. Hutchinson and McGuckin (1985, 1990, 1995) had reported that *Staphylococcus aureus* prevailed in 23% to 76% of DFU cases. The organism is both pathogenic and evasive in nature. It is beyond the scope of this study to find out MRSA strains. Similarly, the isolation of anaerobic micro-organisms is also not done, although it is being proposed for future studies. *Escherichia coli* is also a well known pathogen in DFU cases. However, the *Pseudomonas aeruginosa* is the major

concern in DFU, as it is usually multidrug resistant, in effect. In the present study, 18 isolates were *Pseudomonas* sps. Giovanni bonfiglio (1998) from Italy reported 19.5% *Pseudomonas* in DFU; Sapio *et al.* (1994a, b, 2009) from California, united states had reported a prevalence of 6.3% *Pseudomonas* in DFU cases. This shows that the bacterial infections in DFU cases could vary according to the environment, as well as, to the individual immune status. The present study also showed the anticipated antibiogram result, where in, except for Imipenam and Piperacillin, almost all other drugs (Table 2) were more than 30% resistant to the *Pseudomonas* isolates. Majority of the cases of *Pseudomonas* infection were in the category of Grade III of Wagner's classification of DFU. This also corroborates with the many previous reports on diabetic foot ulcer.

Table.1 Bacterial Isolates from DFU cases from Chennai, Tamilnadu
(n = number of cases=75) ; Number of isolates=104

Name of Bacterial Isolates	**Number (%)**
Escherichia coli	23 (22.2)
Staphylococcus aureus (Coagulase Positive)	18 (17.3)
Pseudomonas aeruginosa	18 (17.3)
Klebsiella spp	11 (10.6)
Coagulase negative *Staphylococcus* (CONS)	11 (10.6)
Proteus spp	10 (9.6)
Streptococcus spp	6 (5.8)
Corynebacterium spp	4 (3.8)
Enterococcus	3 (2.9)

Table.2 Resistant pattern of *Pseudomonas aeruginosa* from DFU cases
(n=18)

Antimicrobial agent	**Resistant**	
	No.	**(%)**
Cefotaxime	10	66
Ceftriaxone	8	44
Ciprofloxacin	8	44
Ampicillin	7	38
Gentamicin	6	33
Ceftazidime	6	33
Co-amoxyclav	4	22
Piperacillin	2	11
Imipenem	1	5.5

Table.3 Wagner's Grade of DFU in *Pseudomonas aeruginosa* infection

Wagner's Grade	Number	%
Grade III	**9**	**8.6**
Grade IV	**4**	**3.8**
Graded II	**3**	**2.9**
Grade V	**2**	**1.9**

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