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One Year Bacteriological Study of Diabetic Foot Infections and its Antibiogram

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Foot infections are common in diabetic patients and its sequelae is the common cause for disability and hospitalization. Understanding the bacteriology and accuracy of the culture methods is important in selecting antibiotics to these patients. In India studies of microbiology of diabetic foot infections are scanty and magnitude of this problem goes unnoticed. The present study was undertaken to document the nature of diabetic foot infections in our region and to identify aerobic bacteria associated with diabetic foot infections and its antibiogram. The present study was a cross sectional study carried out in the Department of Microbiology, Shimoga Institute of Medical Sciences, Shimoga during January 2010 to December 2010. A total of 100 diabetic patients were included in the study with inclusion criteria as presence of foot infection due to diabetes of grade 1 and above (Wagner's classification) and hospitalized patients. Pus samples were collected from above patients with aseptic precautions and were subjected to bacteriological examination. Organisms and its antibiogram were identified by standard conventional techniques.

Out of the hundred cases of foot infection in diabetics 72 were male and 28 female with mean age between 34 to 70 years. All the cases studied were of non insulin dependent diabetics mellitus (NIDDM) and the duration more than 5 years. Out of the 100 cases studied, 64 were diabetic ulcers, 21 diabetic cellulitis and 9 diabetic gangrene.of the bacteria isolated 56 were gram positive cocci, 91 were gram negative bacilli. An appropriate selection of antibiotics based on the antibiograms of the isolates from the lesions is the most critical for the management of these infections. Nevertheless the initial empirical therapy often has to be decided based on the knowledge of susceptibility profile of microbial flora recovered from previous cases.

Key words: Diabetes mellitus, microbial infection, antibiogram.

Diabetes mellitus is a disease as old as mankind itself and is a major health challenge. The chronic nature of diabetes and its tendency to affect various target organs has led to some people to call it, the disease of complications[1]. Diabetes mellitus confer special vulnerability to infection due to defects in both cell mediated and humaral

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immunity, probably due to hyperglycemia. Once these infections occur they are more difficult to treat and pose a greater threat to diabetic than healthy person. Treatment of infections in the diabetic patients remains a challenging endeavor and frequently requires a team effort. Foot infections are common in diabetic patients and its sequelae is the common cause for disability and hospitalization [2,3].

Three main factors responsible for diabetic foot infections are neuropathy, angiopathy and immunopathy [4]. Various studies have shown that diabetic foot infections are polymicrobial in nature. Understanding the bacteriology and accuracy of the culture methods is important in selecting antibiotics to these patients. In India studies of microbiology of diabetic foot infections are scanty and magnitude of this problem goes unnoticed.

The present study was undertaken to document the nature of diabetic foot infections in our region and to identify aerobic bacteria associated with diabetic foot infections and its antibiogram.

MATERIALS AND METHODS

The present study was a cross sectional study carried out in the Department of Microbiology, Shimoga Institute of Medical Sciences, Shimoga during January 2010 to December 2010. A total of 100 diabetic patients were included in the study with inclusion criteria as presence of foot infection due to diabetes of grade 1 and above (Wagner's classification) and hospitalized patients. Patients with clinically diagnosed venous ulcers were excluded from the study.

Pus samples were collected from above patients with aseptic precautions and were subjected to bacteriological examination. All the aerobic bacteria were identified by standard conventional techniques and antibiotic susceptibility was done for all isolates by Kirby-Bauer disc diffusion method.

RESULTS

Out of the hundred cases of foot infection in diabetics 72 were male and 28 female. The mean age was between 34 to 70 years(Table 1). All the cases studied were of non insulin dependent diabetics mellitus (NIDDM) and the duration of the disease was more than 5 years. Out of the 100 cases studied 64 were diabetic ulcers, 21 were diabetic cellulitis and 9 were diabetic gangrene. (Table 2).

Out of 100 cases 149 organisms were isolated, accounting for an average of 1.5 organisms per case. Culture was negative in 2 cases.

Table 1. Age and Sex Distribution of the study Group

Age group (years)	Male	Female	Total
31-40	07	02	09
41-50	22	08	30
51-60	24	11	35
61-70	13	06	19
71-80	06	01	07
Total	72	28	-

Table 2. Clinical Diagnosis of the study group

Clinical diagnosis	No. of Cases
Ulcer	64
Cellulites	27
Gangrene	09

Table 3: Organisms isolated in the Study Group

Organisms	Number	Percentage
Staphylococcus aureus	41	27.51
Pseudomonas aeruginosa	27	18.12
Klebsiella pneumoniae	18	12.08
Proteus mirabilis	17	11.4
Escherichia coli	13	8072
Enterococcus species	08	5.36
Coagulase negative Staphylococci	07	4.69
Proteus vulgaris	05	3.35
Citrobacter freundii	03	2.01
Enterobacter species	03	2.01
Morganella morganii	02	1.34
Corynebacterum species	02	1.34
Klebsiella oxytoca	02	1.34
Acinetobacter species	01	0.67
Total	149	-

50% of the culture positive cases were polymicrobial in nature and the remaining 48% were monomicrobial. All the 149 isolates were aerobes and facultative anaerobes. 56 were gram positive cocci, 91 were gram negative bacilli and 2 were *Corynebacterium* species. *Staphylococcus aureus* is the most frequently isolated organism followed by *Pseudomonas aeruginosa, Proteus mirabilis* and *Escherichia coli* (Table 3). Among gram positive cocci *Staphylococcus aureus* was sensitive to Cloxacillin, Cephotaxime and Ciprofloxacin. Out of the 41 isolates of *Staphylococcus*, 7 were Methicillin Resistant *Staphylococcus aureus* (MRSA). All MRSA strains were sensitive to Vancomycin Enterococcus species showed maximum susceptibility to Gentamycin and Ciprofloxacin.

Gram negative pathogens showed maximum sensitivity to Fluoroquinolone (ciprofloxacin), Aminoglycosides (Amikacin and Gentamycin) and III generation Cephalosporin (Cephotaxime).

DISCUSSION

The feet of diabetic patients are pone to soft tissue infection. It is important for the treating physician to recognize that the appearance of a diabetic foot ulcer on the plantar surface does not mean that an infection is present. The aetiology of diabetic foot ulcers is multifactorial, with mechanical factors playing a large role. In the absence of ischemia, the vast majority of diabetic foot ulcers are the result of increased pressure on the soft tissues.[5,6]

Appropriate specimen collection and optimum culture methods helps in understanding the microbiology of foot infections as well as in selecting appropriate antibiotics.

In the present study, diabetic foot infections were common in men (72%) compared to the study of Ramani *et al.* (86.6%), Pathare *et al.* (78.5%) and Sapico*et al.* (61.5%) [7,8] .This could because diabetes mellitus is more common in men and are prone for trauma because of their outdoor occupation.

In our study, diabetic foot infections were more common in 40-60 year age group, accounting for 65% of the total cases, which was similar to the study of Pathare *et al.* (40-60 years) and Ramani *et al.* (58 years). This may be due to delayed detection of diabetes in these patients.

Diabetic foot infections are known to be polymicrobial in nature. It is reported 39.90% of all diabetic foot infections to be polymicrobial [9,10]. Due to inadequate facilities for anaerobic identification in our laboratory, we evaluated only the aerobic bacteria. In the present study, 50% of the cases were polymicrobial in nature.

An average of 1.5 organisms were isolated per case in the present study, compared to the study conducted by several authors .In the present study, the average number of organisms was less compared to other studies because it included only aerobic isolates.

Monomicrobial infection accounted for 48% of the cases in the present study, which was more common in diabetic ulcer cases. Among the monomicrobial infections, Staphylococcus aureus was the commonest isolate (29.2%), which is less compared to the study of Pathare *et al.* (66.6%) and Wheat *et al.* (80%) [11]. The next common isolates were gram negative bacilli *i.e. Pseudomonas aeruginosa, Proteus mirabilis* and *Escherichia coli.* There appears to be a gradual change in the pattern of organisms causing diabetic foot infection.

Among the gram positive cocci, Staphylococcus aureus was sensitive to Cephotaxime and Ciprofloxacin. There was also an increase in MRSA isolation. All MRSAs isolated were sensitive to Vancomycin. To decrease the incidence of resistance among the bacteria empirical use of antibiotics has to be decreased. Vancomycin can be considered as an important drug in the treatment diabetic foot infections especially in settings with higher resistance to other antibiotics. Gram negative bacilli were sensitive to Flouroquinolones, Aminoglycosides & III generation Cephalosporins. But in a recent Indian study, organisms belonging to Enterobacteriaceae were sensitive to Ticarcillin – Clavulanate, Cephoperazone – Sulbactum and Imipenem [12].

Combinations of above antibiotics may be used to treat diabetic foot infections in areas where there is increased drug resistance. So it should be mandatory to do a culture and sensitivity test of pus samples from diabetic foot infections[13].

An appropriate selection of antibiotics based on the antibiograms of the isolates from the

lesions is the most critical for the management of these infections. Nevertheless the initial empirical therapy often has to be decided based on the knowledge of susceptibility profile of microbial flora recovered from previous cases [12,13].

REFERENCES

1. Levin H.E, Oneal L. Ed., Diabetic foot. St. Louis: Mosby Publications, 1988.
2. Pathare N.A, Bal A, Talvalkar G.V, Antani D.U, Diabetic foot infections A study of Microorganisms Associated with the Different Wagner grades. *India J. Pathol. Microbiol* **41**(4):437-441 (1988).
3. Shea Kevin W, Jly, Antimicrobial Therapy for Diabetic Foot Infections. *Post Graduate Medicine*, **106**(1): 85-94 (1999).
4. Joseph Warren S., Treatment of Lower Extremity *Infections in Diabetics. Drugs,* 1991; **42**(6): 984-996.
5. Grayson M.L *et al.*, Use of Ampicillin/ Sulbactum versus Imipenem/Cilastain in the Treatment of Limb Threatening foot Infections in Diabetic Patients. *Clin. Infect. Dis*, 1994; **18**: 683-693.
6. Smith Andrew J *et al.* 1996: Soft Tissue Infections and the Diabetic Foot. The Am. J. of Surg, 172(Suppl 6A): 7S-12S.
7. Ramani Ananthakrishnan *et al.,* Bacteriology of Diabetic Foot ulcers. *Indian J. Pathol. Microbiol*., 1991; **34**(2): 81-87.
8. Pathare N.A *et al.*, Diabetic Foot Infections A study of Microorganisms Associated with the Different Wagner Grades. *Indian J. Pathol. Microbiol.,* 1998; **41**(4) 431-441.
9. Wheat L. Joseph *et al.*: Diabetic Foot infections – Bacteriological analysis. *Arch Intern. Med.,* 1986; **146**: 1935-40.
10. Goodson William H *et al.,* Wound healing and diabetic patient. *Surg Gynecol and Obst*. 1979; **149**: 600-08.
11. Sapico Francisco L *et al*. 1980: Quantitative Aerobic and Anaerobic Bacteriology of Infected Diabetic feet. *J. Clin. Microbiol.,* **12**(3): 413-20.
12. Anandi C *et al...,* Bacteriology of diabetic foot lesions. *Indian J Med Microbiol*; 2004; **22**: 175-8.
13. Singh N, Armstrong DG, Lipsky BA. Preventing foot ulcers in patients with diabetes. *JAMA;* 2005; **293**: 217-28.