Comparative Study of Community and Hospital Acquired Infections in Diabetic Foot

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Citation

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Abstract

Objective: To compare the microbiological profile of community acquired diabetic foot infections and hospital acquired infection in the same patients following a week of treatment. To study the morbidity associated with hospital acquired infections in terms of number of days ofhospitalization and requirement of further surgical interventions.Materials and methods: 55 individuals admitted with diabetic foot infections to tertiary referral hospital of a developing country were included in the study. Two microbial swabs were taken one at admission and the second a week later and data studied.Result: The first culture grew Klebsiellae (25.5%), E-coli (20%), Enterococci (16.4%). The surgical procedures undertaken were debridement in 57.2%, amputation in 20% and fasciotomy in 21.8%. 94 % of patients developed hospital acquired infection, the predominant organism being pseudomonas (50.9%) and E- coli-(14.9%). The surgical procedure undertaken after this was debridement in 83.6%. Conclusion: The community acquired infections varied in character and polymicrobial in nature. Hospital acquired infections were responsible for the extended morbidity of the patients and no mortality was observed in the study duration. 94% of patients developed hospital acquired infection, the predominant organism being pseudomonas and its treatment may be the key to lower the morbidity rate in patients.

INTRODUCTION

In the past few decades, diabetes has emerged as a devastating disease in the world and India in particular, has evolved as one of the leading nations amidst the rest. Foot problems commonly develop in people with diabetes and can quickly become serious. To this complexity, introduction of hospital induced infections acts as a catalyst to worsen the condition. This study is important because not much study is done in hospital induced infection in diabetic foot per se.

. Here one swab is taken for culture as the patient comes to the hospital and the organism obtained is labeled as ‘community acquired’ and another culture is obtained a week later which is labeled as ‘hospital acquired’. As the patient is admitted to the hospital and is under strict supervision, the follow up is easy and errors are less likely to happen.

MATERIALS AND METHODS

AIMS AND OBJECTIVES

To study the profile of common community acquired infections

To study the hospital acquired infection in the same patients following a week of treatment

Morbidity associated with hospital acquired infections in terms of number of days of admission and requirement of further surgical interventions.

Study design: Follow up study

Study duration: 2 months

RATIONALE FOR THE SAMPLE SIZE

One of the studies carried out by Leichter et al, 1988, as indicated, that nearly 70% of the diabetic foot infections are likely to have aerobic infection. Sample size for the present study has been estimated based on the above incidence rate of aerobic infections with a precision of +/- 10, and with a desired confidence level of 90%; it is estimated that nearly 55 subjects are needed to be studied.

INCLUSION CRITERIA

Diabetic patients between the age group of 18-80yrs

Patients with diabetic foot, visiting for the first time to the hospital without taking any treatment requiring admission.

EXCLUSION CRITERIA

Patients with diabetic foot who are already on antimicrobial treatment

METHOD

The model chosen for this study is a follow up study .55 individuals admitted with diabetic foot infections to our hospital were included in the study. The first swab from the ulcer was taken on admission after taking consent and sent for culture and the organism labeled as 'community acquired'. The patients underwent regular dressing and were advised proper footwear. The report of the 1 st culture was obtained after three days and the surgical procedure if any done and noted down. One week later another swab was taken and sent for culture again. If any growth was present, its profile, culture and sensitivity data were studied and labeled as 'hospital acquired'. Any surgical procedure done after it was noted. Later morbidity due to the hospital acquired infection in terms of further hospitalization and surgical intervention was studied in the consecutive week. Also, patient's diabetic status, limb vascularity, renal function and nerve involvement were assessed.

RESULTS

By using the SYNTAX software, the results have been tabulated.

The results of this study are tabulated in terms of the variables in relation to diabetic foot. Of the 55 patients, 41(75%) were males and 14 (25%) were females. The cases varied between the age group of 35 to 75, the peak being 57-58 years which is due to the progressive atherosclerosis. Doppler investigation showed that 9(16%) had narrow lumen or blocked arteries. Six (10%) had peripheral neuropathy. Nineteen (35%) patients had diabetes in control and the other 36(65%) had uncontrolled diabetes. Twenty (36.4%) had an abnormal renal function test signifying renal damage. Thirty five (63.6%) were found to be anemic.

Figure 1

Table 1. First culture showing community acquired infections

Organisms isolated	Frequency (%) (n=55)
Klebsiella	14 (25.5)
E-coli	11 (20)
Enterococci	9 (16.4)
Proteus	4 (7.3)
Staphylococcus aureus	4 (7.3)
Enterobacter	3 (5.5)
Pseudomonas	1 (1.8)
Gram negative cocci	1 (1.8)
Non-fermenting gram neg bacilli	1 (1.8)
No growth	7 (12.7)

The first culture taken from patients showed the presence of a variety of organisms including pseudomonas, E.coli, klebsiella, proteus, Enterococci, Staphylococcus aureus, gram negative cocci, non-fermenting gram negative bacilli, Enterobacter, the percentage of distribution of which has been described in table 1. This community acquired infection did not show any pattern of establishment with the variables and were random in nature. Most of the community acquired infection were sensitive to the antibiotics and didn't grow in the second culture. Of the bacteria obtained, only 7.3% showed gram positive organism.

Figure 2

Table 2: Surgical procedure after the first culture

Procedure	Frequency (%) n=55
Debridement	32 (57.2)
Amputation	11 (20)
Fasciotomy	12 (21.8)

The surgical procedure undertaken after 1 st culture included debridement, amputation and fasciotomy for cellulitis followed by debridement.

Figure 3

Table 3: Second culture showing hospital acquired infections.

Organism isolated	Frequency (%)
Pseudomonas	28 (50.9)
E. coli	8 (14.5)
Proteus	7 (12.7)
Gram positive cocci in pairs	4 (7.3)
Staphylococcus aureus	4 (7.3)
Non-fermenting gram negative bacilli	1 (1.8)
No growth	3 (5.5)

Figure 4

Table 4. Surgical procedure after the second culture.

Procedure	Frequency	Percent	Valid Percent
Debridement	46	67.2	83.6
No action taken	9	13.4	16.4
Total	55	82.1	100

The results of the second culture varied from no growth to different species of bacteria isolates, of which the predominant organism was Pseudomonas in 50.9% as compared to 15% showed by the studies done previously.

The poor maintenance of hygiene may play an important role in the development of pseudomonas infection in developing countries.

The 2 nd culture of patients with controlled diabetes showed either no growth or Non-fermenting gram negative bacilli. Patients with uncontrolled diabetes showed varied growth but patients with FBS >250 &PPBS >300 showed the growth pattern of either proteus or Gram positive cocci in pairs. 83.6% of them underwent debridement, a course of antibiotic treatment and regular dressings whereas the others underwent only a course of antibiotic treatment and regular dressings. The hospital stay varied from 4 – 37 days with the mean of 16 days for the 55 patients. However in these patients 28 were infected with pseudomonas and their mean admission was 24 days on an average which is significant.

DISCUSSION

Diabetic foot is an umbrella term for foot problems in patients with diabetes mellitus. Amongst the people suffering from diabetes, atleast 15% of them develop foot ulcers at some phase or the other during their life time. 85% of the amputations are preceded by ulcers [1]. Damage to blood vessels and impairment of the immune system from diabetes makes it difficult to heal these wounds. Therefore diabetic foot ulcers are common and serious complication of diabetes mellitus. To this complexity, introduction of hospital induced infections acts as a catalyst to worsen the condition. Aggressive surgical intervention and appropriate antibiotic therapy can reduce the likelihood of a major amputation and duration of hospitalization [2] but are also associated with severe clinical depression and dramatically increased mortality rates. Two main risk factors that cause diabetic foot ulcer are Diabetic neuropathy and micro as well as macro ischemia [3]. Due to arterial abnormalities and diabetic neuropathy, as well as a tendency to delayed wound healing, infection or gangrene of the foot is relatively common. A review of literature confirms that the presence of an unhealed diabetic foot ulcer negatively affects several domains of patient's quality of life and the risk of infection, amputation and death. Infection is a common and serious complication of diabetic foot wounds [4]. Infection leads to formation of micro thrombi, causing further ischemia, necrosis, and progressive gangrene. Massive infection is the most common factor leading to amputation.

Such infected ulcers resulting in amputation account for a three fold increased risk of death within 18 months Foot related problems are responsible for up to 50% of diabetes

related hospital admissions.The main reason for this is that the foot ulcers are highly susceptible to infections. Diabetic foot infections is one of the chronic infections that man suffers today. Most chronic infections, including bacterial that are associated with chronic wounds, exist as biofilm communities[4-7]. To this complexity, introduction of hospital induced infections acts as a catalyst to worsen the condition. Aggressive surgical intervention and appropriate antibiotic therapy can reduce the likelihood of a major amputation and duration of hospitalization. [8].

Aerobic gram-positive staphylococci and streptococci usually are the cause of infection; however, gram-negative organisms are frequently present as well. Anaerobic infection is common. Leichter et al [15] found that the serious infections in their series were polymicrobial; 72% of organisms cultured were gram-positive and 49% were gram-negative.

In the study Survey of bacterial diversity in chronic wounds using pyrosequencing by BMC Microbiol. 2008, the following result was obtained: BMC Microbiol. 2008 Mar 6; 8():43.

Staphylococcus aureus was the predominant organism and monomicrobial infection was common in diabetic foot. But they conducted a broad survey of wounds using a variety of molecular methods and concluded that the bacterial communities in diabetic foot ulcers had a high degree of diversity[9].

Though some studies on the bacteriology of diabetic foot infections (DFIs) over the past 25 years have been reported, the results have varied and have often been contradictory. A number of studies have found that Staphylococcus aureus is the main causative pathogen[10-12], but two recent investigations reported a predominance of gram-negative aerobes[13, 14]. The role of anaerobes is particularly unclear, because in many studies specimens were not collected or cultured properly to recover these organisms.

Since our study is considering only aerobic organism, no light is thrown on the prevalence of anaerobic microbes in diabetic foot.

Microbial cultures are foundational and basic diagnostic methods used extensively as a research tool in molecular biology. It is often essential to isolate a pure culture of microorganisms. A pure (or axenic) culture is a population of cells or multicellular organisms growing in the absence of other species or types. A pure culture may originate from a single cell or single organism, in which case the cells are genetic clones of one another.Culturing technique is extremely important in cases of diabetic foot infection. Appropriate antibiotic therapy with a broad spectrum antibiotic should begin immediately before cultures have been obtained; the antibiotic can then be adjusted based upon the sensitivities of the causative organisms after the microbiology reports have been obtained. Many diabetic foot infections contain gram-negative organisms; therefore, the initial antibiotic chosen should be effective against gram-negative as well as gram-positive organisms.

CONCLUSION

Thus by this study, we were able to establish the most prevalent aerobic bacterial isolates in diabetic foot before and after the antimicrobial therapy. We were also able to establish a valid relationship between diabetic foot and many other variables.

Thus early prophylaxis against the ulcer formation is the key to lower the rate of morbidity in patients.

From this study, we were able to conclude that,

The community acquired infections varied in character and nature.

Hospital acquired infections was responsible for the extended morbidity of the patients and no mortality was observed in the study duration.

Pseudomomas was the main causative organism of the hospital acquired infections and its treatment may be the key to lower the morbidity rate in patients.

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