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Full Length Research paper

Bacterial wound infections in diabetic patients and their therapeutic implications

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In order to identify the bacterial pathogens associated with diabetic wounds and testing the antibiotic susceptibility of main antibiotics against predominant anaerobic bacterial types in comparison with some plant extracts, a total of 27 diabetic patients in each types; Insulin dependent (IDDM) and non-insulin dependent NIDDM and 30 non-diabetic patients with wound infection were introduced in the present study that was conducted between October - December 2007. It has been found that wounds are highly infected by aerobic and anaerobic bacterial types; Propionibacterium granulosum - as anaerobic bacteria- was a predominant pathogen in diabetic wound infections, in comparison with *Pseudomonas aeruginosa* which is predominant in non-diabetic wounds. Amoxycillin/ calvulanic acid was the best effective antibiotic which gave 20 mm inhibition zone in comparison with other standard antibiotics, and aqueous extracts of *Myrtus communis* and *Nerium oleander* gave II and 10 mm inhibition zone, respectively.

Keywords: Bacterial infections, diabetics, antibiotics.

INTRODUCTION

There is a general consensus among clinicians that diabetic patients are at increased risk of developing infection (Braces, 2007). This special vulnerability has been attributed to impaired leukocyte function associated vascular diseases, poor glucose control and altered host response (McMahon and Bistrian, 1995; Bhatia, 2003).

Once infection occurs, it is difficult to treat since the clinical course of the infection is more fulminant and severe, and posses a greater threat to the glycemic status of the patient (Louie et al., 1993; Beckert et al., 2006).

With the advent of the new strategies and approaches in the prevention of these infections as with the introduction of new insulin preparation for good glycemic control, presumption in the altered patient behaviour may reduce the incidence of infections or alter the type of infection (Eaglstein, 1997; Piaggesi et al., 2007).

There are several well accepted predisposing factors that place patients with diabetes at high risk for a lower-extremity amputation. The most common components in the causal pathway to limb loose include peripheral neuropathy, ulceration, infection and peripheral vascular disease (Armstrong et al., 1998).

The development of wounds is a serious complication for patients with diabetes. Numerous factors related to diabetes can impair wound healing, including wound hypoxia (inadequate oxygen delivered to the wound) infection, nutrition deficiencies, and the disease itself (Lavery, 2007).

Fluctuating blood sugar and hypoxia from poor circulation may impair the ability of white blood cells to destroy pathogenic bacteria and fungi, increasing infection risk (Stadelmann et al., 1998).

The aims of the present study was to determine the role of insulin and or/ antibiotics in wound infection of diabetic patients, and to Identify the bacterial pathogens associated with diabetic wounds and testing the antibiotic susceptibility of main antibiotics against predominant anaerobic bacterial types in comparison with some plant extracts.

MATERIALS AND METHODS

27 diabetic patients were included in this study in both sexes (males and females), the patient arranged into two groups:
IDDM: Insulin dependent diabetic mellitus.

Table 1. Numbers of diabetic patients according to sex and types of diabetes mellitus (DM) ($p < 0.05$).

Types of DM	Male no. of cases (%)	Female no. of cases (%)	Total
IDDM	11(61.1)	7(38.8)	18(66.6)
NIDDM	3(33.3)	6(66.6)	9(33.3)
Total	14(51.8)	13(48.0)	27
Non diabetic patient	18(60.0)	12(40.0)	30
Total	32(56.0)	25(43.8)	57

IDDM: Insulin-dependent DM; NIDDM: non insulin-dependent DM.

Table 2. Types of antibiotics and mode of administration attending to DM patients with wound infection.

Antibiotics	Mode of administration	No. of cases (%)
Penicillin	Injection	16
Tetracyclin	Ointment	16
	Orally	5
Cephalexin or Cephotaxime	Orally	6
	Injection	9
Gentamicin	Injection	15
Ampiclox	Injection	18

NIDDM: non-insulin dependent diabetes mellitus and 30 non diabetic patients with wound infection.

Sample

A sterile swab were taken from various location of wounds from diabetic patients then brain heart infusion added to swab for enrichment, and incubated for 2 - 4 h.

Bacteriological study

Loop full of inoculated brain heart infusion cultured by streaking onto nutrient agar and blood agar (oxoid) and kept in anaerobic candle jar to supply anaerobic condition, another loop full streaking onto same media in aerobic condition and incubated for 24 - 48 h in 37^{O}C.

Classification and identification of aerobic and anaerobic bacterial types were done according to standard routine techniques proposed by Finegold and Baron (1986).

Antibiotics and plant extract

Six types of commercial antibiotics (HiMedia India) were used in therapeutic study. These are: Penicillin G (P) (10 U), Cephalothin (Ch) (30 mcg), Tetracyclin (T) (30 mcg), Gentamicin (G) (10 mcg) Amoxycillin/ Calvulanic acid (AC) (20/10 mcg) and ciprofloxacin (CF) (5 mcg).

Two aqueous plants extract, in concentration 1000 mcg were used in this study from two plant genera: *Myrtus communis* (Al-Yas in Arabic), *Nerium oleander* (Al-Difflah in Arabic). Antibiotic susceptibility test was measured by agar diffusion method (disc test) to determine diameter of inhibition zones measured by (mm) by using Mueller-Hinton Agar (HiMedia) Fingold and Baron (1986).

Control patient

30 non-diabetic woundy patients were introduce in this study in comparison with diabetic wound infections.

RESULTS

From 27 DM patient 11 and 3 were IDDM and NIDDM males, respectively, while 7 and 6 IDDM and NIDDM females, respectively. In other hand 30 non DM patient with wound infection are 18 males and 12 females ($p < 0.05$) Table 1.

Table 2 illustrated types of antibiotics and mode of administration attending to DM patients. It has been found that Ampiclox injection was given as greater therapy for 18 patients followed by penicillin injection and orally tetracycline was given to 16 (patients) followed by other antibiotics. Also, it has been noticed that the patient may be given two or three antibiotics as a therapy for wound infection.

Aerobic and anaerobic bacterial types isolated from both diabetic and non-diabetic wound infection were illustrated in Table 3. It has been found that

Table 3. Aerobic and anaerobic bacterial types isolated from diabetic wound infections and non-diabetic wound infection (p< 0.01).

Bacterial types	Diabetic patient		Non-diabetic patient	
	No. of cases	(%)	No. of cases	(%)
Aerobic				
S. aureus	4	4.59	7	7.52
S. xylosus	6	6.89	13	13.97
S. saprophyticus	12	13.79	16	17.2
P. aeruginosa	9	10.34	20	21.5
S. pyogenes	4	4.59	0	-
S. mutans	8	9.19	5	5.37
B. subtilis	2	2.29	0	-
P. mirabilis	4	4.59	6	6.45
E. coli	3	3.44	8	8.6
C. sp.	2	2.29	0	-
Anaerobic				
P. acnes	9	10.34	2	2.15
P. granulosum	17	19.54	6	6.45
C. difficle	7	8.04	0	-

Table 4. Modes of isolation of bacterial types isolated from diabetic wound infection.

Mode of isolation	Diabetic patients		Non-diabetic patients	
	No	(%)	No	(%)
Single pathogen	6	22.2	5	16.6
Double pathogens	4	14.8	11	36.6
Three pathogens	10	37	8	26.6
Over than three pathogens	7	25.9	6	20
Total	27		30	

Table 5. Antibiotics susceptibility test of six antibiotics and two plant extracts against *Propionibacterium granulosum* isolated from diabetic wound infection.

Antibacterial agent	Symbol	Conc.	Inhibition zone (mm)
Penicillin	(G)	10 µ	9
Cephalothin	(Ch)	30 mcg	12
Tetracyclin	(T)	30 mcg	10
Gentamicin	(G)	10 mcg	12
Amoxicillin/ clavulanic acid	(AC)	20/10 mcg	20
Ciprofloxacin	(CF)	5m cg	14
Aqueous extract of *Myrtus communis*		1000 mcg	11
Nerium oleander		1000 mcg	10

Propionibacterium granulosum as an anaerobic bacteria was a predominant pathogens in diabetic wound (17cases) followed by *Staphylococcus saprophyticus* as aerobic bacteria (12 cases) . While *Pseudomonas aeruginosa* was a predominant pathogens isolated from non diabetic wound infection.

Also, we can isolate *Propionibacterium acnes* and *Clostridium difficle* from (9 and 7) diabetic wound, respectively, p < 0.01. Table 4 described mode of isolation “How many bacterial types found in one case?” It has been found that mode of three pathogens was pre-dominant in 10 diabetic wounds while double pathogens

was predominant in 11 non diabetic wound followed by another modes of isolation ($p < 0.05$). Table 5 illustrate antibiotic susceptibility test of six antibiotics and two plant extracts against anaerobes *P. granulosum*.

It has been study that, Amoxycillin/Clavulanic acid gave a greater inhibition zone (22 mm) followed by another antibiotics, while aqueous extract of *M. communis* and *N. oleander* gave (11 and 10 mm) against these bacteria within the limits of antibiotic inhibition zones.

DISCUSSION

The prevalence of bacterial infections (aerobic and anaerobic) among IDDM and NIDDM diabetic patients, the most predominant bacterial types and the most common isolates and sensitivity pattern were carried out in this study. It has been found there are greater percentages of aerobic and anaerobic bacterial infections/ pathogens from diabetic patients.

These findings are approved by another studies such that, lycos (2007) explain this risk by abnormally high levels of blood sugar in the diabetic patient which damage blood vessels, causing them to thicken and leak, over time, this makes the vessels less able to supply the body, especially the skin, with the blood if needs to remain healthy.

The result of poor circulation leads to ulcers, especially those located in the feet. These ulcers are slow to heal and often become deep and infected (Alcantara, 1999; Altavilla, 2001). Our study reveal high incidence of bacterial wound infections in diabetic patients in comparison with non diabetic patients. This finding approved by other studies, such that Pomposelli et al. (1998) which indicate that high blood sugar can increase infection rate and impair wound healing, and wound inflammation and infections can elevate blood sugar. Poorly controlled diabetes adversely affects the ability of leukocytes to destroy invading bacteria and to prevent the harmful proliferation of usually benign bacteria present in the healthy body O Dell (1999).

Also, Coulston (1998) noticed that malnutrition further impairs wound healing in the diabetic patients. Hyperglycaemia may result from several factors: inflammation and infections, the use of steroid medications, and the feeding process. Feeding schedule and medications may need to be adjusted for optimal blood sugar control.

Gordon (1999) indicated that, the systemic oral antibiotics should be initiated for all diabetic wounds, even chronic, if an active infection is felt to be invading beyond the point of local control, if there are no clinical signs of infection, oral antibiotics should be avoided by diabetic patients.

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