

Diabetic Foot Ulcer Infection rate, Bacterial Etiology and Antibiotic Susceptibility: A Cross Sectional Study

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Aim of the study; to determine the diabetic foot ulcer infection rate, bacterial etiology and antibiotic susceptibility. Research design: A cross sectional study design was utilized to fulfill the aim of this study. **Setting:** The study was conducted in out-patient diabetes clinic at Asyut University Hospital. **Patients:** A total of two hundred adult patients (both males and females) having type I or type II diabetes, with a foot ulcer. One tool was used for data collection of this study; structured diabetic patient interview questionnaire sheet with the following parts: **Part I: Diabetic Patients demographic characteristics, Part II: Medical profile of the studied patients and Part III: Laboratory tests: Glycosylated Hemoglobin (Hg A1C) and Pus culture and sensitivity results. Results:** The present study revealed that 53.5 % of the studied sample was female, 56.5 % were married, 45.5 % were in the age group between 50 to less than 65 years and 39.5 % were illiterate. 56 % of the sample was having type II diabetes, mean duration of diabetes in years was 13.14 ± 7.36 , mean body mass index was 26.95 ± 6.75 , regarding treatment regimen; 46.5 % were taking insulin, 53 % were in poor glycemic control, 28 % fair and 19 % were in good glycemic control. 51 % of the studied patients their duration of foot ulcer was less than a month, 27 % from 1 – 2 months, 69 % of the studied sample was having a superficial ulcer. 89 % was having a positive pus culture result out of which 23 % was related to pseudomonas aeruginosa, followed by Escherichia coli (20 %), Staphelococcus aureus (19 %) and the least common organism was Citrobacter isolates (2 %). 37 % of the causative organisms were sensitive to Piperacillin tazobactam, 22 % were sensitive to Gentamicin, 16 % to Vancomycin, 13 % to Azithromycin and 12 % were sensitive to Levofloxacin.

Keywords: Antibiotic susceptibility - Bacterial etiology - Diabetic foot ulcer - Prevalence.

World Health Organization (WHO) defined Diabetes Mellitus (DM) as a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both (WHO,1999). It leads to long-term

complications affecting almost every system in the body and often leading to blindness, heart and blood vessel disease, stroke, kidney failure, amputations, and nerve damage (Kahsu, *et al.*, 2015).

Approximately one half of all patients with foot ulcers have peripheral arterial disease

(PAD) which is considered an important predictor of outcome (Prompers *et al.*, 2008). Patients in whom their foot ulcer progress to diabetic foot infections suffer from prolonged hospitalization, amputations of their foot which increases the rates of mortality (Nyamu *et al.*, 2003).

Foot ulcers can lead to lifelong disability and substantially diminished quality of life, put restrictions on mobility, poor psychosocial adjustment, and lower self-perceptions of health than patients who do not have ulcers, moreover the survival rate of patients with diabetic foot ulcer was decreased compared to diabetic patients without foot ulcer (Spanos *et al.*, 2017).

It is imperative that appropriate antibiotic therapy is instituted as the infection of foot ulcers is often due to more than one organism (Viswanathan *et al.*, 2002). Morbidity and the finances involved will increase to a significant extent if the infection was caused by multidrug resistance organisms (Hartemann-Heurtier *et al.*, 2004).

Aim of the study

This study aimed to determine the diabetic foot ulcer infection rate, bacterial etiology and antibiotic susceptibility.

Significance of the study

It is estimated that 415 million people are living with diabetes worldwide; this is estimated to be 1 in 11 of the world's adult population. 46% of people with diabetes are undiagnosed. This number is expected to rise to 642 million people by 2040. Diabetic foot ulcers are a major complication of diabetes which can lead to amputation of the foot or limb. Treatment of this complication is a global major health care problem resulting in high care costs and mortality rate. Early recognition of infection is highly important to determine factors that predict the healing progress of DFU and the risk of amputation.

MATERIALS AND METHOD

Research design

A cross sectional study design was utilized to fulfill the aim of this study.

Setting

The study was conducted in out-patient diabetes clinic at Asyut University Hospital.

Patients

A total of two hundred adult patients (both

males and females) having type I or type II diabetes with foot ulcer, exclusion criteria; patients who had traumatic ulcers due to other than diabetes causes like motor car accidents, burn and any injury due to sharp materials, also patients on broad spectrum antibiotics were excluded from the study. Data were collected over a period of 8 months from October 2017 till May 2018. The sample size was determined based on the epi info program using 10 % acceptable error, and 95 % confidence coefficient.

Tool

One tool was used for data collection of this study; structured diabetic patient interview questionnaire sheet with the following parts:

Part I: Diabetic Patients Demographic Characteristics: Age, gender, marital status, educational level, occupation, and area of residence.

Part II: Medical profile of the studied patients: Type of diabetes, duration of diabetes, body mass index, smoking status, treatment regimen, duration and depth of ulcer.

Part III: Laboratory tests: 1.Glycosylated Hemoglobin (Hg A1C) to measure the control level of the blood glucose level.

Pus culture and sensitivity results

It included the laboratory results of the pus culture taken from the diabetic foot ulcer causative agent and the antibiotic sensitivity.

METHOD

1. Permission for data collection was obtained from the responsible authorities after explaining the aim of the study.
2. Validation of the tool was assessed before starting data collection by a jury of 5 experts in medicine, research, and nursing fields for content validity to ascertain the appropriateness of items for measuring what they supposed to measure.
3. Tool reliability was calculated using Cronbach's Alpha test which equal 0.96.
4. A pilot study was carried out on 10% (20 diabetic patients) to ascertain the relevance, clarity, and applicability of the research tool, no modifications were needed.
5. Data were collected through an individual interview. An informed agreement was obtained from patients after explaining the purpose, and nature of the study to gain their cooperation.

Table 1. Patients' distribution according to socio-demographic characteristics (n = 200)

Patient Characteristics	N.	%
Sex		
- Male	93	46.5
- Female	107	53.5
Marital status		
- Single	17	8.5
- Married	113	56.5
- Divorced	25	12.5
- Widowed	45	22.5
Age		
- 18 > 30	13	6.5
- 30 > 40	26	13
- 40 > 49	70	35.5
- 50 > 65	91	45.5
Educational level		
- Illiterate	79	39.5
- Reading and writing	47	23.5
- Preparatory school	33	16.5
- Secondary school	25	12.5
- University	16	8
Occupational status		
- Non-working	102	51
- Professional work	80	40
- Farmer	18	9
Residence		
- Rural	116	58
- Urban	84	42

6. The researcher met with each patient individually for filling the questionnaire, after this a sample of venous blood was taken for analysis of the Hg A1C and a wound swab was obtained from the floor of the ulcer. Direct microscopic examination and aerobic cultures were done by standard methods, the bacteriological spectrum and the sensitive antibiotics were noted for each patient.

Ethical Considerations

The purpose of the study was explained to each diabetic patient and an informed written consent to participate in the study was obtained.

Table 2. Medical profile of the studied patients (n = 200)

Patient's related Medical Data	N.	%
Type of diabetes		
- Type 1	88	44
- Type 2	112	56
Duration of diabetes (years)		
- Range	2.0 – 40.0	
- Mean ± SD.	13.14 ± 7.36	
Body mass index (BMI)		
- Range	16.67 – 58.32	
- Mean ± SD.	26.95 ± 6.75	
Smoking status		
- Smokers	105	52.5
- Non-smokers	95	47.5
Treatment regimen		
- Insulin	93	46.5
- Oral hypoglycemic agent	80	40
- Combined	27	13.5

Glycemic control

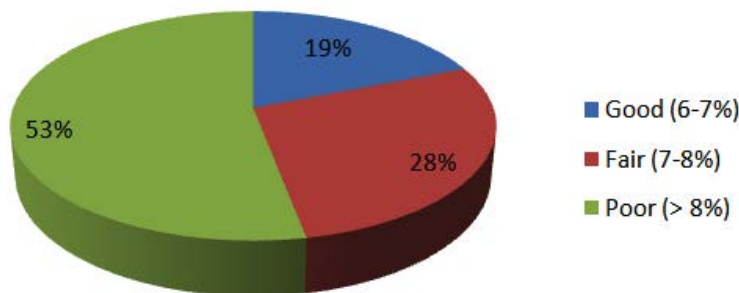


Fig. 1. Distribution of the studied sample as regard glycemic control

Confidentiality of the collected data and the right to withdraw at any time were ensured.

Statistical analysis of the data

Data were fed to the computer and analyzed using SPSS software package version 20. Qualitative data were described using number and percent. Quantitative data were described using minimum and maximum, mean and standard deviation.

Table 3. Distribution of the studied sample according to pus culture result

Result of culture	N.	%
Positive	178	89
Negative	22	11

RESULTS AND DISCUSSION

The present study revealed that 53.5 % of the studied sample was female; this study result comes in accordance with Bagdady, 2014 who found that two thirds of her studied sample was females. 56.5 % were married, 45.5 % were in the age group between 50 to less than 65 years, This finding was in the same line with El-Nahas *et al.*, 2008, Faris *et al.*, 2012 and Hurley, *et al* 2013 who reported that, the peak incidence of foot ulcer was in age group from 50 to 65 years. 39.5 % were illiterate, 51 % were not working and this comes in the same line with Hurley *et al.*, 2013 who illustrated that the majority (48%) of their sample has primary education and the university graduates comprised only 6% of their subjects and were not working. 58 % of them were living in rural areas.

Duration of Ulcer

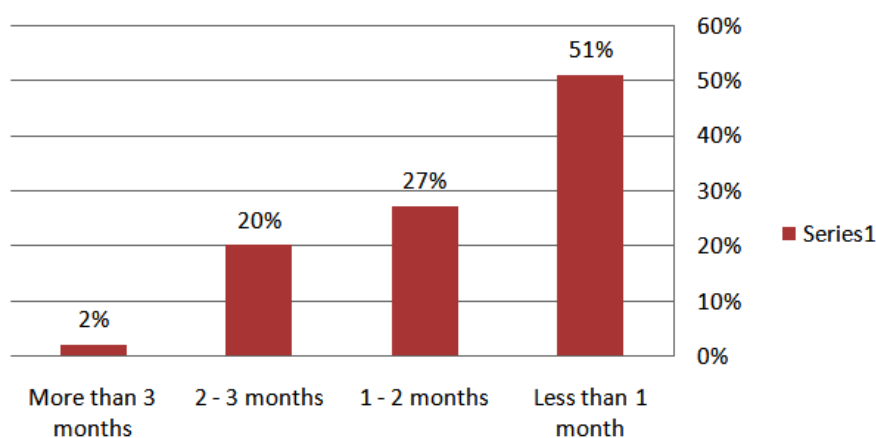


Fig. 2. Distribution of the studied sample according to duration of ulcer

Depth of ulcer

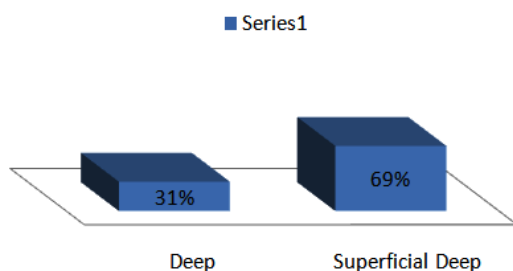


Fig. 3. Distribution of the studied sample according to Deep Superficial

56 % of the sample was having type II diabetes, and this result is supported by Akhil *et al.*, 2015 who reported that type II diabetes represented 82.6 % of their study sample, duration of diabetes in years ranged from 2 to 40 years with a mean and standard deviation of 13.14 ± 7.36 this result comes in disagreement with Akhil *et al.*, 2015 who reported that the mean duration of diabetes in years was 18 years, body mass index ranged from 16.67 – 58.32 with a mean and standard deviation of 26.95 ± 6.75 this finding is comparable to the results by El-Nahas *et al* 2008, 52.5 % were smokers; this result is in line with Khalil *et al.*, 2014 and

Al Kafrawy *et al.*, 2014 findings and regarding treatment regimen; 46.5 % were taking insulin, 40 % oral hypoglycemic agents and 13.5 % were using combined therapy this comes in line with the results of Nyamu *et al.*, 2003 who reported that there was an observed high proportion of patients on insulin.

Regarding glyceimic control; 53 % were in poor glyceimic control, 28 % fair and 19 % were in good glyceimic control, this result comes in accordance with the results by Kathirvel *et al.*, 2018 who reported that 44.66 % of the sample were in poor glyceimic control, 36 % fair and 19.33 % in good control.

51 % of the studied patients their duration of foot ulcer was less than a month, 27 % from 1

– 2 months, 20 % from 2 - 3 months and 2 % were more than 3 months, 69 % of the studied sample was having a superficial ulcer while 31 % were having a deep foot ulcer, these results agree with the results of Kathirvel *et al.*, 2018 who reported that 68 % of the ulcers were <1 month, 22.7 % from 1-2 months, 6 % from 2-3 months and 3.3 % >3 months and the highest percentage in their sample (61.33 %) had a superficial ulcer.

Out of the 200 cases included in the present study 178 patients (89 %) was having a positive pus culture result while 11 % of the sample was having negative pus culture result, this study result is in the same line with the results of

Isolated organism in pus

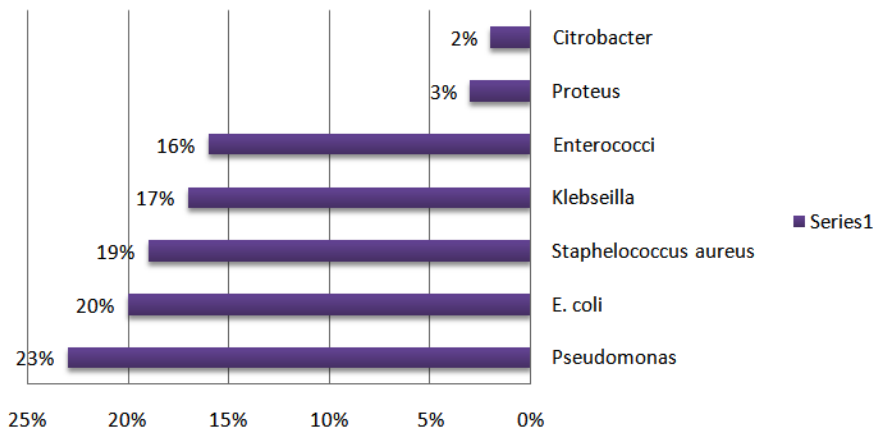


Fig. 4. Distribution of the studied sample according to isolated organism in pus

Sensitivity to antibiotics

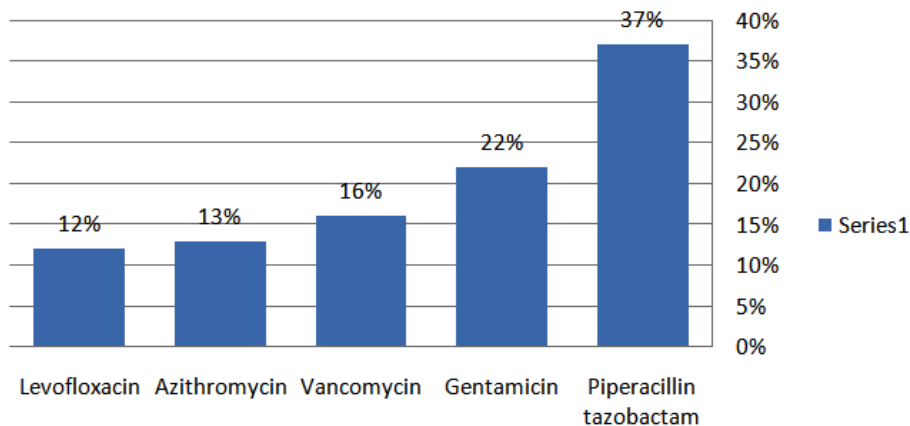


Fig. 5. Distribution of the studied sample according to sensitivity to antibiotics

Vaddadhi *et al.*, 2019 who reported that out of 100 samples processed 90(90%) were culture positive.

Out of the 178 (89 %) positive cases 23 % was related to pseudomonas aeruginosa, followed by Escherichia coli (20 %), Staphelococcus aureus (19 %), Klebseilla spp. (17 %), Enterococci (16 %), Proteus (3 %) and the least common organism was Citrobacter isolates (2 %). Out of the causative organisms 37 % were sensitive to Piperacillin tazobactam, 22 % were sensitive to Gentamicin, 16 % to Vancomycin, 13 % to Azithromycin and 12 % were sensitive to Levofloxacin. These study results comes in agreement with Vaddadhi *et al.*, 2019 who documented that Pseudomonas aeruginosa 23(23%), was the most common isolate causing diabetic foot infections, followed by Escherichia coli and Out of 23(23%) Pseudomonas isolates, 22(95%) were sensitivity to Piperacillin tazobactam. 13(56%) were sensitive to Gentamicin and Only 2 (8 %) were least sensitive to Azithromycin.

CONCLUSION

The current study concluded that out of the 200 cases included, 178 patients (89 %) was having a positive pus culture result out of which 23 % was related to pseudomonas aeruginosa, followed by Escherichia coli (20 %), Staphelococcus aureus (19 %), Klebseilla spp. (17 %), Enterococci (16 %), Proteus (3 %) and the least common organism was Citrobacter isolates (2 %). 37 % of the causative organisms were sensitive to Piperacillin tazobactam, 22 % were sensitive to Gentamicin, 16 % to Vancomycin, 13 % to Azithromycin and 12 % were sensitive to Levofloxacin.

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