International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Study of Etiopathological Factors, Clinical Parameters and Culture Sensitivity of Patients Suffering from Diabetic Foot Ulcer

Rishikesh Sinha, Mayank Devangan, Varun Goswami

Abstract: ***Background: Foot ulceration is one of the most common complications of diabetes, estimated affecting 15% of diabetic patients during their lifetime. The most common cause of morbidity and mortality in diabetic foot ulcer (DFU) is infections, which are seen in 40%–80% of the cases. Initially antimicrobials are selected empirically for treatment of DFU infections. The main objective the study was to evaluate etiopathological factors, Clinical Parameters and Culture Sensitivity in a patient suffering from Diabetic foot ulcer. Methods: A prospective cross - sectional study was conducted at Raipur Institute of Medical Sciences, Raipur, Chhattisgarh, involving 70 DFU patients. All the data were analysed using SPSS version 24.0. Results: Among the 70 DFU patients, 51.43% were male and 48.57% were female, majority of the patients belonged to 51 - 60 age group with a mean age of presentation at 57.8 (±15.03) years Mean duration of hospital stay was 25.63 days. Majority of patients have diabetes for more than 5 years and HbA1c >= 7. Most of the patients belong to IWGDF/IDSA class 3.60% patients have atherosclerosis and 57.14% have neuropathy Ulcer is most common presentation with Staphylococcus being the most common organism.24.29% cases of multi - drug resistance were noted.97.14% cases recovered after treatment. Conclusion: Findings of this present study revealed that DFU are common in males and majority of the patients (27.1%) were from age group 51 - 60 years. Majority of DFU patients have poor glycaemic control and neuropathy and a significant number have atherosclerosis. Gram - positive bacteria are the predominant infections. Staphylococcus is the most common Gram - positive and Pseudomonasis most common Gram - negative infective bacteria in DFU. The number of multi - drug resistant cases noted is a matter of concern. Majority of the patients were treated with Debridement followed by SSG, I&D, Fasciotomy, and Amputation. Most of the patients have high morbidity. Most of patients recovered (97.1%) and only two patients expired. It is essential to educate all the diabetic patients at risk about good glycemic control, risk factors, proper foot care, periodic foot examination and neurological examination of lower limbs, prompt treatment of foot lesions and regular follow - up.***

Keywords: Diabetic foot ulcer, Bacterial infection, Treatment, Antibiotics

1. Introduction

Diabetes mellitus is a major health concern in India, there has been a rapid increase in its prevalence over the last few decades. As per the data of the International Diabetes Federation (IDF) Diabetes Atlas 2019, it has been anticipated that 77 million adults belonging to the age group of 20 years to 79 years were living with diabetes mellitus (DM) in India. The prevalence rate for diabetes mellitus in adults was approximately 8.9%, and this number was expected to rise in the years to come.

"Diabetic foot" is a term used to describe the foot - related pathophysiological process of DM, which increases the risk of ulcer formation and tissue damage. In 1998, Florkowski and Payne.

The damage to the foot due to infection, gangrene & ulceration leads to hospital admission of patients with diabetes mellitus. [1]

Any break in the continuity of the epithelium of the skin of the foot results in foot ulcers. If a foot ulcer occurs as a complication of diabetes, then it is known as a diabetic foot ulcer. [2]

Among all the complications that are occurring as a result of diabetes mellitus, complications occurring in the foot are considered to be the most avoidable.

The prevalence of Diabetic Foot Ulcers (DFU) globally is 6.3%. Males are more likely to have it (4.5%) than females (3.5%). Compared to Type 1 Diabetics (5.5%), Type 2 Diabetics have a higher prevalence of foot ulcers (6.4%). [3]

The probability of developing foot ulcers in a patient suffering from diabetes mellitus during his/her lifetime is estimated to be around 25%. [4]

The prevalence of Diabetic foot ulcers with respect to the Indian scenario accounts for approximately 3 - 6 % [4].

Compared to patients without diabetic foot, those with the condition are older, have a lower body mass index, a history of diabetes for a longer period of time, and are more likely to have a history of smoking, hypertension, and diabetic retinopathy.

There are various risk factors for diabetic foot ulcers [5]

First - degree risk factors: These include the patient's age, prior ulcerations, and sensorimotor diabetic polyneuropathy.
Second - degree risk factors: The conditions that fall under this category are hyperkeratosis, hallux valgus, claw toe or hammer toe, and peripheral arterial occlusive disease.
Third - degree risk factors: These include retinopathy and nephropathy, the length of diabetes mellitus, male gender, and late issues of type 2 diabetes mellitus.

Diabetic foot ulcers are categorized as either uninfected, mildly infected, moderately infected, or severely infected according to the IWGDF / IDSA foot infection classification system. [2]

A diabetic foot infection requires the presence of two or more of the following symptoms:

a) Local swelling or induration
b) Erythema > 0.5 cm around the wound
c) Local tenderness or pain
d) Local increased warmth
e) Purulent discharge

Furthermore, the inflammatory response of the skin cannot be attributed to any other cause, including trauma, gout, acute charcot neuro - osteoarthropathy, fracture, thrombosis, or venous stasis.

Microbial Aspect in Diabetic Foot

The two most common subtypes of a spectrum of infections known as complex skin and skin structure infections (cSSSIs) are major abscesses and diabetic foot infections (DFIs).

According to the Food and Drug Administration (FDA), cSSSIs are defined as infections of the deeper soft tissues requiring surgery or a serious underlying illness limiting the effectiveness of treatment. Furthermore, superficial infections in anatomical sites with a high probability of involvement from anaerobic or Gram - negative pathogens need to be categorized as cSSSIs [6'7].

cSSSIs are linked to high rates of morbidity and mortality in addition to costly, protracted hospital stays. [8].

Both antibiotic therapy and surgical debridement of the infection are part of the management of chronic SSSIs. [9]

Gram - positive cocci, including Staphylococcus aureus and β - hemolytic streptococci, are the primary causes of cSSSIs [6, 8].

Of the cultured isolates in a recent multicenter randomized clinical trial, 65 percent were gram - positive cocci, comprising thirty - three percent S. aureus and fifteen percent β - hemolytic streptococci. Gram - negative bacilli (twenty - eight percent) and anaerobes (seven percent) were observed in smaller proportions. [10] However, there are regional differences in the types and amounts of species isolated. [11]

For the best possible antibiotic therapy and clinical decision - making, accurate and timely pathogen identification is essential.

Presently, routine bacteriological evaluation of biopsies from cSSSIs is based on culture, which requires the use of viable pathogens in tissue and suitable culture conditions for growth.

Pathogens that are hard to culture, those that are scarce, or those that have died before or during the infected tissue sample might make culture identification challenging and time - consuming. Low sensitivity and an overestimation of bacterial prevalence could arise from this.

One of the most significant and prevalent problems among diabetic patients is diabetic foot ulcers can lead to amputation or even death for the patient. It is crucial to comprehend the elements that affect the severity of diabetic foot ulcers because these issues arise when the ulcers get severe. Determining the degree of the illness can be made easier by being aware of these variables. Thus far, research has looked at every facet of beneficial factors and measured them across many groups. By linking the etiopathogenesis, current IWGDF clinical parameters, culture, and antibiotic sensitivity of patients with diabetic foot ulcers, we hope to aid patients in their early recovery

2. Materials & Methods

Study design: Prospective Cross Sectional Study

Study Area

The study will be conducted in the indoor patients of General surgery ward at Raipur Institute of Medical Sciences, Raipur, Chhattisgarh and its associated hospitals and health centres.

Study Population

The Study population will be patients with Diabetic Foot Ulcer from the In - patient ward of General Surgery of Raipur Institute of Medical Sciences, Raipur, Chhattisgarh and its associated hospitals and health centres.

Inclusion Criteria: Patients with age > 18 years presenting to Surgical OPD or emergency department with Diabetic foot ulcer.

Exclusion Criteria:

- Patients below 18 years of age
- Pregnant females
- Psychiatric Patients
- Diabetic patients who have ulcer due to other causes such as traumatic ulcers, venous ulcers etc.

Study duration: 18 Months

Sampling Technique: By Yamanes formula

$$n= \frac{N}{1+N\,(e)^{2}}$$

where

'n' is the calculated sample size, '

N = is the estimated number of cases we expect per month and e = the acceptable sampling error

Sample Size:

Expected cases per month of Diabetic foot Ulcer=N= 10

Acceptable sampling error= 5% of 10 =0.5

Therefore,

$$n= \frac{N}{1+N\,(e)^{2}}$$

$$n= \frac{10}{1+10\,(0.5)^{2}} = 3.5 \text{ cases per month}$$

since the study duration is of 18 months

Sample size will $18 \times 3.5 = 63 \approx 70$

Statistical Analysis: Data was entered in excel sheet and analysis will be done with the help of SPSS version 24. Categorical variables are expressed in % and proportion and chi square test was used for association of variables.

The results of the study were entered in the master - chart using MS EXCEL. Statistical analysis was done by using descriptive and inferential statistics. Software used in the analysis were SPSS (Statistical Product and Service

Solutions) 24.0 version and P < 0.05 is considered as level of significance

Parameters

Clinical parameters:
Clinical history includes the following points - Age and gender distribution, known case of diabetic or not, Duration of diabetes, regarding the treatment received if any, Family history of diabetes, any history of injury, Local symptoms such as swelling, pain, wound, discoloration and Personal habits such as smoking and alcoholism.

Clinical features of neuropathic foot are - Warm with intact pulses, Diminished sensations, callus, Ulceration, Sepsis, Local necrosis, Edema, Charcot's joints.

Clinical features of ischaemic or neuro - ishaemic foot are Cold with absent pulse, diminished sensations, Ulceration and Necrosis or gangrene.

In the examination of the feet, the following points are to be noted - Types of lesion and extent, evidence of any predisposing factors, any changes suggestive of neuropathy or vascular involvement.

The neurological status of the lower limb assessed to rule out diabetic neuropathy. All the sensations, power, reflexes, and neurological deficit were noted.

Vasculopathy of the limb was found by assessing Colour of limb: normal, pale, purpule, black, local temperature: normal or cold and the pulsations of the lower limb: dorsalis pedis, posterior tibial, popliteal and femoral artery.

Morbidity Of the patient was recorded by length of hospital stay.

USG colour Doppler was used to rule out the Atherosclerosis as a non - invasive technique.

The wound was classified according to IWGDF/IDSA foot infection classification system.

IWGDF / IDSA foot infection classification system [2]:

Clinical Classification Of infection with definitions	IWGDF classification
Uninfected:	
No systemic or Local Symptoms or signs of infection	1 (uninfected)
Infected: Atleast 2 of these items are present: a) Local swelling or induration b) Erythema > 0.5 cm* around the wound c) Local tenderness or pain d) Local increased warmth e) Purulent discharge And no other cause (s) of an inflammatory response of the skin (eg. Trauma, gout, acute charcot neuro - osteoarthropathy, fracture, thrombosis or venous stasis)	
Infection with no systemic manifestations (see below) involving a) Only the skin or subcutaneous tissue (not any deeper tissues), and b) Any erythema present does not extend > 2cm** around the wound	2 (mild infection)
Infection with no systemic manifestations, and involving: a) Erythema extending >=2cm* from the wound margin, and/ or b) Tissue deeper than skin and Subcutaneous tissues (eg. Tendon, muscle, joint, bone)	3 (moderate infection)
Any foot infection with associated systemic manifestation [Of the systemic inflammatory response syndrome (SIRS)], as manifested by >=2 of the following: a) Temperature > 38C or < 36C b) Heart Rate > 90 beats/minute c) Respiratory Rate> 20 breaths/ minute or PaCo2 < 4.3 kPa (32mmHg) d) White Blood Cell count > 12, 000/ cu mm, or < 4, 000/cu mm, or > 10% immature (band) forms	4 (Severe infection)
Infection involving bone (Osteomyelitis)	Add " (o) " after 3 or 4***

Note: *Infection refers to any part of the foot, not just of a wound or an ulcer. **In any direction, from the rim of the wound. The presence of clinically significant foot ischemia makes both diagnosis and treatment of infection considerably more difficult. ***If osteomyelitis is demonstrated in the absence of ≥2 signs/symptoms of local or systemic inflammation, classify the foot as either grade 3 (O) (if) (if <2 SIRS criteria) or grade 4 (O) if ≥2SIRS criteria

Biochemical Parameter: HbA1C>=6.5
FBS >=126 mg/dl
PPBS>=200 mg/dl

Microbiological Parameter: Pus or Tissue culture and sensitivity

Bacterial isolates are classified into Sensitive to all antibiotics (S), Resistant to one antibiotic (SDR), Resistant to more than 1 antibiotics (MDR).

3. Results

The analysis of 70 cases of diabetic foot was done. These cases were treated in different surgical units in the Department of Surgery, Raipur Institute of Medical Sciences, Raipur from October 2022 to April 2024.

Age Distribution

Table 1: Represent the age distribution

Age group	N	%
31 - 40 years	8	11.43
41 - 50 years	14	20
51 - 60 years	19	27.14
61 - 70 years	14	20
71 - 80 years	11	15.71
>80 years	4	5.71
Total	70	100

Out of 70 cases studied, majority of the patients (27.14%) were from age group 51 - 60 years followed by 20% of cases belonging to age group of 61 - 70 years.

Table 2: Represent the Mean and Median Age Distribution

Age in years			
Min - Max	Median	Mean	SD
33 - 84	53	57.8	15.03

Sex Distribution

Table 3: Represent the sex distribution

Sex distribution	N	%
Male	36	51.43
Female	34	48.57
Total	70	100

Table 3 represents gender wise distribution of studied subjects. Out of 70 patients, 51.4% were male and 48.6% were female. There was no significant gender wise difference observed.

Length of Hospital Stay

Table 4: Represent the length of hospital stay

Length of Hospital Stay			
Min - Max	Median	Mean	SD
12 - 68	24	25.63	9.89

In this study mean duration oh hospital stay was found to be 25.63 days (+/ - 9.89) and median duration of hospital stay was 24 days.

Duration of Diabetes

Table 5: Represent the duration of diabetes

Duration of diabetes (Years)	No.	%
Below 5	26	37.1
5 to 10	17	24.3
11 to 20	27	38.6

Out of 70 diabetic patients, majority of the patients (38.6%) had duration of diabetes between 11 to 20 years, 37.1% had duration of diabetes below 5 years, and 24.3% had duration of diabetes between 11 to 20 years.

Table 6: Represent the mean duration of diabetes

Variables	Mean	Std. Deviation
Age (in years)	57.80	15.03
Duration of Diabetes (in years)	9.10	7.06

The mean duration of diabetes was 9.10 (±7.06) years.

HbA1c level:

Table 7: Represent the HbA1c level

HbA1c level	No.	%
HbA1c ≥ 7	56	80
HbA1c ≤ 7	14	20

In this study 80% of patients had HbA1c more than 7 and 20% of patients had HbA1c less than 7.

Table 8: Represent the mean and median HbA1c level

Hba1c			
Min - Max	Median	Mean	SD
6.8 - 13.8	8.4	8.85	1.71

In this study mean HbA1c was found to be 8.85 (+/ - 1.71) and median HbA1c was found to be 8.4.

IWGDF/IDSA Classification

Table 9: Represent the IWGDF/IDSA class

IWGDF/IDSA class	N	%
1	5	7.14
2	21	30
3	25	35.71
4	19	27.14
Total	70	100

IWGDF/IDSA class - 3 was commonly observed in our study seen in 35.7% of participants and class - 1 was the least common (7.1%).

Complications:

Table 10: Represent the complications

Complications	N	%
Neuropathy	42	60
Atherosclerosis	40	57.14

In present study, neuropathy was seen in 60% of study participants, while 57.14% had atherosclerosis.

Mode of Presentation

Table 11: Represent the mode of presentation

Mode of Presentation	N	%
Ulcer	41	58.57
Gangrene	7	10
Ulcer+ Gangrene	1	1.43
Abscess	9	12.86
Cellulitis	12	17.14
Total	70	100

In this study, ulcer was the commonly observed mode of presentation (58.57%), followed by cellulitis (17.14%), abscess (12.86%) and gangrene (10%). Only one patient had both ulcer and gangrene.

PUS/ Tissue Culture

Table 12: Represent the culture of micro organisms in culture media

Culture	N	%
Staphylococcus	39	55.71
Pseudomonas	8	11.43
Proteus	5	7.14
Non Hemolytic Streptococci	2	2.86
Klebsiella	9	12.86
E Coli	3	4.29
No Growth	5	7.14

In this study 7.14% culture samples had no growth, majority of the samples showed growth of single organism. Staphylococcus (55.71%) was the most common single bacterial isolate followed by Klebsiella (12.86%), Pseudomonas (11.43%), Proteus (7.14%) and E. coli (4.29%) and Non - haemolytic Streptococci (2.86%).

Drug Sensitivity

Table 13: Represent the drug sensitivity test result

Drug sensitivity Test	Number	%
No growth	5	7.14
Sensitive	44	62.86
SDR	4	5.71
MDR	17	24.29
Total	70	100

In this study 5 samples (7.14%) were negative on culture, 44 samples (68.57%) were sensitive to all drugs, 4 samples were resistant to single drug and 17 samples (24.29%) were found to be multi - drug resistant.

Surgical Treatment

Table 14: Represent the surgical modality of treatment

Treatment	N	%
Debridement	42	60
SSG	12	17.14
I & D	9	12.86
Fasciotomy	5	7.14
amputation	1	1.43
Disarticulation+ Debridement	1	1.43
Total	70	100

Majority of the patients were treated with Debridement (60%) followed by SSG (17.14%), I&D (12.86%), Fasciotomy (7.14%), and Amputation (1.43%).

Outcome

Table 15: Represent the outcome of the patient

Outcome	N	%
Death	2	2.86
Recover	68	97.14
Total	70	100

Most of patients recovered (97.14%) and only two patients expired (2.86%).

4. Discussion

This 18 - month prospective cross - sectional study involved patients with diabetic foot ulcers who were admitted to the general surgery department at the Raipur Institute of Medical Sciences in Raipur, Chhattisgarh. This study included 70 patients with DFU in total.

One of the most debilitating consequences of diabetes is foot ulceration.

The majority of patients (27.14%) in the present investigation were between the ages of 51 and 60 years old, with a mean age of 57.8.

51.43% were male and 48.57% were female.

For more than ten years, the majority of DFU patients (38.6%) had diabetes.

A similar finding had been reported by Maskari et al. [14] and Gadepalli et al. [13]

60 percent and 57.1 percent of the cases in the present investigation had neuropathy and atherosclerosis, respectively. These findings were consistent with other earlier research by Narinder K et al. [15], Yerat RC et al. [16], and Mohanasoundaram KM et al. [17]

A third of diabetic patients have diabetic neuropathy, and treating diabetic foot ulcers (DFU) is becoming more difficult for doctors due to the rising rate of multidrug - resistant infections. [13]

IWGDF/IDSA grade - 3 was the most commonly observed in our study seen in 35.71% of participants and grade - 1 was the least common (7.14%).

Mendes et al. also reported poor glycemic control (HbA1c ≥ 7) in 79.6% of cases, which is similar to the 80% of cases found in this study. [18]

Mean HbA1c was found to be 8.14.

A single organism was growing in the majority of the study's culture samples, with 7.14 percent exhibiting no growth at all. *Staphylococcus* (55.71%) was the most prevalent isolate of a single bacteria, followed by *Pseudomonas* (11.43%), *Klebsiella* (12.86%), *Proteus* (7.14%), and *E. coli* (4.29%) and Non - haemolytic *Streptococci* (2.86%).

Bansal et al. [19] evaluated 103 patients and found that 61.8% of the cases had monomicrobial growth, 37.08% had polymicrobial growth, and 7.2% had sterile culture.32.9% of the bacterial isolates were Gram - negative bacteria, whereas 67.1% of the isolates were Gram - positive. However, earlier research indicated that Gram - negative pathogens were more common. [16]

Gram - negative bacilli are a common cause of diabetic foot infections in India [20]. Numerous studies from the West, such as Mendes et al. [18], have shown that Gram - positive organisms predominate in DFU. [21]

It is mostly unknown that Gram - positive as well as Gram - negative organisms differ in their predominant prevalence.

As an alternative, Turhan et al. [22] proposed that environmental factors, such as hygienic practices like washing one's hands with faecal flora after defecating, may contribute to bacterial infections in developing nations.

Of all the samples collected, 7.14% of samples showed no growth and 92.86% showed bacterial presence on culture, out of which 62.86% were sensitive to all the drugs, 5.71% samples were resistant to single drug and 24.29 % of samples were multi - drug resistant.

In a related investigation, Amit Kumar Singh et al. [23] found that the most prevalent isolate (27.3 percent) was susceptible to cefotaxime (80 percent), imipenem (90 percent), amikacin (86.6 percent), and gentamicin (83.3 percent). The most prevalent isolate, Staphylococcus aureus (19.1 percent), was susceptible to imipenem (99p percent), amikacin and gentamicin (100 percent), and ofloxacin (99 percent). Significant resistance to ampicillin and amoxicillin - clavulanic acid was observed in Proteus, Klebsiella, E. coli, and Pseudomonas.

The minimum hospital stay was 12 days and the maximum was 68 days. The average length of hospital stay was 25.63 days which signifies high morbidity in these patients.

Out of 70 patients, 68 patients (97.14%) recovered and there were only 2 (2.86%) deaths. So mortality came out to be on the lower side.

Lihong Chen et al. [24] in a systematic review and meta - analysis estimated the global mortality to be around 50% within 5 years.
So, estimated mortality in our study is low.

5. Conclusion

Findings of this present study revealed that DFU are common in males and majority of the patients (27.1%) were from age group 51 - 60 years.

Majority of DFU patients have poor glycaemic control and neuropathy and a significant number have atherosclerosis.

Gram - positive bacteria are the predominant infections. *Staphylococcus* is the most common Gram - positive and *Pseudomonas*is most common Gram - negative infective bacteria in DFU.

The number of multi - drug resistant cases noted is a matter of concern.

Majority of the patients were treated with Debridement followed by SSG, I&D, Fasciotomy, and Amputation.

Most of the patients have high morbidity.

Most of patients recovered (97.1%) and only two patients expired.

It is essential to educate all the diabetic patients at risk about good glycemic control, risk factors, proper foot care, periodic foot examination and neurological examination of lower limbs, prompt treatment of foot lesions and regular follow - up.

Conducting a comprehensive study on etiopathological factors, clinical parameters, and culture sensitivity in diabetic foot ulcers within the Indian healthcare context is essential to optimize management strategies. Such research can guide tailored interventions, improve clinical outcomes, and reduce the economic burden associated with DFUs in India.

References

[1] Stancu B, Ilyés T, Farcas M, Coman HF, Chiș BA, Andercou OA. Diabetic foot complications: a retrospective cohort study. International Journal of Environmental Research and Public Health.2022 Dec 23; 20 (1): 187.
[2] Schaper NC, Van Netten JJ, Apelqvist J, Lipsky BA, Bakker K, International Working Group on the Diabetic Foot. Prevention and management of foot problems in diabetes: A Summary Guidance for Daily Practice 2015, based on the IWGDF guidance documents. Diabetes research and clinical practice.2017 Feb 1; 124: 84 - 92.
[3] Zhang, Pengzi; Lu, Jing; Jing, Yali; Tang, Sunyinyan; Zhu, Dalong; Bi, Yan (2016). Global Epidemiology of Diabetic Foot Ulceration: A Systematic Review and Meta - Analysis. Annals of Medicine, (), 1–21.
[4] Boulton AJ, Vileikyte L, Ragnarson - Tennvall G, Apelqvist J. The global burden of diabetic foot disease. The Lancet.2005 Nov 12; 366 (9498): 1719 - 24.
[5] Volmer - Thole M, Lobmann R. Neuropathy and diabetic foot syndrome. International journal of molecular sciences.2016 Jun 10; 17 (6): 917.
[6] U. S. Food and Drug Administration (FDA) (1998) Guidance for industry. Uncomplicated and complicated skin and skin structure infections—developing antimicrobial drugs for treatment. Available online at: http: //www.fda. gov/ohrms/dockets/98fr/ 2566dft. pdf. Accessed 12 September 2013
[7] DiNubile MJ, Lipsky BA. Complicated infections of skin and skin structures: when the infection is more than skin deep. Journal of Antimicrobial Chemotherapy.2004 May 1; 53 (suppl_2): ii37 - 50.
[8] Lipsky BA, Weigelt JA, Gupta V, Killian A, Peng MM. Skin, soft tissue, bone, and joint infections in hospitalized patients: epidemiology and microbiological, clinical, and economic outcomes. Infection Control & Hospital Epidemiology.2007 Nov; 28 (11): 1290 - 8.
[9] Stevens DL, Bisno AL, Chambers HF, Everett ED, Dellinger P, Goldstein EJ, Gorbach SL, Hirschmann JV, Kaplan EL, Montoya JG, Wade JC. Practice guidelines for the diagnosis and management of skin and soft - tissue infections. Clinical Infectious Diseases.2005 Nov 15; 41 (10): 1373 - 406.
[10] Gyssens IC, Dryden M, Kujath P, Nathwani D, Schaper N, Hampel B, Reimnitz P, Alder J, Arvis P. A randomized trial of the efficacy and safety of sequential intravenous/oral moxifloxacin monotherapy versus intravenous piperacillin/tazobactam followed by oral amoxicillin/clavulanate for complicated skin

and skin structure infections. Journal of antimicrobial chemotherapy.2011 Nov 1; 66 (11): 2632 - 42.

[11] Moet GJ, Jones RN, Biedenbach DJ, Stilwell MG, Fritsche TR. Contemporary causes of skin and soft tissue infections in North America, Latin America, and Europe: report from the SENTRY Antimicrobial Surveillance Program (1998–2004). Diagnostic microbiology and infectious disease.2007 Jan 1; 57 (1): 7 - 13.

[12] Keane WF, Brenner BM, De Zeeuw D, Grunfeld JP, McGill J, Mitch WE, Ribeiro AB, Shahinfar S, Simpson RL, Snapinn SM, Toto R. The risk of developing end - stage renal disease in patients with type 2 diabetes and nephropathy: the RENAAL study. Kidney international.2003 Apr 1; 63 (4): 1499 - 507.

[13] Gadepalli R, Dhawan B, Sreenivas V, Kapil A, Ammini AC, Chaudhry R. A clinico - microbiological study of diabetic foot ulcers in an Indian tertiary care hospital. Diabetes care.2006 Aug 1; 29 (8): 1727 - 32.

[14] Al - Maskari F, El - Sadig M. Prevalence of risk factors for diabetic foot complications. BMC family practice.2007 Dec; 8: 1 - 9.

[15] Kaur N, Kaur N, Kumar R, Gill AK. Clinical and susceptibility profile from diabetic foot patients in tertiary care hospital. Scholars J Appl Med Sci.2014; 2 (2D): 865 - 9.

[16] Yerat RC, Rangasamy VR. A clinicomicrobial study of diabetic foot ulcer infections in South India. International Journal of Medicine and Public Health.2015; 5 (3).

[17] Mohanasoundaram KM. The microbiological profile of diabetic foot infections. J Clin Diagn Res.2012; 6 (3): 409 - 411.

[18] Mendes JJ, Marques - Costa A, Vilela C, Neves J, Candeias N, Cavaco - Silva P, Melo - Cristino J. Clinical and bacteriological survey of diabetic foot infections in Lisbon. Diabetes research and clinical practice.2012 Jan 1; 95 (1): 153 - 61.

[19] Bansal E, Garg A, Bhatia S, Attri AK, Chander J. Spectrum of microbial flora in diabetic foot ulcers. Indian journal of pathology and microbiology.2008 Apr 1; 51 (2): 204 - 8.

[20] Yin K, Qiao T, Zhang Y, Liu J, Wang Y, Qi F, Deng J, Zhao C, Xu Y, Cao Y. Unraveling shared risk factors for diabetic foot ulcer: a comprehensive Mendelian randomization analysis. BMJ Open Diabetes Research and Care.2023 Nov 1; 11 (6): e003523.

[21] Gandhi C, Kadam P, Kamepalli V, Kadam Y. PEDIS grading and its role in diabetic foot ulcer management. International Surgery Journal.2019 Jun 29; 6 (7): 2548 - 52.

[22] ShankarRao AG, Behera PK, Tripathy KP, Nair AA. Clinico - Microbiological Profile and Culture Sensitivity Pattern of Micro - Organisms Isolated from Diabetic Foot Ulcers: Study from a Tertiary Care Centre. The Journal of the Association of Physicians of India.2022 Apr 1; 70 (4): 11 - 2.

[23] Singh AK, Yeola M, Singh N, Damke S. A study on diabetic foot ulcers in Central rural India to formulate empiric antimicrobial therapy. Journal of family medicine and primary care.2020 Aug 1; 9 (8): 4216

[24] Chen L, Sun S, Gao Y, Ran X. Global mortality of diabetic foot ulcer: a systematic review and meta-analysis of observational studies. Diabetes, Obesity and Metabolism.2023 Jan; 25 (1): 36 - 45.