Original Research Article

To study the various Clinical and Radiological Presentation of patients with Diabetic foot Osteomyelitis at Tertiary care centre.

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Abstract:
Introduction-Diabetic Foot Ulcer is one of the complications of diabetes associated with severe morbidity, mortality, and reduced quality of life and socioeconomic implication. The incidence of DFU continues to raise. The insensate foot is very prone to trauma which may be unperceived and hence neglected and the ulcer remains unnoticed and very soon it develops a septic complication. Osteomyelitis is a common complication of infected diabetic foot ulcers, occurring in 10%-15% of moderate and 50% of severely infected feet[1].
Diabetic foot osteomyelitis is the consequence of a soft tissue infection that extends into the bone in diabetic individuals, affecting the cortex first followed by marrow. In all DFUs chronic wounds, recurrent ulcers with clinical findings of inflammation, bone involvement should be suspected.
Methods: This study was conducted on 75 consecutive patients admitted in various surgery units in Department of General Surgery, J.A. Group of Hospitals, G.R. Medical College, Gwalior during period February 2019 – august 2020. Well, and informed consent from the patient was taken before enrolling them in the study.
Result: -Diabetes Foot Osteomyelitis is mostly present in pateint of neuropathic symptom. Mostly patient of our study having ABPI of 0.6 -0.89.
Radiological test PTB test and Xray foot shows osteomyelitis present 90% and 91 percent accordingly. Various inflammatory marker was raised in our study .Deep tissue culture shows staph aureus in 47% followed by streptococcus in 10 percentage of patients .
Conclusion: The diagnosis of osteomyelitis is primarily based on clinical signs of infection supported by laboratory, microbiological, and radiological evaluation. However, the diagnosis remains a challenge and DFO is often not recognized easily in its initial phase.

KEY WORDS:- Diabetic foot ,Gangrene ,Necrosis, DSA

INTRODUCTION

Diabetic foot ulcer is characterized as a full-thickness wound below the ankle in a diabetic individual, irrespective of the period, as per the international consensus on diabetic foot .
      Foot ulceration is a very common complication among diabetics in the Indian population and can be due to various social, and cultural activities such as barefoot walking,

lack of awareness, poverty, poor foot care & hygiene, and poor access to health care[2] It has been predicted that at least 19-34% of diabetic patients are likely to be infected throughout their lifetime with a diabetic foot ulcer with a recurrence rate of 50% within the next 5 years[3]

About 60% of diabetic foot ulcers (DFUs) may get infected[4]. Infection is the forerunner of lower limb amputation in more than two-thirds of the patient with DFU With the progress of diabetes structural anatomy of the foot undergoes alteration and gait pattern to change due to vasculopathy and neuropathy. The insensate foot is very prone to trauma which may be unperceived and hence neglected and the ulcer remains unnoticed and very soon it develops a septic complication. Osteomyelitis is a common complication of infected diabetic foot ulcers, occurring in 10%-15% of moderate and 50% of severely infected feet[5]. Osteomyelitis complicated ulcers often require surgical care with prolonged antibiotic therapy. To ensure successful care and reduce the risk of minor and major amputations, early and accurate diagnosis is necessary . The initial presentation of about 85 percent of lower extremity amputations appears to be DFUs. Diabetic foot ulcers, 15 times higher than in the non-diabetic population, remain a significant cause of non-traumatic lower extremity amputations worldwide. The length of hospital stay for patients with diabetic foot ulcers is approximately 60 percent longer compared to those without diabetic foot ulcers.

CLINICAL PRESENTATION OF DIABETIC FOOT INFECTION
Local foot problems
Pain ,Tenderness ,Purulent discharge ,Swelling , Erythema , Induration , Ulceration
Sinus tract formation
Evidence of systemic infection
Fever $>38^0$C or $<36^{0,}$ Chills , Nausea , Vomiting , Tachycardia (pulse >100), Malaise , Fatigue , Respiratory rate (>20 breath /min)

ASSESSING SEVERITY OF DIABETIC FOOT INFECTIONS
Infections most often involve the forefoot, especially the toes and metatarsal heads, and particularly on the plantar surface.
Wagner system foot lesions are divided into 6 grades based on the depth of the wound and extent of tissue necrosis.

INVESTIGATIONS
CRITERIA FOR THE DIAGNOSIS OF DIABETES MELLITUS: -
1.   Symptoms of diabetes with plasma glucose concentration is > or = to 200mg/dl (11.1 mmol/l).
2.   FPG > or = 126mg/dl (7.0 mmol/l).
3.   2-hr post-load glucose > or = to 200 mg/dl (11.1 mmol/l)

URINE EXAMINATION -urine sugar,P:resence of Ketone Bodies, Albuminuria
BLOOD EXAMINATION
- Hemoglobin percentage,TLC, DLC, ESR, Bleeding and clotting time
- Blood grouping and Rh typing BLOOD SUGARS
- FASTING BLOOD SUGAR (FBS)
- POST PRANDIAL BLOOD SUGAR (PPBS):
- GLUCOSE TOLERANCE TEST
- Glycosylated hemoglobin HbA1C- Measurement of glycated hemoglobin is the standard method for assessing long term glycaemic control.

RENAL FUNCTION TEST - Blood urea , Serum creatinine
LIPID PROFILE
Total cholesterol ,HDL cholesterol , LDL cholesterol , VLDL , Triglycerides

NEUROLOGICAL EXAMINATION
- Tendon reflexes to evaluate impaired neurological status.
- 128 Hz tuning fork test: the graduated 128 Hz tuning fork could be used to measure vibratory sense semi-quantitatively.

PERIPHERAL VASCULATURE EVALUATION
- **Dorsalis pedis / posterior tibial pulses**: Vascular assessment must include palpation of all lower extremity pulses. The femoral, popliteal, posterior tibial, and dorsalis pedis pulses may be examined.

  Ankle-brachial pressure index:ABPI is a simple and easily reproducible method of diagnosing vascular insufficiency in the lower limbs. ABPI is obtained by dividing the ankle by brachial systolic pressures.
- **Transcutaneous oxygen saturation**: transcutaneous oxygen tension (normal >40mmHg) measurement has been used as a non-invasive measurement of limb perfusion.
- **Duplex ultrasound scanning of the lower limbs**: duplex ultrasound scanning combines color flow imaging with B-mode and pulsed Doppler. This provides anatomical detail, visualization of flow, and flow velocity data.
- **Angiography**: it is indicated in diabetic patients with non-healing ulcers or osteomyelitis requiring endovascular and surgical planning.
- **Digital subtraction angiography**: this is currently considered the gold standard in the assessment of occlusive disease.
- **CT angiography**: it produces high-resolution images of the vascular artery and gives information about soft tissues that may be associated with PAD, such as aneurysms, popliteal entrapment, or cystic adventitial disease.
- **MRA**:MRA is particularly useful in patients who are at high risk for contrast-induced nephropathy, particularly elderly diabetic patients.

  Culture and sensitivity of discharge: Organisms isolated from reliable specimens that are the sole or predominant bacteria on both Gram-stained smear and culture are likely to be the true pathogens.

  Two specific clinical signs are predictive of osteomyelitis.
- First the width and depth of the foot ulcer. An ulcer larger than 2 cm^2 and Deeper more than 3 mm is usually associated with diabetic foot osteomyelitis[4].
- The second diagnostic criterion to detect DFO is the "probe-to-bone test" (PTB).
- Microbiological culture: microbiological studies of diabetic foot osteomyelitis suggest that the majority of cases are polymicrobial; S. aureus is the most commonly isolated agent (~50%) while S. epidermidis (~25%), Streptococci (~30%) and Enterobacteriaceae (~40%) are also frequent isolates of 22. bone biopsy is the diagnostic gold standard.
- PTB- PTB is performed probing the ulcer area with a sterile blunt probe. If the probe hits the surface of bone the PTB is considered positive .in the presence of infected ulcers, a positive PTB test is highly suggestive of osteomyelitis, but a negative test does not exclude it

  The combination of the PTB test with X-ray improves the sensitivity and specificity in the diagnosis of DFO.

Serum inflammatory markers:
1. WBC count
2. C-reactive protein estimation

3.   erythrocyte sedimentation rate (ESR)

4.   procalcitonin (PCT) estimation

•   **Radiographic (plain X-ray foot) appearance of osteomyelitis**: the presence of soft tissue swelling, periosteal new bone formation, cortical bone destruction, focal osteopenia, and permeative radiolucency are diagnostic for osteomyelitis.

•   **Three-phase Technetium bone scan**: triple-phase bone scan (TPBS) test used for diabetic foot infection to determine the presence of osteomyelitis in patients with negative radiographs.

•   **Gallium scan**: gallium 67 citrate localizes in areas of infection. If the gallium scan is normal, osteomyelitis can be excluded.

Magnetic resonance imaging: It readily delineates an infection extent, guides surgery, characterizes soft tissue abnormalities, and excludes osteomyelitis. Its advantages are the precise anatomic definition and improve lesion characterization.

AIMS AND OBJECTIVES-

 to stuhdy the Various clinical and Radiological Presentation of patients with Diabetic foot Ulcer at tertiary care centre .

MATERIAL AND METHODS

Sample Size- A minimum of 75 Patients

Type of study: Observational study (Prospective)

Source of data: Patients diagnosed with attending the Outpatient department and getting admitted to Department of surgery, J.A. Group of hospitals, Gwalior.

Inclusion Criteria   :

1.   All patients with foot ulcer were admitted to the department of general surgery of G.R. Medical College in the above mention period.

2.   Duration of ulcer ≥ 2weeks

3.   Ulcer width >2 cm and depth >3 mm with or without gangrene

EXCLUSION CRITERIA

1)   Non-diabetic patients with foot ulcers.

2)   Presence of peripheral vascular disease (<0.6 ABI)

3)   Patients who have diabetes with superficial ulcer (width<$2cm^2$ and depth<3mm).

STATISTICAL ANALYSIS

All Statistical calculations were done with the help of Chi–Square test with degree of significance <0.5% with SPSS software version 22.0

OBSERVATION & RESULTS

Following observations were made :-

TABLE 1 : NEUROPATHIC SYMPTOM IN STUDY POPULATION

DIABETIC NEUROPATHY	FREQUENCY	PERCENTAGE
YES	55	73.33%
NO	20	26.67%
TOTAL	75	100

In our study 55(73.33)% of a patient having some neuropathic symptom.

TABLE 2: ANKLE BRACHIAL INDEX IN STUDY POPULATION

ABI		FREQUENCY	PERCENTAGE
>1.30	ARTERIAL CALCIFICATION	0	0
0.90–1.30	Normal	23	30.67%
0.60–0.89	Mild arterial obstruction	52	69.33%
0.40–0.59	Moderate obstruction	EXCLUDED	
<0.40	Severe obstruction	EXCLUDED	

In our study out of 75,52(69.33%) patients present with mild arterial obstruction.

TABLE 3 : PROBE TO BONE TEST RESULT IN CONDUCTED TEST

PTB	FREQUENCY	PERCENTAGE
POSITIVE	49	81.66
NEGETIVE	11	18.33
TOTAL	60	100

In our study out of 75 patients, 60 patients tested done and 49(81.66%) patients showing a positive result.

TABLE 4: X-RAY FOOT FINDING IN STUDY POPULATION

XRAY FOOT	FREQUENCY	PERCENTAGE
osteomyelitis changes	32	91.42%
normal x-ray	3	8.57%
Total	35	100

In our study out of 75 patients, x-ray foot was done in 35 patients, out of 35 patients 32(91.2%) x-ray showing osteomyelitis changes and 3 patients having normal x-ray foot in spite of diabetic foot osteomyelitis.

TABLE 5: FINDING OF BONE BIOPSY IN STUDY POPULATION

BONE BIOPSY	FREQUENCY	PERCENTAGE
OSTEOMYLITIC CHANGE	36	69.23%
NEGETIVE	16	30.76%
TOTAL	52	100

In the present study out of 75 cases only, sent 52 samples for histological confirmation but only 69.23% cases confirmed rest biopsy result is doubtful.

TABLE 6 : INFLAMMATORY MARKER(TLC,ESR,CRP) IN STUDY POPULATION

TEST VALUE	TLC	ESR	CRP
ELEVATED	60(80%)	61(81.33%)	55(73.33%)
NORMAL	15(20%)	11(14.66%)	18(24%)
TEST NOT DONE	0	3(4%)	2(2.66%)

In the present study, most diabetic foot osteomyelitis patients presented with elevated inflammatory markers TLC, ESR, CRP.

TABLE 7: DEEP TISSUE CULTURE AND BONE CULTURE

DEEP TISSUE CULTURE/BONE BIOPSY	FREQUENCY	PERCENTAGE
POSITIVE	60	85.71%
NEGATIVE	10	14.29%
TOTAL	70	100

In the present study out of 75 patients, 70 patients tested for antibiotic sensitivity, out of 70, 60(85.71%) sample positive, and 10(14.29%) showing no growth of the organism.

TABLE 8: MICROORGANISM IN DIFFERENT CULTURE

MICROORGANISM	FREQUENCY	PERCENTAGE
Staph aureus	33	47.14%
Streptococcus	21	30%
Pseudomonas	14	20%
E.coli	9	12.86%
Klebsiella	8	11.43%
Proteus	7	10%
No growth	10	14.29%

In our study 47.14% culture positive for staph aureus 30% for streptococuss ,20% for pseudomonas 12.86% for e.coli, 11.43% for klebsiella,10% for proteus and 14.29% sample showing no bacterial growth.

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DISCUSSION
NEUROPATHY
Mohan et al[6] reported foot ulcers in 69.85% as purely neuropathic ulcers and 23.3% having neuro-ischaemic ulcers.In our study 73.33% of patients (55 out of 75 were diagnosed to have neuropathy) emphasizing the fact that the diabetic foot infection is developed against the background of neuropathy.When monofilament is applied patient should be able to identify area being touched and should also be able to detect the presence of monofilament at the time it buckles. **Yuzhe Feng Felix et al**[7] also stressed that in a clinical setting the insensitivity to the 10 gram 5.07 monofilament was the single most practical measurement of risk assessment.
 VASCULOPATHY
Pendsey reported 23.21% of patients who underwent amputations had vasculopathy causing ischemia. It is generally believed that 75-90% of diabetic patients with foot lesions will have neuropathy in India and 10-15% will have vasculopathy. There would be some who have neuro-ischemic feet as well.[79]

In our study, 69.33% of patients had mild vasculopathy and severe vasculopathic patients were not included.

CULTURE AND SENSITIVITY COMPARISION

	Grayson et. Al. [8]	Alina Tone et al. [9]	Present Study
Staph aureus	22	34.5	47.14
Streptococcus species	13	3.4	30
Pseudomonas species	3	3.4	20
E.Coli	7	3.4	12.86
Klebsiella	4		11.43
Proteus	11	6.9	10
No growth			14.29

In the present study, the commonest organism cultured was Staphylococcus aureus in 33 (47.14%) cases which was similar to the study conducted by **Alina Tone et al[9].**

DIAGNOSIS OF DIABETIC FOOT OSTEOMYELITIS (DFO)

In the present study maximum DFO cases were diagnosed with simple plain radiograph (91.42%) and PTB (Probe to bone) (81.66%).

Grayson et al[8] have shown that in a high percentage (85%) of cases simply probing to the bone can make the diagnosis of osteomyelitis.

CONCLUSION

- The maximum case of DFO can be detected with the only combination of the probe to bone test and plain radiograph and it helps to initiate early treatment. And CT, MRI, bone scans are other costly investigations, and poor availability of these investigations in a developing country.
- Deep tissue culture and bone culture helps to guide appropriate antibiotic therapy.
- Slightly higher healing with less recurrence found in surgically managed DFO and statistically nonsignificant.
- Diabetic patients at risk for foot complication must be educated about risk factors and the importance of foot care, including the need for self-inspection and surveillance, monitoring foot temperatures, daily foot hygiene, use of proper footwear, good diabetes control, and prompt recognition and early professional treatment of newly discovered lesions.

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