

A profile of diabetic foot ulcer

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Abstract

Introduction: The term diabetic foot indicates that there are specific qualities about the feet of people with diabetes that sets this disease apart from other conditions that affect the lower extremity (Habershaw and Chzran, 1995). However, that which affects the foot in those with diabetes can affect the foot in those without diabetes. So, another definition could be the many different lesions of skin, nails, bone and connective tissue in the foot which occur more often in diabetic patients than non-diabetic patients such as ulcers, neuropathic fractures, infections, gangrene and amputations.

(De Heus-Van Putten, 1994). The term “Diabetic foot” implies that the pathophysiological processes of diabetes mellitus do something to foot, that puts at increased risk of tissue damage leading to ulcer formation. (Payne & Florkowski, 1998). The aim in managing diabetic foot is always to keep the patient at as low a stage as possible. At each stage of the diabetic foot, it is necessary to

intervene early and take control of the foot to prevent further progression. No one person can take control of the diabetic foot.

Members of the team will include physician, general surgeon, orthopedic surgeon, radiologist, expert nurse and podiatrist. It is helpful if the team works closely together, within the focus of the diabetic foot clinic and also meets regularly to conduct ward rounds and x ray conferences. Each team member should be available quickly in an emergency.

Methods: This Prospective observational study was conducted comprising of 100 patients of Diabetic foot ulcers admitted in the surgical unit of MGM Medical College & Hospital.

Results and conclusion: This study comprised of 100 cases of diabetic foot patients with emphasis on surgical management and its complications. After analysis of the data the following are the conclusions- The highest number of patients was seen in the age group of 51-60

years (31%). Males are almost two times more affected than females. (Males are more vulnerable to trauma). Agriculturists had more incidence of diabetic foot lesions. Diabetic foot ulcers have seen more in NIDDM. Duration of diabetes varied from just diagnosed to 25 years. In study 96 patients were known diabetic and 4 diagnosed at the time of presentation. Trivial trauma of some kind was the initiating factor in nearly half of the cases. Minimum stay in hospital was 1 week and maximum 12 weeks, most of patients stays for 4 to 6 weeks. Commonest presenting lesion was Ulcer 48%, followed by Cellulitis 28%, and Gangrene 18%. After 5 to 6 years of diabetes most of patients present with neuropathic lesions and they are in 35 to 80years age group some of them develops gangrene. Staphylococcus aureus is a commonest organism causing infection. Atherosclerotic changes may lead to formation of ulceration of foot in diabetic patients. Conservative treatment consisting of control of diabetes with Plain/Lente insulin along with appropriate oral / IV antibiotics was effective in some cases. Wound debridement, slough excision followed by dressing with Povidone/magnesium sulphate/ framycetin /metrogyl/ collagenase dressing resulted in healing in some cases. Split skin grafts, Disarticulation, Trans metatarsal amputation, below knee and above knee amputations were the other modes treatment. 96 patients cured and 4 patients died during course of treatment.

Keywords: diabetes, diabetic foot, ulcer, debridement, amputation.

Introduction

The term diabetic foot indicates that there are specific qualities about the feet of people with diabetes that sets this disease apart from other conditions that affect the lower extremity (Habershaw and Chzran, 1995).

However, that which affects the foot in those with diabetes can affect the foot in those without diabetes. So, another definition could be the many different lesions of skin, nails, bone and connective tissue in the foot which occur more often in diabetic patients than non-diabetic patients such as ulcers, neuropathic fractures, infections, gangrene and amputations. (De Heus-Van Putten, 1994). The term “Diabetic foot” implies that the pathophysiological processes of diabetes mellitus do something to foot, that puts at increased risk of tissue damage leading to ulcer formation. (Payne & Florkowski, 1998).

Foot disorders such as ulceration, infection and gangrene are one of the leading causes of hospitalization in patients with diabetes mellitus¹.

Natural history of the diabetic foot

Evidence that the pathological process of Diabetes has put the foot at increased risk for tissue damage has occurred and the foot is at risk for end stage complications (amputation). Of all the complications of Diabetes, those that occur in the foot are considered most preventable.

Epidemiology²

3-5% of those with diabetes have a foot ulcer.

15% of all those with diabetes will, during their lifetime develops an ulcer.

4-5 % of foot ulcers are precipitated by external trauma.

Up to 20% undergo an ipsilateral amputation within 12 months.

Up to 50% undergo a contralateral amputation within 1-3 years; 75% within 5 years

3years mortality after amputation is 20-50%

Most important risk factors are

- Loss of protective sensations.
- Longer duration of diabetes.
- Higher foot pressure.

Nowadays the diabetic foot care and management of problems related to foot are gaining more emphasis, the reason for this is that diabetic foot condition is considered to be one of the most cost-effective preventable morbidity. The studies conducted have shown that just observing the foot and going through proper foot care procedure will considerably reduce the incidence of diabetic foot and also it will decrease the severity of diabetic foot.

In 2000, the International Diabetes Federation endorsed the International Working on the Diabetic Foot as a Consultative Section on the Diabetic Foot. Together the organizations established goals for the future of diabetic foot care worldwide³.

Goals

- To inform people of the extent of diabetic foot problems worldwide.
- To raise awareness of the diabetic foot among those at risk and those in a position to take action.
- To persuade healthcare decision makers that action is both possible and affordable.
- To warn healthcare decision makers of the consequences of not taking action
- To inform people with diabetes of the measures they can take to prevent foot complications

Multidisciplinary management³

The aim in managing diabetic foot is always to keep the patient at as low a stage as possible.

At each stage of the diabetic foot, it is necessary to intervene early and take control of the foot to prevent further progression. No one person can take control of the diabetic foot.

Members of the team will include physician, general surgeon, orthopedic surgeon, radiologist, expert nurse and podiatrist.

It is helpful if the team works closely together, within the focus of the diabetic foot clinic and also meets regularly to conduct ward rounds and x ray conferences. Each team member should be available quickly in an emergency.

Aim and objectives

AIM

- The aim of this study is to study the recent trends involving the pathology, complications and management of diabetic foot ulcers.
- To study the co-relation between atherosclerotic changes in the blood vessels of the lower limb & diabetic ulcers.
- To study the bacterial flora & progression of the ulcer with the relation to severity of diabetes.

Objectives

- To understand the pathology of diabetic foot and relative distribution of this condition according to age, sex, and occupation among diabetic patients
- To study the mode of presentation of diabetic foot ulcers.
- To understand the pathology of diabetic foot ulcers, its complications and to prevent these complications.
- To study the different treatment modalities in management of diabetic foot
- Ulcer.

Materials and methods

Methodology

Source of data: This Prospective Observational Study was conducted comprising of 100 patients of Diabetic foot ulcers admitted in the surgical unit of MGM Medical College & Hospital.

Inclusion criteria

- 100 cases of diabetic ulcers admitted in MGM hospital surgical unit.
- Patients above 30 years of age.

- Adult maturity onset diabetes.
- Both males & females.
- Both healing & non healing ulcers.

Exclusion criteria

- Patients with juvenile diabetes.
- Paediatric & younger age group patients.
- Patients with ulcer and Gangrene of foot other than Diabetic etiology.

Methods of collection of data

After registration and admission, detailed clinical history of patient taken. This was followed by detailed Clinical examination of patient with particular reference to the lesion of foot.

The name, age, sex, addresses and profession of each patient was noted. The Clinical features were recorded in chronological order and each symptom was elaborated in detail.

Clinical features of neuropathic foot

Warm with intact pulses

Diminished sensations, callus

Ulceration (especially on the tip of toes and planter surfaces under metatarsal heads) Sepsis

Local necrosis

Edema

Charcot's joints

Clinical features of ischemic foot-

Cold with absent pulse

Usually diminished sensation

Ulceration (especially on the margins of foot, tips of toes, and heels)

Necrosis or gangrene

Critical ischemia (urgent attention) foot pink, painful, pulse less and often cold. Early diagnosis is essential.

Unilateral warmth and swelling in a neuropathic foot is suggestive of developing Charcot's joint. Bone scan are

more sensitive indicators of new bone formation than radiography, and should be used to confirm the diagnosis. Gallium white cell scanning and magnetic resonance imaging should be done to exclude infection as the cause.

Enquiry was made with regards to incidence of diabetes in any other member of family to know the hereditary tendency. Any history of injury noted. Details of injury were asked e.g., thorn prick, nail paring or shoe pressure. History of local symptoms such as swelling, pain, wound or discoloration and their duration were noted.

The diabetic detail history noted as whether the patient was known diabetic or not. If the patient was known diabetic then the duration of diabetes was noted. Regarding the treatment which patient was receiving before admission was also recorded.

The personal habit of smoking and alcoholism also noted. General physical examination of the patient was done to record the pulse blood pressure, temperature and respiration rate. Anaemia if present was particularly given importance. Other systemic examination was also done.

Examination of the feet

Following points were noted.

- Types of lesion and extent.
- Evidence of any predisposing factors.
- Changes suggestive of neuropathy
- Changes suggestive of vascular involvement

Examination of normal foot

Classification of diabetic foot lesions which are used commonly- angier's classification of diabetic foot lesions- (48)

Grade- 0	High risk foot and no ulceration.
Grade- 1	Superficial ulcer.
Grade- 2	Deep ulcer (cellulites).
Grade- 3	Osteomyelitis with ulceration or abscess.

Grade- 4	Gangrenous patches, partial feet gangrene.
Grade- 5	Gangrene of entire foot.

The neurological status of the lower limb assessed to rule out diabetic neuropathy. Neurological examination was done by assessing the sensation using 10gram nylon monofilament. Power, reflexes and neurological deficit were noted.

Vasculopathy of the lower limb was found by assessing Colour of the limb: normal, pale, purple or black.

Local temperature

Normal or cold Pulsations of the lower limb: dorsalis pedis, posterior tibial, popliteal and femoral arteries were noted.

Whenever vasculopathy due to diabetes was suspected echocardiogram, fundoscopic examination and Doppler study of the lower limbs was done.

In all the diabetic foot patient's pus was sent for culture and sensitivity examination before starting antibiotics. X ray of the diabetic foot antero-posterior and oblique view was taken in all cases of non-healing ulcers to rule out bony changes due to diabetes and Osteomyelitis.

Management

1. Explanation to the patient for the care of diabetic foot
2. Conservative treatment:
 - Daily dressing
 - Local application of solutions, ointment.

3. Operative treatment

Debridement

Amputation

- Digital
- Trans metatarsal
- Below knee
- Above knee
- Skin grafting

4. Supportive treatment

- Oral antidiabetic drugs
- Insulin
- I.V. Or oral antibiotics
- Analgesics

The principles used for Debridement were as follows. (Steed et al 1998) All necrotic skin, muscle, fascia, tendon and fat are removed. First Debridement was aggressive, meticulous and adequate.

Most of the times incision was taken on the non-pressure bearing area. Vascularity to the distal part was maintained.

For adequate Debridement removal of one or more toes were considered. We tried to preserve the pressure bearing areas and bones like head of 1st metatarsal, calcaneum.

Therapy as per the recent advances in diabetic management was also started for certain patients who did not show improvement with conservative measures. The healing of ulcers with application of such measures was also noted.

At the time of discharge from the hospital health education was given regarding foot care, diabetes control and regular exercise. All patients were advised to come for follow up after one week and whenever necessary. During the follow up diabetic status was checked and detailed examination of the lesion was done.

Observation and results

An analysis of 100 cases of Diabetic foot was done. These cases were admitted and treated in different surgical units in the Department of Surgery at MGM Medical College and Hospital.

In our study 100 patients of diabetic foot lesions were studied. In 14 patients only incision and drainage and fasciotomy was done, healing of wound occurred without complications. In 50 patients debridement was done as the definitive treatment, as a preliminary to amputation.

Skin grafting was considered in 16 patients once the wound was clean and granulating.

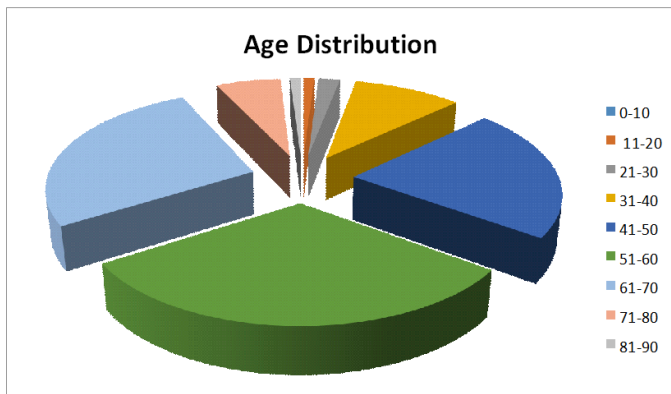
In our study amputation rate was 20 %. Out of these patients 4 patients underwent minor amputations. In 16 patients' major amputations like B. K. and A.K. amputations done. 6 patients had wound infection and suture gaping. For these patients with suture line gaping secondary suturing was done. In 4 patients A.K. amputations were done, 2 patients stump was closed primarily and in 2 patients Guillotine amputation was carried out, 4 patients died because of various complications of diabetes during course of treatment.

Age distribution

Table 1: Showing the age distribution

Age (Years)	No of Patients	Percentage (%)
0-10	-	-
11-20	1	1%
21-30	2	2%
31-40	10	10%
41-50	22	22%
51-60	31	31%
61-70	27	27%
71-80	6	6%
81-90	1	1%
Total	100	100 %

Graph 1



Of 100 cases studied, youngest patient was 19 years and oldest was 84 years of age.

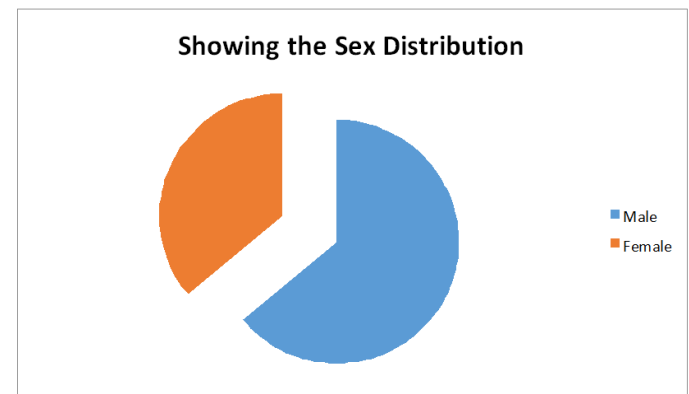
Highest number of cases was found in the age group 51-60 years (31%) followed by 61-70 years (27%). Maximum number of diabetic foot i.e.80% is between the age group of 41 to 70 years.

Sex

Table 2: Showing the sex distribution

Sex	No of cases Studied	Percentage (%)
Male	64	64%
Female	36	36%

Graph 2:



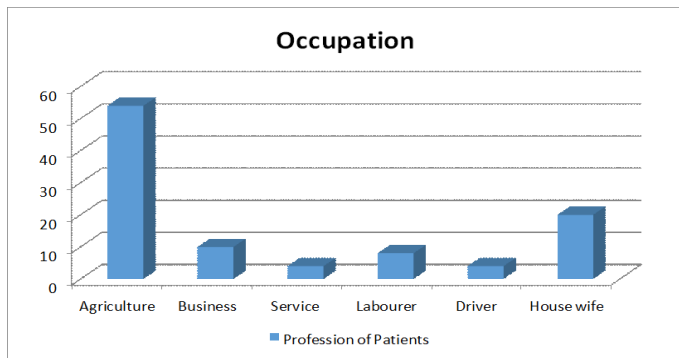
Of the 100 cases studied in this series, 64 (64%) cases were male and 36 (36%) cases were female.

Occupation

Table 3: Occupation

Sn.	Profession of patient	Number of Cases	Percentage
1	Agriculture	54	54%
2	Business	10	10%
3	Service	4	4%
4	Labourer	8	8%
5	Driver	4	4%
6	House wife	20	20%
Total		100	100%

Graph 3:



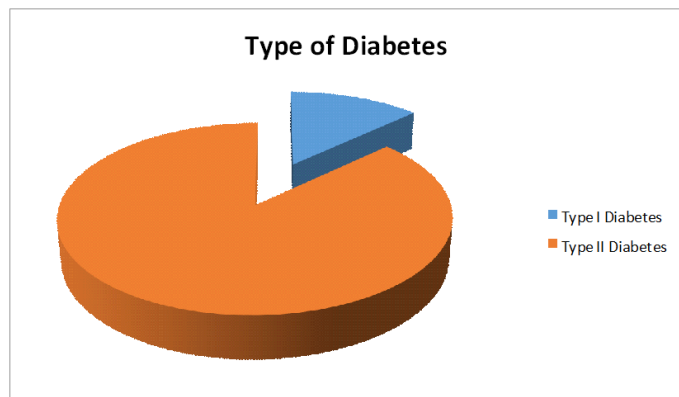
In this study maximum patients were agriculturist (54%) and minimum patients were drivers and servicemen (4%)

Type of diabetes

Table 4:

Type of Diabetes:	No of Patients	%
I	13	13%
II	87	87%

Graph 4:



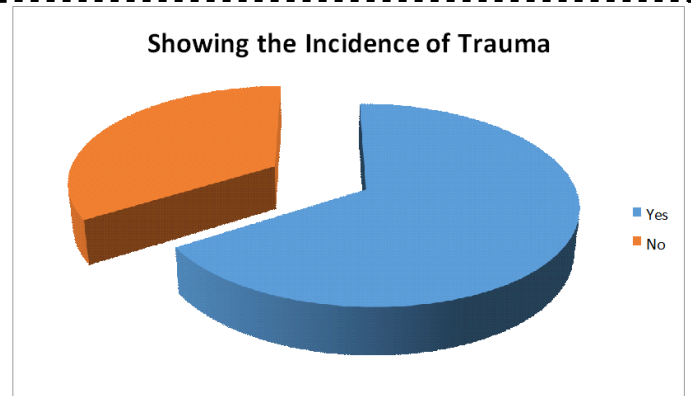
In this study 13 patients had type one Diabetes, remaining 87 patients had type two Diabetes.

History of trauma

Table 5: Showing the incidence of trauma

History of Trauma	No Of Cases	%
Yes	66	66
No	34	34

Graph 5:



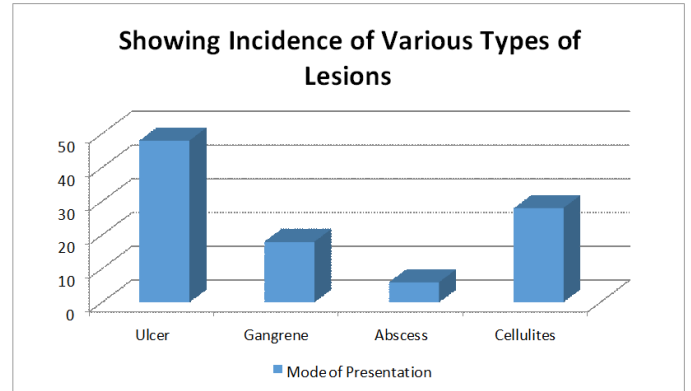
In this study 66 cases revealed a history of some kind of injury (trauma) before the onset of lesion.

Mode of presentation

Table 6: Showing incidence of various types of lesions

Mode of Presentation	No of cases	Percentage (%)
Ulcer	48	48
Gangrene	20	20
Abscess	6	6
Cellulites	26	26

Graph 6:



The different types of lesions seen including ulcer, cellulites, abscess, gangrene. Most of the patients present with more than one lesions. Only major lesion is considered here. Ulcer was the major lesion seen in present series being present in 48 patients., 6 patients presents as an abscess was the least common lesion.

In above patients X- ray of 12 cases showed changes of Osteomyelitis.

4 patients present with Charcot's joint.

Doppler studied in four patient showed atherosclerotic changes with low volume flow in anterior and posterior tibial arteries.

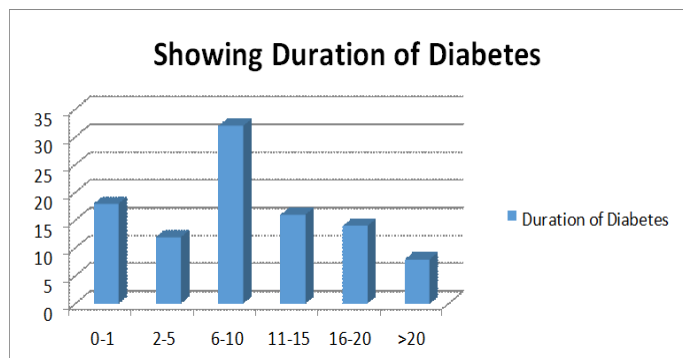
Duration of diabetes

Duration is not accurately known, as few patients were unaware of being diabetics and were diagnosed as suffering from diabetes on admission with complaints of non- healing ulcers.

Table 7: Showing duration of diabetes

Duration of Diabetes In Years	No of Patients	Percentage (%)
0-1	18	18
2-5	12	12
6-10	32	32
11-15	16	16
16-20	14	14
>20	8	8
Total	100	100

Graph 7:



In our study 18 % presented with duration less than or equal to 1year, most of these patients were diagnosed post admission. Only 8 patients had diabetes of more than 20 years. Maximum 32 patients in our study were diabetes of 6 to 10 years.

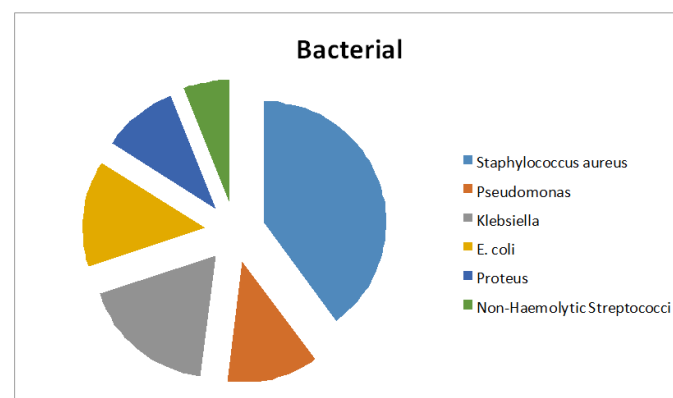
In the present series 4 patients were detected as a diabetic at the time of admission.

Culture and sensitivity

Table 8: Culture and Sensitivity

Percentage (%)	Bacterial	No of Cases
40	Staphylococcus aureus	40
12	Pseudomonas	12
18	Klebsiella	18
14	E. coli	14
10	Proteus	10
6	Non-Haemolytic Streptococci	6

Graph 8:



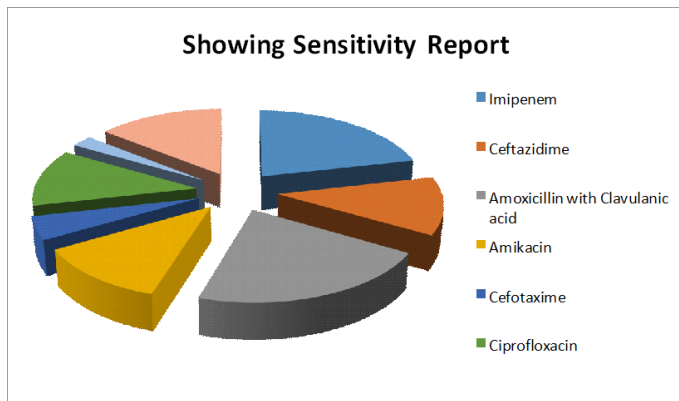
In our study Majority of the septic lesions yielded Staphylococcus aureus 40% on culture of pus. Other organisms that were isolated are, Pseudomonas-20%, Klebsiella-18%, E. coli-14%, Proteus-10%

Antibiotic sensitivity

Table 9: Showing antibiotic sensitivity according to culture and sensitivity report

Antibiotics	% of patients
Imipenem	45%
Ceftazidime	25%
Amoxicillin with Clavulanic acid	45%
Amikacin	25%
Cefotaxime	10%
Ciprofloxacin	25%
Ampicillin	5%
Vancomycin	30%

Graph 9:



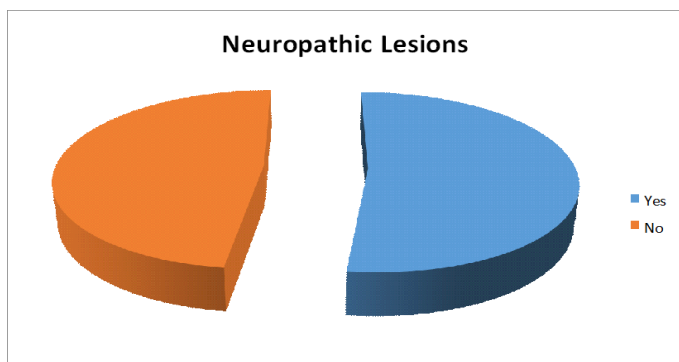
Imipenem and Amoxicillin with clavulanic acid were sensitive against most of the organisms as they cover a wide range of organisms.

Neuropathic lesions

Table 10: Neuropathic lesions

Neuropathic lesions	No. of cases	%
Yes	52	52%
No	48	48%

Graph 10:



In the present study 52 cases were found to have neuropathy. Patients with neuropathy varied from 35-80 years. Majority had history of diabetes of more than 5 years. This shows that peripheral neuropathy is common in long standing diabetic patients. 20 (20%) patients had Gangrene.

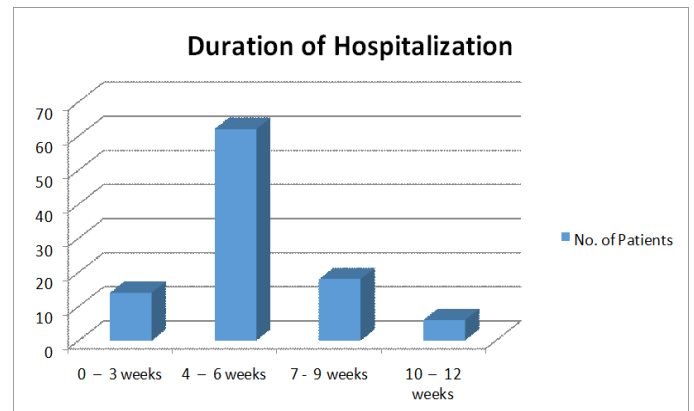
Duration of hospitalization

Table 11:

Stay in Hospital	No of Patient
0 – 3 weeks	14

4 – 6 weeks	62
7 - 9 weeks	18
10 – 12 weeks	6

Graph 11:



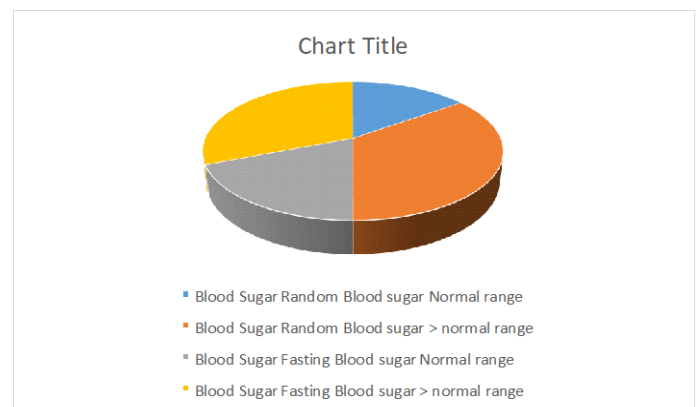
In this study minimum stay in hospital was 1week (7 days) and maximum was 12 weeks (84 days). Most of patients stayed in hospital from 4 to 6 weeks.

Investigations

Table 12: Showing blood sugar level at the time of admission

Blood Sugar			
Random Blood sugar		Fasting Blood sugar	
Normal range	> normal range	Normal range	> normal range
30	70	38	62

Graph 12:



In this study at the time of admission 70 patients had RBS more than normal range and 30 patients had RBS within normal range while Fasting blood sugar at the time of admission in the same age group more than

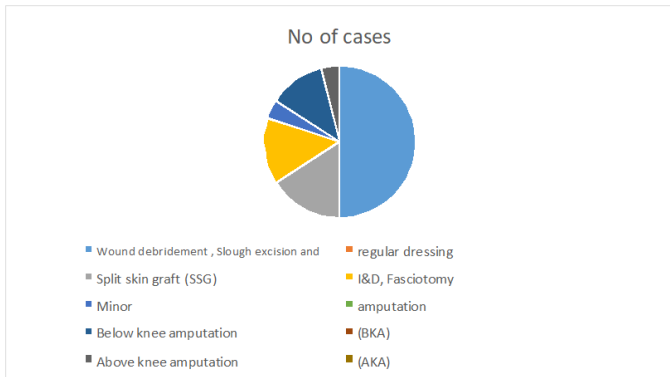
normal range in 62 patients and within normal range in 38 patients.

Treatment

Table 13: Treatment

Treatment	No of cases	Percentage (%)
Wound debridement, Slough excision and regular dressing	50	50
Split skin graft (SSG)	16	16
I&D, Fasciotomy	14	14
Minor amputation	4	4
Below knee amputation (BKA)	12	12
Above knee amputation (AKA)	4	4

Graph 13:



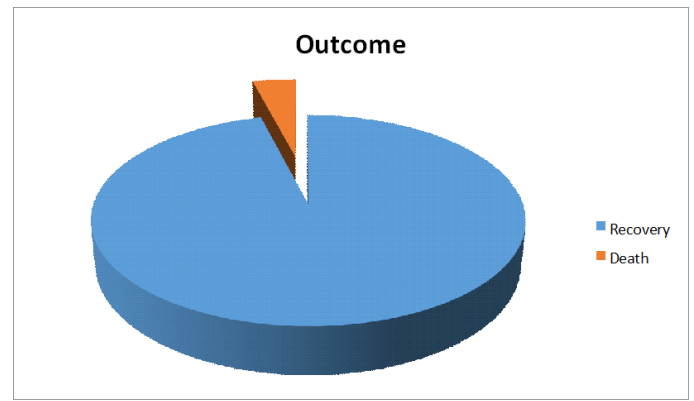
In this series 50 cases were managed by daily dressing and wound debridement, and slough excision. 16 patients were treated with Split skin graft, 14 patients under went incision and drainage for abscess and some of them fasciotomy, Minor amputation was done in 4 cases. Below knee amputation was done in 12 cases and above knee amputation in 4 cases. In most of the cases, limb was salvaged by conservative treatment and minor amputations.

Outcome

Table 14: Outcome

Result	No. of cases	%
Recovery	96	96
Death	4	4

Graph 14:



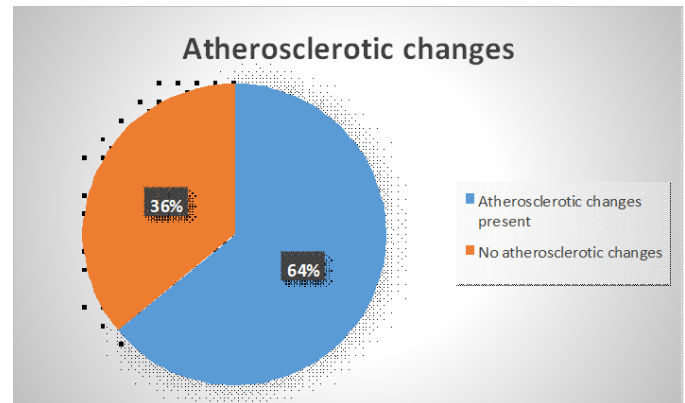
In the present study 96 patients recovered from their lesion after treatment while remaining 4 patients died due to various complications.

Atherosclerotic changes

Table 15: Atherosclerotic changes

Result	No. of cases	%
Atherosclerotic changes present	64	64%
No Atherosclerotic changes	36	36%

Graph 15:



Out of 100 patients with diabetic ulcers 64 patients showed atherosclerotic changes in the major arteries of lower limb which was proven categorically by an arterial colour Doppler examination. This finding suggests that atherosclerotic changes are hastened by diabetes as shown in literature and has been proved statistically in our study with a P value of <0.05 by application of Chi square test.

Discussion

“It has been forced upon me that diabetic gangrene is not heaven sent but earth born.” - E. P. Joshin (1934). Diabetes is a common affliction. It affects approximately 16 million people of all ages and is a major cause of end stage renal disease, cardiovascular disease, blindness and peripheral neuropathies. The disease is chronic and affects the metabolism of carbohydrate, protein, fat, water and electrolytes. Many diabetic ulcers are neglected because they may produce few symptoms and their importance is not appreciated by patients and secondly it falls between specialties, not being entirely in the surgeons or physician domain⁴. Reduction in the incidence and prompt treatment of foot ulceration would ultimately lead to fall in the amputation rate in diabetic patients. Without doubt, the problem of foot infection in diabetic patient population is costly to both the patient and society. Consequently, health care expenditure and medical efforts must be directed at patient education and prevention, early detection and prompt therapy of foot infection⁵.

Total 100 cases of diabetic foot were included in this study. Following are the results of the study conducted at MGM Medical College and Hospital. The analysis of this study is as follows.

Age

Prevalence of diabetes is greater in persons over the age of 50 years. Pedal infection is a debilitating and grave complication of diabetes seen often is elderly patients.

In our study of 100 patients age was ranging from 19 years to 84 years. It was found that age group 51-60 years, had the highest number of (31) patients.

- A.K. Ramani et al⁶ 51 – 60 years
- Surgical unit of Khyber Hospital (2002 – 2003), Pakistan 41 – 50 yrs.

- In a study Qari F A and A K Akbar D (2000)⁷ observed mean age 59 +/- 9.6.
- Oyibo S O, Jude E B, Armstrong DJ (2001)⁸ observed the mean age of 56.6 +/- 12.6.
- Rooh- Ul- Muquim, Ahmed M, Griffin S (2003)⁹ found in their study of diabetic foot, most patients with diabetic foot lesions were between age group 40-60yrs.
- Jeffco ate WJ, Chip chase SY (2006)¹⁰ found the mean age of diabetic foot 66.7 +/- 13.2.

In the present study the age incidence is very much comparable to the standard study

Sex

Most of the diseases have the male predominance; this is same with the diabetic foot also. In our series 64% patients were males and 36% patients were females.

- Oyibo, Jude and Armstrong (2001)⁸ found predominance of male sex in diabetic foot lesions (77%).
- Ekere A V, Yellowe B E (2005)¹¹ found diabetic foot in 64% male.
- In Qari F A and A K Akbar D (2000)⁷ study also majority of the patients were male.

The following may be the reason for the male preponderance males are exposed to the outside environment more than females hence they are likely candidates for injury leading to ulcer formation. Alcoholism and smoking habits are more common in males and this may be a significant factor. Barefoot walking is more common in India this also contributes to the foot ulceration.

Occupation

As seen in our study, Agriculturists had more incidences of diabetic foot lesions because of ignorance of having diabetes, lack of foot care and poor management of

diabetes. It is evident from the table that the surgical complications of patients whose profession exposes them to the risk of trauma and injuries making the susceptible to the complications of diabetic foot.

As per the literatures, it is said that the disease is more common in the people who perform sedentary work, but this series depicts that the complications are more common among those professionals, who are exposed to risk the of trauma and injury during their work.

Type of Diabetes

As per literature foot ulcers have been more in the patient with NIDDM (87%) as per our study. NIDDM age group is being elder, foot complications are more in these patients.

History of Trauma

66 cases in this series had history of trauma, before the onset the foot lesion.

In majority of the cases of surgical complications of diabetes, some kind of trauma is the beginning of the problem. This is because of three factors, they are Ischemia: - Due to ischemia the parts, which are traumatized, will be under perfused.

Thus impairing the healing process.

Neuropathy

Result in loss of sensation and the patient will be unaware of the injury and neglects it. Hyper glycaemia acts as a perfect medium for the multiplying organisms.

Mode of presentation

Neuropathy which is seen more than 50% of diabetics of long-standing duration (pirate 1978) is considered at be the single most major course of ulceration. In present study. Neuropathy changes seen in 52 cases, Ischemic complication were noted in 20 cases and infective complication of foot noted in all cases.

Type of lesions

In our study of foot lesions are cellulites, abscess, ulcer and gangrene. In some patients there was more than one lesion. Ulcer (48%), Cellulites (26%), Gangrene (20%), Abscess (6%). Ulcer was the commonest presentation.

Table 15: Different types of lesions –in past studies

Type of Lesion	Kao Hsiung et al ¹⁵
Ulcer	75.0%
Cellulites	78.8%
Gangrene	68.0%
Abscess	12.5%

As compared with the other study. Ulcer is the commonest presentation.

Cellulitis presentation is less compared to the other study because mild cellulites may be missed because of the thick and dark skin in our peoples.

Table 16: Gangrene

	No of cases	No of cases with Gangrene	Percentage
Bell series (1960)	964	236	24.9
Pennsylvania Hospital Series	614	274	44.78
Diabetic Researchcenter (2005) Chennai ¹⁶		64	5
Present Study	100	20	20

The incidence of gangrene in the present series is comparatively less than that of Bell series of 1960. Probably because of awareness of patients towards disease, early diagnosis and better treatment modalities.

Diabetic status

In our study 96% patients were known diabetics. Other 4 patients we diagnosed after admission to the hospital.

Boston¹⁴ - known diabetics are 92 % and unknown are 8 %. It is shown that the unknown diabetics in our study are same as compared to previous study.

Duration of Diabetes

In our study mean duration of diabetes mellitus is 7.42 years.

- Stone et al (1972)¹² –Duration is 11 years
- Bess man et al (1975)¹³ - Duration is 13 years
- Present study - Duration is Between 6 to 10 years.
- In our study mean duration of diabetes mellitus is less than the other studies. May be because, our patients have lack of knowledge regarding the diabetes control and foot care. So there will be early foot complications in comparison to the western studies.

Culture and Sensitivity

In our series pus was sent for culture and sensitivity in 48 patients. In most of the patient's more than one organisms were grown on culture.

In our study Staphylococcus aureus (40%), E. coli (14%). Klebsiella pneumonia (18%), Proteus Species (10%) pseudomonas species (12%) were the commonly isolated organisms.

In a study conducted at department of dermatology, Adan teaching hospital, Ministry of Health Kuwait (2005), by Abdul Razak A, Biter Z I, Al-Shamali A A, MO basher L A, and Staphylococcus aureus was the most common isolate, being recovered from 38.4% of cases. Other organisms were Pseudomonas Aeruginosa (17.5%) and Proteus mirabilis (18%), anaerobic gram-negative organisms (10.5%), mainly Bacteroides fragilis.

Imipenem, Meropenem, and Cefepime were the most effective agents against gram-negative organisms. Vancomycin was the most effective against gram-positive Organisms²¹.

In another study conducted by El-Tahaway A T (April 2000)²²

Staphylococcus aureus was the commonest isolate being recovered from 28% of cases, including Methicillin resistant staphylococcus aureus in 9 of 30 (30%) patient wounds. The other organisms isolated were Pseudomonas Aeruginosa (22%) and Proteus mirabilis (18%), anaerobic gram-negative organisms (11%) mainly Bacteroides fragilis.

Most effective against gram-positive and Imipenem was the most effective against gram-negative organisms.

In a study conducted by Raja N S in 2007, a retrospective analysis was conducted of clinical specimens taken from patients with diabetic foot infections over a 12-month period from July 1, 2004 to June 30, 2005²³.

Both aerobes and anaerobes were grown in the cultures. Most studies in the past implicated aerobes as the most important organism. Now there is good evidence that anaerobes play an equally important role. Most commonly isolated anaerobes are Bacteroides and clostridia organisms. Both aerobes and anaerobes have got synergistic action in spread of infection²⁴.

In our study 12 patients had osteomyelitis, most of the patients had osteomyelitis of phalanx and metatarsals, most of the osteomyelitis of foot begin as chronic perforating ulcers. If the ulcer is neglected or improperly cared bacterial invasion may progress at the base of the lesion by spreading along the fascial planes or by perforating fascia and soft tissue to reach the periosteum, similarly puncture wounds can also lead to Osteomyelitis.

Spread of infection

After trauma there will be devitalization of the tissue, if the infection supervenes there is rapid formation of inflammatory exudates, especially in the deeper underlying tissue which leads increased pressure in the

compartment resulting in obstruction to the blood supply, ultimately resulting in gangrene and uncontrolled infection.

Due to vasculopathy and neuropathy, foot infections are neglected, there is spread of the infection from distal part to the proximal part.

Factors which are responsible for impaired wound healing in diabetes are¹⁴

- Decreased vascularity.
- Reduced resistance to infection
- Retained devitalized tissue due to vasculopathy and neuropathy
- Oedema due to inflammation
- Poor nourishment
- Repeated Trauma

Co-relation of atherosclerosis and diabetic ulcers

As seen in various studies, diabetes leads to micro and macro angiopathy with resultant atherosclerosis of blood vessels leading to decreased vascularity to the distal lower limb causing ulcerations, gangrenes, etc.

Our study also corroborates these findings by showing high incidence and atherosclerosis in the patients with diabetic ulcers which can be considered as one of the causes.

Neuropathy

Neuropathic foot has got three main complications neuropathic ulcer, neuropathic joint (Charcots) and neuropathic edema¹⁷.

Neuropathy consists of three main components sensory, motor and autonomic. In our series 52% patients had neuropathy. It was diagnosed by weakness of small muscles, foot deformity, loss of sensation, loss of sweating.

In a study conducted by Qari F A, Akbar D (2000) Peripheral neuropathy was the main precipitating factor (94%) in the development of diabetic foot lesions. This

may be due to the poor glycaemic control in the population studied.

In the study of diabetic foot patients by O'Rourke I, Heard S, Treacy J, Gruen R, Whitbread C (2002)¹⁸ 41% ulcers were neuropathic ulcers.

In the Maulik and Geoffrey study (2003)¹⁹ 61% of the patient had diabetic neuropathy. In the above series, neuropathy incidence is variable as this depends on the clinical evaluation.

In neuropathic foot there is weakness of the small muscles leading to the foot deformity, resulting in formation of new pressure points, callosities and ultimately ulcer.

In autonomic neuropathy skin becomes dry as a result of loss of sweating. There will be cracking of skin and impaired defense against infection. In case of sensory neuropathy there will be loss of sensation which predispose to the trauma and ulcer formation²⁰.

Duration of Hospitalization

In this study minimum duration of stay in hospital was 7 days (1 week) and maximum was 84 days (12 weeks). Most of patients stay in hospital for 4 to 6 week.

This long duration of hospitalization can be explained by the refractory to patient's diminished resistance of body. Uncontrolled sugar level, resistance of the organism to antibiotic therapy, poor nutrition, advanced age.

Investigations

The present study indicated that at the time of admission in hospital, Random blood sugar level of 70 patients were above the normal level and Fasting sugar level of patients done that showed 62 patients had more than normal range. It suggested that diabetic patients present with diabetic foot lesions in uncontrolled blood sugar level. 30% patients showing normal blood sugar level because they are regularly taking antidiabetic treatment.

Treatment

Management: In our study diabetic foot management is a difficult task because of

- Illiteracy and ignorance.
- Walking barefoot and poor socioeconomic status.
- Taking treatment in earlier stages by quacks because of fear of amputation.
- Careless removal of nails and unhygienic foot care.

Most of the cases in our study were referred to us in an advanced stage with serious infection and associated complications.

Before starting treatment every patient must be assessed to decide the relative importance of predisposing factors – neuropathy or vascular disease. In absence of severe ischemia, conservative medical and surgical management give good results. In presence of ischemia unless the limb is salvaged by direct arterial surgery, we may have to consider major amputations.

Medical management

For successful management it is important to assess the diabetic status, severity of infection and general nourishment of the patient.

Control of diabetes

By Diabetic diet, Oral Hypoglycemic and Insulin Therapy. All our patients were advised diabetic diet with low cholesterol and high polyunsaturated fat.

All patients were shifted to crystalline insulin therapy. According to the blood sugar level dosage of the insulin was adjusted.

In case of ketoacidosis, planned aggressive treatment was necessary because this is life threatening complication, where severity of infection is more and there is defective neutrophil function²⁴.

Principles of the treatment are,

- Correction of fluid and electrolyte imbalance.

- Reversal of acidosis and ketosis with crystalline insulin therapy.

- Dosage of insulin was required more in case of ketoacidosis, severe infection. After correction of ketoacidosis and control of infection, the dosage of insulin required was reduced.

At the time of discharge 40 patients were shifted to oral hypoglycemic, 46 patients to Lente insulin and the rest were continued with the crystalline insulin.

Control of infection

Control of infection was done by meticulous debridement and antibiotic therapy. The role of antibiotics in foot infection is to limit the spread of infection¹⁹.

Indication for antibiotic therapy were

- Limiting cellulites and spreading infection.
- Prevent secondary infection.
- Prophylactic therapy before surgery.

In our study most of the patients were treated with multidrug regime. In our studies we have used higher antibiotics because it is known to grow resistant organisms in diabetic foot infection Staphylococcus was the commonest organism grown, which was sensitive to Cefotaxime, Ampicillin and Gentamicin in 80 to 90% of cases. Penicillin was less effective antibiotic against staphylococcus which is shown in the study of Rami ani et al (1991)⁶.

We have used combination antibiotic therapy. Combination antibiotic therapy is advised by Brodsky J.W. et al & L. Bhasker Reddy et al.

Brodsky J.W. Advised the following combinations
Ticarcillin + clavulanic acid.

Vancomycin + metronidazole + metronidazole.
3rd generation cephalosporin's + metronidazole

L. Bhasker Reddy et. al. Advised following combination:
Cefotaxime + metronidazole

According to the availability of drugs we could use broad spectrum antibiotics like Ciprofloxacin, Cefotaxime, in combination with Metronidazole and Gentamycin.

Ampicillin, Penicillin, Erythromycin, Tetracycline were used in some of the patients.

In the present series, 50 cases were treated by slough excision, 16 with skin graft, 14 by Fasciotomy and I&D. Below knee amputation was done in 12 cases and above knee amputation were done in 4 cases. Minor amputations done in 4 cases.

Proper control of diabetes is very important in diabetic foot management. Fasting and postprandial blood sugar estimations were well under control.

Urine sugar estimation was done thrice daily. Infection was treated with broad spectrum antibiotics. Patients were educated about care of foot and tablet Trental (Pentoxifylline) was administered to inpatients with ischemic lesions.

Table 17: Amputation

	No of cases	No of amputations	Percentage
Collen's series (1962) ²⁵	215	83	38.6%
Osaka kosainekin Hospital (2005) ²⁶	210	110	52%
Present study	100	20	20%

The amputation rate is much lower 20% compared to Collen's series 38.6% in 1962. This could be due to, better education of the patient, better glycemic control, proper care of foot, proper use of antibiotics, extensive debridement and regular dressing. After amputation, wound healed well. The patients were referred to Rehabilitation center for prosthesis.

Results

Out of 100 patients studied in this series 96 recovered and discharged from hospital and 4 patients died during course of treatment due to various diabetes related

complications like septicaemia, ketoacidosis, uremia and respiratory symptoms.

Conclusion

This study comprised of 100 cases of diabetic foot patients with emphasis on surgical management and its complications. After analysis of the data the following are the conclusions. The highest number of patients was seen in the age group of 51-60 years (31%). Males are almost two times more affected than females. (Males are more vulnerable to trauma).

Agriculturists had more incidences of diabetic foot lesions. Diabetic foot ulcers have seen more in NIDDM Duration of diabetes varied from just diagnosed to 25 years In study 96 patients were known diabetic and 4 diagnosed at the time of presentation.

Trivial trauma of some kind was the initiating factor in nearly half of the cases. Minimum stay in hospital was 1 week and maximum 12 weeks most of patients stays for 4 to 6 weeks. Commonest presenting lesion was Ulcer 48%, followed by Cellulitis 28%, and Gangrene 18%.

After 5 to 6 years of diabetes most of patients present with neuropathic lesions and they are in 35 to 80years age group some of them develops gangrene.

Staphylococcus aureus is a commonest organism causing infection. Atherosclerotic changes may lead to formation of ulceration of foot in diabetic patients.

Conservative treatment consisting of control of diabetes with Plain/Lente insulin along with appropriate oral / IV antibiotics was effective in some cases.

Wound debridement, slough excision followed by dressing with Povidone/magnesium sulphate/ framycetin /metrogl/ collagenase dressing resulted in healing in some cases. Split skin grafts, Disarticulation, Trans metatarsal amputation, below knee and above knee amputations were the other modes treatment. 96 patients cured and 4 patients died during course of treatment.

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Legend Figures



Fig 1: showing healing ulcer and third, fourth toe amputation in a diabetic patient.



Fig 2: showing non healing ulcer and second, third, fourth toe amputation in a diabetic patient (slough and necrotic tissue seen).