PRESENTATION, MICROBIOLOGICAL PROFILE & OUTCOME OF DIABETIC FOOT AT A TERTIARY CARE UNIT

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ABSTRACT

Background: Diabetic foot ulcer is an important complication among diabetes mellitus, and frequently leads to amputation of the leg. Mortality is high and healed ulcers often recur.

Objective: This study was done to define the presentation, microbiological profile and risk factors determining outcome of diabetic foot ulceration leading to amputation at tertiary care hospital in Peshawar, Pakistan.

Material and Methods: In this descriptive study conducted at Hayatabad Medical Complex Peshawar, Pakistan from August 2010 to August 2012, the presenting feature, grade of foot ulceration and risk factor for ulceration and lower limb amputation in 145 diabetic patients presenting with foot ulceration were assessed. Patients of both gender and above 15 years were included. Patients with end-stage renal disease were excluded. Lesions were classified according to Wagner classification.

Results: A total of 145 cases were recorded. Males were more affected than females with M:F ratio of 1.41:1. The ages of the patients ranged from 15 to 80 years, out of which 102 (70.3%) of the cases were in the age group of 40-60 years (Table 1). 58 (40%) had duration of diabetes of less than 10 years, 46 (31.7%) had between 10 to 20 years and remaining 41 (28.3%) had duration of more than 20 years (Table 1). 108 (74.4%) patients had type 11 diabetes and 37 (25.6%) had type 1 diabetes. About 86 patients (59.3%) had poor glycaemic control, 42 (29%) had fair control and 17 patients (11.7%) had good glycaemic control. Majority of lesions were located on toes 58 (40%) and sole 43 (29.6%). Right foot was involved in 87 patients (60%), left foot in 39 patients (26.8%) and bilateral in 19 patients (13.1%). The grade frequency of diabetic foot according to Wagner´s classification is shown in (Table 2). Osteomyelitis was present in 23 (15.8%) patients (Table 1). The most common infecting organisms isolated on culture was Staphylococcus aureus 43 cases (29.6%) followed by Pseudomonas aeruginosa in 32 cases (22.5%). MRSA was isolated in 7 cases (16.2% of Staphylococcus aureus). About 22 patients (15.1%) were managed conservatively and in remaining 123 patients (84.9%) surgical intervention was carried out. Amputation was performed in 47 (32.4%) cases.

Conclusion: Majority of diabetic foot lesions were in the grade 11-1V. Lesser grade responded well to conservative measures and those with higher grades needed amputations. Amputation rates, time of healing and morbidity increases with increasing stage and grade. Effective glycaemic control, timely hospital admission, appropriate surgical/medical treatment along with patient's education in foot care, can decrease morbidity and mortality due to diabetic foot disease.

Key words: Diabetic foot ulcer, Bacterial profile, amputation.

INTRODUCTION:

Diabetes mellitus is a very common ailment in our community1. Diabetes affects about 10% of our population and the prevalence of diabetes varies from 5.3% to 16.2%2. About 150-170 million populations are suffering from this disease worldwide and the diabetes prevalence will be double by 2025 as by WHO reports3. Diabetes is one of the foremost causes of death in many countries and a leading cause of renal failure, blindness and non-traumatic amputation.

Main complication associated with diabetes mellitus are cardiovascular disease, retinopathy, nephropathy, neurological, peripheral vascular diseases and infections. One of the most common complications of diabetes in the lower extremity is the foot ulcer4. In Pakistan 15% of diabetics suffer from foot problem5. Approximately 15% of all diabetics develop some foot problems during the course of their illness6. Foot ulcers carry a 25% risk of major amputation7. In Pakistan the amputation rate has been shown to be as high as 21-48%2,5. Common risk factors for amputation following ulceration includes the presence of peripheral vascular disease, severity of neuropathy, structural foot deformity and concomitant infection8,9, which leads to devastating complications like sepsis, osteomyelitis, amputation, and death in severe cases. Most of the cases if identified early and treated appropriately initially in the community can be treated effectively with antibiotics at an early stage and in an out- patient setting10.

Foot infection in a diabetic patient plays a major role in the development of moist gangrene11. A number

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of studies have found that Staphylococcus aureus and others gram positive aerobes are the most causative pathogens isolated in more than 60% of cases12. However many ongoing studies including the two recent prospective studies reported a predominance of gram negative aerobes13,14.

The diabetic foot ulcers are commonly classified according to Wagner´s classification15. The decision for amputation is dictated by the stage of the disease, and the patients that are managed without classifying the stage of disease have poor outcome, longer hospital stay, and higher cost of treatment.

But unfortunately, because of the late referrals primarily, unhygienic conditions and poor medical facilities in the far flung and tribal areas, less education about diabetes and foot ulcers in particular leads to loss of limbs and loss of life in some cases even when they reach a tertiary care hospital5.

This study was conducted to classify the diabetic foot disease according to Wagner´s classification in order to define the presentation, microbiological profile and risk factors determining outcome of diabetic foot ulceration leading to lower limb amputation in a tertiary care hospital in Peshawar, Pakistan. It will help to identify measures to decrease morbidity and mortality associated with the diabetic foot disease.

MATERIAL AND METHODS:

This was a descriptive study, included consecutive 145 patients with diabetic foot disease between August 2010 to August 2012. All patients presenting during the study period of both gender above 15 years were included. Patients with end-stage renal disease, patients lost to follow up, patients with foot infections due to other causes such as non -diabetics- post traumatic, arterial disorder alone, venous disorder alone, non- diabetic peripheral neuropathy and secondary to implant infection were excluded.

The patients were enrolled from surgical and medical outdoor clinics, emergency units and from other wards of the hospital. After obtaining an informed consent, the detailed history of each patient was taken regarding the duration of diabetes and its type whether type 1 or type 11 diabetes. They were asked about compliance and control of diabetes. A detailed history was obtained about the foot ulcer, its onset, duration, progression and any previous surgical intervention for it. Age, sex and socioeconomic status of each patient were also recorded. Complete examination of each patient was done including Blood pressure checking and detailed foot examination and ulcers were classified according to Wagner´s classification. Vascular evaluation of the lower limb was done checking capillary refill and pulses included dorsalis pedis, posterior tibial, popliteal and femoral arteries. ABI was measured where needed. Neurological assessment included light touch, pinprick, position sense and vibration sense on every patient and data were collected on pre-designed proforma. Preliminary tests including Haemoglobin, fasting and random blood sugar, serum urea and creatinine, urine R/E, HbA1c, ECG and chest X-ray were done.

Glycaemic control was assessed by measuring glycosylated haemoglobin (HbA1c) and a HbA1c <6.5% was regarded as good glycaemic control, 6.6-7.5% fair control and> 7.5% poor. Where HbA1c was not available glycaemic control was assessed on the basis of the fasting (FBG) and random blood glucose (RBG). FBG <120mg/dl was good control, 121-140mg/dl fair and >140mg/dl as poor glycaemic control. Similarly RBG of < 160 mg/dl was good control, 160-180 mg/dl fair and >180 mg/dl as poor glycaemic control16. Diabetic foot infection was defined clinically and biochemically on the basis of foot ulcer with purulent discharge and with three or more of the following including fever(>38c) or WBC count > 10000/mm3, localized oedema, signs of inflammation like erythema, tenderness, pain, warmth or induration12. Plain radiographs of the foot were taken in Wagner grade >2 ulcers for detection or involvement of the adjacent bone and osteomyelitis and Magnetic Resonance Imaging of foot were done in cases where needed. Each wound was thoroughly irrigated with saline before acquiring the infected tissue from the lesion. Pus or discharge were also swabbed and sent for culture and sensitivity. Empirical antibiotics were started initially. Wounds debridement/disarticulation of toes or amputation were performed on the basis of severity of lesions. The outcome of the disease in terms of resolution or worsening of infections and the events of amputation were noted.

The patients were evaluated and managed by classifying their disease according to Wagner´s classification for diabetic foot. All data were collected and analysed on SPSS-11, and frequencies were calculated.

RESULTS

A total of 145 hospitalized patients with diabetic foot lesions were included in the study. Out of 145, 85 (58.6%) were males and 60 (41.4%) were females with M:F ratio of 1.41:1. The ages of the patients ranged from 15 to 80 years, out of which 102 (70.3%) of the cases were in the age group of 40-60 years (Table 1). Majority of the patients 72 (49.7%) were admitted through emergency department, 42 patients (29%) through out-patient clinics and 31 patients (21.3%) were referred from other units of the hospital. About 108 (74.4%) patients had Type 11 diabetes and 74 (68.5%) of them were on irregular treatment. Others 37 (25.6%) had Type 1 diabetes and 23 (62.1%) were on irregular treatment (Table 1). Out of 145 patients, 58 (40%) had duration of diabetes of less than 10 years, 46 (31.7%) had between 10 to 20 years and remaining 41 (28.3%) had duration of more than 20 years (Table 1). Out of 145 patients, 85 patients (58.6%) were hypertensive and 65

(44.8%) were smokers. A total of 18 (12.4%) patients had ischemic heart disease, 5 (3.4%) had stroke in the past,14 (9.6%) had nephropathy (serum creatinine> 1.8mg/dl), 42 (28.9%) had retinopathy, 92 (63.4%) had neuropathy and peripheral vascular disease was present in 19 (13.1%) patients (ABI <1.0). 35 patients (24.1%) had BMI of more than 25 kg/m2,with M:F ratio of 1:1.9 (Table 1).

About 86 patients (59.3%) had poor glycaemic control, 42 (29%) had fair control and 17 patients (11.7%) had good glycaemic control. The grade frequency of diabetic foot according to Wagner´s classification is shown in (Table 2). Thirty two patients (22%) presented with Wagner´s grade 2 ulcers, fifty eight (40%) with grade 3 ulcers, forty (27.5%) with grade 4 ulcers,12 (8.2%) with grade 1 ulcers and 3 (2%) with grade 5 ulcers. Osteomyelitis was present in 23 (15.8%) patients (Table). Majority of lesions were located on toes 58 (40%) and sole 43 (29.6%). Right foot was involved in 87 patients (60%), left foot in 39 patients (26.8%) and bilateral in 19 patients (13.1%). Regarding type of foot ulcer, 55.8% had neuropathic ulcer, 43.4% had neuro-ischemic ulceration and about <1% had pure ischemic ulceration (Table 1). About 22 patients (15.1%) were managed conservatively with tight glycaemic control, antibiotic cover and foot care and all were cured. In remaining 123 patients (84.9%) surgical intervention was carried out. The most common procedures done were incision and drainage in 28 patients (19.3%), debridement in 69 patients (47.5%) and some form of amputation in 47 patients (32.4%) (Table 3).

In our study, a total of 145 specimens were cultured and isolates 148 organisms, with 10 specimens being sterile (Table 4). 87 (60%) had growth of single organism, while the rest were polymicrobial and about 5% yielding 3 or more organisms. 142 (95.9%) had grown aerobic facultative organisms and 6 (4.1%) of the growth could not be categorized as aerobes. This may be due to anaerobic organisms. In our study, the gram negative aerobes were isolated in 82 (57.7%) cases with predominant organisms being E-coli (n=27,19%), Pseudomonas (n=32,22.5%), Proteus (n=16,11.2%). Among gram positive organisms Staph aureus was isolated in 43 cases (29.6%) followed in decreasing order by streptococcus 8 cases (5.6%), MRSA in 7 cases (16.2% of S aureus) and enterococcus in 3 cases (2.1%) as shown in (Table 4).

Sensitivity pattern showed that aerobic gram negative isolates like Enterobacteraiaceae and Pseudomonas aeruginosa were susceptible to imipenem (96%), piperacillin-tazobactem and ciprofloxacin, ceftazidime and aminoglycosides. Piperacillin-tazobactam and quinolones were active against more than 60% of the gram negative organisms, while amoxicillin clavulanate, cefoxatime and cefuroxime were the least active of the antimicrobial tested. Most of the Gram positive cocci were found to be highly resistant to penicillins, gentamicin and erythromycin. However they showed good sensitivity to amikacin and cephalosporin. Staphylococcus aureus exhibited a high frequency of resistance to the antibiotic tested methicillin (44%) and erythromycin (36%). High level of resistance to ciprofloxacin (28%) and erythromycin (24%) were found in Enterococcus species. However no high level of aminoglycosides was observed in enterococcal isolates. Methicillin resistant staphylococcus aureus (MRSA) was found in 7 (16.2%of the Staphylococcus) cases, susceptible to both Vancomycin and Linezolid respectively.

Two of the patients died of their disease: one of them died due to myocardial infarction and second one due to end stage renal disease.

Table 1: General characteristics of the patients (n=145)

No.	Characteristics	Frequency	Percentage
1	**Age group (years)**		
	< 40	14	9.6
	40-50	56	38.6
	50-60	46	31.7
	60-70	18	12.4
	> 70	11	7.5
2	**Gender**		
	Male	85	58.6
	Female	60	41.4
3	**Type of DM**		
	Type 1	108	74.4
	Type 11	37	25.6

4	**Duration of illness**		
	< 10 years	58	40
	10-20 years	46	31.7
	> 20 years	41	28.3
5	**HbA1c at admission**		
	< 6.5 %	17	11.7
	6.5-7.7 %	42	29
	> 7.5 %	86	59.3
6	**Duration of ulcer**		
	< 3 months	82	56.5
	> 3 months	63	43.5
7	**Type of ulcer**		
	Neuropathic	81	55.8
	Neuro-ischemic	63	43.4
	Purely ischemic	1	0.68
8	**Hypertension**	85	58.6
	Smokers	65	44.8
	Heart disease	18	12.4
	Stroke	5	3.4
	BMI > 25 kg/m2	35	24.1
9	**Retinopathy**	42	28.9
	Nephropathy	14	9.6
	Neuropathy	92	63.4
	Osteomyelitis	23	15.8
	Peripheral vascular disease	19	13.1

Table 2: Management according to Wagner´s classification

Wagner classification		**Treatment**	**Our study incidence**	**Percentage**
Grade 0	Foot at risk	Prevention	0	0 %
Grade I	Localized, superficial ulcer	Antibiotics and glycemic control	12	8.2
Grade II	Deep ulcer to tendon, bone, ligament or joint	debridements, Antibiotics and glycemic control	32	22
Grade III	Deep abscess, osteomyelitis	Debridements, some form of amputation	58	40
Grade IV	Gangrene of toes, forefoot	Wide debridements and amputation	40	27.5
Grade V	Gangrene of entire foot	Below knee amputation	3	2

Table 3: Treatment Provided (n=145)

Type of Treatment	No of Patients	Percentage
Conservative	22	15.1
Surgical	123	84.9
Incision and drainage	28	19.3
Debridement	69	47.5
Amputation	47	32.4
Rye´s	33	22.7
Trans-metatarsal	8	5.5
Below knee amputation	5	3.4
Above knee amputation	1	0.68

Table 4: Frequencies of infective organisms on culture

Bacteria category	Percentage
N isolates	148
Aerobic and facultataive isolates	142 (95.9%)
Gram negative	82 (57.7%)
Pseudomonas	32 (22.5%)
E-coli	27 (19%)
Proteus	16 (11.2%)
Klebshiella	04 (2.8%)
Enterobacter	03 (2.1%)
Gram positive	54 (38.1%)
Staphylococcus aureus	43 (29.6%)
Streptococcus	08 (5.6%)
Enterococci	03 (2.1%)
Contaminants	06 (4.1%)

DISCUSSION

Diabetic foot is the most common complication of diabetic patiebts17. Foot ulcer often precedes lower limb amputation. The most frequent underlying aetiologies are trauma, neuropathy, deformity, high plantar pressure and peripheral arterial disease18. Although infection is rarely implicated in the aetiology of diabetic foot ulcer, the ulcers are susceptible to infection once the wound is present.

Diabetic foot disease is more common in older age groups as compared to younger ones. In our study, 85 (58.6%) were males and 60 (41.4%) were females with M:F ratio of 1.41:1. The ages of the patients ranged from 15 to 80 years, out of which 102 (70.3%) of the cases were in the age group of 41-60 years (Table 1).Similar observation regarding age incidence of diabetic foot was made by Gul,et al19. About 108 (74.4%) patients had Type 11 diabetes and 37 (25.6%) had Type 1 diabetes and in most of them diabetes was not controlled properly (Table 1). Out of 145 patients, 85 patients (58.6%) were hypertensive and 65 (44.8%) were smokers. Duration of diabetes and poor glycaemic control are known risk factors for diabetic foot ulcers20, as shown by Lipsky and Sheehan21. In our study most of the patients were poorly controlled at the time of presentation as shown in (Table 1). Diabetic peripheral neuropathy is considered to be a major contributor for developing diabetic foot ulcer, as shown 61% incidence of peripheral neuropathy in their study by Aamir AH et al22. Our study also showed similar finding of 63.4% peripheral neuropathy incidence. Our study also confirmed that most of the ulcers (40%) were present on the forefoot, as also shown in their studies by Aamir AH et al22 (59%) and Lipsky et al23 (50%). Right foot was involved in 87 patients (60%), left foot in 39 patients (26.8%) and bilateral in 19 patients (13.1%). Similar findings of right foot (61.7%), left foot (31.3%) and bilateral

foot (6.9%) involvement were noted by Shah SF,et al24.

We used Wagner classification for ulcers and in our report most of the cases were of grade 2-4 as shown in (Table 2). Similar findings were reported by Aamir AH, et al22 and Shah et al24 in their local studies, while international figures shows early presentation of the diabetic foot25. This showed the fact that ulcers are not well managed in the community in our setting because of poor education and health system in developing world and because most of the patients with (Grade 0 and 1) are managed by physicians and they presented to surgeons later with fairly advanced diseased and better patient awareness and good disease control in developed countries.

In our study, a total of 145 specimens were cultured and isolated 148 organisms (Table 4). 142 (95.9%) had grown aerobic facultative organisms and 6 (4.1%) had of the growth cannot be categorized as aerobes. This may be due to anaerobic organisms. In our study Staphylococcus (29.6%) was the most common organism isolated on cultures followed by Pseudomonas aeruginosa (32, 22.5%). Similar findings have been reported by many local and international studies such as Shah, SH et al24 and Abdul Razaq A, et al26 and Sotto A, et al27. MRSA was isolated in 7 cases (16.2%of the S. aureus) as compared to 10 cases (19.2% of the S.aureus) in his study by Aamir AH, et al22.

Sensitivity pattern showed that aerobic gram negative isolates like Enterobacteraiaceae and Pseudomonas aeruginosa were susceptible to imipenem (96%), piperacillin-tazobactem and ciprofloxacin, ceftazidime and aminoglycosides. Piperacillin-tazobactam and quinolones were active against more than 60% of the gram negative organisms, while amoxicillin- clavulanate, cefoxatime and cefuroxime were the least active of the antimicrobial tested. Most of the Gram positive cocci were found to be highly resistant to penicillins, gentamicin and erythromycin. However they showed good sensitivity to amikacin and cephalosporin. Staphylococcus aureus exhibited a high frequency of resistance to the antibiotic tested methicillin (16.2%) and erythromycin (36%). High level of resistance to ciprofloxacin (28%) and erythromycin (24%) were found in Enterococcus species. However no high level of aminoglycosides resistance was observed in enterococcal isolates. Methicillin resistant staphylococcus aureus (MRSA) was found in 7 cases (16.2% of Staphylococcus), susceptible to both Vancomycin and Linezolid respectively in more than 95% of the cases.

About 22 patients (15.1%) were managed conservatively with tight glycaemic control, antibiotic cover and foot care and all were cured. In remaining 123 patients (84.8%) surgical intervention was carried out. The most common procedures done were incision and drainage in 28 patients (19.3%), debridement in 69 patients (47.5%) and some form of amputation in 47 patients (32.4%). Out of 47 (32.4%) amputations, 41 (28.2%) were toe/forefoot amputations and 6 (4.13%) were above or below knee amputations. All six (4.13%) patients requiring major amputation were grade 4-5 ulcers (Table 3). Similar high rate of some type of amputation were noted by Aamir AH,et al (22.8%)22 and Shah SF, et al (35%)24 respectively. In our study, 6 patients (4.1%) needed above or below knee amputations (BKA/AKA), in contrast by Aamir AH,et al (6.1%)22, Shah SF (13%)24 and Ali SM, et al (10.2%)28 of BKA/ABA.

Preventing strategies including patient education in foot care, prophylactic skin and nail care and appropriate footwear reduce the risk for foot ulcers and lower extremity amputations by 25% in Pakistan with no specific risk factor.

CONCLUSION

Majority of diabetic foot lesions were in the grade 11-1V. Lesser grade responded well to conservative measures and those with higher grades needed amputations. Amputation rates, time of healing and morbidity increases with increasing stage and grade. Effective glycaemic control, timely hospital admission, appropriate surgical/medical treatment along with patients education in foot care, can decrease morbidity and mortality due to diabetic foot disease.

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