

**WAGNER'S GRADING OF DIABETIC FOOT LESIONS-A TERTIARY CARE EXPERIENCE**N. Krishna Mohan<sup>1</sup>, D. Devender<sup>2</sup><sup>1</sup>Associate Professor, Department of General Surgery, Gandhi Medical College, Hyderabad.<sup>2</sup>Post Graduate, Department of General Surgery, Gandhi Medical College, Hyderabad.

**ABSTRACT: PURPOSE OF STUDY:** Diabetic foot is the most common complication of diabetes. Amputation which is the end result of diabetic foot disease is associated with significant morbidity and mortality.

Since it is crucial to identify those at an increased risk of diabetic foot complications, a detailed study of the natural history of diabetic foot, various clinical characteristics, according to Wagner grading of lesions, their outcome and management protocol followed in our hospital was undertaken in our hospital.

**AIM AND OBJECTIVE:** Evaluation of diabetic foot lesions based on Wagner grading system, outcome and management protocol followed in our hospital.

**MATERIALS AND METHODS:** A prospective study done on hundred diabetic foot patients in our own hospital over a period of one and half year. Data was obtained from a questionnaire developed to record the medical history, examination details, investigations reports, treatment details and final outcome at the end of stay. Infection was classified based on Meggitt-Wagner, classification/grading.

**RESULTS:** Diabetic foot was very common in elderly age group (>55yrs) 54% and male dominant (87%). Majority of them had diabetes for more than five years (47%) and complications of diabetes were present on admission in 15% of them. Grade I(29%), Grade III (27%) & Grade IV (24%) lesions based on Wagner's grading accounted for majority of diabetic foot lesions. Multiple toe disarticulation/ above knee / below knee amputation accounted for a quarter (23%) of surgical interventions in our hospital. The glycemic control in most of patients was very poor with RBS>200 mg/dl (70%) and glycosylated hemoglobin>7g% (74%) of them. A quarter of the patients stayed for at least a month in the hospital (25%).

**CONCLUSION:** It can be concluded that diabetic foot in various forms accounts for significant morbidity in the surgical wards. Wagner's grade I (29%) Grade III (27%), Grade IV (24%) constituted majority of lesions. Factors contributing mainly are poor glycemic control at the time of admission, presence of gangrene, complications of diabetes nephropathy, neuropathy and associated co morbidities ( peripheral vascular disease, hypertension, ischemic disease). A lot of scope for improvement is their in the approach to treatment of diabetic foot as most of the cases belong to Grade I (29%) where proper patient education can avoid dreadful complications and Grade III (27%), Grade IV (24%) if properly managed morbidity can be reduced considerably.

**KEYWORDS:** Wagner Grading, Diabetes Mellitus, Diabetic Neuropathy.

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**INTRODUCTION:** Diabetic foot is the most common complication of diabetes and is greater than retinopathy, nephropathy, heart attack and stroke combined.<sup>(1)</sup>

The ultimate result of diabetic foot disease is amputation and is associated with significant morbidity and mortality.<sup>(2)</sup>

Diabetes associated problems are the second most common cause of lower limb amputations in India. Wagner's Grade I (29%), Grade III (27%), Grade IV (24%) constituted majority of lesions. Disorders such as ulcerations, infection, and gangrene are the leading causes of hospitalization in patients with diabetes mellitus.<sup>(3)</sup>

Majority of amputations are preceded by foot ulcerations. It is crucial to identify the patients at an increased risk<sup>(4)</sup> therefore a detailed study of the natural

history of diabetic foot, the various clinical characteristics, the role of microorganisms their contribution towards worsening of the ulceration is crucial for optimal treatment and possible cure.

**AIM:** Evaluation of diabetic foot lesions based on Wagner grading system, outcome and management protocol followed in our hospital.

GRADE	LESION
0	No open lesions, but high risk foot.
1	Superficial diabetic ulcer (partial / full thickness)
2	Deep ulcer extension to ligament, tendon, joint capsule, or deep fascia without abscess or osteomyelitis
3	Deep ulcer with abscess, osteomyelitis or joint sepsis
4	Localized gangrene.
5	Extensive gangrenous involvement of entire foot.

**Table 1: Wagner diabetic foot lesion grading system<sup>(5)</sup>**

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**MANAGEMENT OF DIABETIC PATIENTS WITH FOOT**

**LESIONS:** The management of diabetic patients with infected foot has to be individualized based on Wagner's grading of foot lesion.

**Grade 0 Foot:** A grade 0 feet has no open lesions but is at a risk foot.<sup>(6)</sup> Separate callus and see whether any ulcer underneath. If any ulcer is present it should be reclassified as Grade1.

Grade 0 feet with deformities such as intrinsic-minus, hammer or claw toes, Charcot's joint or hallux valgus need purposely designed shoes. Proper patient education plays a key role in the management of diabetic patients with grade 0 feet. Use of lubricants in dry skin is good. Patients should not use chemical agents in removing callus and corns.<sup>(7)</sup>

**Grade 1 Lesion:** This consists of superficial ulcer but with thickness skin loss, in plantar surfaces of toes of metatarsal heads. But "kissing lesion" occurs in between toes caused by over tight shoes. Thus mainstay of treatment is to release pressure from ulcerated area, surrounding callus removal and ulcer debridement until healthy granulation is seen.<sup>(8)</sup> Saline irrigation is usually enough in these relatively clean superficial ulcers. If infection is present, a wound swab should be taken and antibiotic therapy with broad spectrum agents should be started immediately. The most important of treatment is to relive pressure till lesions heal.

**Grade 2 Lesion:** The ulcer is deep and often penetrates subcutaneous fat down to tendon. This patients should be admitted to hospital and blood and ulcer cultures should be taken and foot x-rayed.<sup>(9)</sup>

Culture for aerobes and anaerobes should be done. Fluocloxacillin and metronidazole are used as blind first line therapy. Deep infected ulcer need to be debrided either in ward or under general anesthesia. After debridement, deep ulcer should be packed with eusol and paraffin in 175mm or 250mm gauge wick to encourage healthy granulation tissue growth. Otherwise simple dry dressings advised.<sup>(10)</sup> Topical antibiotics are not useful.

**Grade 3 Lesions:** They have deep infection with cellulitis or abscess formation often with underlying osteomyelitis to culture and sensitivity.

Initial treatment constitutes bed rest, elevation of foot, antibiotics according to culture and sensitivity. Optimal glycemic control is also needed. X-ray foot must be reviewed. Soft tissue swelling, bony changes, large amounts of subcutaneous gas on x-ray foot indicate serious anaerobic infection. Patient with serious foot infection often needs iv antibiotics, iv insulin, grade 3 foot with good blood supply can often be treated without amputation, with surgical drainage, dressing and wound irrigation.<sup>(11)</sup> Amputation may be need if severe infection of progressive anaerobic infection is present.

Level of amputation is determined by the site at which wound healing will occur easily and residual limb which is functionally useful. Clinical signs suggest level of

amputation like skin changes, vascular pulsation, and peripheral neuropathy and rest pain. These are very important in proper wound healing and later rehabilitation with prosthesis.

The most wound healing concept is widely accepted in treating diabetic foot ulcers. The standard of care recommended by the American diabetes association is saline moistened gauze. Hydrocolloid dressings and hydrogels can maintain the moist wound environment while providing some autolytic debridement.<sup>(12)</sup> Aligates and other absorptive dressing absorb drainage well and maintain moist wound environment.

Other dressings impregnated with collagen, zinc, or other factors that stimulate wound healing. Foam dressings may provide some padding in addition to absorbency. There have been no large, controlled studies to show the efficacy of hyperbaric oxygen therapy and electrical stimulation on DFU.

**MATERIALS AND METHODS:** A prospective study was carried out on 100 diabetic patients with foot ulcers for a period of one and half years from January 1<sup>st</sup> 2014 to June 30<sup>th</sup> 2015.

All cases with diabetic foot infections who were admitted to general surgery wards were selected. Diabetic foot infection is defined as the presence of ulcers ( superficial to deep) on examination or evidence of inflammation, i.e cellulitis or purulent discharge, or evidence of necrosis, with or without osteomyelitis or systemic toxicity.<sup>(13)</sup>

Diabetes were diagnosed on the basis of fasting plasma glucose of 126mg/dl and above or if symptoms were present (i.e polyuria, polydipsia, polyphagia, weight loss and blurred vision) and a random plasma concentration of 200mg/dl or more, on 2 different occasions.

A semi structured questionnaire was developed to record the medical history, examination details and investigation reports. Detailed medical history and physical examination included demographic data, duration of diabetes, treatment compliance, method of glycemic control,<sup>(14)</sup> history of previous amputation, awareness about complications, personal habits like smoking and alcohol consumption, history of ischemic heart disease, hypertension or cerebrovascular disease, nephropathy, neuropathy, duration of wound, history of antibiotic intake prior to admission. Neuropathy was assessed with tuning fork, ischemia by pulsations of dorsalis pedis and categorization of foot ulcers into five types based on Wagners classification.

The extent of foot infection was assessed based on Wagner's classification as follows:<sup>(15)</sup>

**Grade 0:** No ulcer but high risk foot.

**Grade 1:** Ulceration involving only the dermis.

**Grade 2:** Ulceration involving tendons and/or joint capsules.

**Grade 3:** Extending to bone, usually causing osteomyelitis.

**Grade 4:** Localized gangrene.

**Grade 5:** Gangrene involving a major part of the foot.

**Specimen Collection:** wound was thoroughly washed with saline to remove the slough and the local antiseptic application applied during previous dressing. Specimen was collected from the edge of the wound and sent to the lab immediately. Gram’s staining was done followed by culture on 5% sheep blood agar, Mac Conkeys agar. After 24-48 h of incubation, bacterial growth was identified by colony morphology, Gram’s staining and biochemical reactions. Antibacterial susceptibility test was done by Kirby Bauer’s method for appropriate antibiotics.<sup>(16)</sup>

**RESULTS:** An analysis of data obtained from 100 patients admitted in the surgical ward of tertiary hospital from January 1<sup>st</sup> 2014 to June 30<sup>th</sup> 2015.

- 1. Age Distribution:** As presented in table 1 people belonged to the group of 25 to 80 years. However, most of the patients accrued in the study were of more than 45 years of age with 34% being in the 46–55 years, 33% in between the age of 56–65 years and about 21% of >65 years of age.
- 2. Sex Distribution:** Majority of the patients receiving treatment for diabetic foot were males (87%), while females accounted for only 13% indicating a marked difference on basis of the gender.
- 3. Duration of Diabetes Mellitus:** Most of the patients were ignorant in expressing the precise duration of diabetes mellitus. However from the best of their knowledge it was expressed that the average duration available, was 29% (1-5 years), 13% (6-10years), 13% (10-15 years) respectively.

Newly detected diabetes	6%
Information not available	21%
1 – 5 years	29%
6 – 10 years	13%
10 – 15 years	13%
16 – 20 years	9%
21 – 25 years	5%
>25 years	1%
< 1 year	3%
<b>Total</b>	<b>100%</b>

**Table 2: Duration of Diabetes Mellitus**

- 4. Complications of Diabetes Mellitus:** Diabetes causes multiple secondary complications and information accrued from the study indicates that nearly 28% of the patients with the diabetic foot also had neuropathy, 22% had diabetic retinopathy, 15% had nephropathy at the time of admission.

Complication	Total patients
Retinopathy	20%
Nephropathy	15%
Neuropathy	22%
Osteomyelitis	1%

**Table 3: Complications of diabetes mellitus**

- 5. Mode of Presentation of Diabetic Foot:** Diabetic foot complications manifests in myriad forms and in this study it was observed that 27% patients presented with

abscess, with 21% with cellulites, 25% with gangrene of one or more toes including forefoot along with abscess/ cellulites/ulcer, 19% with ulcer foot in various forms and 5% with necrotizing fasciitis.

- 6. Wagner Distribution:** In this study, it was observed that Grade 1, 3 and 4 had almost equal distribution of 29%, 27% and 24% respectively, while 19% belonged to grade 2 category.

Grade 1	29%
Grade 2	19%
Grade 3	27%
Grade 4	24%
Grade 5	0%
Grading not available	1%
<b>Total</b>	<b>100%</b>

**Table 4: Wagner grading of wound**

- 7. Treatment Modality:** Incision and drainage (24%) and wound debridement/slough excision (27%) formed the major chunk of surgical intervention in the hospital which goes with the common mode of presentation. 19% of them underwent toe disarticulation (simple/multiple) and also 2% had below knee amputation and above knee amputation each, while 8% of them were treated with split skin grafting.

Conventional daily dressing only	12%
wound debridement/ slough excision	27%
Incision and drainage	24%
Fasciotomy	7%
toe disarticulation	19%
below knee amputation	2%
above knee amputation	2%
split skin grafting	8%
Secondary suturing	1%
Callosity shaving	1%

**Table 5: Treatment modality**

- 8. Associated Co Morbidities:** In addition to diabetic foot most of the patients (29%) were hypertensive, while 10% had peripheral arterial occlusive disease and 13% presented a history of ischemic heart disease.

- 9. Mode Of Control Of Diabetes:** In our study, at the time of admission it was observed that most of the patients (43%) were on oral hypoglycemic agents, 18% were on insulin and 4% were not on any treatment. Most of the patients (90%) were regular with their treatment while, a miniscule percentage (6%) of the patients was irregular with their treatment.

Insulin only	18%
Oral hypo glycemics only	43%
Both	9%
No treatment taken	4%
On irregular treatment	6%
Treatment details not available	20%
<b>Total</b>	<b>100%</b>

**Table 6: Mode of control of diabetes**

**10. Glycemic Control:** The data on RBS and glycosylated hemoglobin was unavailable in all cases. Among the available cases, it was observed that 53(68%) patients had RBS more than 200mg/dl, while glycosylated hemoglobin more than 7 in 43(74%) available of the 58 patients.

**11. Average Duration Of Stay:** From the available information it was observed that nearly 58% of the patients needed hospitalization for nearly a month while 10% stayed for more than a month. How ever stay of nearly 32% was unclear.

Duration not available	30%
1-2 weeks	33%
3weeks to 1 month	25%
More than 1 month	10%
Less than 1 week	2%
<b>Total</b>	<b>100%</b>

**Table 7: Post intervention duration of hospital stay**

**12. Culture and Sensitivity Profiles of Organisms Isolated From Wounds:** Microbiological studies performed represented a mosaic of pathogenic organisms. It was observed that out of the 55% patients in whom the wounds swab was taken, 36% had isolated single bacteria, while 19% showed poly microbial growth. Different staining indicated that 55% of organisms were gram negative while remaining were gram positive.

Further characteristics indicated the infection to be mostly by staphylococcus (20.6%), pseudomonas (16.2%), E.coli (14.7%), Klebsiella (11.8%), MRSA and Enterococcus (10.3%).

Culture sensitivity studies showed that E.coli was sensitive to Gatifloxacin (100%), Levofloxacin (60%), Amikacin (100%) and Gentamicin (60%). Klebsiella species were sentive to Imipenem, Meropenem, Gatifloxacin. Streptococcus was sensitive to ampicillin and Amoxicilli. Pseudomonas was sensitive to Amikacin (78%), Cefaperazone–sulbactam (50%), Imipenam, Meropenam (43%). Proteus bacteria was sensitive to Ceftriaxone (33%), Imipenam (100%), Meropenam (100%), Piperacillin (100%), Cefaperazone–sulbactam (100%). Stephylococcus was commonly sensitive to ceftriaxone, Co trimaxazole, Amoxy clav, Vancomycin, ofloxacillin while the drug resistant MRSA was sensitive to Teicoplanin, Vancomycin, Amikacin and Gatifloxacin.

**Association of Bacteria Isolated with Wagners Grading and Complication in the Patient:** Co relation of the organisms with the clinical complication showed an association with the Wagner,s grading. In the study it was observed that staphylococcus and were pseudomonas associated with majority of grade 2, 3 and 4 wounds. MRSA with Grade 1, 2 and 3(33%). Klebsiella with Grade 2 wounds (75%) and E.coli with Grade 1, 3 and 4(25%). Further observation showed that staphylococcus was reported in few abscesses (54.5%), MRSA in some ulcer,

abscess and necrotizing fasciitis (33.3%). Pseudomonas in some gangrene of toes, necrotizing fasciitis and ulcer foot (85.7%). While Klebsiella observed in most ulcers (75%) and necrotizing fasciitis (25%).

**Other Observations:** In our study it was observed that 31 patients (31%) had to undergo amputation. Additionally it was also observed that patients in whom the amputation had to be performed had diabetic nephropathy(34.4%), neyropathy(18.8%) and peripheral vascular disease(18.8%).

**DISCUSSION:** Based on the analysis of the results and comparing with other similar studies, following inferences can be drawn:

**1. Sex Distribution:** In our study, diabetic foot was dominated by males (87%) which is comparable with the study done Bansal et al (2008).<sup>(11)</sup> This may be due to increased exposure of males to trivial trauma to the foot where as females are mostly indoors.

**2. Age Distribution:** Most of the patients belong to age group 46–55 years (34%), 56–65 years(33%), >65 years (21%). In Bansal et al, among those with diabetic foot ulcer 56.31% were in the age group of 51–70 years which is comparable to our study.

**3. Duration of Diabetes Mellitus:** The duration for which patients is suffering from diabetes is directly related to the degree of wounds and also indirectly making the patient more vulnerable due to the complications of diabetes like nephropathy, neuropathy and retinopathy in long term disease. 29% suffered from diabetes mellitus for 1-5 years followed by 6-10 years and 10-15 years accounting for 13% each respectively.

In Bansal et al,<sup>(11)</sup> 48.54% had diabetes mellitus for than 10years which is more than three times our study. This can be substantiated by the fact that most of the patients were ignorant in expressing the precise duration of diabetes mellitus leading to inaccuracy in the duration of diabetes.

**4. Complication of Diabetes:** In diabetes, much of the damage is done by the sequel rather than the disease per se. complications such as nephropathy, retinopathy and neuropathy go hand with diabetes mellitus.

22% of the patients had neuropathy, equal proportion had retinopathy. Nephropathy was also quite common constituting 15%.

In Bansal et al, 76% had neuropathy which doesn't match with our study.

Another observation by Marvin E. Levin, the incidence of neuropathy in 10-20% which is comparable with our study.

**5. Mode of Presentation:** Patients with diabetic foot can manifest in myriad forms ranging from trival non healing ulcer, abscess, toe gangrene, callosities to the florid necrotizing fasciitis and wet gangrene.

In our study majority of them presented with abscess (27%), followed by 40% of the patients presented with cellulitis and foot ulcers.

25% had gangrene of one or more toes at the time of admission itself.

It was noted that time of admission that inevitably ended up in amputation.

**6. Wagner's Grading:** In our study, all grades except grade 5 wound were found, grade 1, grade 3 & 4 accounted for 29, 27 & 24% respectively in our study which is comparable with the study by Catherine et al.<sup>(17)</sup>

**7. Treatment:** the treatment options for diabetic foot are numerous depending on the various modes of presentation.

Incision and drainage (24%), wound debridement/slough excision (27%) formed the major chunk of surgical intervention in our study which is the common mode of presentation(abscess, ulcer) as mentioned above.

19% of them underwent toe disarticulation (simple/multiple) and also 2% had below knee amputation each.

8% of the diabetic foot were treated with split thickness skin grafting during the same admission itself which is advantageous to the patients.

UP-PGH Philippine's General Hospital diabetic extremity care team reported an amputation rate of 66% out of 473 cases which is remarkable high compared to our study.

**8. Associated Co Morbidities:** The diabetic foot complications are aggravated because of the commonly associated co morbidities like hypertension, peripheral arterial occlusive disease and ischemic heart disease.

About one third (29%) of patients had hypertension at the time of admission, 10% had peripheral arterial occlusive disease and 13% of the patients had ischemic heart disease.

In Catherine et al, 25.4% had hypertension and 35.7% suffered from ischemic heart disease which is quite high compared to our study.

Another feature noted in our study was that none of the patients with peripheral vascular disease underwent any surgical intervention to improve the vascularity of the vessel which is a major drawback in the treatment strategy for limb salvage in diabetic foot. In the article by Robert G Fryberg, it is stressed that arterial reconstruction surgery forms an important part in the strategy for the limb salvage therapy.

**9. Duration of Hospital Stay (Post Intervention):** diabetic foot is commonly associated with lengthy hospital stay adding on to the financial burden of the patients.

Data available for 70% of patients among whom majority stayed up to one month (58%) and 10% stayed for more than a month.

**10. Association of Bacteria with Wagner Grading:** Majority of grade 2, 3 and 4 wounds isolated staphylococcus and pseudomonas in our study.MRSA equally distribute among grade 1, 2 and 3 (33%) wounds.

**11. Association of the Mode of Presentation With Type of Organism:** Staphylococcus was the most organism grown (54.5%) in diabetic foot with abscess.

Pseudomonas predominantly found in patients with gangrene (toes), necrotizing fasciitis and foot ulcers (85.7%).

**12. Other Observations:** 34.4% of all amputation done in our study were presided foot ulcers in various forms.

34.4% of these patients (amputation) had nephropathy and 18.8% had neuropathy and peripheral vascular disease each.

85% of foot amputations are presided by foot ulcer according to Trautner et al.

A critical analysis showed that 34.4% of the amputations were preceded by an ulcer indicated that effective treatment of the ulcer can prevent amputation.

#### CONCLUSION:

1. Wagner's grading is the most common and widely accepted classification for grading of diabetic foot lesions based on depth of wound grade I, grade III & grade IV accounted for 29%, 27%, & 24% respectively in our study.
2. Amputations in the form of single, multiple toe disarticulations are rampant, contributing to significant morbidity, but notable feature is that 8% of these patients have undergone complete treatment for diabetic foot in the form of skin grafting at the first admission itself.
3. The lack of multidisciplinary approach in the treatment of diabetic foot is quite obvious and there is a lot of scope of improvement in the form of holistic approach to a patient with diabetic foot rather than just treating the foot, mainly in the grade I who require lot of patient education and grade III & IV lesions where morbidity can be reduced considerably.

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Fig. 1: Diabetic Foot Lesions



Fig. 3: Grade 4 Lesions



Fig. 2: Grade 3 Lesions



Fig. 4: Grade 5 Lesions

