

Formulating Treatment Protocol in Diabetic Foot by Assessment of Neurological, Vascular, Dermatological and Skeletal Status

Vivek Kunwar¹, Dr. Mohit Jain², Dr. Anubha Srivastava³, Ravi Raj Patil⁴, Bhasker Chowdhary⁵, Utkarsh⁶

^{1, 4, 5, 6}Junior Resident, PG Department of General Surgery, M. L. N. Medical College, Prayagraj, India

³MD, Associate Professor (Internal Medicine) P. G. Department of Internal Medicine M. L. N. Medical College, Prayagraj, India

²Professor, PG Department of General Surgery M. L. N. Medical College, Prayagraj, India

Abstract: ***Background:** Diabetic foot is one of the most significant and devastating complications of diabetes and is defined as a foot affected by ulceration that is associated with neuropathy and / or peripheral arterial disease of the lower limb in a patient with diabetes, especially among the older population. Diabetic foot ulcer have been found to affect health related quality of life in various dimension such as physically, mentally, socially and economically. **Aims and objective:** Formulating treatment protocol (medical, conservative and surgical) in diabetic foot by assessment of neurological, vascular, dermatological and skeletal status. **Material and method:** A Prospective study was carried out in patient presented with diabetic foot and were treated by classifying the patients into neurological, vascular and neurovascular lesion related groups. Patients managed by medical treatment, conservative (I&D and fasciotomy, slough excision and debridement, regular dressing) or surgical (split thickness skin graft or flap rotation, angioplasty/bypass surgery, major/minor amputation) with strict glycemic control, health education, and use of offloading or protective footwear and follow up for outcome. **Results:** In study, out of 50 patients, 41 patients (82%) was improved as healing of wound was good under 20 weeks of duration of follow up and 9 patients (18%) was not healed. Out of 13 cases of neurological patient, 12 cases (92.30 % of total neurological) had good outcome, out of 9 cases of vascular lesion, 8 cases (88.88% of total vascular) had good out come and out of 28 cases of neurovascular cases, 21 cases (75% of total neurovascular) had also good outcome. In study healing rate was good because of better protocol for management of diabetic foot by clinical assessment and proper treatment as formulated. **Conclusion:** Diabetic patients have always suffered from complications affecting the lower limbs. Foot infection and the subsequent amputation of a lower extremity are the most common cause of hospitalization among diabetic patients. Education regarding foot care and early clinical screening play a vital role in the prevention and treatment of diabetic foot and recurrence.*

Keywords: Diabetic foot ulcers, Gangrene, Ankle brachial pressure index (ABPI), Amputation

1. Introduction

Diabetes mellitus^(1, 2) is worldwide problem. Diabetic foot^(3, 4) is one of the most significant and devastating complications of diabetes and is defined as a foot affected by ulceration that is associated with neuropathy and / or peripheral arterial disease of the lower limb in a patient with diabetes, especially among the older population. Diabetic foot ulcer⁽⁵⁾ have been found to affect health related quality of life in various dimension such as physically, mentally, socially and economically.

A number of component causes, most importantly peripheral neuropathy, interact to complete the causal pathway to foot ulceration⁽⁶⁾. Principal contributory factors that might result in foot ulcer development could be risk factors^(7, 8) for foot ulcers as previous foot ulcer, previous amputation, peripheral neuropathy, foot deformity, peripheral vascular disease, visual impairment, diabetic nephropathy, poor glycemic control, cigarette smoking etc.

Diabetic neuropathy is the common factor in almost 90% of diabetic foot ulcers⁽⁹⁾. Nerve damage in diabetes affects the motor, sensory, and autonomic fibers. Motor neuropathy causes muscle weakness, atrophy, and paresis. Sensory neuropathy leads to loss of the protective sensation of pain, pressure, and heat. Autonomic dysfunction causes vasodilation and decreased sweating, resulting in a loss of skin integrity, providing a site vulnerable to microbial infection.

Peripheral arterial disease is 2–8 times more common in patients with diabetes, starting at an earlier age, progressing more rapidly, and usually being more severe than in the general population. It commonly affects the segments between the knee and the ankle or distal most part of lower limb. It has been proven to be an independent risk factor for cardiovascular disease as well as a predictor of the outcome of foot ulceration. Even minor injuries, especially when complicated by infection, increase the demand for blood in the foot, and an inadequate blood supply may result in foot ulceration, potentially leading to limb amputation. The majority of foot ulcers are of mixed etiology (neuroischemic), particularly in older patients.

Diabetic foot ulceration is a major health problem and its management involves a multidisciplinary approach. Management of diabetic foot requires the correct classification of stage and severity. Adequate care for diabetic foot should include a focus on DM control as well as on wound care, proper infection control, relieving pressure, and optimizing blood flow. Treatment includes thorough wound management, skin grafting, vascular surgery, amputation and good microbiological control using appropriate antibiotics and strict glycemic control. Many recent approaches like vacuum dressing, platelet derived growth factors therapy have revolutionized the management of diabetic foot.

2. Aims and Objectives

Aim and objective of the study: -

To Assess the Neurological, Vascular, Dermatological and Skeletal Status of Diabetic Foot. Formulating Treatment Protocol (medical, conservative and surgical) In Diabetic Foot by Assessment of Neurological, Vascular, Dermatological and Skeletal Status.

3. Materials and Methods

The present study titled “Formulating Treatment Protocol In Diabetic Foot By Assessment of Neurological, Vascular, Dermatological And Skeletal Status” was carried out in P. G. Department of Surgery, S. R. N. Hospital associated with M. L. N Medical College, Prayagraj from September 2019 to September 2020 after approval from the ethical committee and after obtaining written and informed consent either from patient or their legal heir. This study was a prospective study and 50 individuals were selected for study with provisional diagnosis of diabetic foot was part of study.

Inclusion criteria

- Presence of Type 1 or Type 2 diabetes mellitus
- RBS > 140 mg/DL or FBS >126 mg/DL or PPBS >200 mg/DL (ADA 2019 criteria of DM)
- HBA1c >6.5%
- Patient's age >20 year having diabetic changes in foot
- Patient's consent.

Exclusion criteria

- Other causes of foot ulcer such as infected foot ulcer, venous ulcer, vasculitis, amyloidosis, toxic neuropathy, AIDS, renal failure, and alcohol abuse.
- Symptomatic lumbosacral spine disease.
- Conditions which in the view of the investigator might interfere with assessment, safety, results, outcomes of the study.
- Inability to understand and give consent.
- Participants who might not be able to comply with the study procedures till the end of the study.

Potential participants who met the inclusion criteria were identified during their registration at the counter and/or transfer from other department. Introduced himself to the potential participants and inquired if they were willing to participate in the study. If they agreed, then took them to a private room for the history taking and examination procedure.

On admission or on transfer in, a detailed history of patient was taken and Clinical examination was performed on bed side or in examination room after taking verbal consent.

Neurological Assessment:

- 1) Monofilament test: (known as Semmes - Weinstein Monofilaments) perform by using 10 gm nylon filament over 10 spots over the sole of the foot from the toes to the heel for pressure sensory loss as loss of sensation at more than two spot taken as positive test (abnormal).

- 2) Tuning fork test: 256 hz tuning fork taken for vibratory sensation. Vibratory sensation should be tested over the tip of the great toe bilaterally. An abnormal response can be defined as when the patient loses vibratory sensation and the examiner still perceives it while holding the fork on the tip of the toe.
- 3) Ankle reflex: Ankle reflexes can be tested with the patient either kneeling or resting on a couch/table. The Achilles tendon should be stretched until the ankle is in a neutral position before striking it with the tendon hammer. Decrease or absent ankle reflex was taken as abnormal.

Vascular Assessment:

- 1) Pedal pulse: Vascular examination should include palpation of the posterior tibial and dorsalis pedis pulses which should be characterized as either “present” or “absent”. Absent of dorsalis pedis or posterior tibial artery pulse was taken as abnormal.
- 2) Intermittent claudication: Any grade of pain on walking was abnormal.
- 3) Ankle brachial pressure index (ABPI test): The ABPI is a simple and easily reproducible method of diagnosing vascular insufficiency in the lower limbs. Blood pressure at the ankle (dorsalis pedis or posterior tibial arteries) is measured using a standard Doppler ultrasonic probe. The ABPI is obtained by dividing the ankle systolic pressure by the higher of the two brachial systolic pressures. ABPI suggest as abnormal if ABPI <0.9 and ABPI <0.4 was taken as eligible for amputation.

Dermatological Assessment:

- 1) Ulceration: Presence of ulceration over toe, dorsum or plantar of foot or leg.
- 2) Abnormal erythema (cellulitis)
- 3) Gangrenous toe or foot, as abnormal.

Musculoskeletal Assessment

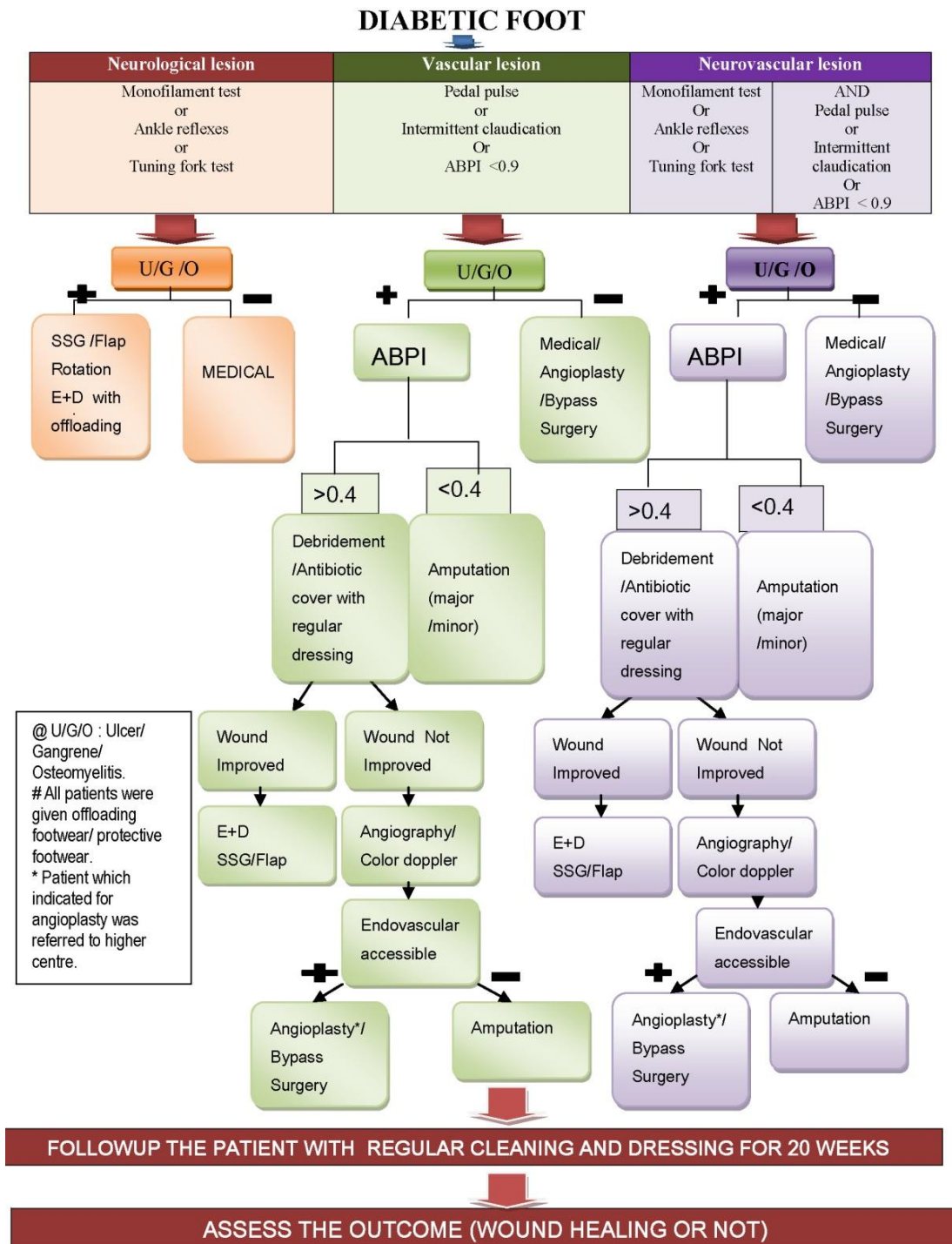
- 1) Foot deformity: Any abnormal position over interphalangeal joint, tarsal joint, ankle joint, flat foot, arched foot.
- 2) Muscle wasting: Decrease in muscle mass
- 3) Bone involvement: Presence of osteomyelitis, as abnormal.

Management: Patient managed by medically, conservative (I&D and Fsciotomy, Slough excision and dressing) or Surgical (SSG, Disarticulation of toe, Amputation). Patients were divided into three categories (neurological, vascular and neurovascular) on the basis of assessment of neurological and vascular examination as The IWGDF Risk Stratification System⁽¹⁰⁾ and corresponding foot screening and examination and frequency and further on basis of dermatological and skeletal status and managed the patient by medically, conservative (I&D and Fasciotomy, Slough excision and dressing) or Surgical (SSG, Angioplasty/Angioplasty combined with other), Amputation/Disarticulation - major/minor).

Followup the patient up to 20 weeks with regular cleaning, dressing and health education and assess the outcome in form of wound healing or not healing and formulate treatment protocol for diabetic foot.

Outcome: In my study, there was improvement in wound healing within 20 weeks of follow up and no need of further treatment for wound.

Flow Chart of the Research Procedures: A framework was created after the analysis of themes for study



Statistical tools employed: The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 21.0 statistical Analysis Software. The values were represented in Number (%) and Mean±SD.

4. Results

There was 50 case of diabetic foot admitted and treated in different unit of surgery department in Moti Lal Nehru Medical College (SRNH) Prayagraj U. P.

In present study, out of 50 cases, maximum patients found in age group of 40 to 60 with mean 56 year, were 30 cases

(60%) followed by above 60 year of age with mean 64 year, were 18 cases (36%) and in age group of 21 to 30 was 2 cases (4%). Out of 50 cases studied, 37 cases (74%) were male and 13 cases (26%) were female.

In this study, 12 cases (24%) were involved Toe, 7 cases (14%) were involved dorsum of foot, 12 cases (24%) were involved plantar of foot, 10 cases (20%) were involved legs

and 9 cases (18%) involved multiple sites in lower limb.

Table 1: Clinical changes

	No. of patient	% of patient
Neurological change	13	26
Vascular changes	9	18
Neuro - vascular changes	28	56

In present study, out of 50 cases, 13 cases (26%) found to had neurological changes, 9 cases (18%) had vascular changes and 28 cases (56%) had neurovascular changes.

Table 2: Clinical change

	Ulcer / Gangrene / Osteomyelitis	
	Present (n=46)	Absent (n=4)
Neurological changes (n=13)	10	3
Vascular changes (n=9)	9	0
Neuro - vascular changes (n=28)	27	1

In this study, out of 50 cases, 46 cases (92%) had ulcer or gangrene or osteomyelitis, in which 10 cases (20%) were presented because of neurological cause, 9 cases (18%) due to vascular and 27 cases (54%) because of neurovascular cause.

Table 3: Doppler changes

	No. of patient	% of patient
Arterial stenosis (Variable degree)	37	74
NO arterial stenosis	13	26

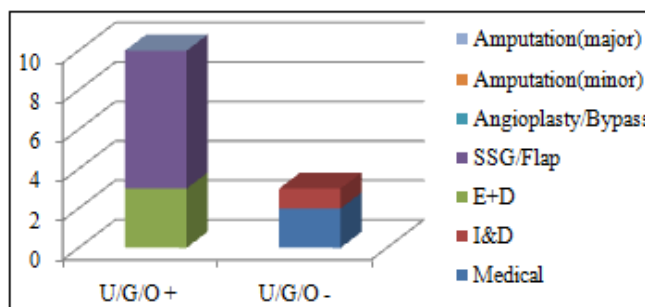
Out of 50 cases, 37 cases (74%) had arterial stenosis (Variable degree) in color Doppler and 13 cases (26%) had no significant changes.

Treatment:

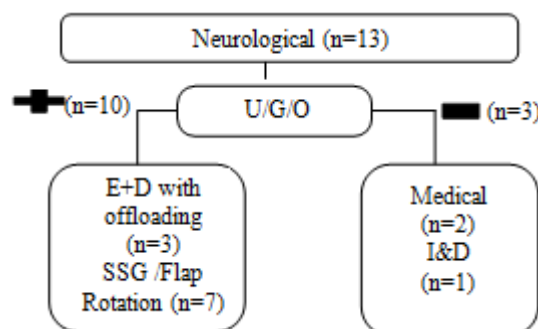
Table 4.1: Neurological lesion

	Medical	I&D	E+D	SSG/Flap	Angioplasty/Bypass	Amputation (minor)	Amputation (major)
U/G/O (+) (n=10)	0	0	3	7	0	0	0
U/G/O (-) (n=3)	2	1	0	0	0	0	0

*All patients were given offloading footwear or protective footwear. ** U/G/O: Ulcer/Gangrene/Osteomyelitis



Graph 4.1



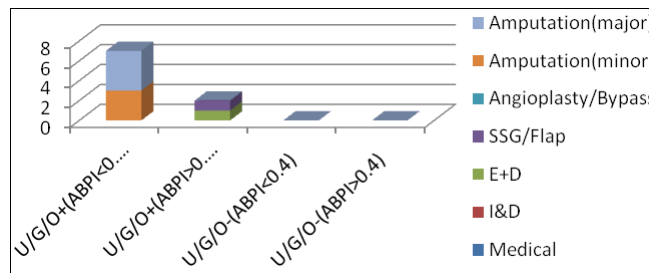
Flowchart 4.1

Out of 13 patient (26%) (Neurological lesion), 10 had ulcer or gangrene or osteomyelitis in which 3 cases (6%) managed by slough excision and debridement and 7 cases (14%) managed by SSG/Flap rotation. 3 case (6%) had no ulcer/ gangrene/

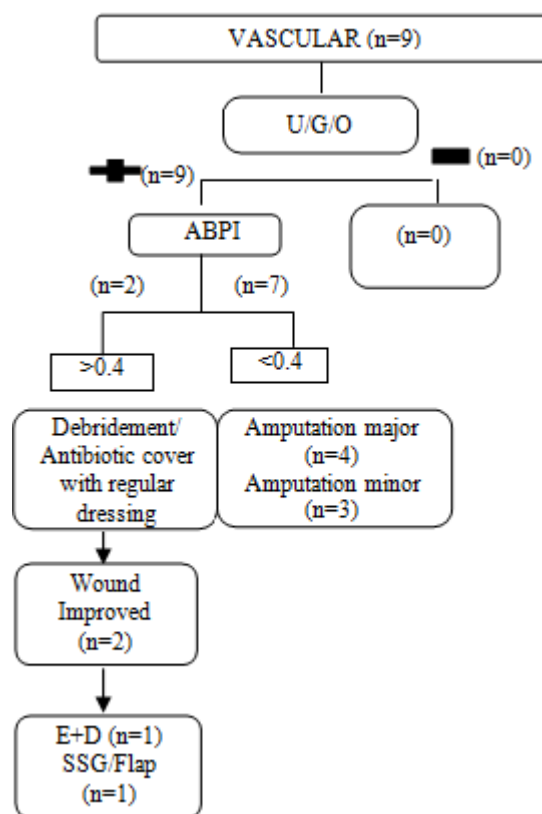
osteomyelitis, were managed medical treatment (2 cases) and by I&D and fasciotomy (one case).

Table 4.2: Vascular lesion

	ABPI	Medical	I&D	E+D	SSG/Flap	Angioplasty/ Bypass	Amputation (minor)	Amputation (major)
U/G/O+ (n=9)	<0.4 (n=7)	0	0	0	0	0	3	4
	>0.4 (n=2)	0	0	1	1	0	0	0
U/G/O - (n=0)	<0.4 (n=0)	0	0	0	0	0	0	0
	>0.4 (n=0)	0	0	0	0	0	0	0



Graph 4.2

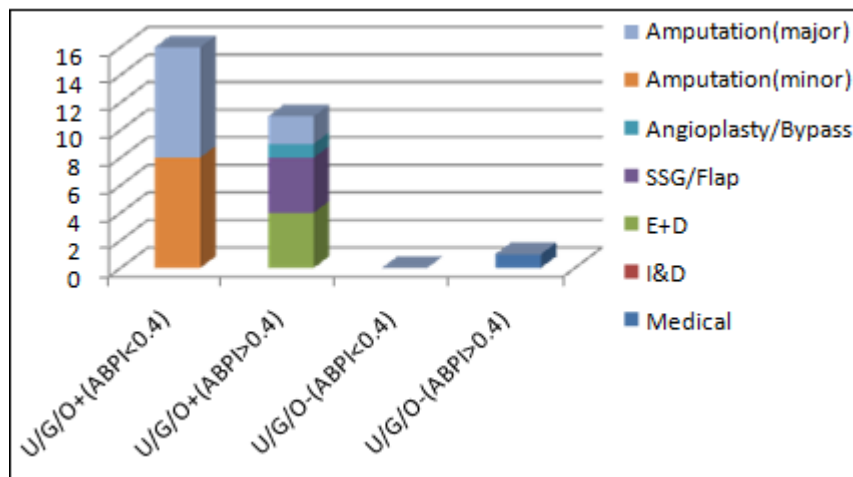


Flowchart 4.2

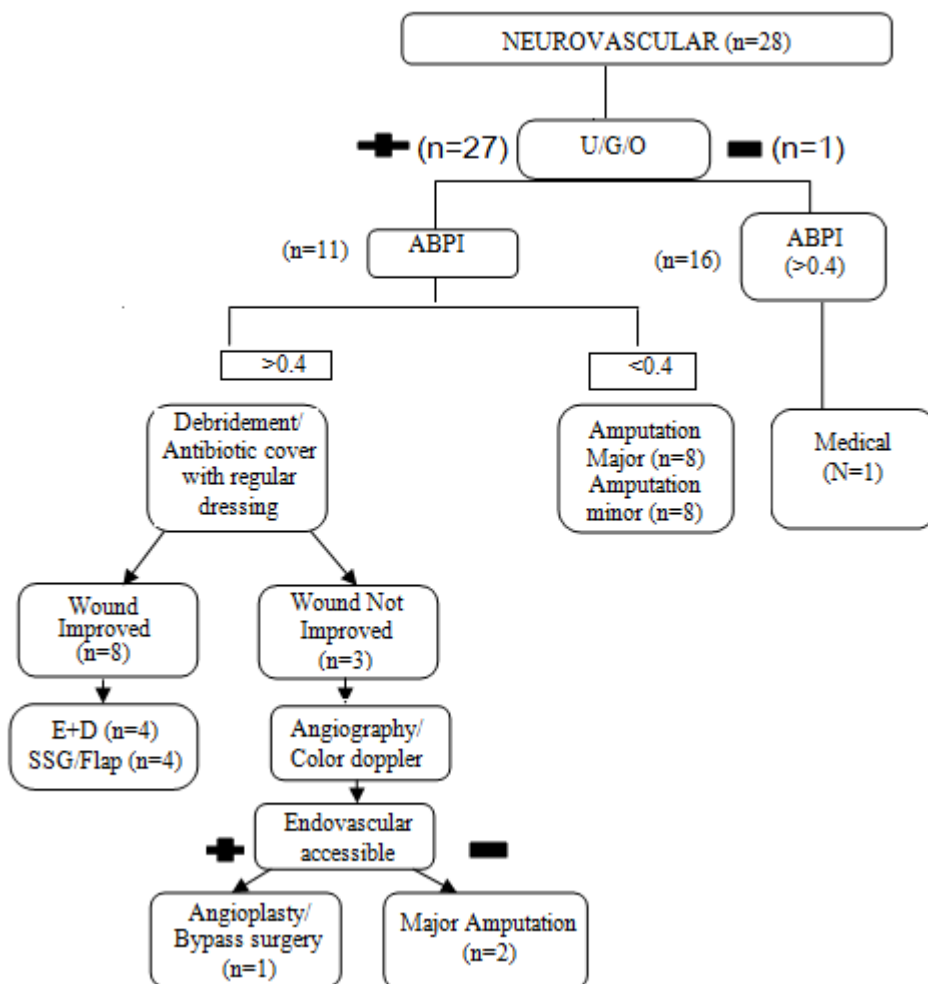
Out of 9 patient (18%) (vascular lesion), 9 cases (18%) had ulcer or gangrene or osteomyelitis in which 2 cases (4%) had ABPI >0.4, managed by slough excision & debridement (n=1) and SSG/ Flap rotation (n=1), and 7 cases (14%) had ABPI <0.4, managed by major amputation (4 cases) and minor amputation (3 cases).

Table 4.3: Neurovascular lesion

	ABPI	Medical	I&D	E+D	SSG/Flap	Angioplasty/Bypass	Amputation (minor)	Amputation (major)
U/G/O+ (n=27)	<0.4 (n=16)	0	0	0	0	0	8	8
	>0.4 (n=11)	0	0	4	4	1	0	2
U/G/O - (n=1)	<0.4 (n=0)	0	0	0	0	0	0	0
	>0.4 (n=1)	1	0	0	0	0	0	0



Graph 4.3



Flowchart 4.3

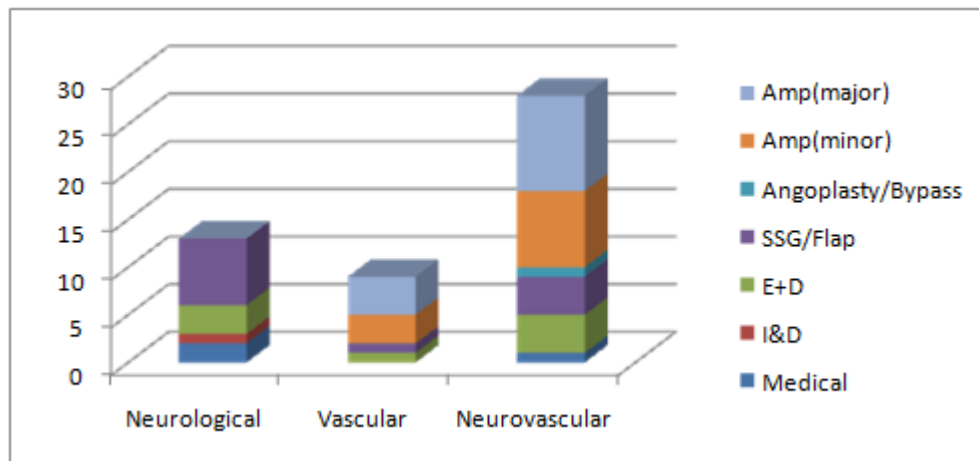
Out of 28 cases (56%) (neurovascular lesion), 27 cases (54%) had ulcer or gangrene or osteomyelitis, in which 11 cases (22%) had ABPI >0.4, managed by slough excision & debridement (4 cases) and SSG/ Flap rotation (4 cases), major amputation (2 cases) and bypass surgery (1 case) and

other 16 cases (3%) had ABPI <0.4, was managed by major amputation (8 cases) and minor amputation (8 cases).

One case (2%) had no ulcer/gangrene/osteomyelitis with ABPI >0.4, managed by medical treatment.

Table 5: Treatment

	Medical (n=3)	I&D (n=1)	E+D (n=8)	SSG/Flap (n=12)	Angioplasty / Bypass	Amp (minor) (n=11)	Amp (major) (n=14)
Neurological change (n=13)	2	1	3	7	0	0	0
Vascular changes (n=9)	0	0	1	1	0	3	4
Neuro - vascular changes (n=28)	1	0	4	4	1	8	10

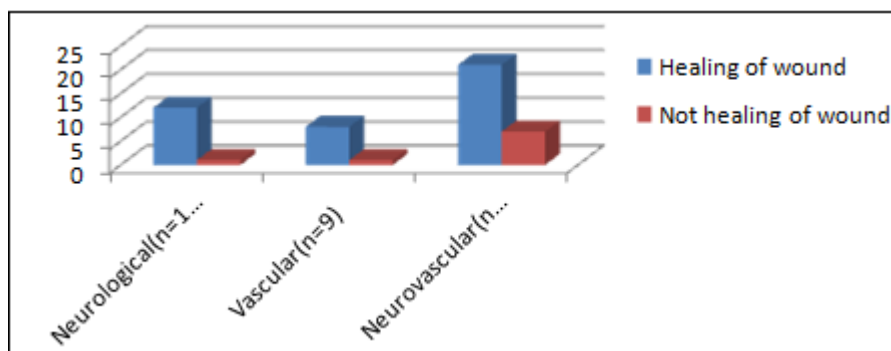


Graph 5

In my study, Out of 50 cases, 13 Neurological patient (26%) was managed by medical treatment (2 cases - 4%), I&D and Fasciotomy (1 cases - 2%), Slough excision & debridement (3 cases - 6%) and SSG/Flap rotation (7 cases - 14%). 9 cases (18%) with vascular lesion was managed, 1 case (2%) by E+D, 1 case (2%) by SSG/ Flap rotation, 3 cases (6%) by minor amputation and 4 cases (8%) by major amputation. 28 cases (56%) with neurovascular lesion, was managed by medical treatment (one case - 2%), E+D (4 cases - 8%), SSG/Flap rotation (4 cases - 4%), Bypass surgery (1 case - 2%) and 8 cases (16%) by minor amputation and 10 cases (20%) by major amputation.

Table 6: Outcome of treatment

	Healing of wound (n=41)	Not healing of wound (n=9)
Neurological (n=13)	12	1
Vascular (n=9)	8	1
Neurovascular (n=28)	21	7



Graph 6

In my study, out of 50 patients, 41 patients (82%) was improved as healing of wound was good under 20 weeks of duration of followup and 9 patients (18%) was not healed. Out of 13 cases of neurological patient, 12 cases (92.30 % of total neurological) had good outcome, out of 9 cases of vascular lesion, 8 cases (88.88% of total vascular) had good out come and out of 28 cases of neurovascular cases, 21 cases (75% of total neurovascular) had also good out come as wound healing was good.

5. Discussion

The present study, titled “Formulating treatment protocol in diabetic foot by assessment of neurological, vascular, dermatological and musculoskeletal status” was prospective study done from Sep.2019 to Sep.2020 at MLNMC Prayagraj.

In this study of individuals with diabetic foot ulcer associated with neurological, vascular and other complication were treated by classifying the patients into neurological, vascular and neurovascular lesion related

groups by assessing neurological examination like monofilament test, ankle reflex, tuning fork test or vascular examination like pedal pulse, intermittent claudication and ABPI. Grouping of these patients was also based on other system examination, as dermatological examination and skeletal examination. Presence or absence of ulcer/gangrene/osteomyelitis was key part to start the treatment. Blood investigation and radiological test was used to diagnose the disease, its complication and plan the treatment and follow up.

Observation were made related to age distribution, sex, site of lesion, clinical examination in diabetic foot patient and treatment with their outcome.

Demography: In this study mean age was 56 year. Patient in age group 41 - 60 year was 60% (n=30) and age >60 year was 36% (n=18). This is consistent with incident reported by J. M. Akther et al (2011) ⁽¹¹⁾, who reported peak age incidence in age group 41 - 60.

Sex distribution in this study, was 74% male and 26% female. Diabetic foot is more common in male probably because of more expose to trauma and sequelae. Also reported by Thanh Dinh et al (2008) ⁽¹²⁾ in his study that frequency for men to develop foot ulceration in diabetes is 40% as compared to women 19%.

Site of lesion: In this study, distal part of lower limb was more prone to site of lesion for diabetic foot as 24% cases was involved toe, 14 % involved dorsum of foot, 24% cases involved plantar of foot and 20% had lesion over leg. There was multiple lesion in 18% cases.

Clinical lesion: In present study, 26% (n=13) patient had neurological lesion, 18% (n=9) patients had vascular and 56% (n=28) patients had neurovascular lesion which was very similar to other study.

	Neurological	Vascular	Neurovascular
Present study	26	18	56
O. Oyibo et al (2002) ⁽¹³⁾	36	11.7	52.3
Tjokorda et al (2017) ⁽¹⁴⁾	42	28.1	29.9

In this study, 92% patient (n=42) had dermatological/skeletal lesion (ulcer/gangrene/osteomyelitis). Independently 35 cases (70%) had ulcer, 24 cases (48%) had gangrene and 10 cases (20%) had osteomyelitis. Study of Ali Muthiah (2017) ⁽¹⁵⁾ was showing, 50% patients had ulcer in foot, 34% cases having gangrenous change.

Doppler changes: In my study Out of 50, 37 (74%) patients had abnormal Doppler findings which is very close to finding of study by Ameer G. Parikh et al (2017) ⁽¹⁶⁾ with 70% abnormal Doppler in diabetic foot.

Treatment: The general management and treatment of Diabetic foot ulcers is multidisciplinary. Foot ulceration is a complication caused by diabetes and is invariably infected. The Diabetic state, therefore, needs to be well controlled and infection should be effectively treated.

In this study, Out of 50 cases, 13 Neurological patient (26%) was managed, 4% cases by medical treatment, 2% cases by I&D and Fasciotomy, 6 % cases by Slough excision & debridement and 14% cases by SSG/Flap rotation.

9 cases (18%) with vascular lesion was managed, 2% cases by E+D, 2% case by SSG/ Flap rotation, 6% cases by minor amputation and 8% cases by major amputation.

28 cases (56%) with neurovascular lesion, was managed, 2% cases by medical treatment, 8% cases by E+D, 8% cases by SSG/Flap rotation, 2% case by bypass surgery, 16% cases by minor amputation and 20% cases by major amputation. Vascular and neurovascular complication was more prone to amputation.

Outcome: Wound healing within 20 weeks of follow up was taken as good outcome.

Neurological lesion: Healing rate was 92% (p - 0.0817)

	Healing of Wound (%)	Not healing of wound (%)
Present study	92	8
L. pampers (2008) ⁽¹⁷⁾	84	16

Vascular lesion: Healing rate was 89% (p - 0.824)

	Healing of Wound (%)	Not healing of Wound (%)
Present study	89	11
Alessia S. et al (2012) ⁽¹⁸⁾	88	12

Neurovascular lesion: Healing rate was 75% (p - 0.630)

	Healing of wound (%)	Not healing of Wound (%)
Present study	75	25
JanApelqvist et al (2011) ⁽¹⁹⁾	72	28

In this study, with neurological lesion (p - 0.0817), healing rate (92%) which was higher than the study of L. Pampers; (2008), healing rate 84 %, with vascular lesion (p - 0.824), healing rate (89%) which was slightly higher than the study of Alessia s. et al: 2012, healing rate 88% and with neurovascular lesion (p - 0.630), healing rate (75%) which was higher than the study of Jan Apelqvist et al; 2011, healing rate 72%.

Over all in my study healing rate was higher because of better protocol for management of diabetic foot by clinical assessment and proper treatment.

6. Conclusion

This study comprised of 50 cases of diabetic foot patient with emphasis on examination finding of diabetic foot and its complication and management. After analysis of data the followings are the conclusions.

- Highest number of patient was seen in old age group.
- Male are almost three times more affected than female as male are more vulnerable to trauma.
- More distal part of lower limb, more prone to affected in

diabetic foot. (toe>foot>leg)

- Neurovascular complication is more common in diabetic foot.
- About all patient have dermatological lesion.
- Commonest presenting features was ulcer and followed by gangrene.
- Medical treatment consisting of control of diabetes with insulin or oral hypoglycemic drug and oral/IV antibiotic was effective in some case and health education with offloading and protective footwear. .
- Wound debridement, slough excision followed by dressing with povidone resulted in healing in some cases.
- Split skin graft, flap rotation, angioplasty, bypass surgery minor amputation (disarticulation of toe), major amputation were other mode of treatment.
- Amputation was poorest outcome as patient associated with all complication due to lack of care and late awareness of their disease.
- All patients should advised to follow strict glycemic control and foot care.
- Also advice to family members to take care of their patients that patient should not walking with bare foot.

References

- [1] <https://www.who.int/news-room/fact-sheets/detail/diabetes> the who "global report on diabetes" 2020
- [2] Arun kumar, manish k goel, ram bilas jain, pardeep khanna, and vikas chaudhary india towards diabetes control 10.4066/amj.2013.1791.
- [3] Seema abhijeet kaveeshwar and jon cornwall the current state of diabetes mellitus in india 10.4066/amj.2013.1979
- [4] H b chandalia, d singh, v Kapoor, s h chandalia, p s lamba footwear and foot care knowledge as risk factors for foot problems in indian diabetics 2008 oct; 28 (4): 109 - 13
- [5] Kleopatra Alexiadou and John Doupis, Management of Diabetic Foot Ulcers, 2012 Apr 20. doi: 10.1007/s13300 - 012 - 0004 - 9
- [6] Norman s. williams ms frcs fmed sci professor of surgery and centre lead, centre for academic surgery, bailey and love's short practice of surgery bailey & love's 25th edition page 538,
- [7] Andrew j. m. Boulton, md, frcp1 2, david g. armstrong, dpm, phd3, stephen f. albert, dpm, cped4, robert g.comprehensive foot examination and risk assessment, diabetes care 2008 aug; 31 (8): 1679 - 1685.
- [8] Swezey rn, bsn, cwocn, cws, faccws diabetic foot - risk factors and prevention pendsey, s. understanding diabetic foot. int j diabetes dev ctries.2010; 30 (2): 75 - 79 april 19th, 2013
- [9] Awad mohamed ahmed 24.07 najran university history of diabetes mellitus October 2019 Saudi medical journal 23 (4): 375 - 378
- [10] IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019.
- [11] Jawed mohammad akther, imran ali khan,. Evaluation of the diabetic foot according to wagner's classification in a rural teaching hospital.2011 11: 74 british journal of diabetes & vascular disease (2011)
- [12] Thanh dinh, aristidis veves. the influence of gender as a risk factor in diabetic foot ulceration.; 20 (5): 127 - 31. (2008)
- [13] O. Oyibo, Clinical characteristics of patients with diabetic foot problems: Changing patterns of foot ulcer presentation2002
- [14] Tjokarda Tjokorda Gde Dalem Pemayun Clinical profile and outcome of diabetic foot ulcer, a view from tertiary care hospital in Semarang, Indonesia 2017
- [15] Alli muthiah, ramachandran kandasamy, nagulan s., aruna madasamy, a study on diabetic foot and its association with peripheral artery disease. dx. doi.org/10.18203/2349 - 2902. isj20170937 (2017)
- [16] Sameer g. Parikh, mayur g. Rabari, nilay j. Shah, role of arterial doppler in management of diabetic foot, njirm 2017; vol.8 (3) may - june (2017)
- [17] L. Pampers, Prediction of outcome in individuals with diabetic foot ulcers: focus on the differences between individuals with and without peripheral arterial disease.2008
- [18] Alessia. S., Outcomes of Three Years of Teamwork on Critical Limb Ischemia in Patients With Diabetes and Foot Lesions, 2012
- [19] Jan Apelgevist, Factors related to outcome of neuroischemic/ischemic foot ulcer in diabetic patients 2011
- [20] World health organization classification and diagnosis of diabetesn department for management of noncommunicable diseases, disability, violence and injury prevention <https://www.who.int/health-topics/diabetes>