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Role of colour doppler in management of diabetic foot

Jigar V shah [1], Utsav V Shah [2], Mahesh M Pukar [3]

S.B.K.S.M.I. and R.C, Vadodara. Department of General Surgery. 1- Associate professor, 2-Resident, 3- Professor

Corresponding Author:
Dr. Mahesh M Pukar, Professor, Department of General Surgery. S.B.K.S.M.I. and R.C, Vadodara.
Email: maheshreem11@gmail.com

Abstract:

Background: Diabetic foot ulcer is a major complication of diabetes mellitus, and probably the major component of the diabetic foot. It occurs in 15% of all patients with diabetes and precedes 84% of all lower leg amputation. Major increase in mortality among diabetic patients, observed over the past 20 years is considered to be due to the development of macro and micro vascular complications, including failure of the wound healing process. The etiopathogenesis of diabetic foot lesions are multifactorial. Diabetic neuropathies, vasculopathy, poor control of diabetes and bacterial infection are some of them. Colour Doppler imaging is safe, popular, cost effective, repeatable, non invasive procedure for investing lower limb arteries. Material and method: This is an analytic study of role of colour Doppler in management of diabetic foot. The study was carried out in 40 cases admitted in Dhiraj hospital from May 2011 to September 2013. The duration of Diabetes & disease-specific and/or procedure-specific complications were also recorded to leverage the findings of the study. Results: In the total of 40 patients who suffered with diabetic foot lesions, 75% were in middle age group between 41-60 years, 67.5% were males with majority of patients having some kind of history of injury for the beginning of diabetic foot lesions. 27 out of 40 had positive colour Doppler findings of arterial stenosis. 10 out of 27 had raised serum cholesterol and triglycerides. Out of these 10 patients, 8 patients had total occlusion. Conclusion: The study showed atheromatous plaque changes with significant stenosis/occlusion among the patients with diabetic foot lesions in whom colour Doppler is safe, non-invasive, repeatable and primary modality of choice for screening vascular changes and determining the line of management in these patients.

Key words: Diabetic foot lesions, Trauma, smoking, Colour Doppler scanning, stenosis.

Introduction:

Diabetes is a worldwide problem. A majority of diabetic patients develop foot ulcers in one point of time or other during the course of their illness. A significant number of such patients will require long-term hospital treatment and amputations. The etiopathogenesis of diabetic foot lesions are multifactorial. Diabetic neuropathies, vasculopathy, poor control of diabetes and bacterial infection are some of them.

The reasons for diabetic foot are:

- The foot is the most vulnerable part of the body for injury and infection neglected by patient.
- The site of preference for neuropathy and ischemia is also the foot. Diabetes is one of the major problems of this generation with worldwide dimension. According to Modi et al., overall incidence of diabetics in India is 1.2% [1]. The death in each year is due to its complications (2.1% in urban, 1.5% in rural), which are usually common in age group of 40-60 years affecting both sexes equally. The complications are more prevalent among the people of lower economic due to negligence, illiteracy and poverty. The Lord Moynihan's great dictum "Surgery has been made safe for patients. We must now make the patient safe for Surgery"[2].
- Diabetes is one among the commonest disease in the society, in which no medical speciality is exempt from knowing the disease and complications, so stalk for the surgeons during the management of diabetic foot.
- Long standing uncontrolled diabetes causes peripheral vascular changes and neurological changes which aggravate the disease course through ulceration, infections deformities and other systemic

complications, making an impetus to study the mode of presentation.

• Quite often Diabetic patients present with uncontrolled infection, ulceration leading to compromise of part of foot. Thus there was a need to study various measures to prevent these complications.

Ultrasonic imaging provides a non-invasive assessment of the arterial circulation in the lower limb and is accepted as a valuable diagnostic technique. Grey scale images identify plaque and thrombus, duplex assessment provides a measurement of blood velocity through vessels, and colour Doppler imaging enables the rapid localization of arterial stenosis and occlusions. Its association with interventional endovascular processing explain its significant development these days. It thus allows the evaluation, the quantification and the follow up of the arterial diseases by carrying out a precise vascular mapping that can guide the radiological or surgical processing if necessary. Colour Doppler imaging is safe, popular, cost effective, repeatable, non-invasive procedure for investing lower limb arteries.

Objectives:

• To analyse the patients demographic profile, predisposing factors of diabetic foot lesions.

• To analyse the role of Colour Doppler in diagnosis of diabetic foot.

• To assess the role of Colour Doppler in management of diabetic foot.

• To review the outcome of various management and modalities of diabetic foot.

Materials and methods:

This is an analytical study of patients with diabetic foot admitted in the surgical wards DGH hospital over a period of one and half year. The patients who are willing will be thoroughly investigated before any surgical management is required. Informed consent will be taken before any surgical procedure.

Inclusion criteria:

• Only those patients who are willing to participate in study will be included.

• Patients referred to the General Surgery Department of Dhiraj General hospital for ulcer over foot, will be included in this study.

• Already diagnosed cases of diabetic foot by the help of colour Doppler which either need operative management or follow up and are referred to our general surgery department will be included in study.

Exclusion criteria:

• Patients presenting to general surgery department already being cured completely or partially will be excluded from the study.

Methods of collection of data:

• Detailed history taking.

• Clinical examination.

• Investigation (Routine laboratory investigations)

• Relevant special investigations.

• Colour Doppler of lower limb.

• Conservative management with meticulous dressing and if needed major surgical interventions with its outcome.

Results

Forty cases were studied from January 2012 to July 2013 at Dhiraj hospital, SBKS. On the basis of data collected according to the Performa mentioned. Following observations and results were obtained.

Diabetic foot lesion is common in middle aged person i.e. in 4^{th} and 5^{th} decade of life. Study shows 30 patients out of 40 (75 %) were in middle age group between 41 to 60 years of life.

Higher incidence of diabetic foot lesion in male is due to smoking, trauma and unhygienic habits. Study shows 27 no. Of patients out of 40 (67.5%) were male.

Study showed that out of 40 patients, 12 presented with ulcer which is the most common lesion encountered followed by cellulitis, gangrene and abscess.

Study shows 31 no. of patients (77.5%) were known case of diabetes presented with foot lesions and 9 no. Of patients (22.5%) were newly detected case of diabetes presented with foot lesion. Study shows 25 numbers of patients (62.5%) presented with diabetic foot lesion were having 1 – 10 years of duration of diabetes.

Study shows 25 no. of patients (62.5%) out of 40 patients revealed a history of some kind of trauma before the onset of the lesion.

Study shows out of 27 no. of male patients 15 (55.5%) presented with habit of smoking. Out of 13 female no female presented with habit of smoking.

In the study majority of patients were in Grade – 2 with 47.5%, Grade – 1,3,4 & 5 had 25,5%, 17.5% & 5% respectively. Patient with Grade – 1 & 2 were treated with dressing, local debridement and skin grafting in few patients. Grade – 3,4 and 5 required either major or minor amputations.

Majority of septic lesions yielded Staphylococcus aureus on pus culture. Other organisms isolated are, Pseudomonas, Klebsiella,

E.Coli & Proteus. Most of them were sensitive to Amikacine, Gentamycine & Ampicillin.

Study shows thirteen patients had infective lesions had normal arterial Doppler study. Pure vascular lesion was found in two patients both had blackening of toes and foot. These patients undergone major below knee amputation. Mixed lesion (V+I+N) were found in 25 no. Of patients (62.5%) indicating all component play a role in Diabetic foot lesions.

Study shows that amputation was done in ten patients of which three patients had only generalized atherosclerotic narrowing and seven patients had generalized atherosclerotic narrowing with block. All ten patients had serum triglyceride level more than 251 mg/dl.

Study shows that amputation was done in ten patients of which three patients had only generalised atherosclerotic narrowing and seven patients had generalized atherosclerotic narrowing with block. All ten patients had serum cholesterol level more than 251 mg/dl.

Conservative approach results in healing of diabetic foot lesion in seven no. of patients (17.5%). I & D done in nine no. of patients (22.5%) Debridement alone done in fourteen patients out of forty followed by ten patients that required STG to achieve healing of big open wound and four patients wound healed secondarily. Debridement and amputation was done in six patients, it was of toes amputation, below knee amputation and above knee amputation. Four patient had amputation without debridement. Out of four three undergone major amputation due to generalised atherosclerotic narrowing with block. One had only great toe amputation.

Discussion:

Forty cases were studied from January 2012 to July 2013 at Dhiraj hospital. SBKS MEDICAL INSTITUTE AND RESEARCH CENTRE.

Table 1: Comparison of age distribution

Study	No. of patients	Percentage (%)
Somson Griiffin[16]	79	79
Sri Adichunchanagiri hospital 2004-05[11]	26	52
Dr kaitha et al[26]	34	68
Hussein abd et al[29]	15	50
Present study	31	77.5

Diabetic foot lesions are common in middle aged person i.e. in 4th & 5th decade of life. From table 13 diabetic foot lesions are commonly seen in person aged between 40-60 years, this may be attributed to many factors like duration of diabetes. Thirty one patients out of forty are from middle age group.

Table 2: Comparison of sex distribution

Sex	Somson Griffin	Sri Adichunchanagiri Hospital and research centre 2004-05 [11]	Dr. Kavitha et al [26]	Present study
Male	62 %	74 %	76 %	76.5 %
Female	38 %	26 %	24 %	32.5 %

In a study by Somson Griffin out of 100 patients 62 no. Of patients were male, in another study at Sri Adichunchanagiri Hospital and research centre out of fifty patients thirty seven no. Of patients were male Dr. Kavitha et al also had majority of patients who were males comprising of 76 %. In present study of forty patients twenty seven patients were male.

Table 3: Incidence of limb involvement

Limb	Dr. Kavitha et al [26]	Present study
Right	48 %	55 %
Left	36 %	45 %
Bilateral	16 %	0 %

In present study 55 % cases had right limb involvement and other study also had 48 % cases which had right limb involved.

Table 4: Distribution according to Type of organism on pus culture

Bacteria	Sri Adichunchanagiri Hospital and research centre 2004-05 [11]	Lavery et al [28]	Present study
Staphylococcus aureus	44 %	47 %	42.5 %
Pseudomonas	14 %	20 %	15 %
Klebsiella	20 %	15 %	17.5 %
E. Coli	10 %	13 %	12.5 %
Proteus	8 %	3 %	7.5 %
Non-Haemolytic streptococci	4 %	2 %	5 %

Most common organism isolated from septic lesions of the diabetics patients was Staphylococcus aureus, anaerobes were uncommon.

Table 5: Distribution according to Type of lesions at presentation

Lesion	Sri Adichunchanagiri Hospital and research centre 2004-05 [11]	Dr. Kavitha et al [26]	Present study
Ulcer	56 %	40 %	30 %
Ulcer + cellulitis	15 %	18 %	26.5 %
Cellulitis	5 %	9 %	11.5 %
Gangrene	16 %	26 %	22.5 %
Abscess	8 %	7 %	9.5 %

Table 6: Distribution according to History of smoking

Study	Percentage
G.D. Griffiths and Jeffery et al [16]	65 %
Dr. Kavitha et al [26]	48 %
Present study	55.5 %

In our study 55.5 % of the patients were smokers with average smoking of 25 – 30 cigarette, bedis per day for a period ranging from 10 – 30 years.

The relationship between smokers and PVD is known since 1911 when Erb reported intermittent claudication was three times more common among the smokers.

Table 7: Comparison of Duration of diabetes

Duration of diabetes	Sri Adichunchanagiri Hospital and research centre 2004-05 [11]	Present study
Newly diagnosed	0 %	22.5 %
<1 year	20 %	2.5 %
1 – 10 years	40 %	62.5 %
11 – 20 years	28 %	10 %
>20 years	12 %	2.5 %

In a study at Sri Adichunchanagiri Hospital and research centre, 20 patients out of fifty had diabetes of 1 – 10 years duration. In present study 25 patients out of forty had diabetes of 1 – 10 years accounting for 62.5 %.

Table 8: Distribution according to Gangrene

Study	No. Of patients	No. Of patients with gangrene	Percentage %
Bell series [25]	964	236	24.9 %
Diabetes research centre Chennai [32]	1319	64	5 %
Sri Adichunchanagiri Hospital and research centre 2004-05 [11]	50	8	16 %
Present study	40	9	22.5 %

In our study 22.5 % cases had gangrene B. Ranjan noted that maximum gangrene was associated with distal blocks and popliteal blocks.

Table 9: Comparison of absence of peripheral pulse by palpation and colour Doppler findings:

Arterial segment	By palpation	By colour doppler
FA	29.6 %	25.9 %
PA	37 %	33.9 %
ATA	25.9 %	25.9 %
PTA	29.6 %	11.1 %
DPA	74 %	40.7 %

Table shows femoropopliteal segment was mostly involved. Dorsalis pedis artery by palpation had 74 % involvement and by colour Doppler was 40.7 % even though pulsation was absent clinically. Colour Doppler scanning could detect monophasic flow in the segment showing insignificant diameter reduction which prevented unwanted amputations.

Table 10: Comparison according to amputation

Study	No. Of patients	No. Of amputations	Percentage %
Collen's series 1962	215	83	38.6 %
Osaka Kosainekin Hospital 2005	210	110	52 %
Present study	40	10	25 %

The amputation rate is much lower as compared to other studies, due to better education of the patients, better glycemic control, proper care of the foot, proper use of antibiotics, extensive debridement and regular dressings. After amputation wound healed well.

Table 11: According to level of amputation

Level of amputation	Collen's series 1962	Osaka Kosainekin Hospital 2005	Present study
Above knee	36.1 %	50 %	12.5 %
Below knee	42.1 %	36.3 %	10 %
Toe amputation	21.1 %	13.6 %	2.5 %

The table shows the level of amputation in different studies that were carried out. In present study above knee amputation was done in 12.5 % of patients in whom colour Doppler showed significant or total occlusion.

Conclusion:

Middle age person are associated with increased risk of peripheral arterial atherosclerotic disease associated with diabetes, mean age group between 41 – 60 years. Males are commonly affected. Right limb involvement was seen in more patients. Most common organism isolated in culture was staphylococcus aureus. Ulcer was the most common presenting lesion. Majority of the patient had positive history of smoking for a duration of more than ten years. Duration of diabetes was between 1 – 10 year in 62.5 % of patients. Peripheral neuropathies are found in 55 % of diabetics. In our study 22.5 % of the patients presented with gangrene which was very low as compared to other studies probably because no. Of patients included in our study were less, better glycemic control and infection controlled with appropriate antibiotics and timely dressing prevented diabetic foot amputation to turn into gangrene. Even though pulsation was absent clinically colour Doppler scanning could detect mono-phasic flow in the segment showing insignificant diameter reduction which prevented amputations. Amputation rate is much lower as compared to other studies, due to better education of the patient, better glycemic control, and proper care of foot, proper use of antibiotics, extensive debridement and regular dressing.

Summary:

All the patients were thoroughly investigated and accordingly managed. All patients were given medical treatment in the form of injectable insulin and oral anti-diabetic drugs in addition to injectable antibiotics for control of infection. Apart from rest, regular dressing of the lesion, limb elevation, and surgical treatment included I & D, debridement, amputation and STG. Diabetic foot lesion is common in middle age person. Higher incidence of diabetes foot lesions in male due to smoking, trauma and unhygienic habits. Ulcer was the most common presenting lesion 30 %, followed by cellulitis and gangrene. Around 62.5 % patient presented with diabetic foot lesions were having 1 – 10 years of duration of diabetes. On colour Doppler maximum lesions were found at superficial femoral arteries followed by dorsalis pedis artery.

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