

Original article:

Assessment of peripheral arterial disease of lower limb by colour doppler assisted duplex study

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ABSTRACT

Prospective study of patients referred to the department of radiodiagnosis and imaging for assessment of peripheral arterial disease of lower limb by colour Doppler assisted duplex study. The study intends to evaluate clinically suspected cases of lower limb arterial diseases, to study flow velocity gradients in cases of lower extremity arterial diseases using duplex sonography and to evaluate the pattern of duplex sonography in hemodynamically significant lower extremity arterial stenosis.

Peripheral arterial disease is the commonest condition affecting the arteries of lower extremity with B-mode real time ultrasound and duplex colour Doppler being primary diagnostic technique to identify the patients at risk. It is of the non-invasive nature of the examination, with easy repeatability and no radiation exposure. In spite of being relatively cheap the uniqueness in providing both morphologic and hemodynamic information is major advantage.

INTRODUCTION

Peripheral arterial disease is the most common condition affecting the arteries of lower extremity. Compromise of arterial flow due to stenosis and occlusions can result in limb ischemia, which may manifest as claudication, rest pain, local tissue loss (ulceration), and, potentially, amputation. Patients with PAD may have symptoms but can also be asymptomatic. These patients have an increased risk of mortality, myocardial infarction and stroke. It is an independent risk factor for vascular disease in other regions, resulting in increased rate of cardiovascular events and mortality. It adversely affects the functional status of the limb and is associated with poor quality of life.

Atherosclerosis is the leading cause of occlusive arterial disease of the extremities in patients over 40 years old, highest incidence occurs in 6th and 7th decades. ^[1] It is more common in individuals with diabetes mellitus, hypertension, hypercholesterolemia, hyper-homocysteinuria and in cigarette smokers. The overall mortality rate, however is 20-30% at 5 years and 40-70% at 10 years. ^[2] Overall studies show that the intermittent claudication seems to be about twice as common amongst the diabetic patients as among non-diabetic patients ^[3,4,5] and three times more common among smokers than non-smokers ^[6].

For long angiography has been considered the Gold standard in evaluation of PVD and is done before any surgery is planned. This investigation is done to demonstrate the extent of the lesion, condition of vessels above the lesion, development of collaterals and reformation of distal vessels. It provided excellent anatomical detail. However, it does not give adequate physiological information about the hemodynamics of lower limb. It is associated with risks due to its invasiveness, cost, contrast associated complications and it does not give information about plaque. With the recent introduction of CTA, MRA, the study has become further improvised but because of their high cost and unavailability, colour doppler Duplex sonography becomes the most easily available modality for evaluation of arteries.

Colour Doppler imaging is safe, popular, cost effective, repeatable, noninvasive procedure for investigating lower limb arteries. It can provide most of the essential anatomic information and almost exclusively the functional information

like velocity gradients across the stenosis, degree and extent of occlusive lesion. in postoperative follow- up of operated limbs where arterial surgery has been carried out Doppler studies primary investigation. In this study the peripheral vascular disease was evaluated clinically and by Duplex imaging.

MATERIAL AND METHODS

We collected prospective data of patients referred from the various departments, Rohilkhand medical college and hospital for color Doppler of lower limb with symptoms of peripheral arterial disease in the 12-month period from December 2015 to December 2016.

The study was conducted on 50 patients in the age group of 18 years and above, male or female, presenting with any of the symptoms of peripheral arterial disease. Study was conducted on color Doppler machine by using linear 3 - 12 MHz probes. It was a prospective cross – sectional study.

The equipment used was :

1. GE Logiq V5 Ultrasound Machine
2. Philips Clear Vue 350 ultrasound machine

INCLUSION AND EXCLUSION CRITERION:

Inclusion:

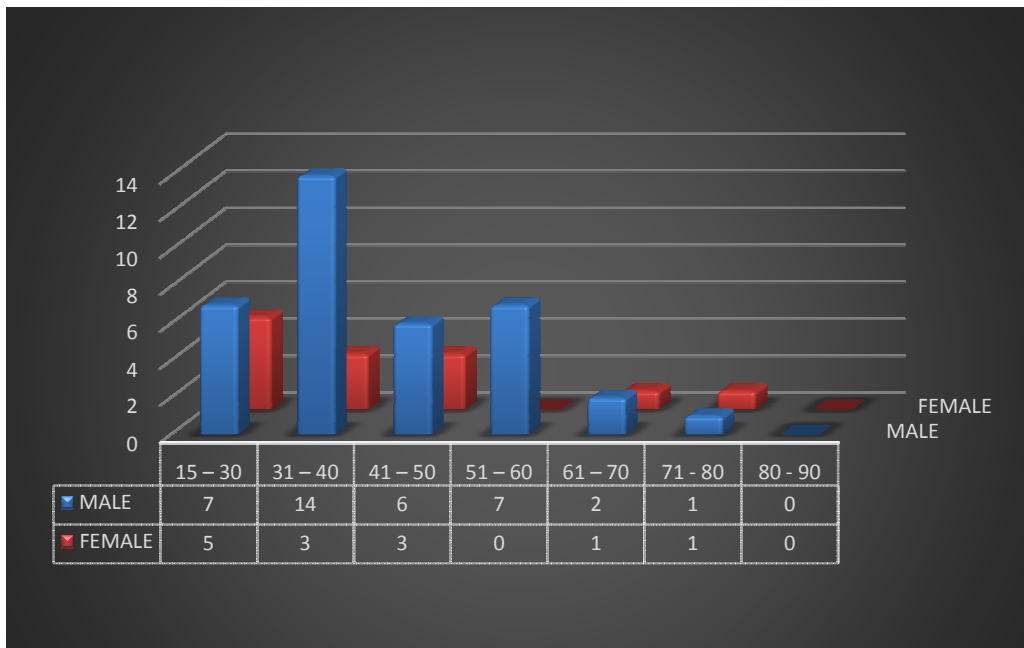
1. Clinically suspected cases of lower limb arterial diseases.
2. As a pre-requisite in proven cases of lower limb arterial disease going for surgery.

Exclusion:

1. Pregnancy.
2. Paediatric patients.

RESULTS AND DISCUSSION:

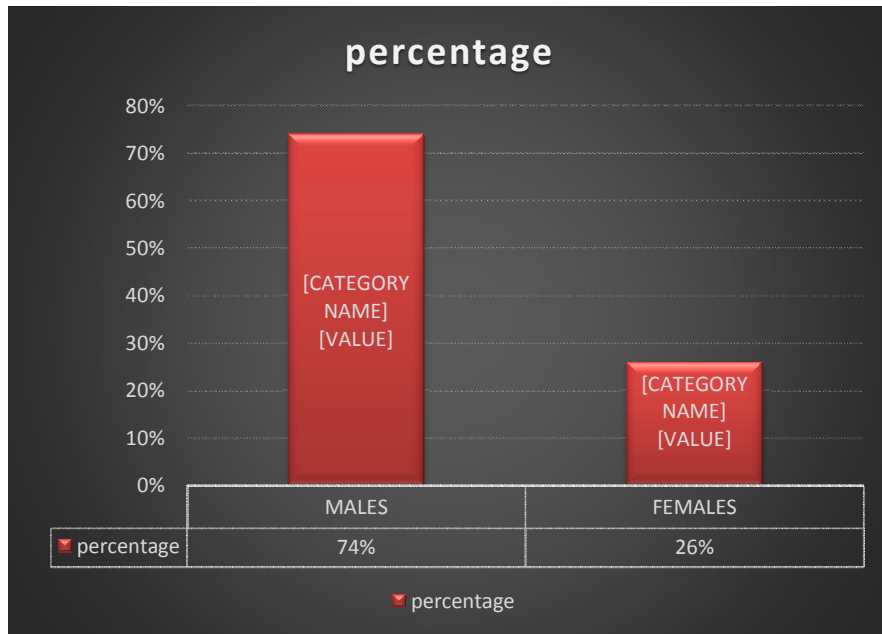
GRAPH 1 : AGE WISE DISTRIBUTION



It is well accepted fact that the extremity arterial disease is the disease of middle and older age groups as cited by Cossman et

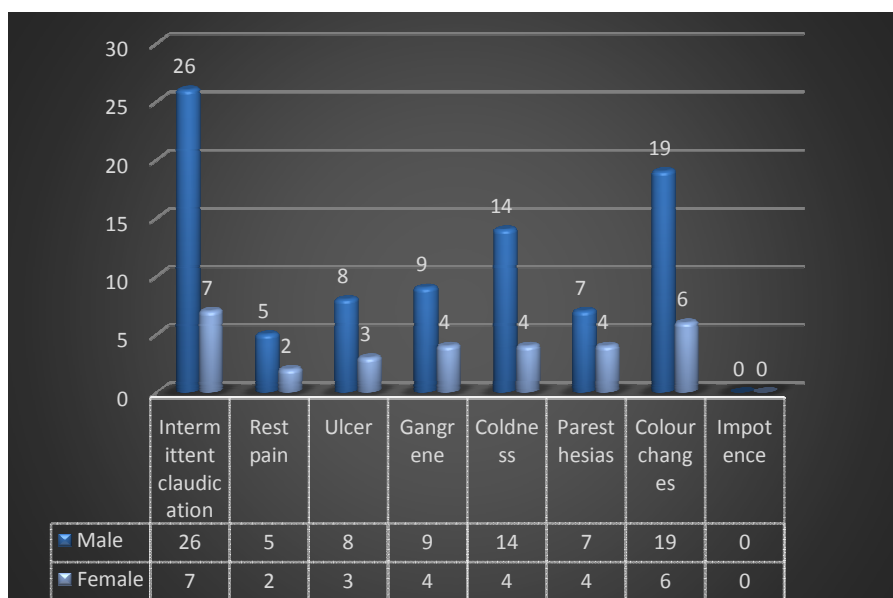
al^[7] and Hughson et al^[8]. Similarly studies by Criqui et al^[9] and Jelnes R et al^[10] showed that most of the peripheral arterial disease cases occur in old age. However in our study 42% of the cases were above the age of 40 years and 58% of the cases were between the age of 15-40 years. The slightly lower lower percentage could be explained by the age under-estimation by majority of the patients due to lesser educational status.

GRAPH 2: SEX WISE DISTRIBUTION



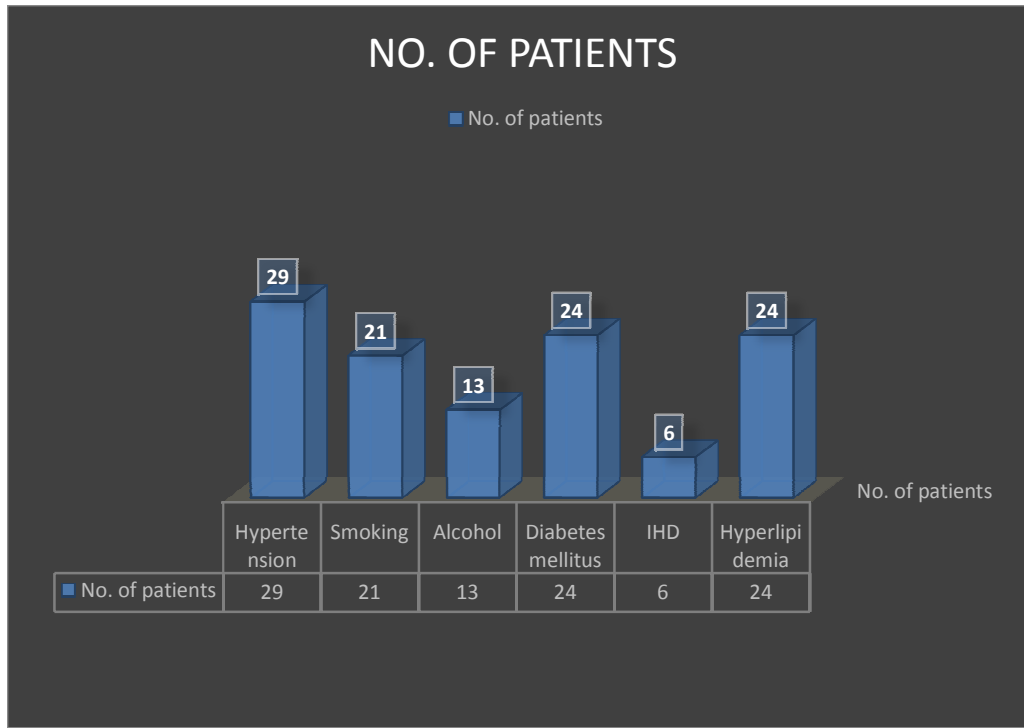
Among the 50 diagnosed cases of peripheral vascular insufficiency, patients who underwent Doppler study, 37(74%) were males and 13 (26%) were females. Hughson et al^[8] observed that 2% of males and 1% of females had symptoms of peripheral vascular disease. However in our comparison the ratio of males to females was even lower at about 2.8:1. This could be a regional occurrence in the Bareilly region where the study was done or as a result of a relatively smaller sample size of population.

GRAPH 3 : SYMPTOM WISE DISTRIBUTION



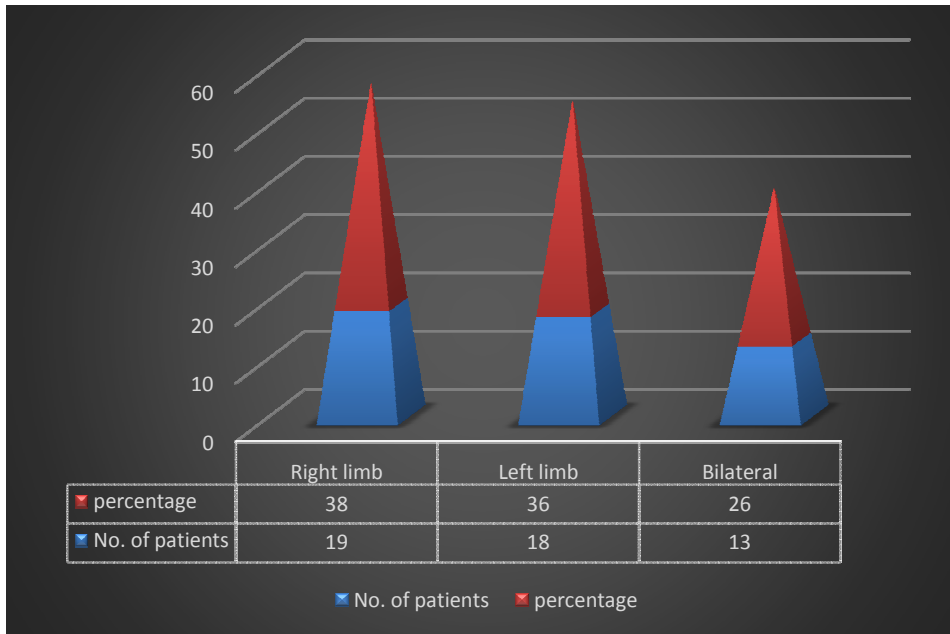
Intermittent claudication was seen in 66% of our subjects which seems slightly higher than that in other studies. This could be due to increased incidence following better access to health centres and better documentation. In random population, according to the Vogt MT et al^[11], the prevalence of intermittent claudication is 1 to 2 % which increases to 5% after the age of 50 years.

GRAPH 4 : RISK FACTORS

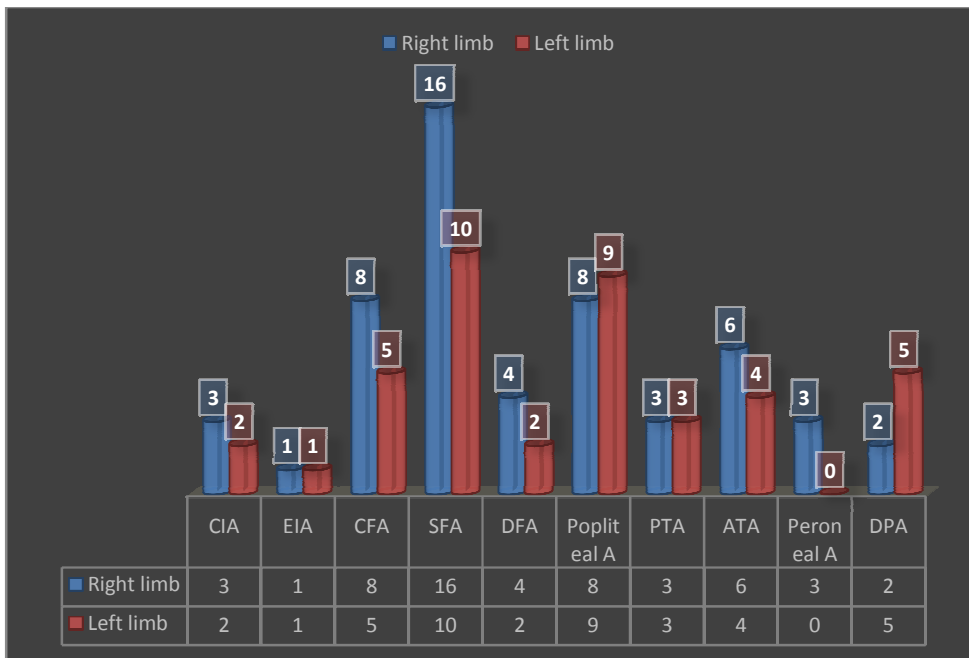


The study done by us showed that 42 % of the patients were smokers with average smoking of 15-20 cigarettes/ bidis per day for a period ranging from 10-20 years. Gordon T et al^[6] stated that cigarette smoking is a strong risk factor for development of PAD, having relative risk of 1.7-1.75. In our study 48% of patients with hyperlipidemia, 58% of patients had hypertension which was the most common co-morbidity, 28% were diabetics and 12% had IHD. Krishnaswamy et al^[12] stated that age, male gender, smoking, diabetes and hypertension are major risk factors for development of the PAD. ShaheenR^[13] was of the conclusion that PAD was significantly more in patients having diabetes for 9.8 years or more.

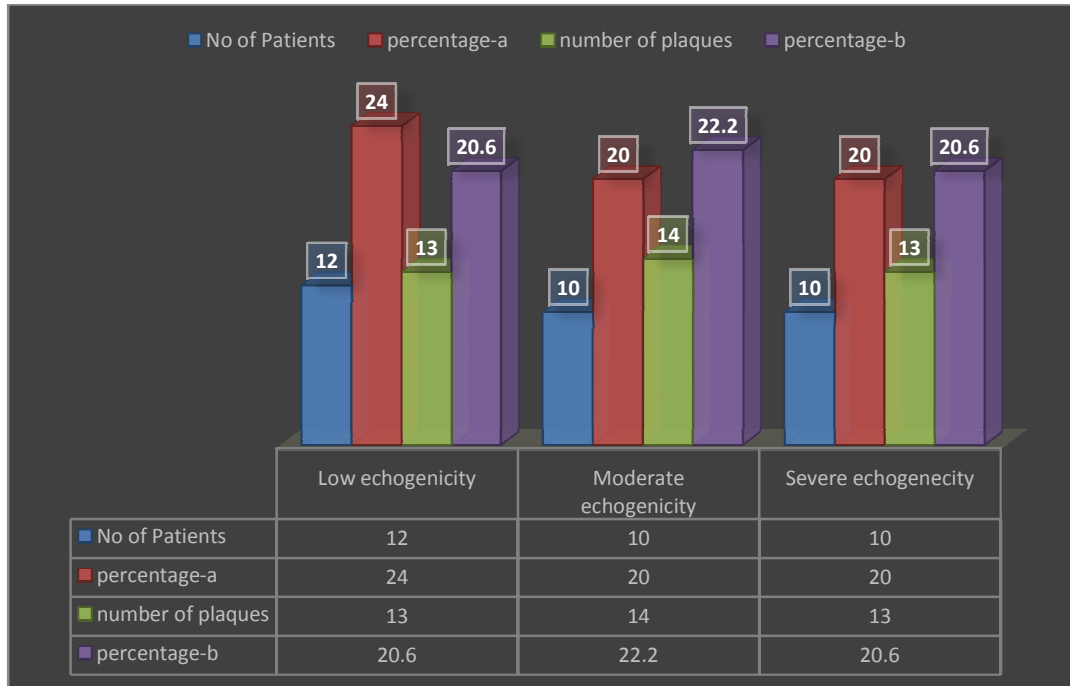
GRAPH 5 : LIMB INVOLVEMENT



GRAPH 6: SITE OF LESIONS BY COLOR DOPPLER IN LOWER LIMB

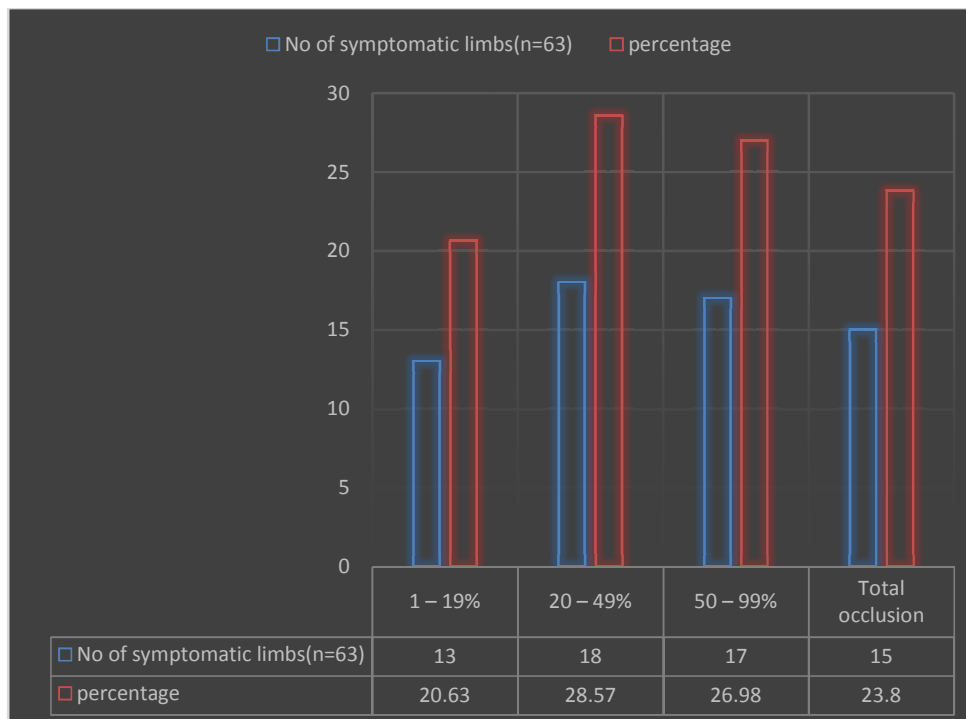


GRAPH 7: PLAQUE CHARACTERISATION



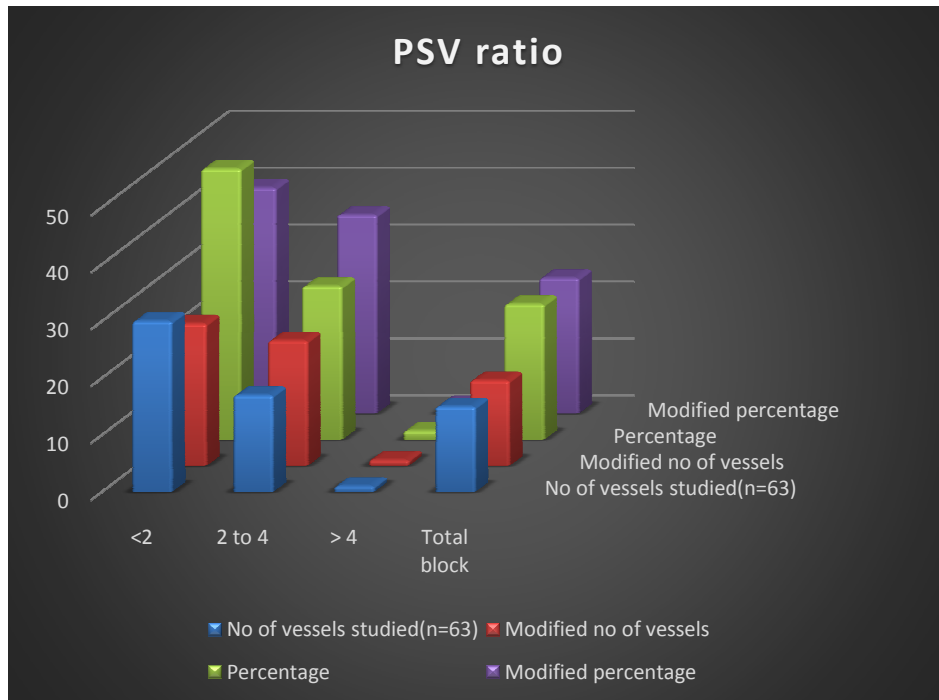
Lusby RJ et al^[14] did study indicating composition of plaque and its characteristics. Of the total number of limbs affected (63 considering bilateral cases), 40 plaques were found with moderate echogenicity forming the majority of the type having 22.2% incidence. Closely following that were the severe (20.6%) and the low echogenic plaques (20.6%). The plaque is highly specific for atherosclerosis and peripheral arterial disease.

GRAPH 8: DISTRIBUTION OF PATIENTS BASED ON STENOSIS



On categorizing patients based on percentage stenosis, 20.63% of a total of 63 symptomatic limbs (due to bilateral involvement in some) showed 0– 19 % stenotic lesions, 28.57% of them showed 20 – 49% of stenosis, 26.98% showed 50 -99% stenosis and 23.80% of them showed total occlusions.

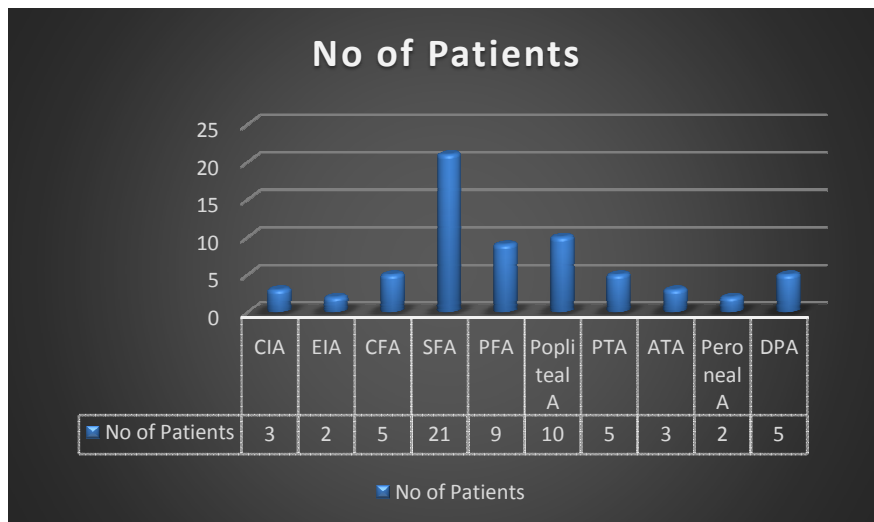
GRAPH 9: DISTRIBUTION OF PATIENTS BASED ON PSV RATIO



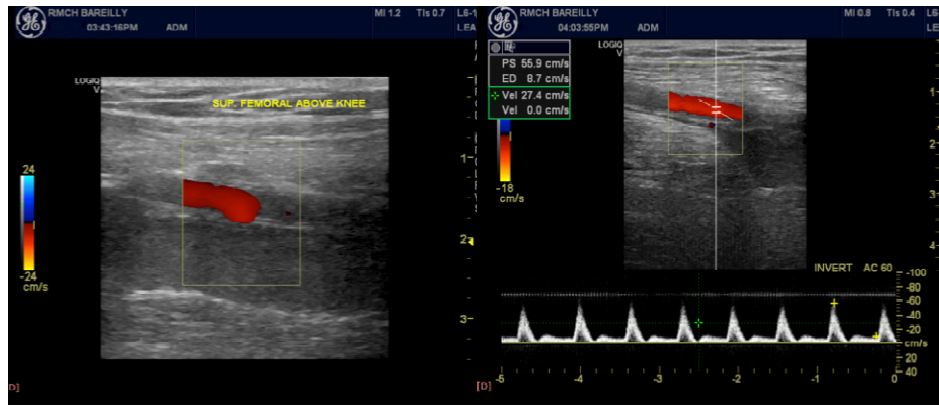
Among the patients studied, 47.61% of them had PSV ratio < 2, 26.98% had in between 2 – 4, 1.58% had > 4 and 23.80% showed total block. However, the values could change as number of borderline values i.e. between 1.9 and 2 are 5(five) making total patients with PSV ratio of approximately 2-4 to be 17+5=22. Also reducing the <2 values to 20-5=15. So the modified percentage is also reflected in the tables .

Cossmann et al^[7] have produced accurate results by using PSV ratio for quantifying degree of stenosis. In our study PSV ratio was used which is easy to remember and it can also sub classify 75-99 % of stenosis.

GRAPH 10: DISTRIBUTION OF PATIENTS BASED ON SITE OF SIGNIFICANT STENOSIS

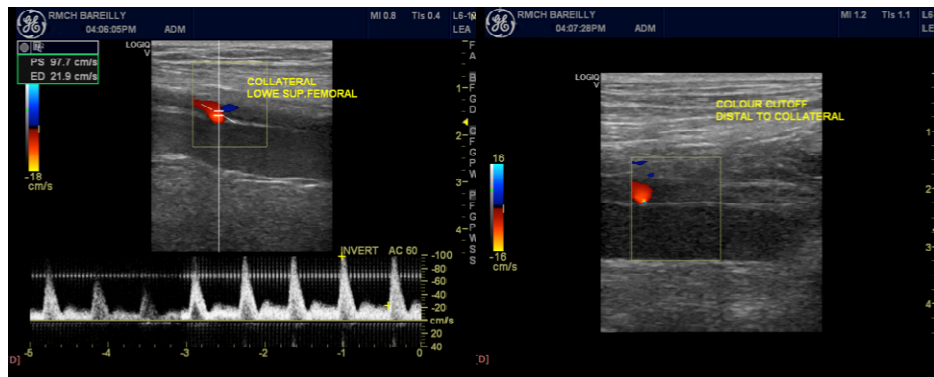


IMAGES



A

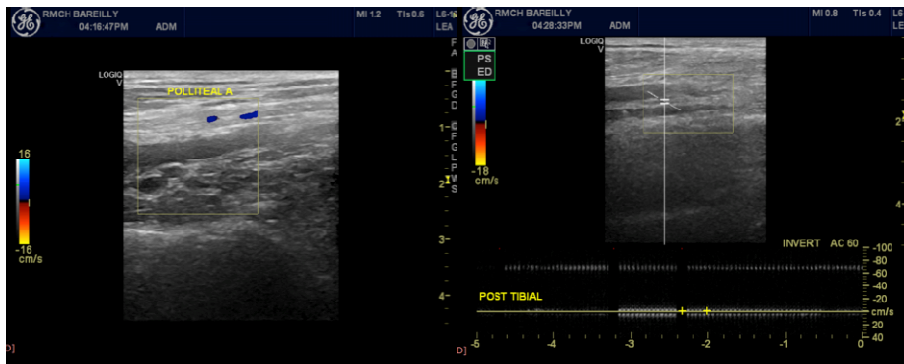
B



C

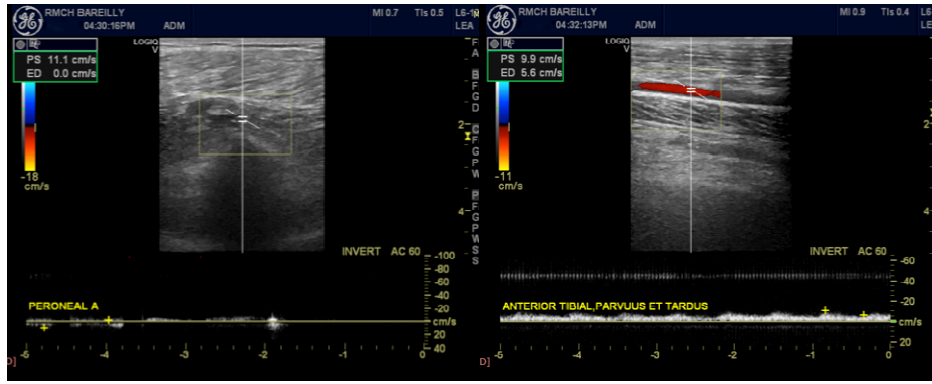
D

PLATE-1: Superficial femoral artery above knee showing normal colour flow(A), normal spectral wave with a velocity of 56(B), presence of a collateral with increased flow of 97cm/sec and cutoff after that collateral.



A

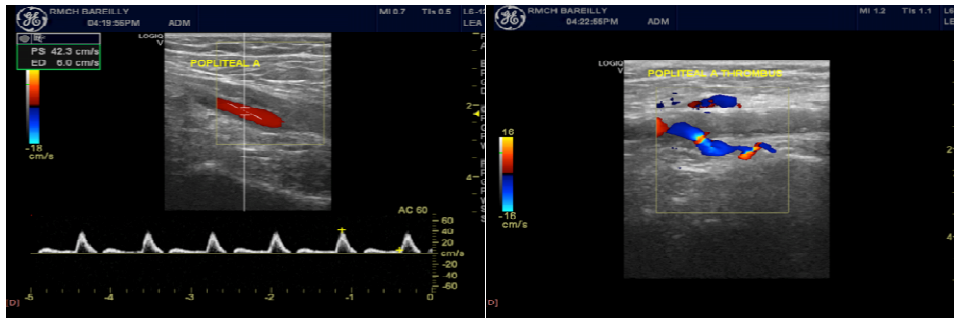
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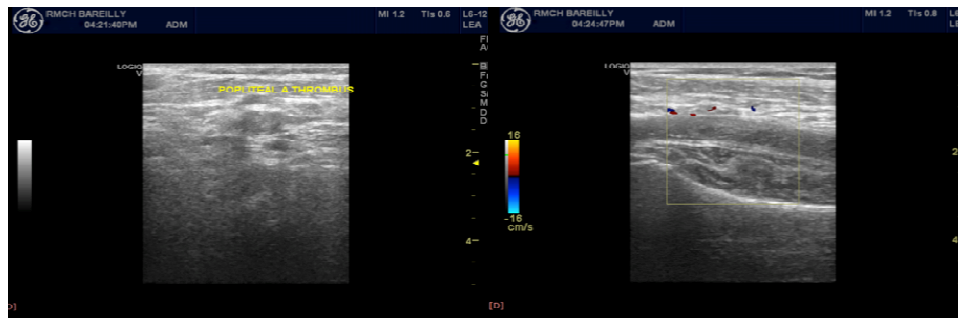
D

Plate-2: Same patient as in the plate 1 shows no flow in the popliteal artery(A), posterior tibial artery(B) and common peroneal trunk(C). The anterior tibial artery shows parvus et tardus waveform signifying the upstream obstruction(D).



A

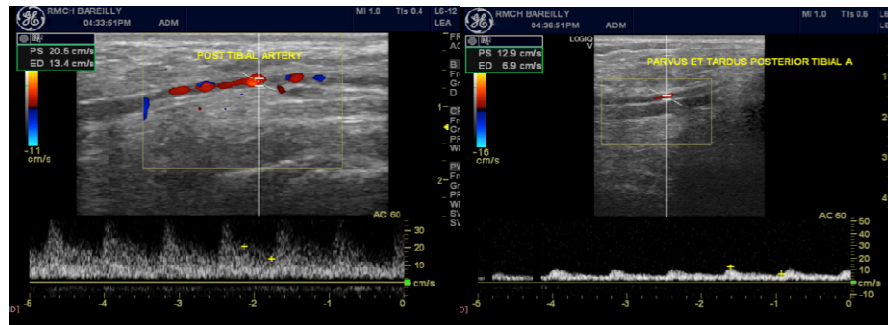
B



C

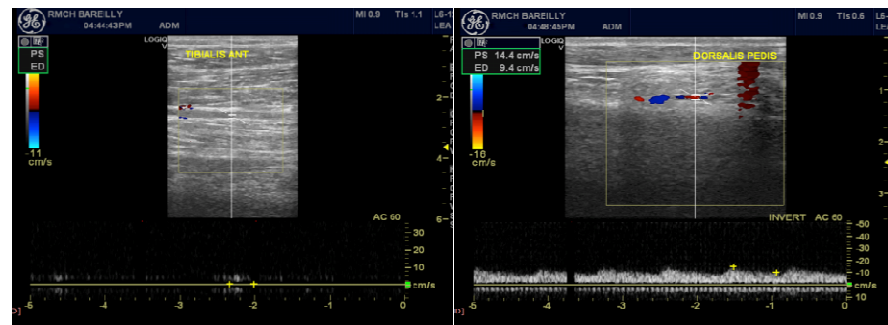
D

PLATE-3: Normal popliteal artery waveform(A), presence of a popliteal artery thrombus with a peripheral collateral(B). Popliteal thrombus in short(C) and long(D) axis.



A

B



C

D

PLATE-4: Same patient as in the plate no 3 shows beading and irregular flow in the upper posterior tibial artery(A) with reduced flow and parvus et tardus pattern in the lower part of the vessel(B). The tibialis anterior shows no flow (C) and dorsalis pedis shows low peak and late peak(D).

Conclusion:

Duplex Doppler imaging is safe, cost effective and non-invasive procedure for investigating lower limb arteries. Hence it is the primary screening modality of choice.

Not only that, the disease can be quantified based on the percentage of the stenosis which in turn is determined from the PSV values and ratios. The results are reproducible therefore the person can be evaluated at the time of choice without any side effect.

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