ADDIS ABABA UNIVERSITY

COLLEGE OF MEDICINE AND HEALTH SCIENCES

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF RADIOLOGY

HOSPITAL BASED PROSPECTIVE CROSS SECTIONAL STUDY ON DOPPLER ULTRASOUND FINDING PATTERN OF LOWER EXTRIMITIES PERIPHERAL ARTERIAL DISEASES IN PATIENTS SCANNED AT CHEST AND VASCULAR UNIT RADIOLOGY DEPARTMENT OF TIKUR ANBESSA SPECIALIZED HOSPITAL, ADDIS ABABA UNIVERSITY, ADDIS ABABA, ETHIOPIA

INVESTIGATOR: TSEGAYE FIKADU (MD, RADIOLOGY RESIDENT)

A RESEARCH FOR PREPARATION OF SENIOR PAPER TO BE SUBMITTED TO RADIOLOGY DEPARTMENT, COLLEGE OF HEALTH SCIENCE, ADDIS ABABA UNIVERSITY IN PREPARATION FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE POST GRADUATE STUDY IN RADIOLOGY.

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INVESTIGATOR: TSEGAYE FIKADU (MD, RADIOLOGY RESIDENT)

ADVISORS: DR. AZMERA GISSILA (MD, CONSULTANT RADIOLOGIST)

DR. AMIR ALWAN (MD, CONSULTANT RADIOLOGIST)

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Abbreviations

AAU- Addis Ababa University

ABI- ankle brachial index

CAD- coronary artery diseases

CT- computed tomography

CTA- Computed tomography angiography

CVA- cerebrovascular accident

CVD- cerebrovascular diseases

DM- diabetes mellitus

DSA- digital subtraction angiography

DUS- Doppler ultrasound

HTN- hypertension

MRA- magnetic resonance angiography

PAD- Peripheral arterial disease

PSV- peak systolic velocity

TASH-TikurAnbessaSpecialized Hospital

US- Ultrasound

WHO-World health organization

VR- velocity ratio

Abstract

Introduction-Peripheral artery disease (PAD) is an important global health problem and associated with considerably high morbidity and mortality. It is a disease process resulting from obstruction of large peripheral arteries, exclusive of the coronary and intracranial cerebrovascular system, commonly due to atherosclerosis. Imaging modalities for evaluating peripheral arterial disease in the lower extremities includes computed tomography angiography, conventional angiography, and Doppler ultrasonography. Doppler US is the only noninvasive technique that does not require contrast enhancement, preparation of the patient before the study, or radiation exposure [10, 11]. Doppler US is a good method for screening and follow-up, as well as for the definitive diagnosis of peripheral arterial disease

Objective- This study generally asses and describe the doppler ultrasound finding pattern of the lower limb peripheral arterial disease with common indication of lower limb peripheral arterial doppler ultrasound in TASH and associated risk factors for the development of PAD.

Methods and materials- This is a hospital based prospective study to assess the doppler ultrasound pattern of lower limb peripheral arterial disease on patients for whom unilateral or bilateral lower limb arterial doppler ultrasound done at TASH department of Radiology, Chest and Vascular unit. The ultrasound was done by final year (R3) radiology residents of AAU.

Result- There were a total of 78 patients involved in the study of whom 49 are male and the rest 29 are female. The age of the patients ranges from 20 to 88 years old with mean age of 54±19. The most common indications for the study are peripheral arterial disease (PAD) followed by intermittent claudication and arterial thrombosis. Regarding the risk factors the top three risk factors identified are diabetics, smoking and hypertension. Of the total patients 56(71.8%) of them have arterial lesions with 43(76.8%) of them having multifocal lesions. 39(50%) of patients had intimal thickening and 39(50%) of patients had arterial plaque being 26(66.7%) of the plaque are multifocal. Arterial thrombus was found in 16(20.5%) of the patients of whom 10 (62.5%) are male and the rest 6(37.5%) are female. 34(43.6%) of patients had arterial stenosis or total occlusion of which 21(61.8%) of them had total occlusion followed by 20 -49% luminal narrowing and 50-99% luminal narrowing each representing 9(26.5%) and 3(8.8%) of the patients with arterial stenosis.

Conclusion-In this study we found DM and cigarettes smoking are the significant risk factor for PAD and multifocal intimal thickening, hypoechoic plaque and total arterial occlusion are frequently seen arterial lesions on doppler ultrasound

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1. Introduction.

1.1 introduction

- Peripheral artery disease (PAD) is an important global health problem and associated with considerably high morbidity and mortality [1]. It is a disease process resulting from obstruction of large peripheral arteries, exclusive of the coronary and intracranial cerebrovascular system, commonly due to atherosclerosis [2]. This chronic slowly progressive disease is usually characterized by occlusion of lower limb arteries ultimately causing acute or chronic limb ischemia. Although the association of PAD with higher risk of ischemic events has been identified, this particular manifestation of systemic atherosclerosis is largely under diagnosed and undertreated [2, 3]. The main systemic atherosclerotic vascular diseases, namely coronary artery disease (CAD), cerebrovascular disease (CVD) and PAD are leading causes of morbidity and mortality and all these diseases share the common pathophysiological process of atherothrombosis [4].

- Advanced age, family history, smoking, diabetes mellitus, hypertension and dyslipidemia are commonly identified traditional cardiovascular risk factors of PAD [5–7]. A number of "nontraditional" risk factors for PAD have also been recognized including race and ethnicity, elevated inflammatory markers such as C-reactive protein, fibrinogen, leukocytes and interleukin-6, genetics, hypercoagulable states of altered blood levels of D-dimer, homocysteine, lipoprotein, and an abnormal waist-to-hip ratio [8]. The risk-factor identification is important because PAD is associated with reduction in functional capacity and quality of life as well as increased cardiovascular morbidity and mortality from myocardial infarction and CVA [9]. It is also associated with personal, social, and economic burden [3].

- Imaging modalities for evaluating peripheral arterial disease in the lower extremities include computed tomography angiography, conventional angiography, and Doppler ultrasonography. Three dimensional CT angiography provides information about atherosclerotic calcifications and the extent of stenosis or occlusion of the arteries. CT angiography has some advantages, such as a shorter examination time, the ability to evaluate the iliac artery, and the fact that it is less

affected by the operator's experience. Conventional angiography is used for vascular interventions such as angioplasty or stent application, as well as in the diagnosis of peripheral arterial disease. Doppler US is the only noninvasive technique that does not require contrast enhancement, preparation of the patient before the study, or radiation exposure [10, 11]. Doppler US is a good method for screening and follow-up, as well as for the definitive diagnosis of peripheral arterial disease [12-16]. Color Doppler US can easily identify arteries by finding round objects with regular pulsation and can be used to detect stenotic or occluded segments [13, 17]. Pulsed-wave Doppler US can show the exact flow velocity of each arterial segment and determine the degree of severity of the stenosis based on an analysis of the pulsed-wave Doppler spectral waveform [18].

- The risk factor modification plays an important role in managing patients with PAD in primary care setting and prevention of its complications [19]. Early diagnosis of PAD is essential to improve quality of life, to prevent further functional impairment, and to reduce mortality and morbidity from CAD and CVD. For sustainable preventive strategies in a country, it is mandatory to identify the prevalence of the disease and identifying country-specific modifiable risk factors.

1.2 Statement of the Problem.

- Peripheral arterial disease is becoming global health problem due to different reasons some of them includes increasing incidence of diseases that predispose the patients for PAD and people choose more sedentary life style leading to co morbid diseases that contribute for PAD.
- The global prevalence of PAD is around 10-12% with tendency to increase more because of the above mentioned and many more reasons. According to study done in our country the prevalence is estimated to be around 10% which is more or less similar to the global prevalence so it is important to build our understanding about the disease in different medical wings one of these is the diagnostic wing.
- There are several imaging modalities that are helpful for the diagnosis of PAD which includes DUS, CTA, MRA and DSA. Of all the investigative modalities DUS is the cheapest and non invasive modality having comparable sensitivity and specificity in diagnosing PAD with that of

MRA and CTA [18] which makes it the most widely used modality. Because of its comparable sensitivity, abundant use, cheapness and non-invasiveness. It's worthy to study the pattern of PAD on DUS to diagnose and guide management.

1.3 Significance of the study

- Since there is no epidemiological data for doppler ultrasound patterns of PAD in our country we are currently using data derived from other countries. There is one study regarding the prevalence of PAD done in Jimma. Otherwise no study has been done on the Doppler ultrasound pattern of PAD. This study aims to assess the local pattern PAD on Doppler ultrasound. It can be used for further studies to look for risk factors and possible intervention. It can give glimpse of the burden of PAD, drawing attention of stake holders.

2 Literature review

2.1 Prevalence of PAD

- The incidence of occlusive arterial diseases of the lower extremities increases with age regardless of the presence of other risk factors for cardiovascular disease. When surveys from different countries are considered, the prevalence of the disease in the general population is about 3-10%, reaching the level of 15-20% after the age of 70. [18] This suggests that the occlusive arterial disease of the lower extremities is largely the problem of elderly.
- According to research done in Southern Africa The community prevalence of peripheral arterial disease (PAD) averages ~ 10% -12% in most studies.[20]The prevalence is age-related being low in patients between 50 – 59 years (2.5% - 5%) and increasing with advancing age. The prevalence exceeds 20% for patients over 70 years.
- According to population based study done in Jimma determined the burden of PAD in Ethiopia using ABI as a screening tool to identify subclinical systemic atherosclerosis. The overall prevalence of peripheral arterial disease was 10.8%. Though there is no national data for comparison, this appears to be similar to a report from rural Southern Africa [20].

2.2 Common clinical indication of PAD for Doppler ultra sound evaluation.

- Doppler US is the only noninvasive technique that does not require contrast enhancement, preparation of the patient before the study, or radiation exposure. Doppler US is a good method for screening and follow-up, as well as for the definitive diagnosis of peripheral arterial disease. There are some indication for ultrasound evaluation in PAD patients in the presence of back ground problems like DM, HTN, cigarettes smoking, hyperlipidemia, and old age. PAD can be asymptomatic or have symptoms such as claudication, rest pain, local ulcerations, and gangrene.
- According to research done in India Symptomatically intermittent claudication was the most common symptom seen in 62% cases followed by color and temperature changes,

gangrene, and rest pain. It also found risk factors identified 60% were having hypertension while 52% had diabetes mellitus. Nearly 50% patients had the habit of smoking.

2.2.1 Intermittent claudication

- Intermittent claudication is caused by arterial narrowing in the lower-limb arteries, and symptoms develop over a number of months or years. Claudication is typified by pain and cramping in the muscles of the leg while walking, which usually forces the patient to stop and rest for a few minutes in order to ease the symptoms. Claudication only occurs during exercise because, at rest, the muscle groups distal to a stenosis or occlusion remain adequately perfuse with blood.
- It is estimated that intermittent claudication affects approximately 4.5% of the population aged between 55 and 74 years, and there is evidence that persons with claudication have a significantly higher mortality rate from cardiac disease than non claudicants. Based on the severity it is classified as mild, moderate and sever by Fontaine and Rutherford categories.

2.2.2 Chronic critical lower-limb ischemia

- Critical limb ischemia often implies limb threat. By definition this entails rest pain of more than 2 weeks duration, with or without tissue loss, not responding to conventional analgesia. Critical lower-limb ischemia occurs when blood flow beyond an arterial stenosis or occlusion is so low that the patient experiences pain in the leg at rest because the metabolic requirements of the distal tissues cannot be maintained. This coincides with Fontaine stages III and IVB, and Rutherford categories 4, 5 and 6

2.2.3 Acute limb ischemia

- Acute limb ischemia, as the name suggests, is due to sudden arterial obstruction in the lower-limb arteries that may threaten limb viability

2.2.4 **Limb ulceration**

- This is focal erosion skin or subcutaneous tissue when there is poor blood flow in the leg (ischemia). Poor blood supply cause cell to die and damage tissue.

2.2.5 **Limb gangrene**

- Total occlusion of the arterial supply leading to loss of the limb part supplied by the particular occluded arterial segment.

- Generally Fontaine's stages and Rutherford's categories is used worldwide to classify the severity of PAD clinically and estimate the percentage of occluded area and further guide the management.

Classification of peripheral arterial disease: Fontaine's stages and Rutherford's categories (Rutherford Et al. 1997)

Symptoms according to PARC*	Fontaine (Stage)	Rutherford (Stage)
Asymptomatic	I	0
Mild claudication/limb symptoms (no limitation in walking)	II	I
Moderate claudication/ limb symptoms (able to walk without stopping >2 blocks or 200 m or 4 min)	IIa	II
Severe claudication/limb symptoms (only able to walk without stopping <2 blocks or 200 m or 4 min)	IIb	III
Ischemic rest pain (pain in the distal limb at rest felt to be due to limited arterial perfusion)	III	IV
Ischemic ulcers on distal leg	IV	V
Ischemic gangrene	IV	VI

2.3 .Doppler ultrasound finding pattern of PAD

- Duplex ultrasonography (DUS) is an accurate method for determining the location of disease and the degree of stenosis of the arteries supplying the lower extremity.[21-23] The DUS combines Doppler waveform analysis and Doppler velocities. Assessment of arteries by Doppler Ultrasound needs B mode (gray scale), color flow and spectral Doppler analysis each of them has great importance to pick pathologies. Generally in the assessment of lower limb arteries by Doppler on PAD patients mainly concentrate on adequate characterization of pattern of plaque formed degree of stenosis/occlusion.

- The sensitivities of DUS in detecting occlusions and stenosis have been reported to be 95% and 92%, respectively, with specificities of 99% and 97%, respectively.[21] Koelemay et al performed a meta-analysis of studies on the use of DUS for detecting a 50% stenosis. They found sensitivity and specificity rates of 86% and 97%, respectively, for the aortoiliac arteries; 80% and 96% for the femoropopliteal arteries; and 83% and 84% for the infragenicular arteries. However, Favaretto et al study showed that DUS presents good agreement with angiography in lower limb artery disease for the aortic–iliac axis, the femoral district, and the popliteal district but not for infrapopliteal vessels.

- The presence and the size of a plaque (height and length) should be described with either B-mode, or Doppler-US. The type of plaque should be ascertained (fibrous, calcified or a mixture of both (most common)). The degree of calcification should also be characterized.

Using ultrasound, the degree of arterial disease in the lower extremities is classified into 4 categories, [18] including

1. **normal (0% stenosis)**
2. **1-49% stenosis,**
3. **50-99% stenosis, and**
4. **Total occlusion (100% stenosis).**

- Velocity criteria for the assessment of lower limb arterial stenosis are based on the peak systolic velocity (PSV) and velocity ratio (VR) when the flow velocity is normal PSV is lower than 1.5 and VR is 1.5:1.In case of a 0-49% stenosis PVS is found between 1.5 and 2, and VR is found 1.5-2:1. For a stenosis between 50-99%, PVR is found >2.0 and VR is calculated as >4:1.Diagnostic criteria for a hemodynamically important ‘50-99% stenosis’ require that the peak systolic velocity is double at the lesion when compared with a more-proximal segment (it is greater than 200 cm/s, with evidence of turbulence).

3 Research methodology

3.1 Study area and period.

- This study is conducted at the chest and vascular radiology unit of department of radiology of Tikur Anbessa Hospital, College of health science, AAU from Jan 2020 to Aug 2020 G.C.

3.2 Study design

- This is hospital based prospective cross sectional study conducted at the vascular and chest unit of department of radiology.

3.3 Population

- Source population: is every patient that will be scanned with Doppler ultrasound at Chest and vascular radiology side of TASH.
- Study population: All patients who are diagnosed to have lower extremities arterial disease.

3.4 Inclusion and exclusion criteria

3.4.1 Inclusion criteria

- Patients seen at chest and vascular radiology side of TASH having lower extremity arterial disease symptoms.

3.4.2 Exclusion criteria

- Patients were excluded if they were post operative and if the scan was used for control to assess the post operative changes.
- Trauma patients in which the arterial doppler is done to rule out arterial involvement by the trauma.

3.5 Sampling method and sample size:

- All patients diagnosed to have lower extremity arterial disease and sent for arterial Doppler examination was included in the study.

3.6 **Sources and method of data collection**

- This study employed both primary and secondary data sources. The primary data was collected from the reports of scanning evaluation and log book by senior radiology resident. Structured Survey questionnaires were used to collect information regarding the socio-demographic data, the presenting clinical symptom, habit of cigarette smoking and the pattern of the disease given based on scanning findings. In cases of incomplete data, patients were directly contacted or patient's charts were reviewed. Secondary data will also be used from articles and journals.

3.7 Data quality control

- The data quality control measures include: proper briefing of data collectors on how to fill the questionnaires from the Principal Investigator, through careful design, pre-testing of the questionnaire, close supervision of the data collecting procedures, proper categorization and coding of the data. The Principal Investigator had an ongoing supervision during the data collection period to ensure the quality of data by checking filled formats for their completeness and consistency and gave clarifications when ambiguity occurred during data collection. Discussions were held among the principal investigator and data collectors, as necessary. Based on the feedback from the supervisors and data collectors, immediate corrective measures were taken.

3.8 **Data analysis and interpretation**

- The data was checked for clarity and completeness. Data was analyzed by using SPSS computer software version 25. Then summarization and comparison of data was done and presented in tables, charts and figures.

3.9 **Ethical considerations**

- In order to respect patient's bill of right, regulation of the hospital where the study was conducted, ethical considerations was taken in to account. Any piece of information was kept confidential by not recording names of patient. Approval from ethical committee of the department was obtained.

4 Results

4.1Background information

- There were a total of 78 patients involved in the study of whom 49(62.8%) are male and the rest 29(37.2%) are female. 50(64.1%) of the patients are from urban region and the rest 28(35.9%) of patients are from rural region. The age of the patients ranges from 20 to 88 years old with mean age of 54±19. The most age groups in the study are above 70 years representing 21(26.9%) of the patients followed by 51 to 60 years and below 30 years which represent 17(21.8%) and 16(20.5%) respectively. (table 1)

4.2 Doppler ultrasound indications

- Of the 78 patients for whom lower limb arterial doppler was done the most common indications for the study are peripheral arterial disease (PAD) representing 21(26.9%) of the indications for the lower limb arterial doppler followed by intermittent claudication and arterial thrombosis accounting 15(19.2%) and 11(14.1%) respectively. (table 2)

4.3 Risk factor assessment

- Of the 78 patients included in the study 46(59%) of them found to be diabetic with most [27(58.7%)] of them having the disease for more than 10 years followed by patients having the disease for 5 to 10 years which account 13(28.3%) of the diabetic patients. (table 3 and fig 1)
- Of the total patients 26(33.3) of patients had history of cigarette smoking or are currently smokers being most of the 10(38.5%) smoke greater than 10 pack years followed by smokes who smoke 7.5 to 10 pack years which account 9(34.6%) smokers in the study.(table 3 and fig 3)
- Of the total patients 21(29.9%) of patients have HTN and most 11(54.4%) of the hypertensive patients having the disease for more than 10 years. (table 3 and fig 2)
- Only 3(3.8%) of the total patients are known to have cardiac disease and only 2(2.5%) are known to have other known chronic illness (asthma).

4.4 **Ultrasound findings**

- All 78 patients included in the study underwent unilateral or bilateral lower limb arterial doppler ultrasound with high frequency linear probe.
- 58(74.4%) of patients had bilateral lower limb arterial doppler and the rest 20(25.6%) had unilateral study (6 right lower limb and 14 left lower limb). Arterial lesion was found in 56(71.8%) of the patients of which the multifocal lesions representing 43(76.8%) and the focal arterial lesion representing 13(23.2%) of the patients found to have arterial lesions.(fig 4 and fig 5)
- Of the 64 patients for whom bilateral and/or right lower limb arterial doppler done the most involved are right SFA and PA each counting 32(50%) of the cases followed by right DFA representing 29(45.3%). Of the 72 patients for whom bilateral and/or left lower limb arterial doppler done the most involved arteries are left PA, SFA and TPT each counting 43(59.7%), 38(52.8%) and 34(47.2%) respectively. (table 4)
- 39(50%) of patients had intimal thickening and 39(50%) of patients had arterial plaque being 26(66.7%) of the plaque are multifocal, the rest 13(33.3%) are focal. Regarding echogenicity of the plaque 13(33.3%) of the plaque of the plaque are hyperechoic as compared to the adjacent muscle echogenicity followed by hypoechoic and calcified plaque each counting 12(30.8%) and 10(25.6%) respectively. (table 5 and fig 6)
- In 34(43.6%) of patients had arterial stenosis or total occlusion of which 21(61.8%) of them had total occlusion followed by 20 -49% luminal narrowing and 50-99% luminal narrowing each representing 9(26.5%) and 3(8.8%) of the patients with arterial stenosis or total occlusion. (fig 7)
- Arterial thrombus was found in 16(20.5%) of the patients of whom 10 (62.5%) are male and the rest 6(37.5%) are female. 4(25%) of the patients had history of cigarette smoking [all of them smoke > 10 pack years]. 3(18.75%) of patient with arterial thrombosis have been diagnosed with DM and only 1(6.25%) of them have been diagnosed with HTN. None of them have known cardiac or other chronic illnesses. (fig 8 and table 6).

- There are a total of 21 patients who have multiple risk factors (DM, cigarettes smoking with/without HTN) all of these patients have arterial lesion (19 multi focal and 2 focal) the arterial lesions are same as the general distribution in this study but no arterial thrombosis seen in patients with multiple risk factors.

- Of the 46 patients with DM the most involved arteries are the SFA, PA and PTA bilateral which is consistent with the general distribution in this study.

Table 1: background information of patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020

Variables		**Number**	**Percentage**
Sex	Male	49	62.8%
	Female	29	37.2%
	Total	78	100%
Address	Urban	50	64.1%
	Rural	28	35.9%
	Total	78	100%
Age- Range	< 30 years	26	20.5%
	31 -40 years	5	6.4%
	41-50 years	13	16.7%
	51-60 years	17	21.8%
	61-70 years	6	7.7%
	> 70 years	21	26.9%
	Total	78	100 %

Table 2: clinical indication of patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020

Indications	Frequency	Percentage
PAD	21	26.9
Intermittent claudication	15	19.2
Arterial thrombosis	11	14.1
Acute limb ischemia	10	14.1
DM with/without HTN	8	10.3
Gangrene	4	5.1
Others	9	11.5
Total	**78**	**100**

Table 3: presence of DM, HTN, cigarettes smoking, cardiac disease and other chronic illnesses on patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

Risk factor presence and frequency					
Risk factors	**Present**		**Absent**		**Total**
	Frequency	**Percentage**	**Frequency**	**Percentage**	
DM	46	59	32	41	78
HTN	21	26.9	57	73.1	"
Cigarettes smoking	26	33.3	52	66.7	"
Cardiac disease	3	3.8	75	96.2	"
Other chronic illnesses	2	2.5	76	97.5	"

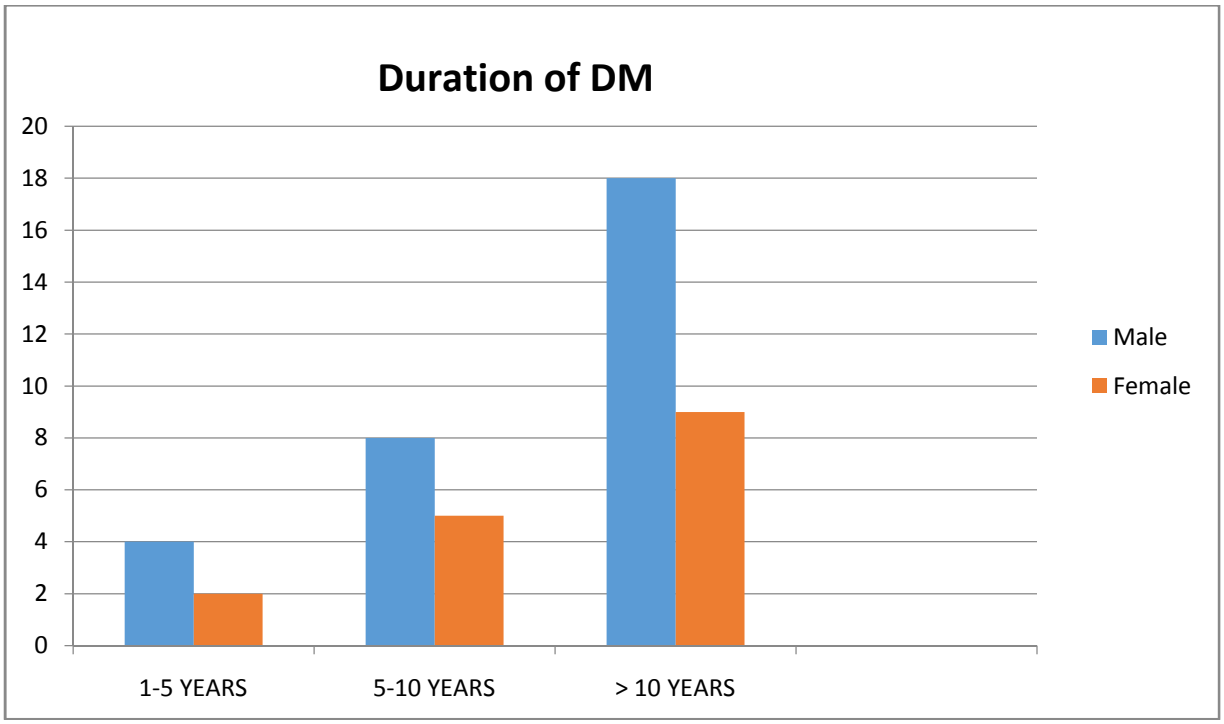

Fig 1: Duration of DM on patients who were diagnosed to have DM and underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

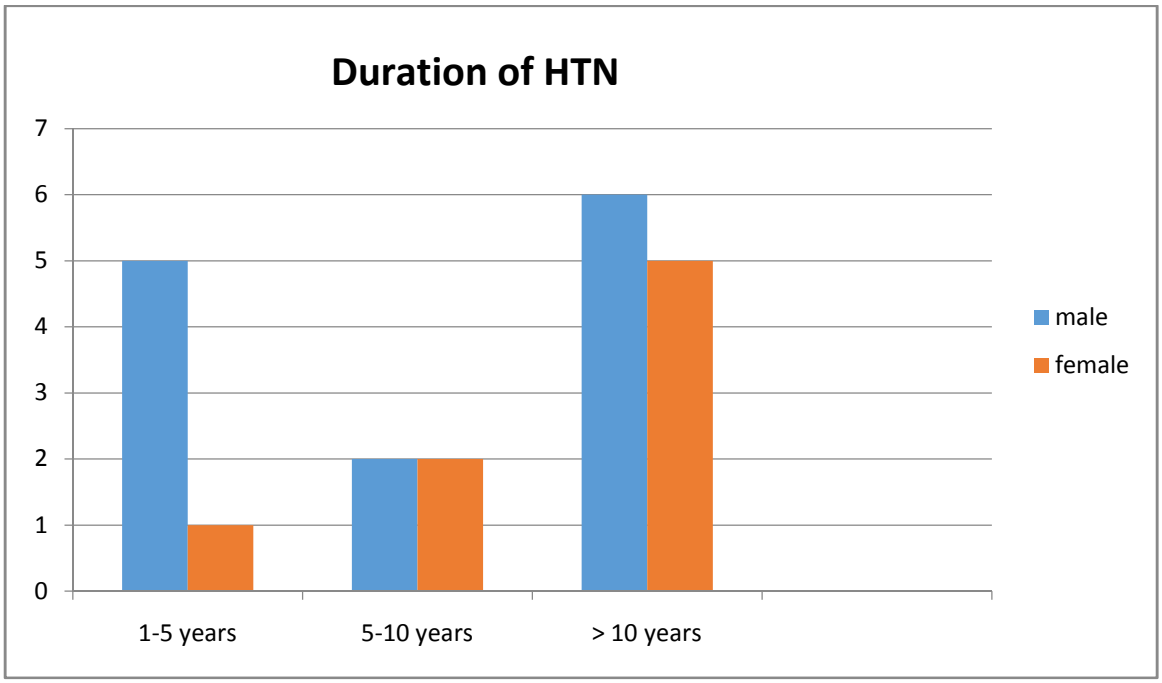

Fig 2: Duration of HTN on patients who were diagnosed to have HTN and underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020

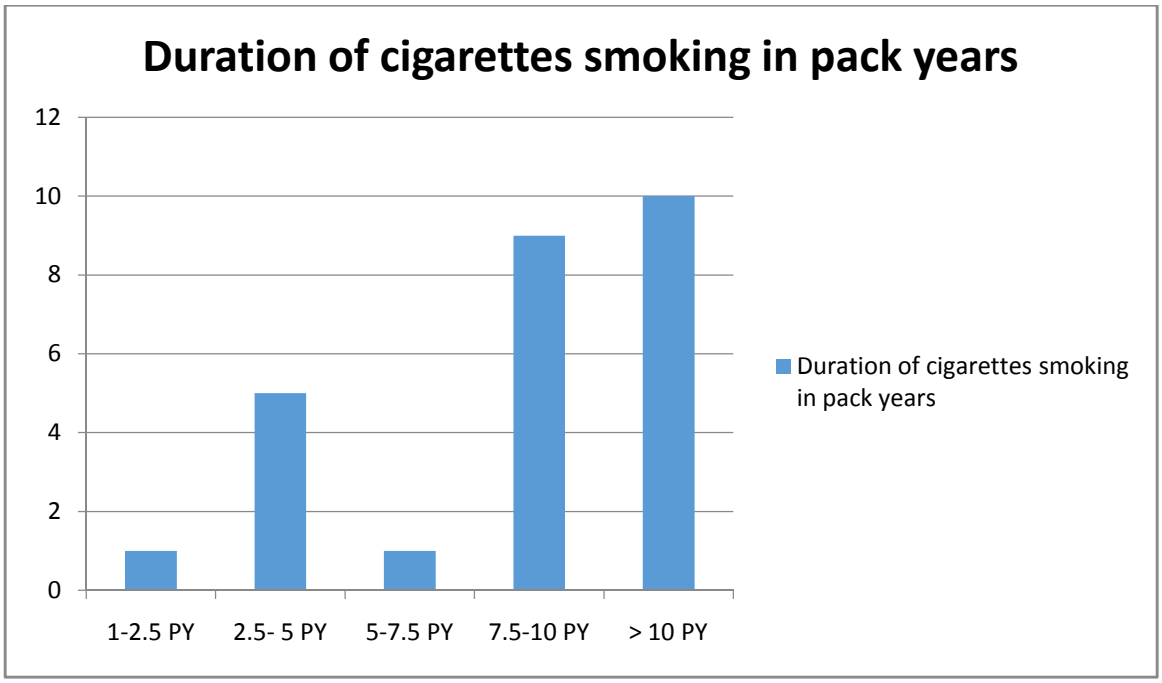

Fig 3: Duration of cigarettes smoking on patients who were smokers and underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020

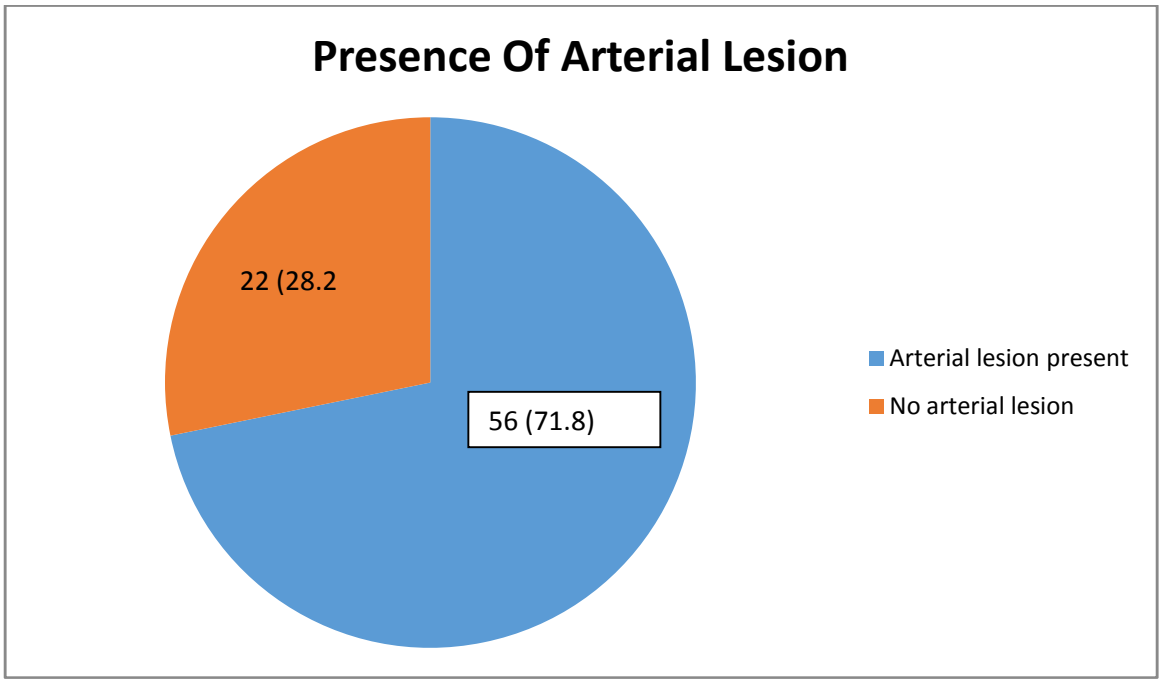

Fig 4: Presence of lower limb arterial lesion on patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

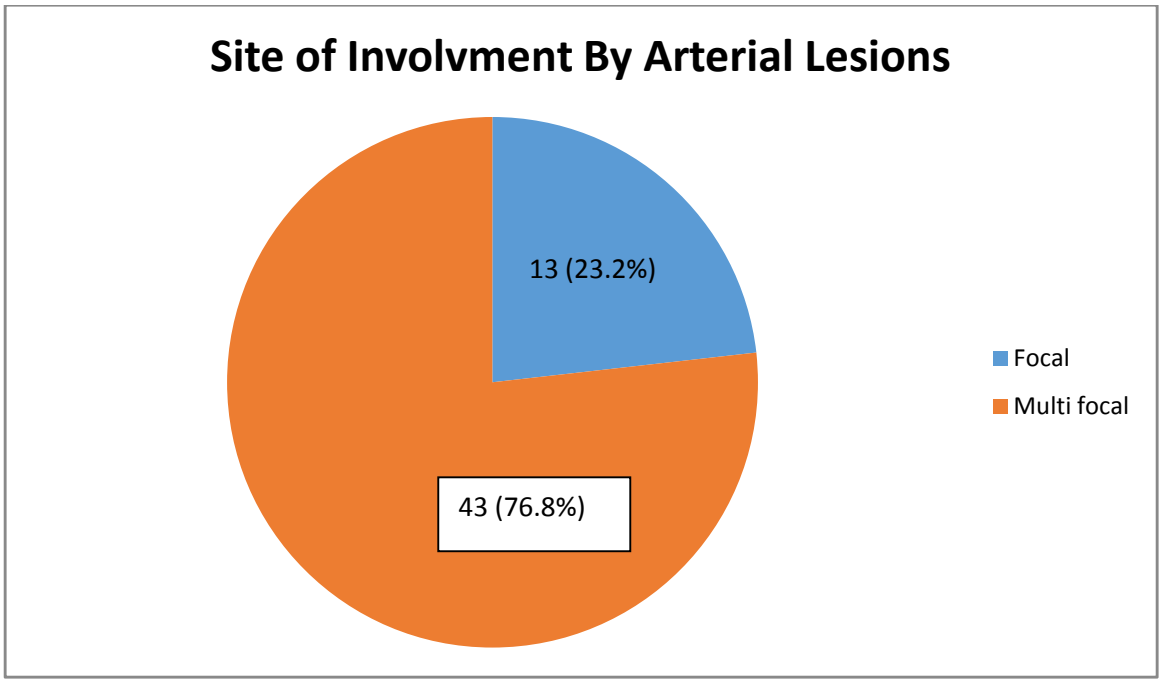

Fig 5: Involved sites by arterial lesion on patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

Table 4: Frequency of involved arteries by arterial lesion on patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

Involved arteries	Involvement					
	Right			Left		
	involved	Not involved	Total	Involved	Not involved	Total
External iliac artery	17	47	64	17	55	72
Common femoral artery	24	40	‘’	25	47	‘’
Superficial femoral artery	33	31	‘’	38	34	‘’
Deep femoral artery	29	35	‘’	32	40	‘’
Popliteal artery	32	32	‘’	43	29	‘’
Tibioperoneal trunk	28	36	‘’	34	38	‘’
Anterior tibial artery	25	39	‘’	27	45	‘’
Posterior tibial artery	23	41	‘’	25	47	‘’
Dorsalis pedis artery	21	43	‘’	19	53	‘’
Posterior tibialis artery	18	46	‘’	18	54	‘’

Table 5: presence and frequency of arterial lesions on patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

Type of arterial lesion	Frequency		
	Present	**Absent**	**Total**
Intimal thickening	39	39	78
Plaque	39	39	"
Arterial thrombosis	16	62	"
Arterial stenosis/occlusion	34	44	"

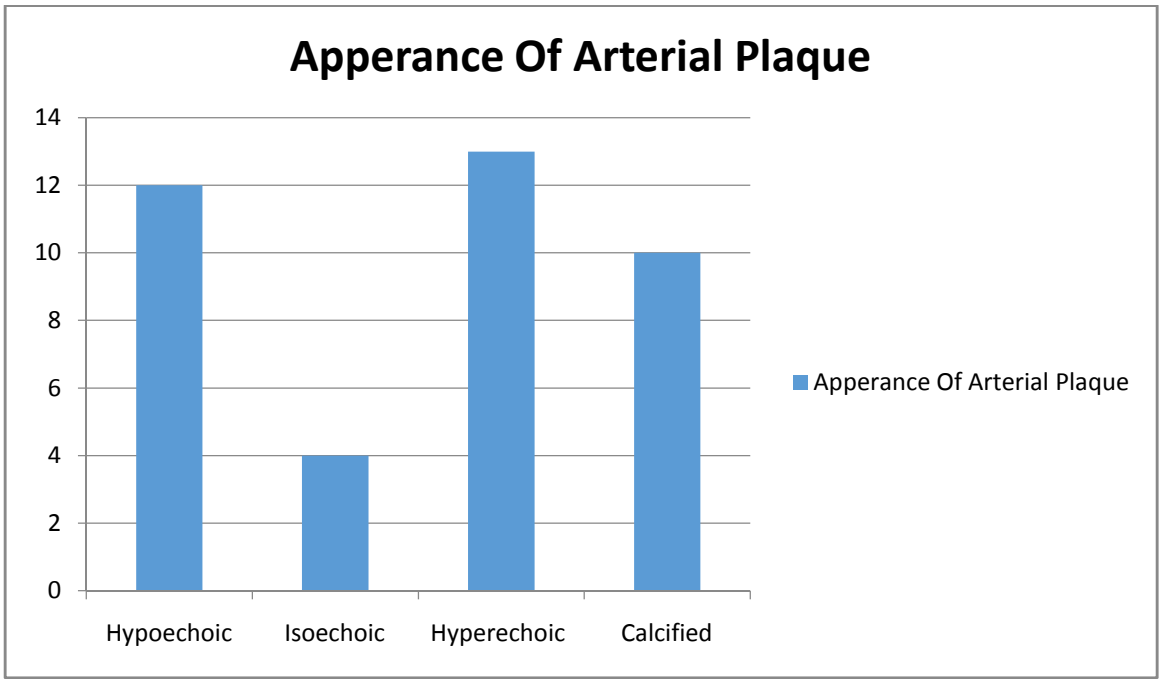

Fig 6: Appearance of arterial plaque on patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

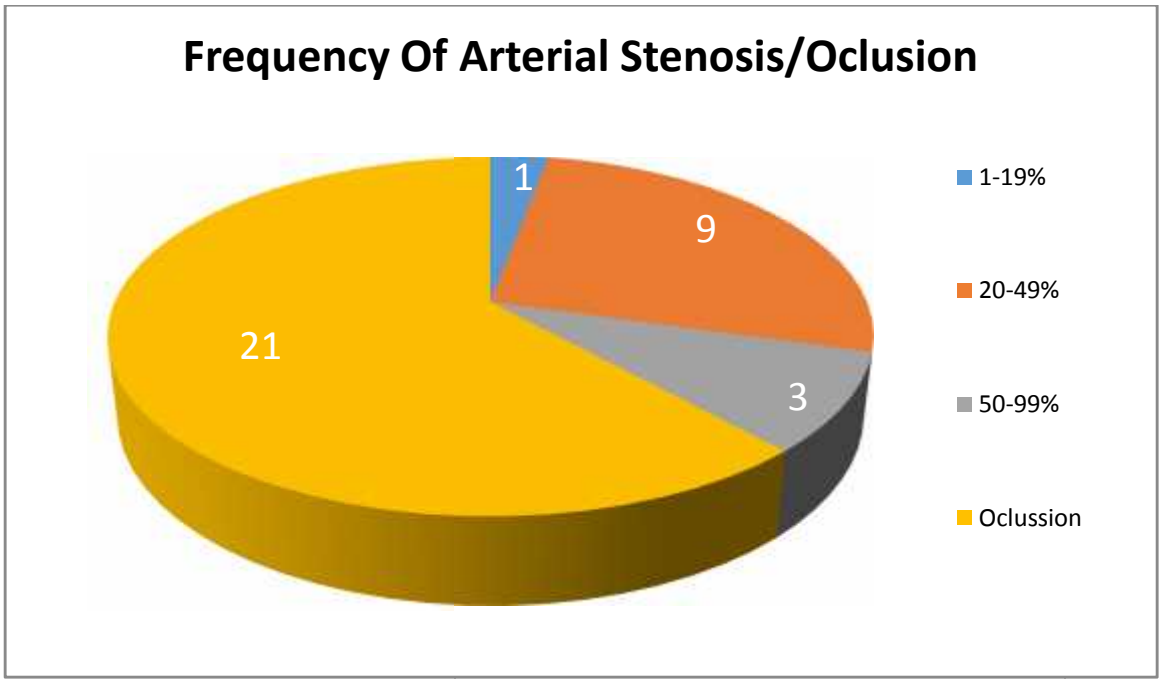

Fig 7: Frequency of severity of lower limb arterial stenosis on patients who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

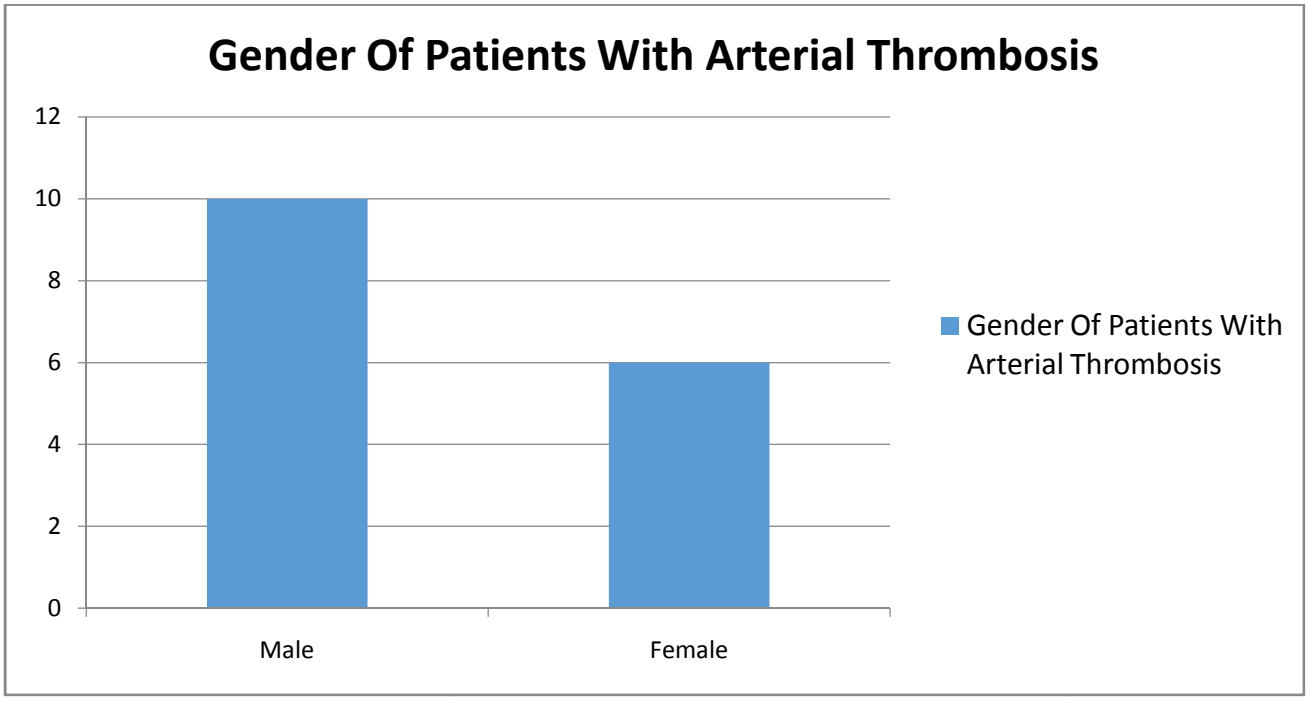

Fig 8: Gender of patients with arterial thrombosis who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

Table 6: Frequency of risk factors on patients with arterial thrombosis who underwent lower limb doppler ultrasound at black Lion hospital from Jan, 2020 to Aug, 2020.

Risk factors	Present		Absent		Total
	Frequency	Percentage	Frequency	Percentage	
DM	3	18.75	13	81.25	16
Smoking	4	25	12	75	"
HTN	1	6.25	15	93.75	"
Cardiac disease	0	0	16	100	"
Other chronic illnesses	0	0	16	100	"

5 Discussion

Regarding the common indication for lower limb arterial doppler we found the most common indication was PAD (peripheral arterial disease) followed by intermittent claudication and arterial thrombus. When we see other researches [3,5,11] listed in the literature review the most common indications are intermittent claudication and limb ischemia, the likely reason why PAD is common indication in our study is since PAD is a clinical diagnosis the clinicians write the diagnosis than listing the patients presenting symptom and the clinicians need the doppler ultrasound to support their clinical diagnosis and the other possible explanation is those patients sent for lower limb doppler ultrasound with indication of PAD may have long term follow up and they may have previous ultrasound. The other common indication we got in this study having larger proportion than other related studies [2] was arterial thrombosis which is the third common indication in our study representing 11(14.1%) of the indications. The possible explanation for this is since TASH is a tertiary referral hospital and vascular procedures (E.g.:- thrombectomy) are available here makes the share of arterial thrombosis higher than the other studies.

Regarding risk factor assessment the common risk factors we found in this study are presence of DM, cigarettes smoking and HTN which are highly associated with the presence of lower limb arterial lesion. Other risk factors like Ischemic heart disease are found in some of the patients. As we compare theses result with other studies[1,2,3,4,5] our finding of risk factors are also major risk factors on other studies but additionally dyslipidemia is the other risk factors listed in most of the cases. The possible reason why we found no significant number patients with those risk factors (cardiac disease and dyslipidemia) is likely because of small sample size we get because the study was prospective and the study period is in the time COVID-19 pandemic which may decrease the health seeking behavior of the patients.

The most involved arteries in our study are SFA, PA and TPT. The most common findings we found are multifocal intimal thickening and arterial plaque which both are found in half (39) patients. These findings are comparable with other studies included in the literature review [2, 5]

Arterial thrombosis was found in 16(20.5%) of patients and all of them having total arterial occlusion making the presence of arterial thrombosis significantly correlated with total arterial occlusion. Regarding risk factor assessment of patients with arterial thrombosis statistically significant ($p<0.01$) correlation was found with the presence of DM other risk factors like cigarettes smoking and HTN found in some of the patients but not statistically significant correlation found, these may be attributed to small number of our sample. As compared to other studies the share of arterial thrombosis is higher in our study [5] possible explanations discussed above [paragraph 4]

34(43.6%) of patients had arterial stenosis or total occlusion being most of them 21(61.8%) had total occlusion followed by 20-49% arterial diameter stenosis representing 9(26.5%). These findings are comparable with other studies [2, 5]

6. Conclusion

In this study we found DM, cigarettes smoking and HTN are the most common risk factor for PAD. Multifocal intimal thickening, hyperechoic plaque and total arterial occlusions are frequently seen arterial lesions on doppler ultrasound in our study.

Limitation of the study

This study has several limitations to list some.

- Small sample size
- Since the study is ultrasound and the arterial doppler ultrasound is time taking there is high chance of inter observer variability.
- There is no senior consultant confirmation on the result of doppler ultrasound which for sure increase the inter observer variability.
- Lack of standard reporting format for peripheral arterial doppler study.
- Incompletely filled questionnaires.

Recommendation

- Because of its low cost and wide availability as compared to other vascular studies we recommend to do more studies (both descriptive and comparative) on arterial doppler ultrasound with CTA and/or MRA on large scale with larger sample size and also including other hospitals in the study.

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8. Appendix

QUESTIONNAIRE

ADDIS ABEBA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF RADIOLOGY

DOPPLER ULTRASOUND PATTERNS OF LOWER LIMB PERIPHERAL ARTERIAL DISEASE.

1. Age _____ Sex _____Card No. _____
2. Address Urban _____ Rural _____
3. Are you diagnosed with

- DM yes _____ no _____

If yes what is the duration?

- o < 1 year
- o 1-5 years
- o 5-10 years
- o > 10 years

- HTN yes _____ no _____

If yes what is the duration?

- o < 1 year
- o 1-5 years
- o 5-10 years
- o >10 years

- IHD yes _____ no _____

If yes what is the duration ?

- < 1 year
- 1-5 years
- 5-10 years
- > 10 years

3.4 if there is other chronic illness please specify the diagnosis and the duration

_____

4. Did you smoke cigarettes (now or in the past)? yes _____ no _____

   If yes for how long did you smoke?

   - < 1 year
   - 1-5 years
   - 5-10 years
   - > 10 years

5. What is your average cigarette consumption per day in

   - 1-5
   - 6-10
   - 11-20
   - >20

6. Is there any lower limb arterial lesion? yes _____ no _____

   If yes is it unilateral _____ bilateral _____

   Focal _____ multi level _____

7. Is there arterial thrombosis yes _____ No _____
8. Which arteries are involved on the right?

- EIA
- CFA
- DFA
- SFA
- PA
- TPT
- AT
- PT
- DP
- PA

9. Which arteries are involved on the left ?
    - EIA
    - CFA
    - DFA
    - SFA
    - PA
    - TPT
    - AT
    - PT
    - DP
    - PA

10. What is the ultrasound findings? (if there are many findings please document the severe form only)
    - Intimal thickening yes _____ no _____
    - Plaque yes _____ no _____

        If yes is it focal _____

        Mild _____

        Moderate _____

        Sever _____

If yes is it isoechoic _____

Mildly hyperechoic _____

Moderately hyperechoic _____

Calcified _____

11. Is there any site of arterial stenosis/occlusion? yes _____ no _____

If yes what is the percentage diameter reduction? (If there are multi level diameter Reduction please takes the severe one only)

- 1-19% diameter reduction
- 20-49% ,,
- 50-99% ,,
- Total occlusion