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Study of Carotid Artery in Hypertensive Patients Using Color Doppler

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ABSTRACT:- Study of carotid artery in hypertensive patients using color doppler, were the data of this study consisted of 368 patients; 130 of them were normal (71 male and 59 female) and 238 hypertensive patient (143 male and 95 female),11 variable were used to collect the data for each of them they include; Systolic blood pressure, Diastolic blood pressure, Body Mass Index, Heart Rate, Plasma Total Cholesterol, Plasma Total Glyceride, Right Intima Media Thickness, Left Intima Media Thickness, Right Resistive Index and Left Resistive Index.

The results of this study reveal there is a real difference between the normal and hypertensive patient for all factors except the age and BMI was not an influential factor they showed inconclusive differences.Using stepwise linear discriminant analysis to classify the data into normal and hypertensive patients, 8 variables were chosen by the program as the most discriminant factors they include: SBP, DBP, BMI, PTC, PTG, Rt IMT, Lt IMT and Rt RI the classification accuracy was 100% as well as the sensitivity and specificity. And the generated model that can be used to classify other groups, Systolic and diastolic blood pressure concerning the normal and hypertensive patients showed remarkable differences between the two group where the values for hypertensive patient in average was apparently exceed that of the normal with a minimum variation that keep the differences between the two groups.

The plasma total cholesterol (PTC) was higher as usual in hypertensive patient than normal and there is a significance differences between the two groups, the intima media thickness for the Rt and Lt carotid artery showed that, hypertensive patient associate with a thicker intima than the normal respondent with considerable variation attributed to hypertensive in respect to the stage of their condition.

Keywords:- *hypertensive patients, carotid artery, color doppler, plasma total cholesterol*

I. INTRODUCTION

Hypertension is one of the most important risk factors in the development of atherosclerosis, coronary artery diseases (CAD), and cerebrovascular disease (CVD) [1-3]. Common carotid artery (CCA) intimamedia thickness (IMT), extracranial carotid artery (ECCA) atherosclerosis, and maximal carotid stenosis have been proved to have significant association with CAD and CVD[4-7]. Bodies of evidence support early detection of atherosclerosis and its associated risk factors in the prevention of atherosclerotic diseases. The measurement of carotid atherosclerosis by ultrasound has been widely used for its simple and reliable detection of early preclinical atherosclerosis [8,9]. and for the high correlation between measured IMT and the actual pathological change it produces [10]. Among all the risk factors, hypertension (HTN) can affect atherosclerosis on different levels [11].

HTN can cause endothelial dysfunction, fatty streaks accumulation, subclinical atherosclerosis, atherosclerosis progression, and the ultimate rupture of plaque [12]. It is thought to be a main factor in the hypertrophy of the media layer in the carotid artery, which can be detected by ultrasonography (US) [13].Evaluation of HTN in atherosclerosis can be considered an important issue in cardiovascular disease risk prediction. Many methods have been proposed for atherosclerosis evaluation. The intima media thickness (IMT) of the carotid artery is measured by US and has been used as a marker of subclinical atherosclerosis for years [14]. As different parts of the carotid artery can be used to determine the thickness, some studies suggested that the common carotid artery (CCA) provides more reliable and reproducible measurements. However, changes in the CCA due to HTN can differ from those of the internal carotid artery (ICA) and external carotid artery (ECA). Different ethnicities may have different implications of thickening in different parts of the carotid artery due to HTN [15]. The literature is ambiguous as to the relationship of HTN with the presence of carotid plaque, as some studies showed a significant association between HTN and plaque presence [16], while other studies found no association [17]. As carotid thickening occurs in the early stages of atherosclerosis and plaque forms at

later stages, it is said that the carotid IMT is a marker of early-stage subclinical atherosclerosis, and plaque presence is a marker of late-stage subclinical atherosclerosis [18].It is less widely recognized that vascular structural changes also predict increased risk. This is hardly surprising as structural and functional changes in blood vessels are more intimately involved in the process leading to atheroma and thrombosis. Heart muscle damage occurs as a consequence of occlusive events in the coronary arteries.

Hypertensive vascular changes include: Thickening of the walls of large elastic and muscular arteries. Remodeling of small muscular arteries resulting in increased wall to lumen ratio. Reduced number of vessels in the microcirculation. Lengthening of small arteries. Some studies have documented the association between carotid atherosclerosis and hypertension [19-21].

II. MATERIAL AND METHODS

This study was done in Libya, A General Electric Doppler machine used with a Hz probe. Water based gel, the patient's sample was 368 males and females all of them was adults. After taking a permission from the patients, patient is positioned lying face-up on the examination table. A clear water-based gel is applied to the lateral aspect of the neck, the transducer is firmly held against the skin with mild to moderate pressure. After completion of the examination the gel is rubbed off using a tissue (Fine), and the patient is asked to wait while the ultrasound images are reviewed.

III. RESULTS

Table 1. show the mean and standard deviation of the study variables for normal and hypertensive patients

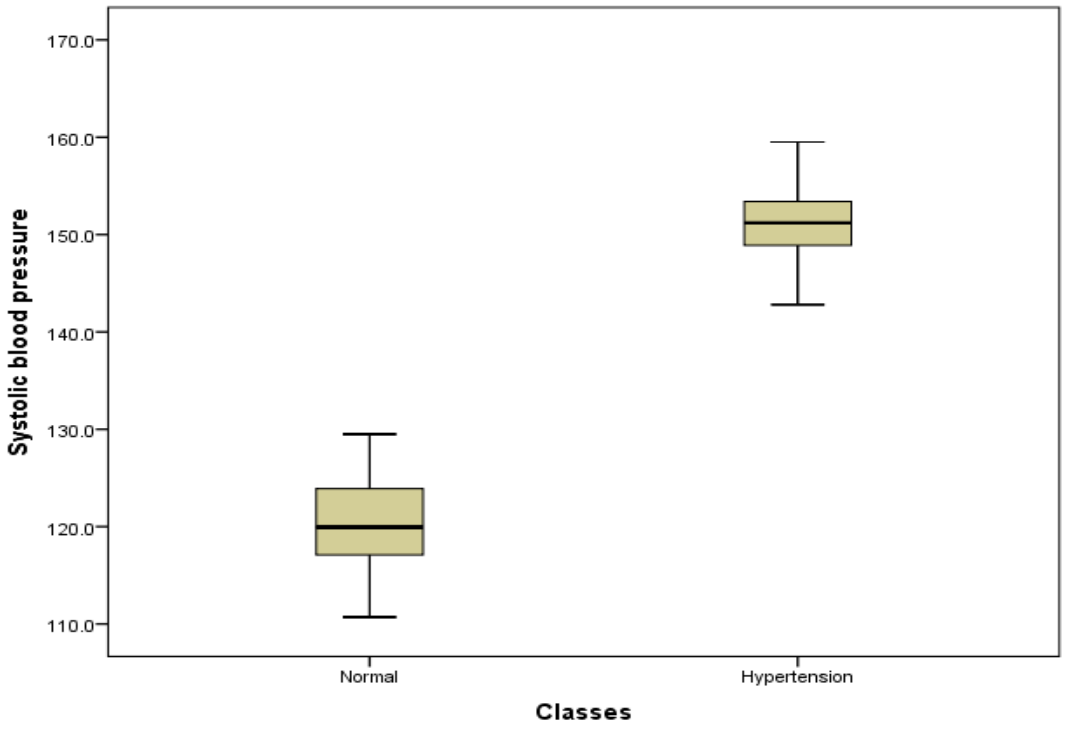
Group Statistics			
Status		Mean	Std. Deviation
Age	Normal	58.4783	4.46063
	Hypertension	60.1087	4.83611
SBP	Normal	120.0087	6.25663
	Hypertension	150.9674	4.61322
DBP	Normal	79.7739	3.64408
	Hypertension	96.3370	3.97969
HR	Normal	79.1391	2.47051
	Hypertension	76.7326	3.40340
BMI	Normal	28.6870	3.58815
	Hypertension	26.9543	3.70811
PTC	Normal	151.7391	21.41346
	Hypertension	173.1326	4.01741
PTG	Normal	117.3304	3.55917
	Hypertension	168.2043	5.94194
RIMT	Normal	0.6474	0.02942
	Hypertension	0.8998	0.05795
LIMT	Normal	0.6109	0.02214
	Hypertension	0.8907	0.03912
RRI	Normal	0.6461	0.03461
	Hypertension	0.7465	0.03825
LRI	Normal	0.6109	0.13941
	Hypertension	0.7528	0.03569

Table 2. confusion matrix shows the classification accuracy between normal and hypertensive patient using linear discriminant analysis and study variables (lab and ultrasound) as input

Classes			Predicted Group Membership		Total
			Normal	Hypertension	
Original	Count	Normal	130	0	130
		Hypertension	0	238	238
	%	Normal	100.0	0.0	100.0
		Hypertension	0.0	100.0	100.0
100.0% of original grouped cases correctly classified.					

Table 3. the generated model coefficient by linear discriminant analysis for classification of unseen data Fisher's linear discriminant functions

	Normal	Hypertension
SBP	8.121	10.441
DBP	10.107	11.752
BMI	3.734	2.621
PTC	7.578	8.934
PTG	10.835	15.784
RIMT	432.257	599.194
LIMT	1582.994	2270.783
LRI	373.227	463.779
(Constant)	-2887.551	-4950.334



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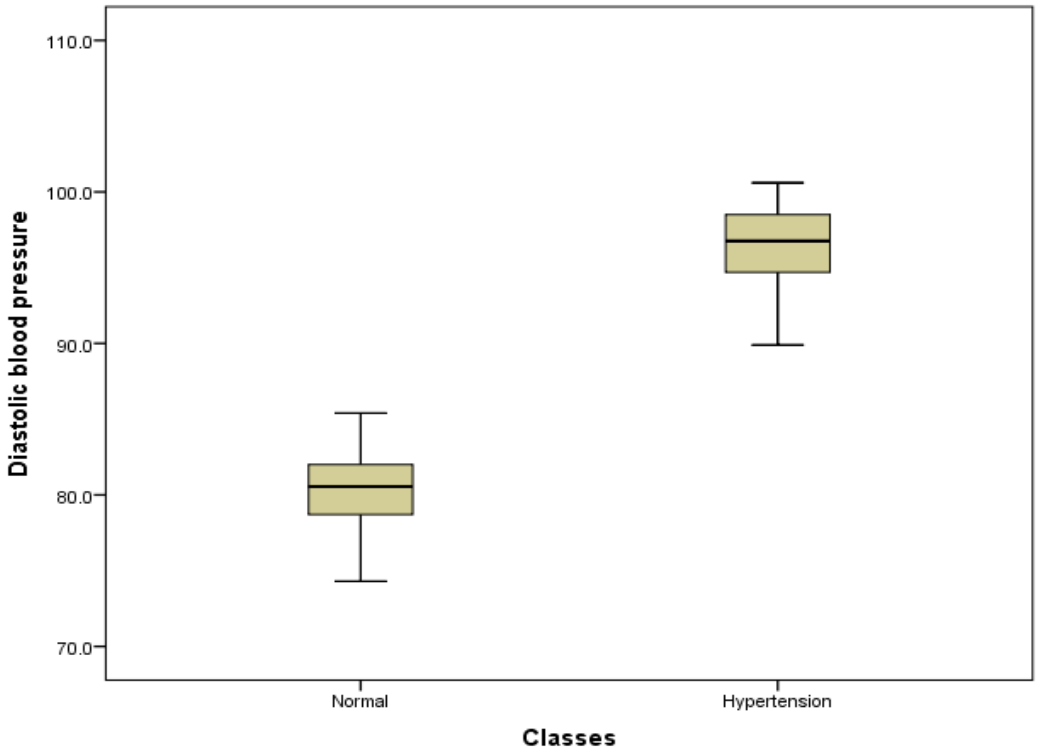

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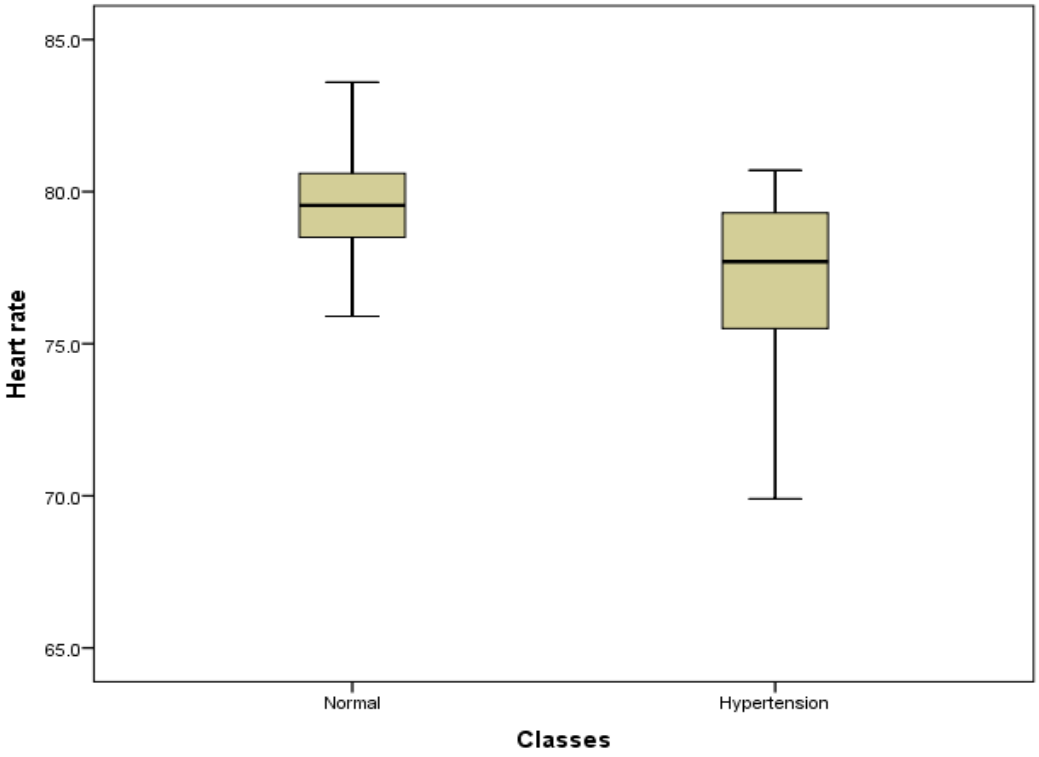
Figure 1. box plot shows the mean and the variation between normal and hypertensive patients for (a) systolic blood pressure and (b) diastolic blood pressure



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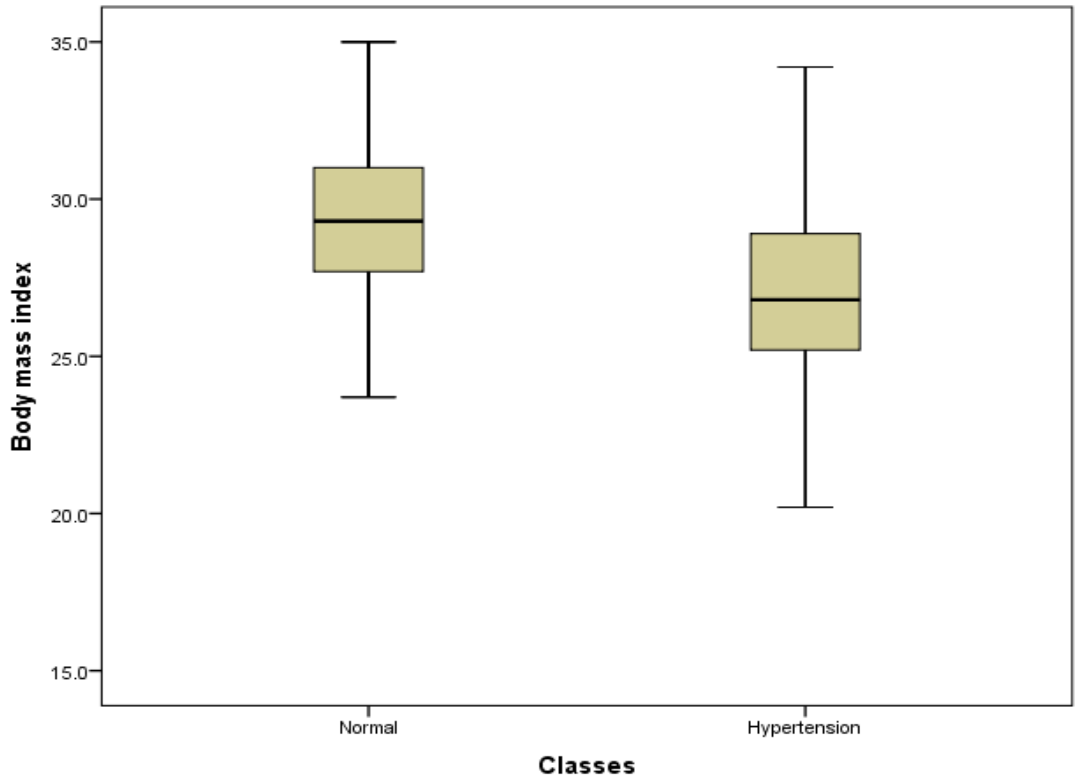
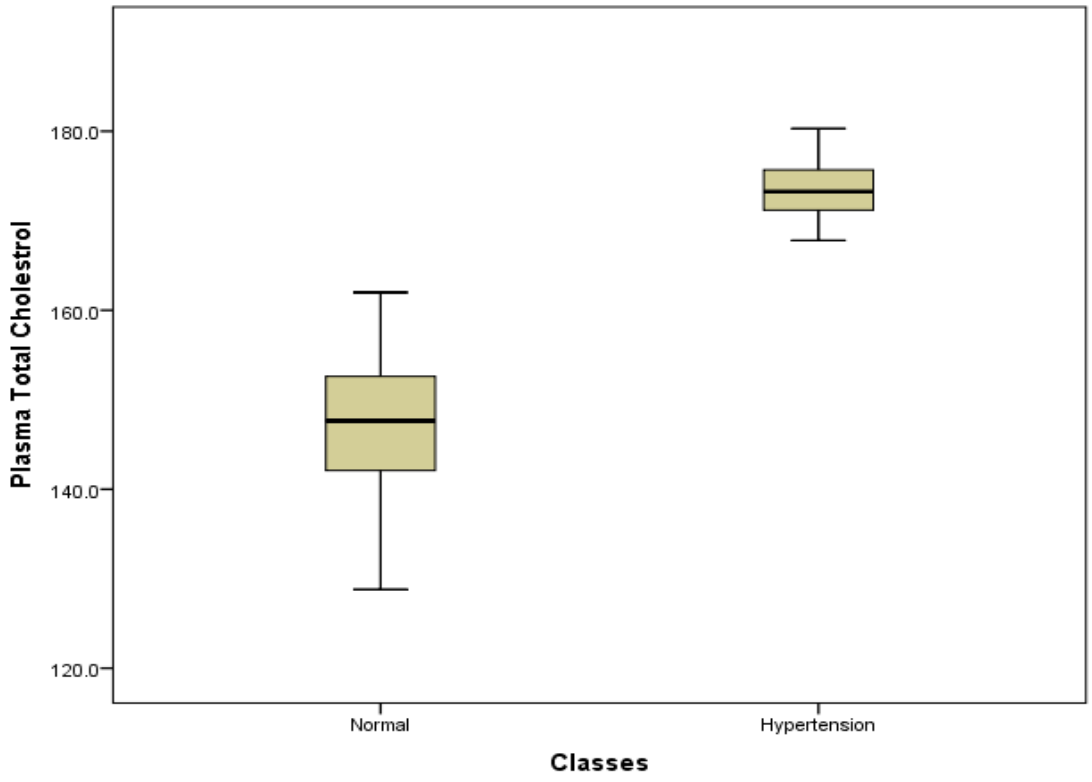


(b)

Figure 2. box plot shows the mean and the variation between normal and hypertensive patients for (a) Heart rate and (b) BMI



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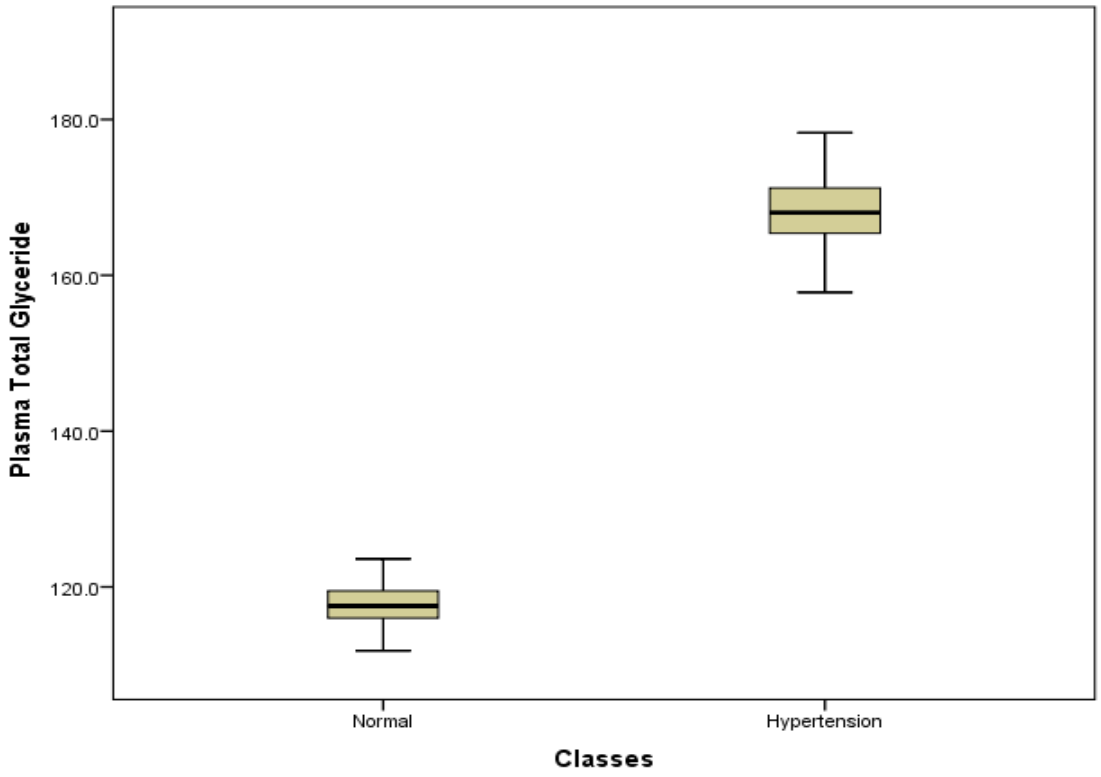
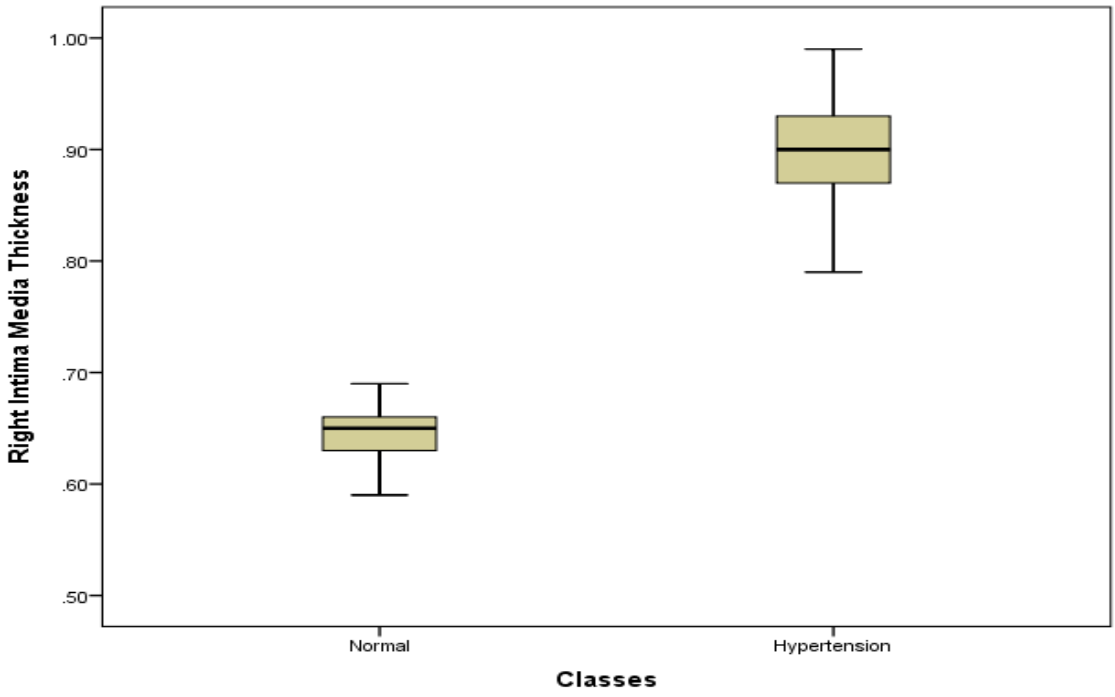


(b)

Figure 3. box plot shows the mean and the variation between normal and hypertensive patients for (a) PTC and (b) PTG



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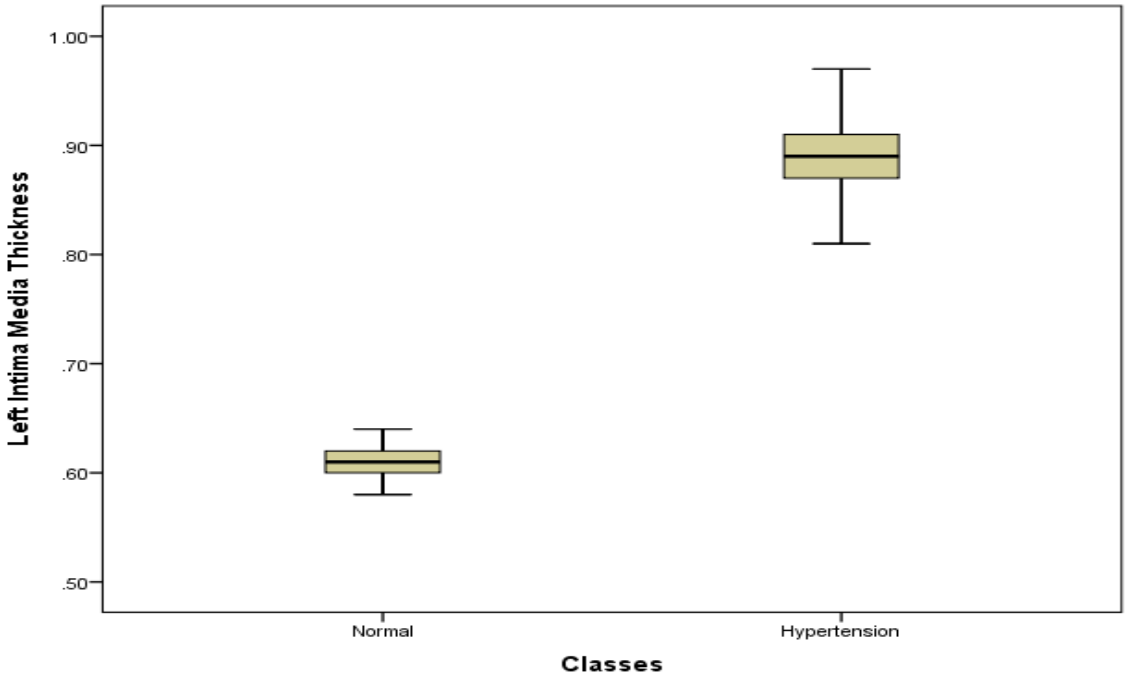
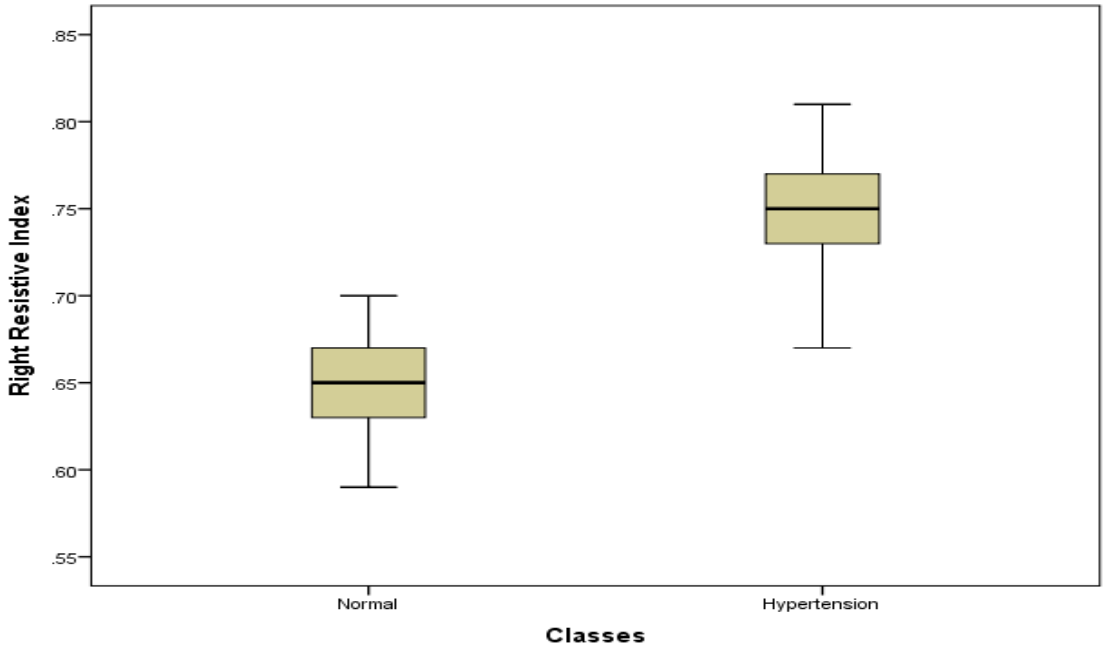


(b)

Figure 4. box plot shows the mean and the variation between normal and hypertensive patients for (a) Rt IMT and (b) Lt IMT



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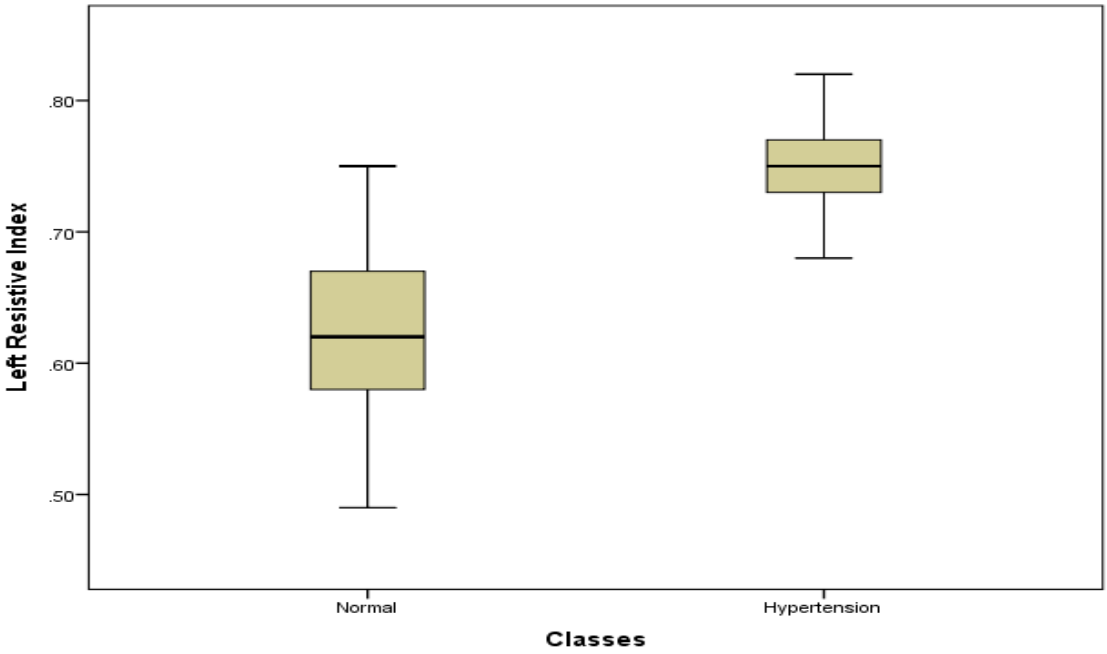

(b)

Figure 5. box plot shows the mean and the variation between normal and hypertensive patients for (a) Rt carotid RI and (b) Lt carotid RI

IV. DISCUSSION

The result of this study reveals there is a real difference between the normal and hypertensive patient for SBP, DBP, HR, PTC, PTG, Rt IMT, Lt IMT, Rt RI and Lt RI and inconclusive for age and BMI, concerning the above-mentioned factors while the age and BMI was not an influential factor, they showed inconclusive differences.this result dictate that, there is a real difference between the normal and hypertensive patient concerning the above-mentioned factors while the age and BMI was not an influential factor, they showed inconclusive differences**Table 1.**

Using stepwise linear discriminant analysis to classify the data into normal and hypertensive patients, 8 variables were chosen by the program as the most discriminant factors they include: SBP, DBP, BMI, PTC, PTG, Rt IMT, Lt IMT and Rt RI the classification accuracy was 100% as well as the sensitivity and specificity **Table 2.** and the generated model that can be used to classify another groups **Table 3.**Systolic and diastolic blood pressure concerning the normal and hypertensive patients showed remarkable differences between the two group where the values for hypertensive patient in average was apparently exceed that of the normal with a minimum variation that keep the differences between the two groups **Fig 1.** The heart rate in average showed a considerable significance differences between the normal and hypertensive patient with some overlaps but usually the normal respondent showed normal higher values than hypertensive patient which tend to have low heart rate than the normal one might be to balance the pressure. While BMI for both groups showed minor differences in average and that difference was not significance using t-test at p = 0.05 hence BMI is not considered as causative factor leading to hypertensive **Fig 2.**The plasma total cholesterol (PTC) was higher as usual in hypertensive patient than normal and there is a significance differences between the two groups with minim variation for hypertensive group and higher relatively in the normal one but with clear boundaries between the two groups, which go with the usual assumption that hypertension associate with PTC status. Similarly, plasma total glyceride (PTG) gives same result PTC but with minim variation between in the normal group and clear cut between the two groups **Fig 3.**

The intima media thickness for the Rt and Lt carotid artery showed that, hypertensive patient associate with a thicker intima than the normal respondent with considerable variation attributed to hypertensive in respect to the stage of their condition and there are significance differences between the two groups using t-test at p = 0.05. while the blood flow concerning resistive index (RI) for Rt and Lt carotid artery reveals higher values for hypertensive patient as usual result attributed to thicker intima and high PTC and PTG. This differences between normal and hypertensive patient was significance at p = 0.05 using t-test; although the variation of RI in the normal group was considerable in **Fig 5.**but mainly left side affected by the strong pressure released directly from the heart and accommodated by the elasticity of the normal intima media.

V. CONCLUSION

Study of carotid artery in hypertensive patients using color doppler, and the results of this study reveal there is a real difference between the normal and hypertensive patient for all factors except the age and BMI was not an influential factor they showed inconclusive differences.Using stepwise linear discriminant analysis to classify the data into normal and hypertensive patients, 8 variables were chosen by the program as the most discriminant factors they include: SBP, DBP, BMI, PTC, PTG, Rt IMT, Lt IMT and Rt RI the classification accuracy was 100% as well as the sensitivity and specificity, and the generated model that can be used to classify other groups, Systolic and diastolic blood pressure concerning the normal and hypertensive patients showed remarkable differences between the two group where the values for hypertensive patient in average was apparently exceed that of the normal with a minimum variation that keep the differences between the two groups.

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