

Sonographic Assessment of Intima Media Thickness of Common Carotid Artery in Normotensive and Hypertensive Individuals

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Abstract:

Intimal medial thickness (IMT) is associated with many cardiovascular diseases as atherosclerosis, coronary artery disease, stroke and hypertension etc. Intimal medial thickness of common carotid arteries (CCA) can be measured by high-resolution modality i.e, B-Mode Ultrasonography.

Objective:

The objective of this study was sonographic assessment of intima media thickness of common carotid artery in normotensive and hypertensive individuals.

Methods:

A total of 70 individuals both hypertensive (40) and normal (30) were included in the study and IMT of both right and left CCA was measured. Intima-media thickness of the anterior wall of the distal part of CCA both right and left was taken in hypertensive and normal (without hypertension and neurologic disease) in Pakistani population.

Results:

In this case control study 70 individuals were scanned, 40 (57.1%) individuals had prior history of hypertension and other 30 (42.9%) were without any prior history of hypertension or any neurologic disease. A significant correlation of intimal medial thickness with increasing age ($r=0.6$ and P value of $.000$) was found. The atherosclerotic changes effect the IMT, as the patients with plaques had increased IMT as compared to those without plaques. Sensitivity and specificity of ultrasound in hypertensive and normotensive patients was 50.0 and 66.7. Sensitivity and specificity of ultrasound in present and absent plaque patients was 87.5 and 87.1.

Conclusions:

IMT increases with advancing age. IMT also increases in patients with other signs of atherosclerosis such as

plaque formation.

Keywords:

Common Carotid Artery, Intima Media Thickness, Plaques, Hypertension.

Introduction:

Atherosclerotic diseases are considered to be the most important factor causing the cardiovascular diseases¹. Age has been found as the strong determinant of atherosclerotic diseases². B-Mode ultrasonography has been used to evaluate the carotid arteries. This was based on the presumption that strokes could be prevented by removing carotid plaques and thus eliminating a source of emboli. IMT is associated with cardiovascular diseases, carotid plaques and atherosclerotic problems³. Determining IMT with high resolution B-Mode ultrasonography is one of the methods of choice for determining the anatomic extent of atherosclerosis and for assessing cardiovascular risk. B-mode ultrasonography is a simple, safe way, inexpensive, accurate and reproducible method to measure the IMT⁴. Intimal medial thickness and plaque formation are related to aging and are accelerated by hypertension and other risk factors². Arterial wall is consisted of three layers: adventitia, intima and media. The adventitia is made up of fibroblasts and collagen. Intima consists of the endothelial cells separated from media by elastic fibers. Medial layer comprises the elastic laminae⁵. The normal carotid wall appears hypoechoic on grayscale. The reflection from the interface between the intimal surface of the wall and the blood within the lumen produces an inner bright line along the carotid wall. B-mode ultrasonography allows the accurate measurement of the blood-intima and media-adventitia interface which is called as IMT⁶. Blood-intima and media adventitia interface sonographically visualized as parallel echogenic lines

separated by anechoic space⁷. This sonographic morphology of the carotid wall is easily seen in most Common Carotid Arteries (CCA) but is more difficult to demonstrate in the Internal Carotid Artery (ICA) and external carotid artery (ECA). CCA can be easily visualized as it is perpendicular to the ultrasound beam and provide accurate quantitative measurements as compared to ICA and ECA⁸. Normally, the thickness is less than 0.9mm. As atherosclerosis develops, the carotid artery wall becomes thicker. Common carotid artery with increased IMT represents the form of atherosclerosis that is manifested as diffuse wall thickening whereas internal common artery with increased proximal thickening is marker for atherosclerotic plaque⁹. Inside the arterial lumen there is a focal structure of 0.5mm size or 50% nearby IMT value is explained as a Plaque¹⁰.

Studies of Raitakari and Juonala show that in early life, exposure of cardiovascular risk factors will produce changes in the arterial wall which may contribute to the development of the future atherosclerotic disease^{11,12}. Universally the major cause of mortality and morbidity is Cardiovascular (CV) disease. It is proposed that risk estimation by classical risk factors (blood pressure, glucose, cholesterol) and circulating biomarkers may fail to adequately predict the risk of Cardiovascular events because their fluctuations over time represent many transient and partial "snapshots" rather than a reliable picture of a complex situation developing over decades. In the earlier study of Ezzati it is concluded that imaging biomarkers of vascular damage might integrate the long lasting cumulative effects of all traditional and non-identified CV risk factors and can be detected as target organ damage before clinical events occur, at a stage when interventions may be effective¹³. Thickened carotid IMT is powerful and reliable parameter for target organ damage in patients with essential hypertension¹⁴. According to Stein, Age is the most powerful independent risk factor for atherosclerosis. Atherosclerosis is also called as disease of aging as it becomes more severe with increased age. Other risk factors are family history, smoking, hypertension, hypercholesterolemia, diabetes mellitus, physical activity, obesity, alcohol, dietary factors and haemostatic factors.¹⁵

The researcher aimed to identify the abnormal changes in

common carotid artery among the patients suffering from hypertension through hypertension. After identification of these abnormal changes in this ITM of CCA among hypertensive patients and to create the awareness through health education among risky group in order to reduce the morbidity resulted due to CCA.

Methods:

A total of 70 individuals both hypertensive (40) and normal (30) were included in the case control study and IMT of both right and left CCA was measured. Intima-media thickness of the anterior wall of the distal part of CCA both right and left was taken in hypertensive and normal (without hypertension and neurologic disease) in Pakistani population as shown in figure 1. Each patient was scanned under scanning guideline and international protocols as shown in figure 2.

Toshiba nemo 35 and Mylab 50 was used with 7-14 MHz Linear probe. Standard techniques and protocols were used for positioning the patients and find out queries about IMT and hypertension. Supine position with slightly extended head by placing pillow under shoulders and rotated neck opposite to the direction of probe. Rolled towels under the neck and pillows under legs for comfort¹⁶. Patients were scanned transversely in proximal direction and then followed the bifurcation then accessed the course and presence of intimal medial thickness and any plaque or stenosis. Color Doppler was used to find the patency and direction of flow.



Figure 1: Showing IMT of RCCA in the 75 years female.

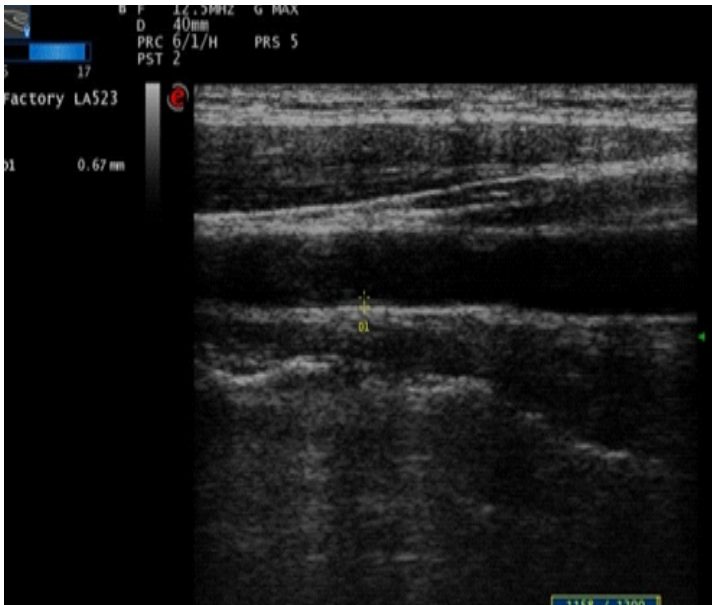


Figure 2: Showing IMT LCCA of a normotensive individual

In this case control study 70 individuals were scanned, 40 (57.1%) individuals had prior history of hypertension and other 30 (42.9%) were without any prior history of hypertension or any neurologic disease. Minimum age was 20 years while maximum age was 80 years. Their range was 60 with mean age of 43.2571 years. For forty hypertensive patients, maximum patient age was 80 years and minimum age was 20 years. Their range was 60 with the mean age of 45.9250 years. For 30 normal (without any prior history of hypertension and neurologic disease) maximum age was 78 and minimum age was 20 years. Their range was 58 with the mean age of 39.7 years. The minimum IMT for all 70 patients was 0.44mm and maximum was 0.92mm and mean was 0.6314 mm. The minimum IMT for hypertensive patients was 0.44mm and maximum was 0.92mm with the mean of IMT 0.6255mm. In normotensive sample, there was minimum IMT of 0.46mm and maximum of 0.82mm with the mean of 0.6393mm. Out of 70 patients, 25 (35.7%) were females and 45 (64.3%) were males. Plaques were present in 8 individuals (11.8%). A significant correlation of intimal medial thickness with increasing age was found ($r=0.6$ and P value of .000). Investigations showed that the atherosclerotic changes effect the IMT. As the patients with plaques had increased IMT as compared to those without plaques. Sensitivity and specificity of ultrasound in hypertensive and normotensive patients was 50.0 and 66.7 (Figure 3).

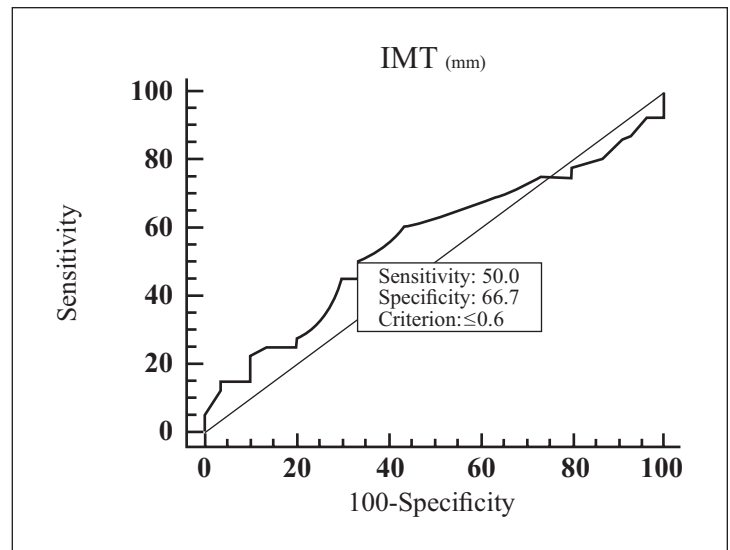


Figure 3: Sensitivity and specificity of ultrasound in hypertensive and normotensive patients

Sensitivity and specificity of ultrasound in present and absent plaque patients was 87.5 and 87.1 (Figure 4).

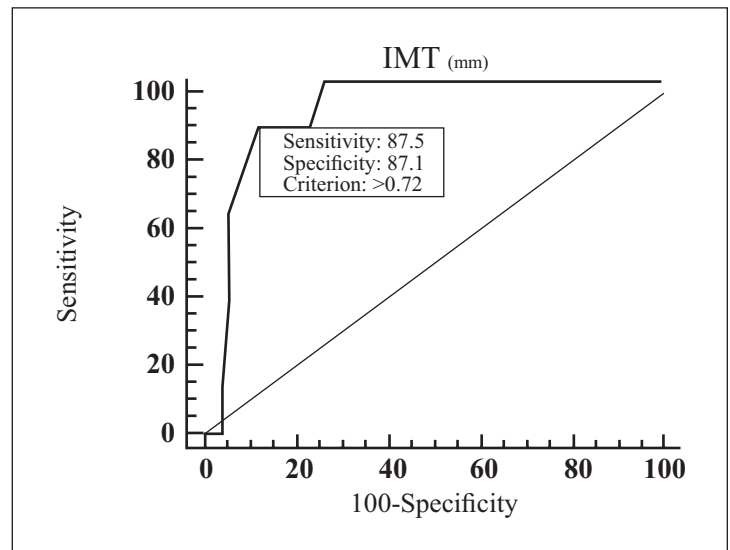


Figure 4: Sensitivity and specificity of ultrasound in present and absent plaque patients

Discussion:

A significant correlation of intimal medial thickness with increasing age ($r=0.6$ and P value of .000) has been observed. Results showed no significant difference in the IMT in the two groups comprising of hypertensive and non-hypertensive patients. This was very interesting and was quite different from what we expected and previously reported results of many studies such as Sharma et al., who found significant difference in the IMT in normotensive and hypertensive patients.¹⁷ The reason for this discrepancy in results was although

difficult to explain but we found a limitation in the stated study that they didn't mention the age of the control subjects. However used age matched controls in our study which might not be the same in their study. As found in current study that age is a very significant factor in IMT and it is very important to have age match controls in order to see the effect of hypertension on IMT. However noticed a very significant difference in the IMT in patients having plaque and those with its absence irrespective of the fact that they had or had not hypertensive disease. In a study conducted by Bots *et al.*, a significantly increased risk of myocardial infarction and stroke was seen in patients with increased IMT. In that study risk increased in both case and control groups which consisted of both hypertensive and normotensive individuals with increased IMT. These results also showed that normotensive individuals do not necessarily show normal IMT⁵. Recent study of Stein HJ *et al* showed that both IMT and plaques are used as marker for atherosclerosis. Study also indicated that plaque area is the stronger predictor of the atherosclerotic events than IMT¹⁶. Carotid plaque burden is also a predictor of MI and stroke^{18, 19}. In a study conducted by author on increasing thickness of carotid IMT in healthy people concluded that there are many other factors which introduce changes in thickness of IMT other than any pathology. Age is one of the strong factor which is the cause of thickening of carotid IMT in healthy people²⁰. Study conducted by author depicted that there is strong relationship between hypertension and atherosclerosis. Hypertension has a major role in increasing IMT and pathogenesis of atherosclerosis. Thickening of carotid IMT is initiated when hypertension is borderline. Findings indicates that increase in IMT is an earlier pre-clinical atherosclerotic change. This study concluded that carotid atherosclerosis progresses with transition in hypertension, from normotension to borderline hypertension and then to hypertension²¹.

Conclusions:

It is concluded that IMT increases with advancing age. IMT also increases in patients with other signs of atherosclerosis such as plaque formation. IMT thickness might even be seen in normotensive individuals. IMT is not independently affected by hypertension. Hypertension

has a major role in increasing IMT and pathogenesis of atherosclerosis.

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