ORIGINAL ARTICLE

Morphological and Anatomical Features of Left Anterior Descending Artery Intima-Media Thickness in a Sample of Pakistani Population

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ABSTRACT

Background: A recognized surrogate marker that can be utilised for the prediction and profiling of atherosclerotic cardiovascular disease is the thickness of the intima-media layer. Despite the fact that it varies geographically and ethnically, the significantly less likely to have it documented. This is despite the fact that there are many different communities . As a result of the process of atherosclerosis, the left anterior descending coronary artery is one of the coronary arteries that is afflicted the most of the time. As a consequence of this, the goal of this study was to determine whether or not there is a correlation between the intima-media thickness of the left coronary artery and the characteristics of the artery based on its morphology.

Time and Place of study: Shaikh Zayed Hospital Lahore March 2019 to October 2021

Results: The thickness of the intima and media, on average, was 0.334 + 0.05 mm. It was more prevalent in males than in females.0.329+0.01 mm in females, increased with the number of branches of the left coronary artery, starting from 0.329+0.01 mm in males bifurcation to 0.499+ 0.01 mm in pentafurcation; and was also greater in left coronary arteries that were shorter than the average length of the right coronary artery 0.5mm, in addition to those with bifurcation angles greater than 700.

Conclusion: The length, bifurcation angle, and terminal branching pattern of the left coronary artery all have an impact on the intima-media thickness of the left anterior descending artery. Additionally, the intima-media thickness of the left anterior descending artery is greater in males than it is in females. It can be deduced from this that the morphological characteristics of the left coronary artery are anatomical factors that contribute to the development of atherosclerosis.Screening for atherosclerosis ought to be done on those who exhibit these characteristics in order to provide early intervention.

INTRODUCTION

The intima-media thickness, often known as IMT, is a reliable and sensitive marker of subclinical atherosclerosis, as well as an independent predictor of cardiovascular events and injury to target organs . Additionally, it is helpful in the evaluation and stratification of the risk of cardiovascular disease, the prediction of the result over the long term, and the monitoring of the continuing progression and regression of disease. Diseases associated with atherosclerosis are on the rise in Punjab, especially in Pakistan. However, data on IMT from communities continue to be sparse, despite the fact that they are vital in preventing additional increases in the disease's frequency. The coronary artery known as the left anterior descending (LAD) artery is the one that suffers from disease the most frequently. Recent research indicates that the characteristics of atherosclerosis are already evident in this artery at a young age. As a result, the purpose of this study was to determine whether or not there was a correlation between IMT in this artery and the morphological features of the left coronary artery (LCA) in Pakistan.

MATERIALS AND METHODS

This study included postmortem material from samples taken from 100 victims of trauma, 56 of whom were male and 44 of whom were female, none of whom had any record of cardiovascular illness. Those who died of cardiovascular disease such as hypertension, myocardial infarction, stroke, diabetes, renal disease, and peripheral vascular disease were not included in the study because they were either under the age of 20 or over the age of 60. Only people whose deaths could be directly attributed to trauma were considered for this study. People who had a history of smoking cigarettes or drinking alcohol, HIV, or any other viral or bacterial infection were also not allowed to participate in the study. The ages ranged anywhere from 21 to 53 years old. [Average age 43.5 years, plus or minus 5.0] Only seven people (5.6%) were older than 50 years of age, while 71 (56.3% of the total) were younger than 40 years of age. After opening the chest cavity and making a longitudinal cut in the pericardium to expose the heart, which was then removed by cutting it free from the major vessels two centimeters from its base, the chest cavity was closed. A Settler TM balance was used to weigh the hearts, and the results were rounded to the nearest grams. Using a set of dividers, the size of the heart was determined by measuring it at the place where its width was at its greatest. Through dissection, both the LCA and the LAD were uncovered. We did not consider any hearts that weighed greater than 450 grams. In preparation for light microscopy, specimens of 2 millimeters in length were removed from the proximal LAD. Within the first three days after a person's death, specimens were collected to avoid those with obvious postmortem damage to the tissues. They were then trimmed and processed routinely for paraffin embedding by passing them through increasing concentrations of isopropyl alcohol, 50%; 60%; 70%; 80%; 90%; 95%; and 100%; each for one hour; and cleared with cedar wood oil for 12 hours. They were fixed by immersion in a 10% formaldehyde solution for three days. After that, the portions were immersed in wax after being infiltrated with newly molten paraplast wax for a period of twelve hours. Masson's trichrome was used to stain slices measuring five micrometers in thickness. The morphometry was carried out on slides for light microscopy. We used ten sequential sections from each individual specimen. The photomicroscope was set to a magnification of X35 during the entire process of taking the analogue images. After that, the images were scanned using an HPTM scanner, and the Scion ImageTM Multiscan progr was used to perform the analysis. We measured both the intimal and the medial thickness. Between the lumen and the internal elastic lamina was where it was determined that the intima extended to its full extent. We chose four positions at random (ISa, ISb, ISc, and ISd), and using the technique described in [10], we computed the average of those four points. The term "media" refers to the region that was determined to exist between the "internal elastic lamina" and "external elastic lamina." Following the selection of four random spots (Msa, Msb, Msc, and Msd) shown in Figure 1, the average size was calculated. The Statistical Package for the Social Sciences (SPSS) for Windows TM version 23.0 was used to do the coding, tabulation, and analysis of the data that was acquired. To determine the means, frequencies, and ranges for intimal and medial thickness, descriptive statistics were applied. The thickness of the intima in

addition to the thickness of the media was added together to come up with the Intima – Media Thickness. The intima-media thickness was adjusted after taking into account the heart's weight and size. The Student t-test was carried out at the 95% confidence interval, and the differences were deemed to be significant when the p-value was less than 0.05. The findings are illustrated through the use of micrographs as well as tables.

RESULTS

The average IMT was 0.334+ 0.05 millimeters. The tunica media in mild hyperplasia that was present in nearly half of the patients was the primary cause of this condition. IMT was caused by intimal thickness in over 30% of the instances, which accounted for over 50% of the total , and in some cases formed over 80% of the total . High IMT was found to be related, in fifty percent of the cases, with thick highly vascularized tunica adventitia stained with one hundred times the concentration of Mason's Trichrome. TI = Tunica Intima; TM = Tunica Media; TA = Tunica Adventitia.

(i)   Full wall thickness of LAD in a male patient who was 33 years old and showed that his IMT was formed primarily of TM. Take note of the relatively thin tunica intima, which contributes only 20–30% to the IMT;

(ii)   tunica intima and tunica media of the left anterior descending artery in a 40-year-old female demonstrating that the tunica intima contributes more than 50% to the IMT.

(iii)   TI and TM of LAD in a 49-year- female showing the overt predominance of tunica intima, which contributes nearly 79% of IMT;

(iv)   Full wall thickness of LAD in a 45-year-old female showing thickened (TA) forming almost 50% of the wall thickness.

(v)   TI and TM of LAD in a 49-year-old male showing the overt predominance of tunica intima which contributes nearly 80% Take note of the thick tunica adventitia that is very vascular. IMT was measured at 0.31+0.04 mm in males, whereas it was measured at 0.27+0.03 mm in females. This difference was statistically significant [p<0.01], and it remained even after accounting for the size and weight of the hearts of the subjects. After accounting for differences in heart weight, previously observed age differences were shown to be statistically insignificant and vanished altogether.
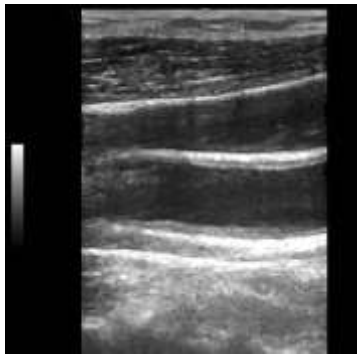

Fig 1: ultrasound image of the common carotid artery showing-thickened intima media

Fig 2: Histological image of the ratio of intima media thickness of atheromas in the aortic root

(vi)   There was a correlation found between the intima-media thickness of the left coronary artery and the branching pattern, length, and bifurcation angle of the artery. Bifurcation made up 54.8% of the LCA branching pattern, whereas trifurcation made up 32.3%, quadrifurcation made up 9.7%, and pentafurcation made up 3.2%. After the pentafurcation, the IMT was measured to be 0.499+ 0.01 mm, up from 0.329+0.01 mm after the bifurcation. The difference was large enough to warrant statistical attention (p < 0.001) There was a statistically significant difference between the sexes in terms of bifurcation and trifurcation. There was not a single instance of quadrifurcation or pentafurcation in female patients . The length of the LCA was 8.45 mm on average, give or take 0.52 mm (Range 2.0-18.5 mm). The majority, which made up 54.7%, ranged in length from 5 to 15 mm. 16 of them, or 38.1%, were less than 5 millimetres, while only 3 of them, or 7.2%, were longer than 15 millimetres. The IMT decreased in direct proportion to the length of the object. It was greatest (0.40+0.04 mm) in the arteries that were the shortest, and it was least (0.29+ 0.014 mm) in the arteries that were the longest .

DISCUSSION

The normal range for the intimal thickness of the LAD is 100-350 micrometer, while the normal range for the medial thickness is 150-250 micromeer. The intima-media thickness of 0.332 mm that was discovered in this study falls within the range that has been described in the previous research. The literature reports are also in agreement with the age-dependent rise in severity. This suggests that the predisposition to atherosclerosis linked with intima-media thickness is similar among populations. If this is the case, then it suggests that the Pakistani population is just as susceptible to atherosclerosis as other populations. It was shown that shorter coronary arteries had an intima-media thickness that was substantially greater than that of normal and longer ones. This conclusion is in agreement with previous reports in the medical literature that shorter common trunks of LCA are associated with an increased risk of atherosclerosis. It is possible that 37.1% of people in the Pakistani population have an inherent factor for atherosclerosis. This is what is implied by the data. Additionally, the intima-media thickness was shown to be greater in the arteries that had a variable branching pattern, such as trifurcation, quadrifurcation, and pentafurcation. This finding is consistent with studies that unique branching patterns induce disrupted flow, reducing wall shear stress, and thereby rendering the affected arteries more susceptible to atherosclerosis . In this perspective, 47.1% of the population of Pakistan would be innately susceptible to atherosclerosis due to the fact that this structural determinant exists. A large branching angle is another constant anatomical trait that is related with high IMT. This is also similar with studies that have been found in the scientific literature stating that high bifurcation angles are related with a higher risk of atherosclerosis . In the current investigation, 41.01% of the participants exhibited bifurcation angles greater than 700, which indicates a greater predisposition to atherosclerosis. Therefore, those who present themselves for a cardiovascular evaluation ought to undergo screening for termination pattern, bifurcation angle, and length of LCA in order to facilitate the early initiation of control measures for cardiovascular disease (CVD). Coronary artery stenosis is caused by a thickness of the intima and media that is too high. The thickness of the carotid intima and media, the histology of the carotid plaque, and cerebrovascular events have been shown to correlate with this kind of stenosis and possible acute coronary syndromes . Indeed, atherosclerosis in the carotid arteries is linked to the development of coronary atherosclerosis . As a result, concurrent ultrasound screening of the vulnerable Pakistan population for carotid IMT could potentially increase early diagnosis of unfavorable cardiovascular risk.

CONCLUSION

The length, bifurcation angle, and terminal branching pattern of the left coronary artery all have an impact on the intima-media thickness of the left anterior descending artery.

In addition, the intima-media thickness of the left anterior descending artery is higher in males than it is in females. This difference is observed in both males and females.

Because of this, t is possible to draw the conclusion that the morphological characteristics of the left coronary artery that have been brought up in this article are anatomical risk factors for atherosclerosis.

Individuals who exhibit these risk factors ought to go through atherosclerosis screening in order to facilitate the formulation of early intervention strategies.

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