Luminal Diameters of Major Coronary Arteries

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Abstract

Background: To measure the luminal diameters of major coronary arteries through micrometry.

Methods: In this descriptive study, after incising pericardium, 0.5cm long segments of major coronary arteries i.e. right coronary artery (RCA), left anterior descending artery (LAD) and left circumflex artery (LCX) were taken at their origin, from adult male cadavers of up to 36 years age. After processing for paraffin embedding, 5µm thick sections were prepared, mounted on glass slides and subsequently stained with hematoxylin and eosin. Luminal diameter for each section was measured through micrometry, at four places along the planes at 45º to each other.

Results: The mean luminal diameters of major coronary arteries i.e. RCA, LAD and LCX were 1.54 ±0.46 mm, 1.48 ±0.31 mm and 1.37 ±0.56mm respectively.

Conclusion: The mean luminal diameters of major coronary arteries in Pakistani population are lower than those reported in international literature. This might be due to geographic and / or ethnic variation(s) in the histological structure of coronary arterial wall

Key words: Luminal diameters, coronary arteries.

Introduction

There is paucity of data on the histological features of the major coronary arteries in Pakistani population and reference cadaveric data is not available. The available literature shows a great variety of histomorphometric observations of coronary arteries in different populations of the world.1,2,3. The present study was designed to conduct the histomorphometric analysis of coronary arteries in Pakistani population. Since the reported observations are based largely on a study of relatively few normal hearts and because of the difficulty in obtaining material that would give a fair representation of what might be called the normal coronary vessel, this study was conducted on twenty carefully chosen specimens. The results of this study will certainly serve as a baseline reference data in medico-legal investigations of undiagnosed and / or sudden deaths in this part of the world.

Materials and Methods

The study was conducted on twenty adult male hearts obtained during routine autopsies at CMH Rawalpindi, Khyber Medical College Peshawar and DHQ Hospital, Rawalpindi from Sept 2009 to March 2010, in collaboration with Dept(s) of Anatomy and Pathology, Army Medical College Rawalpindi.

The cause of death was accident, suicide or homicide and therefore occurred suddenly. The time lapsed between death and autopsy was less than 12 hours. Weights were recorded and hearts weighing more than 400 grams were excluded from the study to avoid the possibility of hypertensive cases. Hearts showing obvious pathological changes of atherosclerosis were also excluded. After incising pericardium, 0.5cm long segments of major coronary arteries (RCA, LAD and LCX) were taken at their origin, from adult male cadavers of up to 40 years age. Segments of the coronary arteries were fixed in 10% formalin and processed for paraffin embedding. 5µm thick sections were taken, mounted on glass slides and subsequently stained with Hematoxylin and Eosin for routine histological study. Luminal diameter for each section was measured through micrometry, at four places along the planes at 45º to each other and then their mean taken as a reading for the respective artery.

Results

The age of study population ranged from 21 to 36 years with a mean value being 29.0 (± 4.16) years. Heart weights of all the specimens were determined before studying which ranged from 243 to 397 grams with a mean value being 314.15 (± 36.60) grams. The mean luminal diameter of major coronary arteries , i.e., RCA, LAD and LCX were 1.54 ± 0.46 mm, 1.48± 0.31 mm and 1.37± 0.56 mm , respectively (Table 1) (Fig. 1&2).
Table 1: Mean luminal diameter of RCA, LAD & LCX (in mm)

<table>
<thead>
<tr>
<th>Coronary arteries</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCA*</td>
<td>0.68</td>
<td>2.57</td>
<td>1.54</td>
<td>0.46</td>
</tr>
<tr>
<td>LAD**</td>
<td>1.02</td>
<td>2.20</td>
<td>1.48</td>
<td>0.31</td>
</tr>
<tr>
<td>LCX***</td>
<td>0.086</td>
<td>2.00</td>
<td>1.37</td>
<td>0.56</td>
</tr>
</tbody>
</table>

*RCA=Right Coronary Artery; LAD= Left Anterior Descending Artery; LCX=Left Circumflex Artery

Fig. 1: LAD section of specimen no. 32 showing arterial lumen, tunica intima, media and adventitia and internal elastic lamina. Approx. X120.

Fig. 2: LCX section of showing arterial lumen, tunica intima, media and adventitia and internal elastic lamina. Approx. X300.

Discussion

The present study has highlighted the variation in luminal diameters of human coronary arteries in cadaveric hearts of Pakistani population. There is paucity of data on histological parameters of coronary arteries in human cadavers. The authors could not find any earlier publication that had described the histomorphometric features of coronary arteries in Pakistani population. The earlier data on dimensions of coronary arteries is based on angiographies/echocardiographies of living subjects mostly with symptomatic CAD. After excluding the various risk factors of CAD, the present histological study was conducted on adult male cadavers to measure the mean values of luminal diameters of major coronary arteries.

In this study, the luminal diameters of major coronary arteries were noted at their origin (Table 1). Results support the observations of Turner and Navratnam (1996) and Okumura et al (2004) who claimed that the caliber of the coronary arteries in both, main stems and larger branches, range between 1.5 and 5.5 mm at their origins but results of the present study are closer to the lower limit of the mentioned range. This study also supports the observations of Podesser et al (1998) who, in an autopsy study on Austrian population, indirectly gave the luminal diameter of coronary arteries to be 0.02 – 2.20 mm. Results of the present study are also comparable to those of Krams et al (1997) regarding mean luminal diameter of RCA. The values of luminal diameter in autopsy specimens in the present study are quite less than those observed during angiographies in living subjects. This difference is understandable since postmortem changes are always present at autopsy and these changes follow the postmortem clock. In addition, artifactual dimensional changes also occur during fixation and histological processing of tissues (dehydration, clearing, embedding, sectioning and staining).

Another explanation to the narrow lumen might be that the caliber of coronary arteries in this part of world are less because of comparatively small stature and physique of Asian population as compared to that of west. Taller men have larger luminal diameters of coronary arteries. Some populations of the world have more atherosclerotic burden though the mortality rate from CAD is less. Example to this fact is the Australian population who has mean percentage luminal narrowing ranging from 40 % (in people aged 20-29 years) to over 60 % (in those aged 60 and above); the narrowing being more pronounced in LAD and least in LCX. According to Levy, aging is responsible for increase in the caliber of the arterial lumen which partially compensates for the effects of atherosclerosis-induced arterial wall rigidity on vascular compliance. The high values of luminal diameter quoted in angiographic studies in adult and old-age living population with evidence of atherosclerosis and/or symptomatic CAD, must be holding this phenomenon of remodeling of coronary arteries with age, as the cause responsible. In this study, this age-related
dilating effect on arterial lumen must have been quite negligible since the study population ranged from 21–36 years. The luminal diameter of RCA in the present study is greater than LAD followed by LCX (Table 1) which supports the observations of other studies. This study contradicts the observations of Ballisteros et al and Ortale et al that the luminal diameters of left coronary arteries are greater than RCA. The larger luminal diameter of RCA in this study must be in accordance with the greater area of distribution of RCA and right dominance (73.3%).

The results of this study will serve as a normal reference data against which the lumen dimensions of coronary arteries can be compared in various pathological states. It can be of particular value while investigating cases of sudden or undiagnosed deaths to exclude diffuse atherosclerosis as a cause.

Conclusion

1. The calibers of coronary arteries in this part of the world are lesser as compared to that of west indicating different atherosclerotic burden in different populations and because of the comparatively small stature and physique of Asian population as compared to that of western population.

2. Genetic studies assessing both genotype and phenotype would be required to assess the role of genetic factors in micro-anatomic variations.

References