Diameter of the Orifice of the Left Coronary Artery: Angiographic Study


SUMMARY: The ongoing advances in the technology of coronary artery angiograms have put high demands on the basic knowledge of coronary arteries. This study describes the angiographic morphology of the ostium (orifice) of the left coronary artery among Sudanese with respect to sex, age, length, and BMI. The study design is a cross-sectional retrospective hospital-based conducted from 2014 to 2016. The inclusion criterion of participants is adult males and females presented to the cardiac centers for elective angiograms. The exclusion criteria are age below 18 years, documented congenital heart disease, and previous coronary bypass. Angiograms were done using a digital radiographic system. Data was collected through a predesigned data collection sheet. The data were entered and analyzed using SPSS v27. A test of correlation was done between the different variables. The data were presented in the form of tables. A P-value of <0.05 was considered statistically significant. The total number of participants was 441; males and females represent 42.9 % and 57.1 %, respectively. The mean age of participants was 56.24±8.68 years. The left coronary artery originated from the left aortic sinus. The mean diameter and length of the left coronary artery were 3.8±0.70 mm and 8.1576±4.32 mm, respectively. A significant negative correlation was reported between the diameter of the orifice and both age and length of the left coronary artery. A non-significant difference between males and females in the diameter of the left coronary artery at ostium (P=0.058) and a significant difference in the length (P=0.00). Sudanese have the smallest diameter of the orifice of the left coronary artery among Africans. Sudanese males have a smaller diameter of orifice than females; females have the longest arteries. A wider orifice of the left coronary artery is associated with a short arterial length.

KEY WORDS: Left coronary artery; Ostium; Orifice; Length; Diameter; Sudanese.

INTRODUCTION

The technology of coronary artery angiogram witnessed significant advances and became the mandatory and gold standard in the management of patients with coronary heart diseases (Alhassen et al., 2021). Thus the presence of basic knowledge about the angiographic anatomy of coronary arteries is essential in the management and during intervention maneuvers such as stenting, balloon dilatation, or graft surgery (Taha et al., 2015).

The left coronary artery (LCA) arises from the left aortic sinus posterior to the pulmonary trunk, and then it passes between the left auricle and infundibulum of the right ventricle to reach the coronary sulcus. On reaching the coronary sulcus, it divides into two terminal branches, circumflex and anterior interventricular arteries. The trunk of LCA is shorter and larger than the right artery. The LCA supplies almost all the left ventricle and atrium (Williams & Bannister, 1995; Sinnatamby, 2013). The ostia of the coronary arteries develop by apoptosis on the aortic sinuses; and the main trunk by ingrowth of endothelial vascular strands that originate from the peritruncal ring of coronary vascular plexus (Bernanke & Velkey, 2002; Ajayi et al., 2015). The absence or shortness of the LCA may indicate the fast ingrowth of the main branches and their subsequent...
attachment to the left aortic sinus (Ajayi et al., 2015). The LCA has great variability in origin, course (Ayalp et al., 2002; Al Khalifa & Omar, 2006), diameter and length (Alhassen et al., 2021; Ru et al., 2021).

Among Sudanese, about 71.7 % were right heart dominant, 23.5 % left dominant, and 4.8 % co-dominant (Taha et al., 2015). Alhassen et al. (2021) reported that the angiographic diameter of the LCA was 3.96 ± 0.55 mm (in the range between 2.90 and 4.90 mm) (Alhassen et al., 2021). The average length of the artery was 8.16 ± 3.89 mm, and females had longer arteries than males (Alhassen et al., 2018).

Many factors can affect the morphology of the coronary artery, such as age, sex, body weight, body surface area, the weight of the heart, and ethnicity or race (Dodge Jr. et al., 1992). It was also reported that there is no correlation between the length of the LCA and its diameter (Alhassen et al., 2021). Sufficient arterial perfusion to the heart depends on the position, shape, and morphometry of coronary ostium (Kulkarni & Paranjpe, 2015).

Many diagnostic and therapeutic procedures and bypass surgeries are done worldwide. In addition to this, the globalization of health services and across margins seeking treatment has put high demands on the basic anatomical knowledge and reference values of the LCA for different ethnicities or races. However, the data available regarding the diameter of the left coronary ostia amongst the Sudanese population is very scarce and lacks data about angiographic anatomy. This study aims to describe the angiographic morphology of the ostium of the left coronary artery among Sudanese in relation to sex, age, length of LCA, and BMI.

**MATERIAL AND METHOD**

The study design is a cross-sectional retrospective hospital-based (Rezigalla, 2020). The inclusion criterion of participants is adult males and females presented to each of the three major cardiac centers for elective angiograms (cardiac center of Khartoum hospital, Sudan heart center, and Alzaytouna Specialist Hospital). The exclusion criteria are age below 18 years and a documented congenital heart disease or previous coronary bypass.

The angiograms were carried out under x-ray control and usually took about 20-30 minutes. The catheterization was done either through brachial or femoral arteries according to the patient’s medical status. Angiograms were done using a digital radiographic system (TOSHIBA DFP/8000A). The angiographic measurements were done using standardized quantitative coronary angiography (QCA) software with electronic calipers (Fig. 1). All measurements were done uniformly during diastole after injection of contrast. For the left coronary ostia, the widest dimension was taken as the ostia diameter (DLCAO). The length (LCA) was measured in contrast filled segments of the left coronary artery free of tortuosity.

![Fig. 1. Show measuring of left coronary artery ostia (A) and length (B).](image)

Data were retrieved from 2014 to 2016. The retrieved variables were the origin, diameter of the orifice (ostia), length of the left coronary artery, and sociodemographic data. The sociodemographic data include age, sex, and body mass index (BMI). Data were collected from the records through a standardized methodology using a predesigned data collection sheet.

The study was ethically approved by the ethical board of the National Ribat University and the ethical committees of the three cardiac centers.

**Data analysis.** The retrieved data were entered and analyzed using SPSS v27. The data were presented in the form of tables. Correlation tests were done between the different variables, and a P-value of <0.05 was considered statistically significant. The confidence interval was set as 95 %.

**RESULTS**

The total number of participants was 441. Males and females represent 42.9 % and 57.1 %, respectively. The mean age of participants was 56.24±8.68 years. The mean age of male participants was 53.44±9.92 years, while that of females was 58.33±6.95 years (Table I). About 47.6 % of the participants were obese; meanwhile, 23.8 % were overweight, and only 19 % had normal BMI. The majority of females were obese (63.64 %) and represented 70 % of...
the obese participants. Meanwhile, among males, 25% were of normal BMI and the percentage overweight and obese among males is equally (37.5%). Males represent 60% of overall overweight.

In all the participants, the LCA originated from the left aortic sinus. The mean DLCAO among participants was 3.8±0.70 mm. While, the mean length was 8.1576±4.32 mm (Table I). A significant negative correlation was reported between DLCAO and both age (r=-0.33; P=0.00) and LLCA (r=-0.386; P=0.00). The DLCAO has a non-significant negative correlation with BMI (Table III).

Among male participants the DLCAO and length of LCA were 3.7±0.83 mm and 6.7±1.97 mm respectively. While among females DLCAO and length of LCA were 3.85±0.60 mm and 9.17±5.16 mm, respectively. On average females have a wider orifice and longer LCA than males. (Table III). Both male and females have a significant moderate negative correlation between DLCAO and both age and LLCA. Independent t-test showed no significant difference between males and females in regards to the DLCAO (P=0.058) and a significant difference in the length (P=0.00) (Table IV).

Table I. Descriptive statistics of participants. DLCAO, diameter of the left coronary artery at the origin. LLCA, length of the left coronary artery.

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>441</td>
<td>43</td>
<td>68</td>
<td>56.24</td>
<td>8.68</td>
</tr>
<tr>
<td>DLCAO (mm)</td>
<td>378</td>
<td>2.00</td>
<td>4.90</td>
<td>3.8</td>
<td>.70</td>
</tr>
<tr>
<td>LLCA (mm)</td>
<td>357</td>
<td>3.60</td>
<td>16.50</td>
<td>8.1576</td>
<td>4.32</td>
</tr>
</tbody>
</table>

Table II. Correlation between age, the diameter of the orifice, and length of the left coronary, and BMI of participants.

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Age</th>
<th>DLCAO</th>
<th>LLCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>-.331**</td>
<td>1</td>
<td>-.386**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>-</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>378</td>
<td>378</td>
<td>357</td>
</tr>
</tbody>
</table>

* Correlation is significant at the 0.01 level (2-tailed).

DLCAO, the diameter of the left coronary artery at origin; LLCA, length of the left coronary artery.

Table III. Descriptive statistics of male and female participants. DLCAO, the diameter of the left coronary artery at origin; LLCA, length of the left coronary artery.

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>189</td>
<td>252</td>
</tr>
<tr>
<td>DLCAO (mm)</td>
<td>147</td>
<td>231</td>
</tr>
<tr>
<td>LLCA (mm)</td>
<td>147</td>
<td>210</td>
</tr>
<tr>
<td>Number</td>
<td>53.4±9.916</td>
<td>58.3±6.946</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>3.71±0.83</td>
<td>3.85±0.60</td>
</tr>
<tr>
<td>Number</td>
<td>6.71±1.97318</td>
<td>9.17±5.16</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>147</td>
<td>210</td>
</tr>
</tbody>
</table>

Table IV. Correlation between age, the diameter of the orifice, the length of the left coronary, and BMI of males and female participants.

<table>
<thead>
<tr>
<th>Correlations</th>
<th>MALES</th>
<th>FEMALES</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLCAO (mm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>-.425**</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>-</td>
</tr>
<tr>
<td>N</td>
<td>147</td>
<td>147</td>
</tr>
</tbody>
</table>

DLCAO, diameter of the left coronary artery at origin; LLCA, length of the left coronary artery. BMI, body mass index.

DISCUSSION

The mean age of the study group was 56.24±8.68 years. Females had the highest mean age (58.33±6.95) and represent the majority (57.14%). Age is deliberated to be a risk factor for CHD (Genazzani et al., 2000). It was reported that over 40% of CHD deaths are among people aged less than 75 years (Mirzaei et al., 2009). Females were reported to have more than a 10% higher difference in mortality than males due to CHD (Keates et al., 2017); this report can justify the increased number of females in the study group. The BMI is a known risk factor for CHD (Umer et al., 2017; Powell-Wiley et al., 2021).

In the current study, the LCA of all participants originates from the left aortic sinus, and no acute angle takeoff was reported. This finding is in accordance with the previous work of Alkhalifa & Omar (2006). They found that about 3% of the study group (270) had an anomaly in the LCA which were limited to the origin of the anterior descending branch (Alkhalifa & Omar, 2006). Anomalous origin of the LCA is less common and has more risk than the right coronary artery (Mery et al., 2018). The anomalous origin of coronary arteries is considered the second most common cause of sudden death among young athletes (Brothers et al., 2007; Angelini & Uribe, 2018).
Los avances en la tecnología de los radiógrafos digitales permiten la obtención de imágenes radiográficas de alta calidad en tiempos breves. Los datos se obtuvieron a través de un sistema de exploración radiográfico digital. Los datos se obtuvieron a través de un sistema radiográfico digital. Los datos se obtuvieron a través de una ficha de datos preseñalizada. Estos fueron ingresados y analizados con SPSS v27. Se realizó una prueba de correlación entre las diferentes variables. Los datos se presentaron en forma de tablas. Un valor P de <0,05 se consideró estadísticamente significativo. El número total de participantes fue de 441; Hombres y mujeres representaron el 42,9 % y 57,1 %, respectivamente. La edad media de los participantes fue de 56,2±8,68 años. La arteria coronaria izquierda se originaba en el seno aórtico izquierdo. El diámetro medio y la longitud de la arteria coronaria izquierda fueron 3,8±0,70 mm y 8,1576±4,32 mm, respectivamente. Se encontró una correlación negativa significativa entre el diámetro del ostio, la edad y la ACI. Además se encontró una diferencia no significativa entre hombres y mujeres en el diámetro del ostio de la ACI (P=0,058) y una diferencia significativa en la longitud (P=0,00). Los sudaneses tienen el diámetro del ostio de la arteria coronaria izquierda más pequeño entre los africanos. Los hombres sudaneses tienen un diámetro del ostio de la arteria coronaria izquierda más pequeña y las mujeres tienen las arterias más largas. Un ostio más ancho de la arteria coronaria izquierda se asocia con una longitud arterial corta.

PALABRAS CLAVE: Arteria coronaria izquierda; Ostio; Longitud; Diámetro arteria coronaria izquierda; Sudanés.

REFERENCES


