CHAPTER 1: INTRODUCTION

The word coronary was contrived by the anatomists when shape of a corona or crown was noticed on the surface of the heart when all muscles its surface of the heart was removed. The right (RCA) and left (LCA) coronary arteries arise from the ascending aorta from its anterior and left posterior sinuses. The level of the coronary ostium is variable. The main arteries and its major branches are usually sub-epicardial, but the branches in the atroioventricular and interventricular grooves are often deeply seated. This can be occasionally hidden by the overlapping myocardium and embedded in it. The major arteries supplying the heart are RCA and left main (LMCA) coronary arteries with the right posterior descending artery (PDA) for RCA and left anterior descending (LAD) and circumflex artery (LCx) for LMCA as the main branches [1].

Coronary artery disease (CAD) is one of the most common causes of morbidity and mortality especially in the developing countries which accounts for more than one-third of the total deaths. Coronary artery diameter is one of the most important factors that affect the procedure and outcome of percutaneous coronary angioplasty (PCI) as well as coronary bypass operations (CABG) [2]. Lumen diameter of normal human coronary arteries and several factors affecting the lumen diameters have been studied previously in different countries on different populations [3–8]. Currently, there is no other multi-centre study with international recognition among South Indian population regarding normal coronary artery dimensions.

1.1 Development of the epicardium and the coronary vasculature

The epicardium, coronary vascular bed and interstitial fibroblasts develop from the protrusion of mesenchymal cells which is covered by mesothelium. The pro-epicardium arises from the pericardium in the region of the sinus venosus during fifth week of gestation. The base of the pro-epicardium encompasses bi-potential pericardial cells, which are recruited either to the cardiac lineage or to the epicardial lineage. The cardiac lineage cells form the venous pole of the heart. The entire structure is expressed by Tbx 18.
Bone morphogenetic proteins, fibroblast growth factors followed by the potential pericardial cells influences the pattern of lineage. The precise mechanism of specification is not yet clear. Cells detach from the pro-epicardium and spread over the myocardial tube, from caudal to cranial part as well as from dorsal to ventral region. Thus, in successive stages, pro-epicardial cells approach the myocardial surface of the developing atria, atrioventricular canal, ventricles and the proximal part of the outflow tract.

The primitive myocardial walls undergo regression and this facilitates the arterial supply towards the distal part of the outflow tract. After the formation of the epicardium, a space is formed between the developing epicardium and the outer myocardial layer. This is named as the subepicardial space, or subepicardium. Mesenchymal cells which are derived from epicardium play an important role in the formation of the coronary vasculature. These are pluripotent cells which can be the precursors of coronary fibroblasts, smooth muscle cells and endothelium.

The coronary arteries were previously assumed to form by means of angiogenesis, or sprouting from the aortic root. However, recent studies have proved that the coronary vessels develop even before the formation of the arterial orifices in the aortic sinuses. The vessels arise by vasculogenesis. The mesenchymal cells in the sub-epicardial space give rise to primitive vessels that invade the myocardium and spread over the myocardial surface. Sprouts of this plexus approach the base of the outflow tract and connect to the sinuses of the aortic root.

RCA and LMCA are formed by the above mentioned mechanism. Small accessory branches of the coronary arteries take its origin directly from the coronary sinuses in few percentages of human hearts. The coronary veins develop by sprouting from the coronary sinus which drains directly to the atrial chambers. Finally, a mature coronary vascular pattern is established by remodelling of the capillary plexuses and reduction in the number of arteriovenous anastomoses [1].

1.1.1 Congenital anomalies of the coronary circulation

Coronary artery anomalies are defined as any variations in the number, origin, course, and termination of the arteries. These are mainly confirmed by angiographic findings which are rarely encountered in the general population [9]. Coronary anomalies may
occur in 1 - 5% of patients undergoing quantitative coronary arteriography (QCA), which in turn depend upon the capability for defining an anatomic variant [10, 11] (Table 1.1) [12]. The clinical perspective and the need for appropriate identification and classification of coronary anomalies are essential. This determines their severity for developing into fixed or dynamic myocardial ischemia which causes sudden cardiac death, particularly in young and healthy persons [13].

### Table 1.1 Incidences of Coronary Anomalies in 1950 Angiograms [12]

<table>
<thead>
<tr>
<th>Sl. no.</th>
<th>Variable</th>
<th>n</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Coronary anomalies</td>
<td>110</td>
<td>5.64</td>
</tr>
<tr>
<td>2.</td>
<td>Split RCA</td>
<td>24</td>
<td>1.23</td>
</tr>
<tr>
<td>3.</td>
<td>Ectopic RCA (right cusp)</td>
<td>22</td>
<td>1.13</td>
</tr>
<tr>
<td>4.</td>
<td>Ectopic RCA (left cusp)</td>
<td>18</td>
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</tr>
<tr>
<td>5.</td>
<td>Fistulas</td>
<td>17</td>
<td>0.87</td>
</tr>
<tr>
<td>6.</td>
<td>Absent LMCA</td>
<td>13</td>
<td>0.67</td>
</tr>
<tr>
<td>7.</td>
<td>LCx arising from right cusp</td>
<td>13</td>
<td>0.67</td>
</tr>
<tr>
<td>8.</td>
<td>LMCA arising from right cusp</td>
<td>3</td>
<td>0.15</td>
</tr>
<tr>
<td>9.</td>
<td>Low origin of RCA</td>
<td>2</td>
<td>0.1</td>
</tr>
<tr>
<td>10.</td>
<td>Other anomalies</td>
<td>3</td>
<td>0.15</td>
</tr>
</tbody>
</table>

*Abbreviations: n- Number, RCA- Right coronary artery, LCA- Left coronary artery, LCx- Left circumflex coronary artery*

Conventional exercise stress testing and intravascular doppler flow studies poorly predicts or helps in the identification and documentation of precise ischemia risk for some of the coronary artery anomalies. These tests may also fail to detect significant anatomic abnormalities [14]. Accordingly, coronary artery anomalies are divided into those that cause and those that do not cause myocardial ischemia. Malignant features of anomalous coronaries include a slit like ostium, an acute angle of takeoff of an artery, an intramural course, and significant compression between the aorta and the pulmonary trunk [15].

### 1.2 Arterial nomenclature

The Coronary Artery Surgery Study (CASS) investigators confirmed the most commonly used nomenclature to describe the coronary anatomy, defining 27 segments of three major coronary arteries. The Bypass Angioplasty Revascularization
Investigators (BARI) modified these criteria by including two more segments namely, ramus intermedius (RAM) and the third DIAG branch (Table 1.2) [16]. In this system, the three major coronary arteries include the LAD, LCx and RCA [9].

1.3 Anatomy of the coronary arteries

The RCA arises from the anterior (right coronary) sinus and the LMCA from the posterior (left coronary) sinus of the ascending aorta. The ostial levels of both the coronary arteries may vary in their position. An oblique inverted corona is formed within the atrioventricular groove by both the coronary arteries. The main arteries and its major branches are usually subepicardial, but those in the atrioventricular and interventricular grooves are often deeply sited, and occasionally hidden by overlapping myocardium [1].
<table>
<thead>
<tr>
<th>n</th>
<th>Map location</th>
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<th>Map location</th>
<th>n</th>
<th>Map location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Proximal RCA</td>
<td>11</td>
<td>LMCA</td>
<td>18</td>
<td>Proximal LCx</td>
</tr>
<tr>
<td>2</td>
<td>Mid RCA</td>
<td>12</td>
<td>Proximal LAD</td>
<td>19</td>
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<tr>
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<td>Distal RCA</td>
<td>13</td>
<td>Mid LAD</td>
<td>20</td>
<td>First OM</td>
</tr>
<tr>
<td>4</td>
<td>Right PDA</td>
<td>14</td>
<td>Distal LAD</td>
<td>21</td>
<td>Second OM</td>
</tr>
<tr>
<td>5</td>
<td>Right posterior atrioventricular</td>
<td>15</td>
<td>First DIAG</td>
<td>22</td>
<td>Third OM</td>
</tr>
<tr>
<td>6</td>
<td>First right posterolateral</td>
<td>16</td>
<td>Second DIAG</td>
<td>23</td>
<td>LCx atrioventricular groove</td>
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<tr>
<td>7</td>
<td>Second right posterolateral</td>
<td>17</td>
<td>LAD septal perforators</td>
<td>24</td>
<td>First left posterolateral</td>
</tr>
<tr>
<td>8</td>
<td>Third right posterolateral</td>
<td>29</td>
<td>Third DIAG</td>
<td>25</td>
<td>Second left posterolateral</td>
</tr>
<tr>
<td>9</td>
<td>Posterior descending septals</td>
<td>27</td>
<td>Left PDA branch</td>
<td>26</td>
<td>Third left posterolateral</td>
</tr>
<tr>
<td>10</td>
<td>Acute marginal segment</td>
<td>28</td>
<td>RAM branch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Abbreviations:** n - Number, RCA - Right coronary artery, PDA - Posterior descending branch, LCA - Left coronary artery, LMCA - Left main coronary artery, LAD - Left anterior descending artery, DIAG - Diagonal, LCx - Left circumflex coronary artery, RAM - Ramus intermedius, OM - Obtuse marginal
Fig. 1.1 Diagramic representation of location of the coronary arteries

Image adapted from Gray’s Anatomy. 41st edn. London: Churchill Livingstone. 2008 [1]
1.3.1 Right coronary artery (RCA)

The RCA arises from the anterior (right coronary) aortic sinus; with its ostium usually below the sinutubular junction. The RCA passes at first anteriorly and slightly to the right between the right atrial appendage and pulmonary trunk, where the sinus usually bulges. On reaching the atrioventricular groove, RCA descends almost vertically to the right (acute) cardiac border. This curves around the posterior (inferior) part of the groove and approaches the junction termed as crux within interatrial and interventricular grooves. The artery ends a little to the left of the crux, often by anastomosing with the LCx branch of the LMCA [1].

The termination of RCA may vary. It ends near the right cardiac border or between the border and the crux, or it may reach the left border, replacing the more distal part of the LCx artery. The branches supply the right and variable parts of the left chambers and atrioventricular septum. Usually, the first branch of RCA is the right conal artery. The RCA ramifies antero-inferiorly over the pulmonary conus and over the superior aspect of the right ventricle, sometimes anastomosing with a similar branch from the left interventricular / LAD artery to form the annulus of Vieussens. This is a tenuous anastomosis around the right ventricular outflow tract.

The first segment of the RCA (between its origin and the right cardiac margin) gives off anterior atrial and ventricular branches. The branches diverge widely, approaching at a right angle mainly in the case of the ventricular arteries [1].

In contrast, the left coronary ventricular branches have acute origins. Usually two or three anterior ventricular branches ramify towards the cardiac apex. The right marginal artery is greater in calibre than the other anterior ventricular arteries and reaches the apex in most hearts. There can be up to three small posterior (inferior) ventricular branches and most often two. They arise from the second segment of the RCA between the right border and crux to supply the right ventricular diaphragmatic aspect. Their size is inversely proportional to that of the right marginal artery, which usually extends to the cardiac diaphragmatic surface. On approaching the crux, the RCA normally produces up to three posterior (inferior) interventricular arteries [1].
The posterior interventricular/ PDA artery itself, lying within the interventricular groove, may therefore be flanked, either to the right or to the left, or on both the sides, by these parallel branches. When these flanking vessels exist, branches of the PDA are small and sparse. The PDA is occasionally replaced by a left coronary branch. The atrial branches of the RCA are anterior, lateral (right or marginal) and posterior groups. They are usually small single vessels of 1 mm in diameter. The right anterior and lateral branches supply the right atrium. The posterior branch is usually single and supplies both atria.

The artery of the sinu-atrial node is an atrial branch, distributed largely to right atrial myocardium. Its origin is variable; most commonly it arises from its right lateral part, and least often from its posterior atrioventricular groove. This ‘nodal’ artery thus usually passes posteriorly in the groove between the right atrial appendage and aorta. It may originate from the LCx of the LMCA. The ramus crista terminalis or nodal artery traverses the sinu atrial node. This supplies the atria and serves as the ‘main atrial branch’ [1].

Septal perforating branches of the RCA are relatively short. This leaves the PDA branch to supply the posterior interventricular septum. There are numerous branches that do not usually reach the septal apex. The largest posterior septal perforating artery commonly arises from the inverted loop and supplies the atrioventricular node. Small, recurrent atrioventricular branches which supply adjacent atrial myocardium originate from the ventricular branches of the RCA as they cross the atrioventricular groove [1].

1.3.2 Left coronary artery (LCA)

The LCA supplies volume of myocardium, including almost the entire left ventricle and atrium and most of the interventricular septum. In hearts with ‘right dominance’, the RCA supplies a variable posterior region of the left ventricle. The LMCA arises from the left posterior (left coronary) aortic sinus. The length of LCA varies from a few millimetres to a few centimetres at its initial portion, between its ostium and first branches. The ostium may lie inferior to the margin of the leaflets and can be double, leading in to major initial branches, usually the LAD and LCx arteries. The course of the artery lies between the pulmonary trunk and the left atrial appendage, emerging in
to the atrioventricular groove, where it turns left. This part is loosely embedded in subepicardial fat and usually has no branches. The artery may give off a small atrial ramus and rarely the sinu- atrial (SA) nodal artery [1].

Reaching the atrioventricular groove, the LMCA divides into two main branches namely, LCx and LAD coronary arteries. The LAD artery is commonly described as a continuation of the LMCA. It descends obliquely forwards and to the left in the interventricular groove. This may sometimes gets deeply embedded in or crossed by bridges of myocardial tissue and by the great cardiac vein and its tributaries. Almost invariably, the LAD reaches the apex, where it terminates in one-third of hearts. More frequently, it turns round the apex into the posterior interventricular groove and passes one-third to one-half of the way along its length, meeting the terminal twigs of the posterior (inferior) interventricular branches of the LCA [1]. The LAD gives off right and left anterior ventricular and anterior septal branches and a variable number of corresponding posterior branches. The arteries cross the anterior aspect of the left ventricle diagonally, and the largest among it reaches the rounded (obtuse) left cardiac border [1].

The left diagonal (DIAG) artery is reported to exist in at least 33-50% of hearts, may be doubled (20%). A small left conal artery frequently leaves the LAD near its origin and anastomoses with its counterpart from the RCA and with the vasavasorum of the pulmonary artery and aorta. The anterior septal perforating branches leave the LAD almost perpendicularly and pass posteroinferiorly with in the septum, usually supplying its ventral two-thirds. The first septal perforator artery usually supplies the atrioventricular bundle at the point of its division. The posterior third of the septum is supplied by smaller posterior septal branches for certain distance from the cardiac apex [1].

The LCx is comparable to the LAD in calibre. It curves to the left in the atrioventricular groove and continues its course by winding around around the left cardiac border in to the posterior part of the groove, terminating in the left of the crux in most hearts. This may sometimes continue as left PDA. Proximally, the left atrial appendage usually overlaps the LCx artery. A large ventricular branch named as the left marginal artery, normally arises perpendicularly from the LCx artery. This
ramifies over the rounded ‘obtuse’ margin, supplying much of the adjacent left ventricle, typically to its apex [1].

Left ventricle gets its arterial supply from smaller anterior and posterior branches of the LCx artery. Anterior ventricular branches course parallel to the diagonal (DIAG) artery when it is present, and replace DIAG artery when it is absent. Posterior ventricular branches are smaller and fewer because the left ventricle is partly supplied by the PDA of RCA. When this artery is small or absent, it is accompanied or replaced by often doubled or tripled interventricular continuations of the LCx artery. The artery to the sinu-atrial (SA node) is often derived from the anterior segment of LCx. It passes over and supplies the left atrium, encircles the superior vena cava and sends a large branch through the SA node [1]. The artery to the atrioventricular (AV node), sometimes the terminal branch of the LCx artery (20%); arises near the crux. When this occurs, the LCx artery usually gives off the posterior interventricular artery [1].

1.4 Indications and contra-indications of QCA

QCA can indicate the presence or absence of coronary stenoses which can be documented and can aid in the determination of therapeutic options for revascularization. The role of QCA as an initial diagnostic tool for determining prognosis in patients with suspected CAD has challenging reports. This is due to low rates of symptoms in patients with CAD or lack of suggestive findings by non-invasive studies [17]. In the year 2012, multi-society guidelines have provided recommendations to add QCA as a diagnostic tool and for the management of patients with stable ischemic heart disease. QCA also serves as a supportive evidence to diagnose CAD along with symptom status and non invasive studies [18].

The Appropriate Use Criteria (AUC) of task force is a commonly used criterion in the cardiac catheterization laboratory to document the indications for QCA and PCI. Furthermore, the AUC has evaluated a number of clinically relevant scenarios for QCA and for PCI. Based on the predominance of the evidence, the need for coronary revascularization is classified in to “appropriate,” “may be appropriate,” or “rarely appropriate” [19, 20]. Diagnostic QCA detects the normal or insignificant CAD with frequency ranges from 20-39%. A dedicated quality assurance program is mandatory
for all the facilities that offer QCA, to ensure that the complication rates are not excessive [21].

1.5 Coronary artery dimensions

Coronary artery size varies among individuals and there is an evidence of some degree of variability among different geographic regions. However, many authors stated that this variability gets nullified when they compare and express mean coronary diameter per unit body surface area (BSA). This comparison is termed as indexing of coronary artery measurements (CAM) with BSA. It helps to rule out the possible bias of BSA which may have effect on CAM [2, 4, 5]. The differences were prominent among various geographic region studies with samples of CAM unadjusted or non-indexed for individual BSA [5, 7].

The calibre of coronary arteries for main stems and its larger branches ranges between 1.5 and 5.5 mm near their origins. This is based on measurements from arterial cast studies or QCA studies. The diameters of the coronary arteries may increase up to the 30th year of life [1]. The external diameter of the LMCA increases from 2.1 mm at the age of 1st year to 3.3 mm at 15th year of life [22]. A significant association has been found between the diameters of the right and left coronary arteries at birth and at 1 and 6 months of age. The birth weight, height and BSA also have an association with the coronary artery diameters [23]. The associated details about the calibre of coronary artery among the Indian population are limited.

1.5.1 Gender associated differences in coronary artery dimensions

The association of gender with coronary artery size is consistent with prior pathologic and angiographic investigations. Gender specificity can be considered as a significant predictor of the outcomes following the PCI procedures [24, 25]. In general, the CAM of the male patients were greater as compared to females in both LCA and RCA systems. However, this difference vanished when diameters were indexed to BSA.

Similarly, important observations of most QCA procedures involving coronary artery dimension analysis have revealed that women have smaller CAM compared to men [2, 4, 6, 26, 27]. There are few studies that have found women to have smaller coronary arteries even after correction for BSA [6, 28, 29]. Nevertheless, poorer prognosis of
cardiovascular events in women was associated with their smaller coronary artery diameters compared to men [30]. However, data regarding the same is limited, contradicting or not reliable. The present study intends to provide sound data to assess whether gender differences exist in the coronary vessel lumen.

1.6 Clinical outcomes following PCI in women

Increased mortality in women post-revascularization has been attributed to gender related differences in coronary size [2, 24] since artery size can be related to the outcomes after PCI [31,32]. It has been hypothesised that women having a smaller coronary lumen were attributed to an increased risk of restenosis and repeated revascularisation after PCI [31-33]. Some investigators have pointed out that the adverse outcomes of PCI could be related to the smaller coronary artery dimensions in women [2, 24, 34]. However, certain prior investigations determining the effect of gender on coronary artery size have produced variable results.

Generally, women have been found to have smaller coronary arteries [4, 35] but some authors reported that this apparent difference in artery size is due to the mass of the heart, not any specific gender trait [36]. Evaluating the potential relationship between gender and coronary artery size from earlier investigations is difficult because of the difference in the methodology such as autopsies and corrosion casting [36-38]. Present study helps to provide reliable output for the existing controversies regarding this aspect.

1.7 Body Mass Index (BMI) and its importance

World health organisation (WHO) recommended that the classifications of bodyweight should be according to the degrees of underweight and gradations of overweight. These degrees are associated with an increased risk of some non-communicable diseases [39, 40]. Based on BMI, which is calculated as weight in kilograms divided by height in metres squared (kg/m²), the populations at health risks are classified. Asian characteristics points to a vast and diverse portion of the world’s population as it also include Asian immigrants throughout the world. Diversity in Asian countries is based on ethnic and cultural subgroups, degrees of urbanisation, social and economic conditions and nutrition transitions. A wide range of morbidity and mortality profiles based on social and economic determinants of health along with
high risks profiles in certain cases which are observed among Asian population [41]. In contrast, June et al., (2002) reports that BMI cutoffs are associated with equivalent risk across ethnic groups even if it differs widely depending on the outcome and the risk estimate [42].

In general, Asians have lower mean BMI than that of non-Asian populations. Most studies assessing the effect of BMI on early clinical outcomes after CABG have compared hospital mortality and morbidity between obese and non-obese patients [43, 44]. Many previous attempts to address this problem were limited by small sample sizes or a lack of data about potentially confounding factors [43–45]. This indicates that cardiologists should pay more attention to find out the relationship between BMI and its effect on CAM as it seems to have an effect on coronary artery morphology and which in turn will have effect on patient outcome.

1.7.1 Uses of BMI cut-off points

BMI cut-off points for overweight and obesity are mainly applicable for policy purposes, to inform and trigger policy action, to facilitate the prevention programmes, and to measure the effect of interventions. The associations between BMI and health outcomes within and across populations are helpful to ascertain the cause of diseases for epidemiological purposes. The purpose of a BMI cut-off point is to identify the proportion of people with a high risk of an undesirable health state within the population. This can warrant a public health to inform policy, trigger action, facilitate prevention programmes, and to assess the effect of clinical interventions [41].

1.7.2 Associations of BMI with body fat

The association between BMI and the percentage of body fat were investigated by various authors. The relation between BMI and the percentage of body fat depends on age and sex, and it differs across ethnic groups [46, 47]. Obesity increases the risk of dyslipidemia and systemic inflammation, which can be the common pathways for the development of both diabetes and vascular disease. However, there are additional pathways that might explain the stronger association of BMI with diabetes followed by CAD [48].
1.7.3 BMI and health risks

The relative percentage of body fat at different BMIs clearly varies within the populations. This in turn depends upon environmental factors and the amount of physical activity. There are differences in percentage of body fat between rural and urban populations in India. The relations between BMI and body fat implies that the higher percentage of body fat at lower BMIs can result in an increased risk of disease such as diabetes, heart disease and even death among Asian populations [41].

1.7.4 Research needs

There is a lack of sufficient data from Asian countries with WHO consultation to describe either there is an association of BMI with body fat or to CAD. Proper statistically correlated data can aid to predict an increase or decrease in morbidity and mortality rates in populations of Asian countries, or in subgroups within countries. Since cardiovascular risk factors are higher in Asians, a lower BMI cut-off values are recommended for them compared to any other races or countries [41]. The present study correlates the BMI and coronary artery dimensions to find out the association between them to be a precursor to CAD.

1.8 Body surface area (BSA) and its implications

The BSA is widely used as a biometric unit. It is defined as the total surface area of the human body. This is mainly used for systemizing the physiologic parameters such as cardiac output, left ventricular mass (LVM), renal clearance [49, 50]. The commonly accepted 50th percentiles for BSA are 1.94 m$^2$ for adult men and 1.69 m$^2$ for adult women [51]. Mosteller, (1987), [52] proposed a simplified calculation of BSA, which can be easily used on a pocket calculator with a square root function. This formula is a modification of the BSA equation by Gehan and George, (1970) [53].

1.9 Myocardial bridging (MB) and its significance

Three major coronary arteries customarily sequel along the epicardial surface of heart. Occasionally, short moieties of coronary artery dip into the myocardium for a variable distance which is termed as MB. This has a prevalence of 5 - 12% among patients and
is usually confined to the LAD [54]. Present study outlooks the prevalence, location as well as gender specificity of the MB. MB has an idiosyncratic presentation on QCA. The bridged segment exhibits a normal calibre during diastole and precipitously constricts with each systole [55].

Analysis of the significance of MB by QCA showed that even though tunnelling provides an atheroprotective locale, atherosclerosis will become an axiomatic phenomenon in segments proximal to the bridged segment. Bridging alters the micro and macro coronary mechanics and also lure and inveigle atherosclerosis in MBs or in the segments proximal MBs [56]. Increased extent of systolic compression and narrowing degree could be the reason behind CAD in the MBs. MB might have a far-reaching role in the safeguarding of distal segments of the bridged arteries from atherosclerosis rather than causing proximal atherosclerosis [57].

Present study attempts to find out if the difference in artery diameter between diastole and systole is directly proportional to the CAD in the MBs or in the segments proximal to MBs. Although bridging is not thought to be of any hemodynamic significance in most cases, MBs were associated with angina, arrhythmia, depressed left ventricular (LV) function and myocardial stunning which can cause sudden death [54, 55]. Intracoronary Doppler studies reported the incidences of diastolic flow abnormalities in patients with MB [54]. Medical treatment generally includes beta blockers. But, nitrates should be avoided because they can worsen the symptoms. Intracoronary artery stenting and surgery have been attempted in selected patients, but the results implicated complication rates were high [54].

MB and its role in CAD have been implicated as a double-edged sword. There is a lack of clarity as to predict whether MB actually has a significant role to play in CAD. Present study approaches MB with its percentage of involvement by means of length in the artery in which it is present. Studies regarding this aspect have not shown consistent results and as their sample sizes have been small. The present study helped in providing reliable data to study this association.

1.10 Coronary arterial distribution

In right dominant cases, the posterior interventricular/ PDA artery is derived from the RCA and in left dominant it is derived from the LCA. In balanced or codominant
patterns, branches from both arteries run in or near the posterior (inferior) interventricular groove. The RCA is dominant in 80-85% of patients and nondominant in 7-13% of patients in which the LCx is the dominant vessel. The remaining 2-5% patients have RCA that gives rise to the PDA, with LCx artery providing all the postero-lateral branches termed as balanced or codominant circulation [9].

Most commonly, the RCA supplies whole of the right ventricle (except a small region of the anterior interventricular groove), a small part of the diaphragmatic aspect of the left ventricle, the posteroinferior third of the interventricular septum, the right atrium and a part of the left atrium. Apart from this, the conduction system as far as the proximal parts of the right and left crura is also supplied by RCA. LCA distribution is reciprocal and includes most of the left ventricle, a narrow strip of the right ventricle, the anterior two-thirds of the interventricular septum and most of the left atrium. Analysis of the variations in coronary arterial supply by corrosion casts methods is difficult as preservation of small vessels is not easy [1].

Present study reported the percentage prevalence of the dominance patterns (DP) and if gender specificity persists among each pattern of dominance. Cardiac DP and their correlations with atherosclerotic prominence give a better understanding of its clinical significance. Though left DP appear to have significantly higher mortality rate; supporting evidences are lacking due to reduced sample size. In this context, the present study outlooks the incidence of right, left and co-dominance patterns in a broader aspect. The present study tries to correlate the relationships of MBs to coronary artery dominance as well as association between the diameters of the coronary artery and to the type of coronary vascular distribution.

1.11 Extent of disease

CAD is defined according to the stenosis involvement percentages in the involved artery. A stenosis diameter of 50% or >50% in one or more sites of coronary artery is regarded as CAD. Stenoses of <50% diameter have major prognostic implications because these lesions most commonly lead to plaque rupture and acute coronary syndromes. Subcritical stenoses of <50% are best characterized as nonobstructive CAD. Meanwhile, obstructive CAD’s are classified as SVD-Single vessel disease, DVD-Double vessel disease and TVD-Triple vessel disease [58].
Different “jeopardy scores” were developed to quantitate plaque burden, to predict patient-based clinical outcomes and to identify the risk factors for the presence of atherosclerosis and its progression. The Califf scoring system divided the coronary circulation into six segments with two points allotted for each 75% or more coronary stenosis (score range, 0 to 12). The Gensini scoring system used an ordinal ranking based on stenosis severity in 11 coronary segments (score range, 0 to 72). The Candell-Riera scoring system used an ordinal ranking (from 1 to 5) of 13 coronary segments (score range, 0 to 65) [9].

In CASS, the major determinants of 6-year outcome were the number of diseased vessels, the number of diseased proximal segments, and the global LV function. These three factors accounted for 80% of the prognostic information. The differences among the various scoring systems were related to their definitions, rather than their ability to provide unique information. More recently, the SYNTAX score has been developed to assess early and late outcomes after PCI and CABG in patients with multi-vessel CAD [9].

1.12 Scope of the study

The present study may help the interventional cardiologists and cardiac surgeons to treat the patient by a bed to needle approach rather than a bed to scalpel approach. The study may also help them not to merely presume the artery size with the concept of ethnic variation. The present study intends to provide sound data regarding whether gender (Sex) differences exist in the coronary vessel lumen. The present study correlates the BMI and coronary artery dimensions to find out the association between them to be a precursor for CAD. The size of the coronary artery with or without a MB may have a major role to play in the causation of CAD. There is a lack of clarity as to predict whether MB actually has a significant role to play in CAD. This study aids in providing reliable data to study this association. Cardiac DP and their correlations with atherosclerotic prominence give a better understanding of its clinical significance.
1.13 Need of the study

Coronary stenting or PCI in the treatment of patients with small vessels is still a causative factor for the recurrent re-stenosis in patients. The present study helps to acquire a precise knowledge of the expected normal lumen diameter at a given coronary anatomic location which could be more useful than the traditional percent stenosis assessments. This could further aid in changing the approach of intervention on the patients, which in turn may help the patient to return to a normal life faster than the routine restrictions and precautions after a coronary bypass surgery. Surgical procedures could be avoided. All these would lead to a lower cost of coronary care, faster recuperation, and better quality of life for the patients; both physically and economically.

1.14 Aim of the study

To study the coronary artery vessel size with and without myocardial bridging (MB) and its association with other pre-selected factors which can predispose to coronary artery disease (CAD) among South Indian population.

1.15 Objectives of the study

i. To assess coronary vessel morphology in patients with and without myocardial bridging (MB).

ii. To find if gender differences exist among normal coronary artery measurements.

iii. To find the possible association of body mass index (BMI) with normal vessel dimensions.

iv. To find the distribution of diseased and non-diseased coronary arteries among normal and bridged coronary arteries.

v. To find an association between cardiac dominance and coronary artery stenosis among each pattern of dominance.