REVIEW OF LITERATURE
Fallopius (1562)\textsuperscript{57} was one of the earliest of the workers to describe the existence of the coronary arteries. He stated that there was a single coronary artery existing. Jan Swammerdam (1637-1680) introduced the preparation of corrosion casts by injecting molten wax for arteries, veins and ducts. When the injection mass solidified, the original tissues were corroded away by means of some reagent which does not destroy the cast. In 1706, Vieussens\textsuperscript{181} was the first person to describe the communication the coronary arteries and the lumen of the ventricles. Thebesius in 1708\textsuperscript{171} first demonstrated by careful dissection the occurrence of anastomoses between both coronary arteries, the existence of intercoronary arterial anastomoses in normal hearts. Banchi (1904)\textsuperscript{16} reported the first ventricular branch of the right coronary artery arising directly from the sinus of valsalva in 33\% of human hearts. He named it as "Adipose Artery" which supplied the conus arteriosus and the superior portion of the sternocostal surface of the right ventricle.

In 1907 Symmers\textsuperscript{164} dissected one hundred human hearts and observed one or more accessory coronary arteries in 38\% of cases. Spaetholz (1907) and Grossin (1921) by injecting colored or radio-opaque gelatin solution into the coronary arteries, with cleaning of tissues followed by dissection and roentgenography of the intact heart, gave following conclusions:

1) In the hearts, no end arteries exist.

2) Anastomoses exist between the branches of each coronary artery.
3) Anastomoses exist between coronary arteries both in their capillary and precapillary distribution.

Tow (1932)\textsuperscript{172} reported the case of a single coronary artery arising from the pulmonary artery in a five month old female child. In 1938, Schlesinger\textsuperscript{154} injected radio opaque lead phosphate, suspended in agar into the coronary arteries. The heart was then unrolled and arteriogram were taken and studied. In his observations of coronary arteries, he found right coronary artery dominance in man.

Blumgart et al (1940)\textsuperscript{27} correlated cases of coronary thrombosis and angina pectoris with the type of arterial patterns. According to them, the incidence of coronary disease is predominant in hearts with left coronary artery predominance. Prinz Metal (1947)\textsuperscript{128} showed considerable anastomoses between the terminal branches of coronary arteries. He reported that anastomoses increases rapidly when blood supply to any area is threatened. Prinz Metal et al (1947)\textsuperscript{128} showed that normal human heart has extensive collateral circulation with anastomoses channels of various types. They perfuse hearts from one ostium with glass beads of known diameter and found that anastomotic channels of arteriolar dimensions were present between the right and left coronary arteries in not less than 11 of 13 normal hearts.

Schlesinger et al (1949)\textsuperscript{155} stated that the conus artery a supernumerary coronary artery arising from the aorta is an important anastomoses channels from aorta to other vessels distal to the site of coronary occlusions. Smith (1950)\textsuperscript{162} reported a single coronary artery arising from aorta, which may follow the normal course of left or right and divide early into a left and right coronary arteries or take an altogether a typical
course with more or less equal frequency. Bourne (1957)\textsuperscript{31} reported the anastomoses between the branches of coronary arteries. He seen a case in which all three main coronary branches had been occluded, but the patient lived fairly comfortable life because of adequate coronary anastomoses.

Vineberg (1958)\textsuperscript{75} established that Capillary anastomoses occur in eight days. He also stated that pattern of myocardial perfusion resembles that of coronary arteries and that ischemic metabolism can be corrected. Jain et al (1958)\textsuperscript{83} described the pattern of distribution of coronary arteries by angiography in man, dog, sheep, goat and buffalo. According to them the right coronary artery dominance was more common in man whereas the left coronary artery dominance was more common in other mammals. They inferred from this that left coronary artery dominance in man is phylogenetically more primitive the other patterns.

Singer (1959)\textsuperscript{45} showed that in addition to two divisions of left coronary artery i.e. anterior descending and left circumflex branch, a third main primary division is present in 21\% of human being. It takes origin from common trunk midway between the circumflex and anterior descending branches. Usually it is smaller than the two main branches and sometimes it is bigger. Another variant is on right side, the conus branch which has a separate orifice from the main right coronary artery in a large number of individuals.

Friedmans (1960) reported the occurrence of a single coronary artery arising from the normal site of origin of right coronary artery. May (1960)\textsuperscript{111} has reported that anatomically there are bilateral source of collaterals in branches of coronaries. Many
inter-arterial, trans-arterial branches originate from them. Branches of main coronaries differ in their origin. Communication exists between coronaries and is arteriolar and not arterio-venous anastomoses and is end-arteries. Hence when there is occlusion of coronaries there is infarction, and the myocardium supplied by that particular branch is necrosed.

Rodriguez et al (1961) described an accessory coronary artery which supplies the cardiac interventricular septum in man and some animals, arising from proximal part of right coronary artery or aorta. James T.N. (1961) described the pattern distribution of coronary arteries in human hearts. He found in human hearts that the right and left coronary arteries were source of vessels to the sinu-arterial node in 55% and 45% of hearts. The site of origin of atrio-ventricular nodal artery from right coronary artery is 90% and 10% from left coronary artery. He observed that the left coronary artery was supplying most of the left ventricle except that adjustment to the posterior interventricular groove. The anterior surface of the right ventricle near the anterior interventricular groove and also most of the interventricular septum was supplied by it.

Anselmi et al (1961) described an anomalous single coronary artery arising from the anterior sinus of valsalva and opened into the right ventricular cavity at the level of the inferior and anterior third of the interventricular septum. Jokl et al (1962) reported a case of normal left coronary artery with a rudimentary right coronary artery. Burchell (1962) reported the anomalous origin of left coronary artery from the pulmonary artery which gave off the usual number of branches. They showed that coronary circulations behaves as though it has three to five separate circulation viz on
the left, is left circumflex, plus a 3rd main primary division which is present in one of
every four individuals. The right main right coronary artery is always present, but with
a conus branch, which varies in size and possess a separate orifice in large majority of
individuals.

Kubica et al (1964)\(^9\)\(^7\) reported that in 60 cases of necropsies, an even distribution of
the coronary arteries was found in 37 cases, left coronary preponderance in 14 cases,
and right coronary preponderance in 9 cases. The coronary artery vascularisation was
dense in thin and sparse in overweight persons. In one case third coronary artery was
found. Toshima (1967)\(^1\)\(^7\)\(^4\) reported a case of a single coronary artery in 16 years old
boy. The right coronary artery was absent. A wide left coronary artery was found
supplying the right side of the heart also. Baroldi and scomazzoni (1967)\(^1\)\(^9\) described
the site of origin of blood supply to the sinu atrial node. The right and left coronary
artery are the source of origin in 51% and 41% and 8% receive a bilateral supply. The
right marginal artery was found to reach the apex in 93% of hearts.

Didio (1967)\(^4\)\(^7\) described particular branches of coronary arteries supplying both atria
and ventricles of normal human hearts which they named rami-atrio ventricular.
According to them, the branches supply the atria from the ventricular arteries and
those supplying the ventricles from atrial arteries were found crossing the atrio-
ventricular sulcus. Perry (1970) described anomalous origin of the left coronary artery
from the pulmonary artery in nine cases. He noticed the left coronary artery arising
from the left posterior pulmonary sinus with normal origin of the right coronary artery
in 7, while in other two, a small accessory right coronary ostium was present
adjustment to the right coronary ostium. Tengelsted et al (1972)\(^1\)\(^6\)\(^8\) reported a rare
anomaly of the right coronary artery arising from the main pulmonary artery in a boy. Fifteen such cases were previously reported. They found a dilated left coronary artery arising from the left posterior aortic sinus and followed the course of left coronary artery.

Thenacho et al (1973)\textsuperscript{169} reported a case of anomalous origin of a small left coronary artery from the pulmonary artery with an unusually large coronary artery. Paulsen and venter (1973)\textsuperscript{122} studied the coronary angiography and macroscopic examinations of 400 hearts, for the anatomical variations of coronary arteries and origin of the blood supply to the sinus node and atrio-ventricular node. In this study 70.8\% of coronary circulation were of right type, 19.7\% of balanced type and 9.5\% of left type. Origin of the blood supply to the sinus node from right coronary artery was 63.8\% and the left coronary artery was 36.2\% fro the origin of the atrio-ventricular node was 90.5\% from the right coronary artery and 9.5 from the left coronary artery. There was no statistically significant difference in sex distribution.

Fox et al (1973)\textsuperscript{60} measured the length of the left main coronary artery in 100 cineangiograms and 100 postmortem hearts. Their results indicated an early bifurcation is very much more common than previously suspected). A single coronary artery was noticed by Sharbaugh and White (1974)\textsuperscript{156}. Leguerrier et al (1976)\textsuperscript{101} studied the anatomical variation of the aortic coronary opening in 80 hearts by dissections. They reported that both coronary ostia are usually in right anterior and in the left posterior position. The anastomotic variation of coronary ostia may be summed up in three patterns. Sometimes there is only one aortic coronary ostium, owing to left coronary artery arising from the pulmonary artery which is not frequent.
Multiple ostia are the common variations. An accessory artery i.e. third coronary artery arises by a separate ostium from the right anterior aortic sinus. Some times anterior interventricular and circumflex arteries originate by separate ostium. Variations in origin are few, affecting most often the right ostium.

Chaitman et al (1976)\textsuperscript{36} studied 3,750 patients having coronary arteriography revealed clinical and angiographic features of 31 patients with anomalous coronary artery origin. 17 cases were of aberrant circumflex artery arising from right sinus valsalva of artery each was retro aortic 7 cases were of anomalous right coronary artery from the left sinus of valsalva. The proximal course of 7 aberrant left coronary artery was from right sinus of valsalva or right coronary artery was related to clinical events.

Kalbfleisch and Hort (1976)\textsuperscript{98} reported the supply area of the large coronary arteries by angiography in 400 human hearts. The largest variation was demonstrated in the region of the posterior ventricular wall and the apex. Hearts in which left ventricular posterior wall was supplied from both right and left circumflex branches (normal type) constituted 82\% of all cases. In the right coronary dominant type (10\%) the left ventricular posterior wall at the base was supplied by the right coronary artery while in the left dominant type (8\%) right coronary artery did not supply any part of the left posterior wall. At the apex the anterior descending branch rise dorsally by about 0.2 to 5.0 cm in 70\% of cases while posterior interventricular artery rarely supplied the apex (1.1\%). The left coronary artery showed most variations in the anterior wall. It divides into two in 41\% into three with an additional diagonal branch in 53\% and into four in 6\%.
Hadziselimovic et al (1978)\textsuperscript{71} described coronary arteries in 60 hearts of newborns of both sexes by dissection and injection. They found three coronary arteries in 60\% of cases and four coronary arteries in one of the hearts. In all hearts examined, the third coronary artery arise from the sinus valsalva dexter. Hutchinson (1978)\textsuperscript{77} described the atrial blood supply to the atria of 40 human hearts mainly to the sinu-atrial node and the atrioventricular node by a clearing technique which leaves the anatomy of heart intact. In 50\% of heart both sinu-atrial and atrio-ventricular nodes were supplied from branches of right coronary artery. In 7\% both nodes were supplied by branches of left coronary artery. In remainder sinuatrial node was supplied by one coronary artery and atrioventricular node by other, in either combination. The actual site of origin of sinu-atrial nodal artery varied considerably, but in 65\% it arises from first part of right coronary artery second most common site was from circumflex branch of left coronary artery in 35\%.

Gregg et al (1980)\textsuperscript{66} reported the post-mortem study of the presence of coronary arterial collateral vessels in normal human hearts at birth and later in life. Some in these vessels are located in epicardium, but they are much prevalent in sub-endocardium. Coronary disease leads to an increase in their size and number in both regions, but increases greater in sub-endocardium than in sub-epicardium. Hadzeslimovic (1980)\textsuperscript{71} studied the coronary arteries, the third coronary artery, the conus branch and vieusen's arterial ring in 100 hearts of people aged from 20-85. The third coronary was established in 62\% of examined cases. It arises from an opening ranging from 0.5 to 1 mm situated in front of right coronary ostium. In two hearts the fourth coronary artery passes in sub-epicardial fatty tissue of coronary
groove and reaches the pulmonary conus where it frequently joins the ramus of anterior interventricular artery forming vieussen's arterial ring. The branch arising from right coronary artery courses along pulmonary conus was described as conus was described as conus branch and was found in 45% of case which in some cases forms vieussen's arterial ring with branch of anterior interventricular ramus. The ring was established in 48% of cases and it was formed also by conus artery.

Anomalous course and branches of human coronary arteries were described by Kumar (1989). The incidence of congenital coronary artery anomalies is 5 - 6% (Mongiardo, 1991). By definition, the term anomalous or abnormal is used to define any variant form observed in less than 1% of the general population (Bekedam & Vligen, 1999). New image-based diagnostic techniques have led to greater reliability in the identification of these anomalies, an in-depth knowledge of the normal anatomy of coronary arteries and their variations being required (Frommelt et al., 2001; McConnell et al., 1995; Post et al., 1995; Ropers et al., 2001). The incidence of all coronary anomalies is 0.23% in autopsy series (Alexander and Griffith, 1956) and ranges between 0.3% and 12% in angiographic series (Chaitman et al., 1976; Engel et al., 1975; Barriales et al., 2001). Owing to their relatively high rate of prevalence, some of these anomalies may be considered as variations within normal limits, taking the 1% presentation criteria as the limit between variations and anomalies (Levin, 1983; Angelini, 1989). Here, variations with a prevalence in the general population of less than 1%, and which are therefore considered as coronary anomalies, are described. In many cases, their presence affects or may affect
the subject’s quality of life and even their survival (Angelini et al., 1999; Basso et al., 2001)\textsuperscript{5,20}.

**CORONARY ORIFICE ANOMALIES**

Atresia or hypoplasia of one or both coronary orifices

The absence of one or both coronary orifices is usually associated with cases of pulmonary atresia (Lenox and Briner, 1972; Calder et al., 1987; Kasznica et al., 1987; Guenot et al., 1989)\textsuperscript{102,34,87,67}. Although cases of supravalvular aortic stenosis in the case of Atresia or hypoplasia of an orifice, the blood reaches the non-atresic portion from the healthy coronary artery by collateral circulation, the functional result being equivalent to that of the single coronary artery. If both coronary orifices are affected, collateral circulation comes from extra-cardiac arteries, or directly from the cardiac cavities (Ueda et al., 1983)\textsuperscript{175}.

**Single coronary orifice**

This anomaly, sometimes also known as single coronary artery is characterized by the absence of the proximal portion of one of the coronary arteries, with the distal portion usually in its normal location (Ogden and Goodyear, 1970)\textsuperscript{120}. Its existence was first noted by Columbus (1559)\textsuperscript{40}, although Thebesius (1716)\textsuperscript{170} published the first description. The incidence of single coronary orifice not associated with congenital cardiopathies is low, and has been placed at 0.04\% for the general population (Alexander and Griffith 1956)\textsuperscript{2} and 0.2\% - 0.4\% in angiographic series (Hillestad and Eie, 1971; Baltaxe and Wixson, 1977; Neufeld and Schneeweiss, 1983)\textsuperscript{73,12,118}. A
single coronary artery originating in the right aortic sinus is slightly more frequent than in the left (51% vs. 49%) (Ogden, 1968)\textsuperscript{119}. The location, level and size of the ostium is very important in successful performance of a coronary angiogram (Engel & Torres, 1975)\textsuperscript{52}.

ANOMALIES OF THE LEFT CORONARY ARTERY

Ectopic origin in a different aortic sinus

The left coronary artery originating from the right aortic sinus

This anomaly has been described as having an incidence of 0.02% in autopsy series, (Alexander and Griffith, 1956)\textsuperscript{2}; and between 0.05% and 0.19% in angiographic series (Chaitman et al., 1976; Kimbiris et al., 1978)\textsuperscript{36,92}. As in the case with the location of both coronary orifices in the left aortic sinus, some authors consider this situation to be a variant of the single coronary artery, regardless of whether or not both arteries originate in a common orifice or not (Boucek et al., 1984)\textsuperscript{30}. The ectopic location of the left orifice in the right aortic sinus may present the following variations (Kragel and Roberts, 1988)\textsuperscript{93} (1) a common orifice with the right coronary artery, which is usually located above the aortic supravalvular ridge, and (2) an independent orifice, anterior or posterior to the right coronary artery origin. The ectopic left orifice usually takes the form of a slit-like orifice in which the left coronary artery originates. This artery emerges forming a 180° angle with the aortic wall on the transversal plane. It may follow various paths from its origin (Ishikawa and Brandt, 1985; Greenberg et al., 1989)\textsuperscript{79,65}. These are anterior, in front of the right ventricular infundibulum (Cheitlin et al., 1974; Libethson et al., 1974)\textsuperscript{38,106}, retroaortic (Murphy et al., 1987)\textsuperscript{112},
inter-arterial, between the aorta and the pulmonary artery (Barth and Roberts, 1986)\textsuperscript{15}, and finally, transeptal, through the crista supraventricularis and the interventricular septum (Cheitlin et al., 1974, Roberts et al 1982)\textsuperscript{38,137}. In most of the cases described, the left coronary artery passes in front of the pulmonary infundibulum or between the aorta and the pulmonary artery, following an inter-arterial path (Kimbiris, 1985)\textsuperscript{91}, the retro aortic path being less common. The inter-arterial path has been associated with sudden death, especially during or immediately after intense exercise (Cheitlin et al., 1974; Barth and Roberts, 1986)\textsuperscript{38,15}. This is due to the compression of the ectopic orifice or compression of the left coronary artery owing to the expansion of the aortic and pulmonary roots during intense exercise. The anterior path of the large vessels does not present relevant haemodynamic problems. However, when this anomaly is associated with a tronco-conal congenital cardiopathy, such as Fallot’s tetralogy, there is a possibility of accidental injury to the left coronary artery or the anterior interventricular branch during surgical handling of the pulmonary infundibulum. The inter-arterial path of the ectopic left coronary artery rises slightly after its origin, followed by an anterior incurvation around the aortic root, between the latter and the pulmonary root. It then assumes a posterior concavity until it reaches the left coronary artery’s normal position, where it divides into its final branches. Between the two great arteries, the left coronary artery is usually located below the level of the pulmonary valve (Liberthson et al., 1974)\textsuperscript{106}. The transeptal path is characterised by an intramyocardial route, almost from its starting point, crossing the crista supraventricularis and the upper part of the interventricular septum, and returns to an epicardial position at some point on the upper two thirds of the anterior
interventricular sulcus. From this point onwards, it forks into its terminal branches – the anterior interventricular branch continues along the anterior interventricular sulcus, while the circumflex branch ascends along the anterior interventricular sulcus until its normal starting point, from where it continues on its normal path (Cheitlin et al., 1974; Roberts et al., 1982; Barth and Roberts, 1986; Reig et al., 1994)\textsuperscript{38,137, 15,132}.

The transeptal path, on its intramyocardial route, typically follows an upper concavity, located below and behind the pulmonary valve (Ishikawa and Brandt, 1985)\textsuperscript{79}. Often, on its intramyocardial route, it supplies the first anterior septal artery, which has been considered as an angiographic sign of the interarterial and transeptal paths (Chaitman et al., 1976; Lipoff, 1988)\textsuperscript{36,109}. The retroaortic left coronary artery path of ectopic origin is the one least commonly observed. Its frequency of presentation, in terms of the total anomalous paths of the left coronary artery, is between 28\% and 40\% (Chaitman et al., Kimbiris, 1985)\textsuperscript{36,91} although some authors refer a lower incidence (Ishikawa and Brandt, 1985; Click et al., 1989)\textsuperscript{79,39}. Ischemic complications have also been noted in cases of a retroaortic path of the left coronary artery, attributed to the angulation of the anomalous vessel towards the left, behind the aorta, and the systolic expansion of the aorta (Murphy et al., 1987)\textsuperscript{117}.

Previous studies have reported wide variation in LCA main trunk branching and have found a greater prevalence of bifurcated expression. Our results (57.8\% of this type) coincided with previous reports indicating 40 – 70\% although this was greater than that reported by Fox et al\textsuperscript{60}. The trifurcated division observed in that work (36.4\%) was in an intermediate range in relation to previous reports giving a frequency of 9 –
although Grande et al. reported trifurcation in 82.5% of their cases. The frequency of LCA tetrafurcation in our study was 5.8%, similar to that reported by previous authors (5 – 7%). Diagonal branch length variations have special importance in heart surgery because their external portion is frequently used for an autogenous bypass implant. The presence of collateral irrigation in the obtuse face of the heart, with Cx artery or LAD, diagonals or collaterals, could respond to vascular compensation for a greater territorial demand in irrigation because of deficiency in the larger arteries. The incidence of the short Cx found in Fox et al.60 work (92.85%) was similar to that reported by Mouchet, but higher than that described by Banchi (70%)16, James (81%)84, Baptista (86.4%)17 and Kalpana (83%)86. Reig et al.130 have reported a low incidence (53%). The frequency of the long Cx in Kalpana’s work86 (7.2%) was lower than that reported in previous studies, which range from 13% to 23%. The high frequency of the short Cx correlated with the low incidence of left coronary dominance observed in their work. Short Cx terminated as marginal branches in Kalpana R. ‘s study86 (25.3%), agreeing with previous studies describing 13–21%. It has been observed in many cases that the marginal branches, besides irrigating segments of the obtuse face of the heart through collateral branches positioned in horizontal or oblique trajectories, participated in doing so with the posterior branches of the left ventricle (right coronary artery), such an association irrigating the intermediate and lateral segments of the posterior face of the left ventricle. The ostium was below the level of STJ in 80% and at STJ level in 20%. The length of the main trunk of LCA was ranging from a minimum of 2mm to a maximum of 20mm with 88% of the specimens having a length between 6 and 15 mms. The main trunk of LCA
bifurcated in 47%, trifurcated in 40% and quadrifurcated in 11% of specimens. One specimen showed Pentafurcation.

Folia Morphol., 2008 studied that The LCA main trunk length recorded was considerably smaller than that reported in other populations (10 to 15 mm) Fox et al⁶⁰ have reported the shortest length to date (5.5 mm), 73% of their samples measuring less than 6 mm. Such data does not agree with other results indicating a short trunk frequency ranging from 7–15%. Only four hearts (2.6%) had LCA main trunk length greater than 15 mm in study of L.E. Ballesteros and L.M. Ramirez, fewer than reported by Green et al. (26%), Mac Alpine (14%) and Reig and Petit (18.9%)¹³⁴. Short trunks are considered risk factors for suitable coronary perfusion during aortic valve replacement.

According to L.E.Ballesteros and L.M. Ramirez, 2008¹⁰⁵, Average LCA main trunk length was 6.48 ± 2.57 mm (male 6.53 mm, female 6.37 mm). Different trunks lengths were observed as under: Short in 55 samples (35.7%), Medium in 95 (61.7%); and Long in 4 (2.6%). The LCA main trunk was bifurcated in 80 hearts (52%), trifurcated in 65 hearts (42.2%) and tetrafurcated in 9 hearts (5.8%). The left coronary artery originating in the posterior aortic sinus. The left coronary artery originating from the posterior aortic sinus is an extra-ordinarily rare anomaly, (Dagonet, 1952; Ogden, 1968; Click et al., 1989; Ishikawa et al., 1990; Iñiguez Romo et al., 1991; Hamamichi et al., 2000)⁴⁴,¹¹⁹,³⁹,⁸⁰,⁷⁸,⁷². There are, however, some descriptions of cases associated
with the transposition of the great arteries (Neufeld and Schneeweiss, 1983; Gittenberger et al., 1986)\textsuperscript{118,63}.

The left coronary artery originating from a systemic artery. Some cases of the left coronary artery originating from a systemic artery have been described, such as the ascending aorta (Di Gugliemo and Guttadauro, 1954)\textsuperscript{50}. These are exceptional cases, most of them presenting an association with aortic arch anomalies. Most cases described of coronary origin in a systemic artery affect one of the left coronary artery's terminal branches (Robicsek et al., 1967)\textsuperscript{140}.

**The left coronary artery originating from the pulmonary artery**

An anomalous coronary artery originating from the pulmonary artery was described for the first time by Brooks (1886)\textsuperscript{32} in the right coronary artery and by Abbott (1908)\textsuperscript{1} in the left coronary artery. An anomalous coronary artery originating from the pulmonary artery is a relatively infrequent anomaly, with an incidence of 0.01% in the general population (Alexander and Griffith, 1956)\textsuperscript{2}. In this anomaly, the left coronary artery normally originates in the left posterior pulmonary sinus, which is the one facing the aorta. It is usually shorter in length than the cases of aortic origin, values of between 2 and 5 mm having been described. After this short path, the left coronary artery divides into its terminal branches, which follow their usual path and layout. The left coronary artery and its terminal branches are macroscopically similar in appearance to a vein, owing to their thin walls. The anomalous origin of the left coronary artery from the pulmonary trunk together with the coronary fistulas is the
congenital coronary anomalies that most commonly produce haemodynamic alterations. Ectopic origins have also been described in the branches of the pulmonary arteries (Smith et al., 1980; Levy et al., 1983).

The main trunk of LCA showed either a direct or trifurcation. (Table-1)

**TABLE-1**

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Table-1 compares the divisions of main trunk of LCA with the studies of Baptisten (1991) and Cavalcante (1998). Kalpana (2005) described about 18% of the specimens in which the anastomosis and the anterior descending branches arose directly from the aorta.

**ANTERIOR INTERVENTRICAL BRANCH ANOMALIES**

Anterior interventricular branches originating from one right aortic sinus

The anterior interventricular branch may originate in an independent orifice in the right aortic sinus, usually in a forward position from the right coronary artery orifice or less frequently, it may originate in the right coronary artery itself. The angiographic incidence of this anomaly varies between 1.5% and 1.25%, which represents 0.1% of
all coronary arterial anomalies (Kimbris et al., 1978; Click et al., 1989). The anterior interventricular branch originating in the right aortic sinus is usually observed in association with various congenital cardiopathies, such as ventricular inversion, transposition of the great arteries, double outlet of the right ventricle and is the most frequently observed abnormal arterial pattern in Fallot’s tetralogy (Dabizzi et al., 1980; Greenberg et al., 1989; Neufeld and Schneeweiss, 1983). Some cases have also been described in patients with no other anomaly (Roberts, 1987; Barriales et al., 2001). The most frequently observed path of the anomalous vessel is the anterior one (Click et al., 1989), in which the anterior interventricular branch is situated in front of the infundibulum of the right ventricle, reaching the anterior interventricular sulcus and from that point following its normal path. The circumflex branch, with a normal path and location, originates in the orifice located in the left aortic sinus. The anterior path of the anomalous vessel in the pulmonary infundibulum is very important to the surgeon since if it is not noticed, it may be cut if a surgical incision is made in the right ventricular infundibulum. Cases associated with congenital cardiopathies that require surgical remodelling of the right ventricular infundibulum are especially vulnerable. In a series of 27 cases of Fallot’s Tetralogy, Berry and Mc Goon (1973) described 8 cases of sudden death during surgery as a result of myocardial infarction due to accidental cutting of the anomalous vessel. For this reason, both the exact location and the degree of twisting of the anomalous artery must be considered when choosing the surgical technique used to correct this congenital cardiopathy (Humes et al., 1987). Cases have also been observed of an anomalous origin of the anterior interventricular branch with interarterial and
transeptal paths (Roberts, 1987)\textsuperscript{136}. These cases hold the same risks as those described when treating anomalous paths of the left coronary artery, mainly in the interarterial path: the possibility of sudden death, especially during or immediately after intense exercise, either as a result of compression of the ectopic orifice or of the anterior interventricular branch itself (Cheitlin et al., 1974)\textsuperscript{38}. In the transeptal vessel, the anomalous vessel crosses the crista supraventricularis and the interventricular septum (Kimbiris et al., 1978; Virmani et al., 1989)\textsuperscript{92,183}. This situation presents characteristics that are partially similar to those observed when the left coronary artery originates in the right aortic sinus, or in cases of a single orifice located in the right aortic sinus, both with a transeptal path of the main left trunk. The transeptal path of the anterior interventricular artery of ectopic origin is a rarely observed anomaly, and only a few cases have been described (Bochdalek, 1867; Sanes, 1937; Saner et al., 1984; Schulte et al. 1985; Reig et al., 1989; Virmani et al., 1989; Dollar and Roberts, 1989)\textsuperscript{28,148,146,152,131,183,48} as well as some angiographically diagnosed cases (Kimbiris et al., 1978)\textsuperscript{92}. Structural changes, consisting of a thickening and elastification of the intimal layer of the arterial wall, together with a marked fibrosis of the middle layer in the intramyocardial portion of the anomalous vessel have been observed (Saner et al., 1984; Schulte et al., 1985; Reig et al., 1989)\textsuperscript{146,152,131}. These are thought to be the arterial wall’s response to the mechanical overload to which it is subjected by the myocardial fibers. These structural alterations afford the intramyocardial portion a macroscopic appearance similar to a vein in study of Kalpana, 2003\textsuperscript{86}. The LAD branch crossed over the apex to reach up to 2-5 cms up the posterior inter-ventricular sulcus in 80\%, up to the anterior apex in 8\% and up to the posterior apex in 12\% of the
specimens. The circumflex branch terminated between the obtuse margin and the crux in 67%, before obtuse margin in 3%, at obtuse margin in 13%, at crux in 6% and beyond crux in 11%. Of these, in one specimen, the circumflex branch was anomalous and found to be arising from the right anterior aortic sinus apart from the RCA and passed towards the left between aorta and left atrium and terminated between the obtuse margin and the crux. In this specimen, however, the LCA arose from the left posterior aortic sinus, the left conus artery was absent and the left anterior descending branch was a direct continuation of the main trunk and passed through the anterior inter-ventricular sulcus and terminated 2 – 5 cms up the PIVS.

The anterior interventricular branch originating from a systemic artery.

Some cases of the anterior interventricular branch originating from a systemic artery have been described, such as the common carotid artery, the subclavian artery or the internal thoracic artery (Evans, 1933; Robicksec, 1967). These cases were associated with aortic arch anomalies or with tronco-conal cardiopathies, such as the Tetralogy of Fallot. From the anomalous origin, the vessel perforates the pericardium and reaches the anterior interventricular sulcus. Usually, the rest of coronary arteries also show some anomalies of origin or trajectory.
The anterior interventricular branch originating from the pulmonary artery

The anterior interventricular branch originating from the pulmonary artery is a rarely observed anomaly and is a variant of the Bland – White - Garland syndrome (Schwartz and Robisek, 1971; Probst et al., 1976; Baltaxe and Wixson, 1977; Donaldson et al., 1979; Singh and Taylor, 1983; Evans and Phillips, 1984; Tamer et al., 1984; Roberts and Robinowitz, 1983). In the published series, the anterior interventricular branch originates in the left posterior pulmonary sinus, after which the anomalous vessel is located in the correspondent sulcus, and follows its usual path. The circumflex branch may vary in origin — in the left aortic sinus through a supernumerary orifice, or in the right coronary artery (Schwartz and Robisek, 1971; Donaldson et al., 1979;). In the latter two cases, the circumflex branch follows a retroaortic path until it reaches the left coronary sulcus, E. Tuccar studied. The LAD artery originating from the right sinus of Valsalva is a rare anomaly and is considered a potentially serious anomaly. LAD may run to the left side of the heart anterior to the right ventricular infundibulum, between the aorta and the pulmonary artery or in the ventricular septum beneath the right ventricular infundibulum. In conclusion, these aberrations should be recognized when evaluating the coronary vessels for cardiac catheterization as well as during surgical procedures. In addition, information like this can be important, if the results can be extended to other populations.
TABLE-II

Termination of Left Anterior Interventricular Branch:

<table>
<thead>
<tr>
<th>Termination</th>
<th>JAMES 1961</th>
<th>KALPANA 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td>Anterior Apex</td>
<td>18 (17%)</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Posterior Apex</td>
<td>24 (23%)</td>
<td>12 (12%)</td>
</tr>
<tr>
<td>2-5 Cms up PIVS</td>
<td>44 (42%)</td>
<td>80 (80%)</td>
</tr>
<tr>
<td>&gt;5 Cms up PIVS</td>
<td>20 (18%)</td>
<td>-</td>
</tr>
</tbody>
</table>

CIRCUMFLEX BRANCH ANOMALIES

The circumflex branch originating from the right aortic sinus

The anomalous origin of the circumflex branch from the right aortic sinus is the most prevalent congenital coronary anomaly. An incidence varying between 0.45% and 0.70 has been described in angiographic series (Chaitman et al. 1976; Vlodaver et al., 1975; Engel et al., 1975; Click et al., 1989; Iñiguez Romo et al., 1991). However, some authors, such as Ogden (1968), Page et al. (1974), Roy et al. (1975), and Gensini (1975) consider that the incidence among the general population is greater than that described, reaching 1%, and that it should therefore be considered as an anatomical variation rather than an anomaly. As regards its association with the various congenital cardiopathies, it has been described as the second most common pattern of coronary anomaly associated with transposition of the great arteries (Neufeld and Schneeweiss, 1983), having also been observed in cases of double outlet right ventricle and persistent truncus arteriosus communis (Vlodaver et al., 1975). Antopol and Kugel in 1933 published the first description of the ectopic origin of the circumflex branch. Later, Page et al. (1974) described three
circumflex branch variations of ectopic origin in the right aortic sinus. The frequency of each of these varieties is similar, although from the analysis of the various cases published (Alexander and Griffith, 1956; Page et al., 1974; Kimbiris et al., 1978)\textsuperscript{2,121,92}. The clinical significance of this anomaly is a matter of controversy. While some authors say that this anomaly has no pathological significance per se, (Neufeld and Scheneeweiss, 1983; Roberts, 1987; Molajo et al., 1988)\textsuperscript{118,136,116}, other authors consider that it is an anomaly that may lead to an alteration in cardiac perfusion (Gallet et al., 1986; Silverman et al., 1978; Piovesana et al., 1989; Samarendra et al., 2001)\textsuperscript{61,158,125,145}. Regardless of its possible role as a producer of ischemic myocardia, the lack of recognition of this anomaly may have clinical consequences, when failure to see the contrast in circumflex branch on a coronary angiography, when this vessel originates in an independent orifice, is interpreted as an obstruction of this branch (Page et al., 1974; Engel et al., 1975)\textsuperscript{121,52}. Given the relative frequency of this anomaly, when the circumflex branch cannot be seen in its normal position during coronary angiography, the possibility of an ectopic origin should always be taken into consideration. Recognition of this anomaly is also vital for correct coronary perfusion during cardiac surgery (Lillehei et al., 1964; Page et al., 1974; Roberts, 1987)\textsuperscript{107,121,136}. In any of the three variations, the path of the circumflex branch is always the same after its origin, it immediately goes backwards and to the left, around and behind the aorta, and is initially situated between the aortic posterior wall and the anterior wall of the right atrium, and subsequently the left atrium, until it is located in the left portion of the coronary sulcus, covered by the left auricular appendix, and finally adopts its usual path. The size and area of distribution of the
anomalous circumflex branch are variable, as in the case of the circumflex branch originating in the left coronary artery (Page et al., 1974; Sañudo et al., 1989) and are related to the distribution areas of the anterior intraventricular branch and the right coronary artery.

The circumflex branch originating from the pulmonary artery

There are very few cases of anomalies of the circumflex branch originating from the pulmonary artery, with most of them found in infancy or adolescence (Roberts, 1987; Krishnamoorthy and Rao, 2001). E. T. CCAR, (2002) studied that the anomalous Cx artery always coursed posterior to the aorta to reach its normal distribution and its course was typical in all his patients. It is generally agreed that this anomaly alone causes no functional impairment of the myocardium and it is therefore considered benign.

RIGHT CORONARY ARTERY ANOMALIES

Ectopic origin in a different aortic sinus

The right coronary artery originating from the left aortic sinus

This anomaly has been observed with an incidence of 0.17% - 0.38% in angiographic series (Chaitman et al., 1976; Kimbiris et al., 1978; Topaz et al., 1992) and with an incidence of 0.03% in a necropsy series (Alexander and Griffith, 1956). The incidence in necropsy series is somewhat greater than that of the left coronary artery originating in the right aortic sinus although its angiographic incidence is lower. This is probably due to the fact that patients affected by the former anomaly usually present
ischemic complications more frequently. Some authors consider this situation to be a variety of the single coronary artery, regardless of whether or not both arteries originate in a common orifice (Boucek et al., 1984). The ectopic location of the right orifice in the left aortic sinus presents some variants (Kragel and Roberts, 1988). These are originating from an independent orifice next to the left coronary one, usually in a more anterior position near the commissure between the left and right aortic valves. In this position, the orifice may be found at the same level as the supravalvular ridge, or above or below it. Originating half way, between the left and right aortic sinuses, above the valvular commissure that joins them. Originating in a common orifice with the left coronary artery, which may be located in the left aortic sinus or half way between the left and right aortic sinuses. The ectopic right orifice usually presents a larger vertical diameter, from where the right coronary artery originates, which is usually located between the pulmonary artery and the aorta, following an inter-arterial path. From its beginnings, the ectopic right coronary artery undergoes a marked angulation, forming an acute angle with the aortic wall on the transversal plane (Roberts, 1987), and then goes towards the right. It is usually located between the aorta and the pulmonary artery, following a path towards the right coronary sulcus (Kimbiris et al., 1978; Neufeld and Schneeweiss, 1983; Sañudo et al., 1998). Some cases in which the right coronary artery’s path lead to it being located in front of the pulmonary artery (Click et al., 1989) or behind the aorta (Neufeld and Schneeweiss, 1983) have also been described. This anomaly was considered relatively benign in the absence of arteriosclerosis (Chaitman et al., 1976) until Benge et al., in 1980, warned of the possibility that it may cause
myocardic ischemia as a result of the artery’s angulation after its origin, which in the case of a large aortic expansion, such as that observed during intense exercise, would lead to a compression of the vessel, giving rise to a mechanism that would end up occluding the ectopic orifice (Cheitlin et al., 1984; Virmani et al., 1986)\textsuperscript{38,182}. The Right coronary ostium was present in all the specimens in the Right anterior aortic sinus. The ostium was below sino tubular junction (STJ) in 90%, at STJ in 9% and above STJ in 1% of specimens (Kalpana R. 2003)\textsuperscript{86} The right coronary artery originating from the posterior aortic sinus is the most commonly found coronary distribution in cases of transposition of the great arteries (Neufeld and Schneeweiss, 1983; Gittenberger-de Groot et al., 1986)\textsuperscript{118,63} but it is a rarely observed anomaly in hearts with no other alteration (Vlodaver et al., 1975; Mahowald et al., 1986)\textsuperscript{184,110}. Analysis of published cases does not show that this ectopic origin may have any pathological consequence.

The right coronary artery originating from another coronary artery

This is a group of very infrequent anomalies, generally found during angiographic exploration. The right coronary artery originating from the left coronary artery, a few millimetres from its beginning, has been described (Barbour and Roberts, 1985)\textsuperscript{13}. This location is in fact similar to that of the right coronary artery originating in the left aortic sinus, and strictly speaking, is a case of a single coronary artery with a left-sided origin.
The right coronary artery may also originate from the anterior interventricular branch (Simkoff et al., 1982; Amsel and Van der Mast, 1986; Habbab et al., 1987) or from an anterior septal branch (Meyers et al., 1984). In these cases, the artery’s path passes in front of the pulmonary infundibulum. It may also originate from the circumflex branch or as a continuation of it (Tavernarakis et al., 1986; Sheth et al., 1988).

**The right coronary artery originating from a systemic artery**

There are very few of these cases described. Among them are origins in the ascending aorta, more than 2 cm from the corresponding sinus (Goldstein et al., 1990) or from another aortic sinus (Miller et al., 1987) or originating in the thoracic aorta (Cheatham et al., 1987). The right coronary artery originating from the pulmonary artery. The first description of the right coronary artery originating from the pulmonary artery was given by Brooks in 1886. It is much less common than an anomalous origin of the left coronary artery, and accounts for between 7% and 9% of cases of coronary arteries of anomalous origin (Ogden, 1968; Boucek et al., 1984). In most published cases, the orifice is located high in the right pulmonary sinus, above the supravalvular ridge. From its ectopic origin, its path and layout are normal. Its vascular wall is thin, similar to that of a vein, and usually has a dilated and twisted appearance. The left coronary artery and its branches also have an increased volume. An anomalous origin of the conus branch from the right pulmonary sinus has also been described, with the same layout as that of the artery originating in the aorta. It is usually connected with other coronary arteries with a normal origin and acts as a
fistulous communication between the high pressure coronary system and the low pressure pulmonary system (Ogden, 1968)\textsuperscript{119}.

The RCA was divided by the crux into proximal and distal segments. Both the segments were present in 89%. The proximal segment was further subdivided into First segment (origin to inferior border) and Second segment (inferior border to crux) (Williams et al, 1995)\textsuperscript{187}. Among those branches, the sinoatrial nodal (SAN) artery, which is responsible for irrigating the structure, which is in charge of initiating each heart beat, is one of the most important branches (Sañudo et al., 1998)\textsuperscript{149}. Bosnian Journal, besides being an excellent guide to the location of the sinuatrial node, detailed anatomical knowledge of the blood supply to the sinuatrial node region, an investigated topic, demands further study due to its application in cardiac surgery and in cardiology, in order to more clearly understand disturbances in its function caused by coronary disease. In the last decade, with the advent of new surgical techniques used in the treatment of arrhythmias, more specifically of atrial fibrillation, knowledge of the characteristics and trajectory of the atrial branches, particularly the sinuatrial nodal branches of the coronary artery (SANA), have assumed great importance. In study of Kalpana R. (2003)\textsuperscript{86} the SA nodal artery (SANA) was found originating in 56% of specimens from RCA, in 35% from LCA.

The second branch of first segment of RCA, the SANA, according to Uemura, (1999)\textsuperscript{176} arises from RCA in more that 60% and from LCA in less than 44% of the specimens. The distribution of SA Nodal arteries allows to understand the possible
ischaemic etiology of the Sinusal nodal syndrome and permits the surgeon, a safe approach to the cardiac diseases (Caetano & Lopes, 1995)\textsuperscript{33}.

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<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td>RCA</td>
<td>51 (51%)</td>
<td>57 (54%)</td>
<td>58 (58%)</td>
<td>56 (56%)</td>
</tr>
<tr>
<td>LCA</td>
<td>41 (41%)</td>
<td>45 (42%)</td>
<td>42 (42%)</td>
<td>35 (35%)</td>
</tr>
<tr>
<td>Both</td>
<td>8 (8%)</td>
<td>4 (4%)</td>
<td>0 (0%)</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Directly from aorta</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 (1%)</td>
</tr>
<tr>
<td>Total</td>
<td>100 (100%)</td>
<td>106 (100%)</td>
<td>100 (100%)</td>
<td>100 (100%)</td>
</tr>
</tbody>
</table>

Table-III compares the source of SANA in Kalpana's study 2003\textsuperscript{80} with that of the studies of Baroldi and Scomazzoni, 1956\textsuperscript{19}; James 1961\textsuperscript{84}; and Caetano & Lopes, 1995\textsuperscript{33}.

INTERCORONARY CONTINUITY

Intercoronary continuity is not a common condition and thus may be considered to be an anomaly, which gives the coronary circulation an "open end" character, with connections between two or more main arterial trunks, as is the case of cerebral circulation or in the extremities, when under normal conditions, coronary artery circulation is "closed end", without a good established connection between the two main coronary arteries (Esente et al., 1983)\textsuperscript{33}. It is found in subjects with no obstructive coronary lesions, although it may occasionally be found accompanying...
congenital or acquired coronary pathologies (Donaldson and Isner, 1984)\textsuperscript{49}, when only the conduction, extra-mural and epicardial vessels are involved. In most cases, intercoronary continuity is probably congenital and its path, which is the continuation of the arteries it connects, generally follows a straight line. Only two vessels are involved, which may or may not be from the same coronary artery. Functional factors encouraging the condition should not be ruled out. Basically, two locations have been described for intercoronary continuity – a communication between the circumflex branch and the right coronary artery and a communication between the two interventricular branches.

The coronary arch

This is the name used for the communication between the right coronary artery and the circumflex branch, by means of a single anastomotic channel, providing continuity between these arteries (Greenberg et al., 1989)\textsuperscript{65}. It is the intercoronary continuity location that is most frequently described. It was mentioned for the first time by Ruyschii (1701-1715)\textsuperscript{143}. Only a few cases from coronary angiography (Hines et al., 1981; Kutcher et al., 1982; Phillips and Berman, 1984; Voci et al., 1987)\textsuperscript{74,93,124} or from dissection (Reig et al., 1995)\textsuperscript{133} have been described, most of which have no signs of ischemic cardiopathy as their common feature.

Continuity between both interventricular branches

The connection between the anterior interventricular branch and the posterior interventricular branch by means of a straight anastomotic vessel that is always over
1.0 mm in diameter throughout the connection has been described in the distal portion of the posterior interventricular sulcus (Linsenmeyer and Schneider, 1983; Donaldson and Isner, 1984; Reig et al., 1995)\textsuperscript{108,49,133}. In the absence of occlusive arterial lesions, the difference between intercoronary continuity and the presence of arterial anastomosis can be clearly established by studying the vessel’s morphology. In the case of anastomotic connections, the vessel looks like an arteriole, with an endothelium sustained by muscular and elastic collagenous fibres with little organisation. However, in the case of intercoronary continuity, the vessel presents the typical well-organised layers of a muscular-type artery (Donaldson and Isner; 1984)\textsuperscript{49}. In cases where intercoronary continuity is seen in hearts affected by occlusive arterial pathology, it does not seem probable, knowing the histological structure in non-pathological hearts, that intercoronary continuity is the result of a transformation of pre-formed channels as a result of ischemic stimuli. The work of Schaper et al. (1988)\textsuperscript{151} show that even when the transformation of these channels takes place in vessels with a macroscopic arterial appearance, they cannot be considered as structurally normal arteries from the histological point of view. Moreover, their rectilinear appearance is very different from the tortuous collaterals that are found at epicardic level (Hines et al., 1981)\textsuperscript{24}.

**TERMINATION ANOMALIES – CONGENITAL CORONARY ARTERIAL FISTULAS**

A communication between a coronary artery and a cardiac cavity or any part of the pulmonary or systemic circulation is known as a coronary fistula (Levin, 1983;
Boucek et al., 1984\textsuperscript{1,0,3,30}, although use of this name is currently reserved for communications where there is an increase in the diameter of the vessel receiving the fistulous communication or where signs of volumetric overload of the affected cavity can be observed. This definition excludes arterio-sinusoidal communications with a small diameter at arteriolar level, as well as the Thebesian veins, which are particularly common in the right cardiac cavities (Angelini et al., 1999)\textsuperscript{6}. The incidence of coronary fistulas in angiographic series varies between 0.1\% and 0.2\% (Said et al., 1997; Barriales et al., 2001)\textsuperscript{144,14}. They account for 0.40\% of congenital cardiopathies (Neufeld and Schneeweiss, 1983)\textsuperscript{118}. Fistulous communications may originate both in the right and left coronary arteries, although a slightly higher incidence has been described in the left artery. The vessel of origin is dilated and twisted in appearance, owing to the increase in blood flow. The termination point of arterial fistulas is located mostly in the right cavities or in the pulmonary artery (Arani et al., 1978; Levin, 1983; Bosc et al., 1985; Said et al., 1997)\textsuperscript{9,103,29,144}. Supernumerary coronary artery which arises independently from the right aortic sinus (sinus Valsvae) and passes through subepicardial adipose tissue of pulmonary conus and anterior side of the right ventricle is called third coronary artery, preinfundibular artery or gentle Vieussens' artery. Edwards (1981) and Miyazaki (1988) state that the third coronary artery is more frequently found in adult hearts than in fetal hearts, concluding thereof that it develops only after birth. The third coronary artery often anastomoses with the branch of the anterior interventricular branch and forms Vieussens' arterial ring. This ring represents a significant path of collateral bloodstream under conditions of
coronary insufficiency. There have been described cases of anastomosis of conal artery with diagonal branch of the left conal artery also with branches of the right conal artery (Pejkovic B et al, Hadziselimovic et al). In patients with occlusive illness of coronary arteries, it is also necessary to perform selective angiography of the third coronary artery. The Right conus artery arising separately from the anterior aortic sinus the Third coronary artery (Schlesinger & Poll, 1949). The first and highest branch of the proximal segment of RCA, arises in 36% of the cases from a separate ostium (Third Coronary Artery), in the Right aortic sinus of valsalva (Williams et al 1995). In Kalpana's study, the third coronary artery was present in 24% James (1961) had noted PIVA as a terminal branch of RCA in 80% of the cases. In Kalpana's study, PIVA arises from RCA in 89% of the specimens.
I
TABLE-IV
Termination of Posterior Interventricular Artery
POINT OF JAMES, 1961 KALPANA 2004

<table>
<thead>
<tr>
<th>Point of Termination</th>
<th>James, 1961</th>
<th>Kalapana R. 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>No. (%)</td>
</tr>
<tr>
<td><strong>Provided by</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Right coronary Artery:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4 Way down PIVS</td>
<td>2 (2%)</td>
<td>9 (9%)</td>
</tr>
<tr>
<td>1/2 Way down PIVS</td>
<td>27 (25%)</td>
<td>46 (46%)</td>
</tr>
<tr>
<td>3/4 Way down PIVS</td>
<td>39 (37%)</td>
<td>26 (26%)</td>
</tr>
<tr>
<td>At Apex</td>
<td>28 (26%)</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>Total</td>
<td>96 (90%)</td>
<td>89 (89%)</td>
</tr>
<tr>
<td>2. Left Coronary Artery:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/4 Way down PIVS</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>1/2 Way down PIVS</td>
<td>5 (5%)</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>3/4 Way down PIVS</td>
<td>3 (3%)</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>At Apex</td>
<td>2 (2%)</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>10 (10%)</td>
<td>11 (11%)</td>
</tr>
<tr>
<td>Grand Total</td>
<td>106 (100%)</td>
<td>100 (100%)</td>
</tr>
</tbody>
</table>

Table-1 describes the point of termination of the PIVA, provided by both the RCA and LCA and comparesKalpana’s study, 200386 with that of James, 196181. The RCA terminated at 1-3 cms beyond crux in 76%, reached upto the left border in 8%, terminated at the crux in 6%, at right margin in 7% and between right margin and crux in 3% of the specimens. The Right coronary artery was the dominant artery in 89% and the Left in 11% of the specimens (Kalpana 2003)86.