

Research Article

A STUDY OF CORONARY ARTERIES IN HUMANS

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ABSTRACT

This study was carried out to expand our knowledge and have a better understanding of coronary arteries. Knowledge of coronary arteries in the diagnosis and management of various cardiac disorders and congenital heart disorders in which coronary arteries may have anomalous origin and a variable branching pattern is important. The increasing use of diagnostic and therapeutic interventional procedures necessitates that a sound, basic knowledge of the coronary artery pattern is essential.

Keywords: Coronary, Artery, Dissection, Cadaveric, Heart, Orcein, Congenital

INTRODUCTION

Knowledge of the coronary circulation is an increasingly vital component in the management of congenital and acquired heart diseases. Advances made in coronary bypass surgeries and modern methods of myocardial revascularisation requires a thorough, sound and complete knowledge of the normal and variant anatomy of coronary artery (Kalpana, 2003).

The anatomical structure of the coronary-aortic junctions in humans was studied and the results suggested that the structure of the coronary-aortic junctions is very different from the structure of typical arterial bifurcations (Zamir and Sinclair, 2005).

In selected patients with coronary artery disease, surgeons use percutaneous transluminal coronary angioplasty (Clinically Oriented Anatomy, 1999). For these procedures, a detailed knowledge of the coronary arteries is required.

Variations though rare, could be in origin or diameter. Cavalcanti (1995) described about 1.82% of the specimens in which the circumflex and the anterior descending branches arose directly from the aorta. The anomalous origin of left coronary artery from the pulmonary trunk was observed (Kumar, 2006).

MATERIALS AND METHODS

The study was conducted in the Department of Anatomy, Dayanand Medical College and Hospital, Ludhiana. The study was done on 20 specimens of hearts obtained from embalmed. After completing the naked eye examination, tissue slices from different coronary arteries were taken for histological examination.

Histological examination was carried out using two methods to stain the slide-

- a) Haematoxylin and Eosin (H/E) Staining
- b) Orcein Staining

Knowledge of the coronary circulation is an increasingly vital component in the management of congenital and acquired heart diseases. Advances made in coronary bypass surgeries and modern methods of myocardial revascularisation requires a thorough, sound and complete knowledge of the normal and variant anatomy of coronary artery. The increasing use of diagnostic and therapeutic interventional procedures necessitates that a sound, basic knowledge of the coronary artery pattern is essential (Kalpana, 2003).

With this aim, the normal patterns of coronary arteries were studied, with reference to the predominance, branching patterns and variations.

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Kamath *et al.*, (2002) studied 50 specimens of the coronary arteries of ages varying from 0-70yrs histologically with Haematoxylin and Eosin stain and Verhoeff's elastic tissues staining techniques. Using ocular micrometer, the thickness of tunica intima and tunica media of right and left coronary arteries were measured, and differences were observed in the right and left coronary arteries.

Beecham (2000) variation in the diameters of the coronary arteries, maximum range recorded in major studies is 1.5 – 5.5mm for coronary arteries at their origins. The study of the diameters of coronary arteries is important to plan invasive procedures like balloon angioplasty or stenting of coronary arteries when required in cases with blocked/stenosed vessels.

According to the new guidelines from the National Institute for Clinical Excellence (NICE) a stent should normally be inserted in arteries with a diameter less than 2.5mm.

Dodge Jr *et al.*, (1992) precise knowledge of the expected normal lumen diameter at a given coronary anatomic location is a first step toward developing a quantitative estimate of coronary artery disease severity that could be more useful than the traditional percent stenosis. Lumen diameter was measured at 96 points in 32 defined coronary segments or major branches. Lumen diameter was not affected by age or by vessel tortuosity.

John *et al.*, (2002) coronary artery anomalies are a well recognized feature of many cardiac malformations and have been catalogued in a number of reviews. This overview concentrates on 1) the interplay between congenital heart defects and coronary morphogenesis, examining how some of the embryology fits with the experiments of nature encountered in clinical practice; and 2) the influence of coronary anatomy on patient management. This overview uses, as examples, pulmonary atresia with intact ventricular septum, complete and congenitally corrected transpositions of the great arteries, and tetralogy of Fallot (John *et al.*, 2002).

Saikrishna *et al.*, (2006) between December 2003 and June 2004, 94 patients who underwent quantitative coronary angiography for evaluation of symptoms of ischemic heart disease and were found to have no coronary artery disease form the sample size.

Ortale *et al.*, (2005) Conclusion: The results demonstrated the complementarity of the lateral, diagonal and anterosuperior arterial branches, as well as the correlation among these branches with the different types of coronary circulation: right dominance, balanced and left dominance. Moon (1957) observed that in older individuals there was an apparent decrease in the rate of intimal fibrosis.

Kaufmann (1966) cross-sectional area of the left and right coronary arteries was determined by quantitative coronary angiography in 52 patients observed coronary artery size increases as left ventricular mass increases in both primary and secondary hypertrophy.

The enlargement of left coronary cross-sectional area is independent of the cause of the increase in left ventricular mass. The size of the coronary arteries is inappropriate with regard to left ventricular hypertrophy.

Janzen (2004) observed that the microscopic transitional zone between elastic and muscular arteries is characterized by a different ratio of scleroproteins (elastin, collagen) and vascular smooth muscle cells in the tunica media.

Kaimkhani *et al.*, (2004) this study was done on 220 patients who underwent diagnostic coronary angiography at NIVCD between May 2000 and December 2000 were studied. Sixty percent patients had right dominance pattern of which 78.1% were male and 21.8% female. By contrast 15% had left coronary dominance of which 78.7% were male and 21.2% female. In patients with left dominant pattern, the mean diameter of the right coronary artery was significantly smaller ($p < 0.001$) as compared to dominant right or co-dominant pattern.

Nakamura *et al.*, (1977) orcein has been used to demonstrate elastic staining fibers in paraffin sections. They contended that orcein is also useful as an electron-opaque stain for elastic fibres in epoxy sections. In order to evaluate their technique, the thoracic aortas of a rabbit and 101yr old male were utilized. They were fixed in 2.5% glutaraldehyde and 1% osmium tetroxide (0.1 M sodium cacodylate buffer, pH 7.4), dehydrated with graded ethanol and embedded in Epon 812.

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For light microscopy, thick (1.5-2 micron meter) were mounted on glass slides that had been coated with egg albumin glycerin, stained with the same orcein solution used for the thin sections for 12 hrs at room temperature, and counter stained for 1hr with weigert's iron haematoxylin to achieve nuclear staining.

Diffuse intimal fibrosis could be recognized in the aged human aorta.

Fine fibrous materials surrounded the smooth muscle cells in that part of the lower layer of the thickened intima closest to the media.

RESULTS AND DISCUSSION

The main coronary artery and their branches were studied. Coronary artery anomalies were looked for and the caliber of the main coronaries was studied.

Section from right and left coronary arteries were stained with hematoxylin and eosin and orcein stains for histology study.

- 1 Out of 20 hearts dissected, 70 % hearts had 2 coronary arteries and 30 % had 3 coronary arteries.
- 2 Right Coronary Artery:
 - Origin of RCA was from right aortic sinus in all the specimens studied.
 - RCA terminated before the crux in 15% of the specimens, at the crux in 10% of the specimens and beyond the crux in rest of the 75% of the specimens.
 - The mean diameter of RCA at the origin was 3.11 +/- 0.68mm with a range of 2 – 4.5mm.
 - The mean diameter of RCA at 1cm from the origin was 3.13 +/- 0.70mm with a range of 2-4.5mm.
- 3 Left Coronary Artery:
 - Origin of LCA was from the left aortic sinus in all the specimens studied.
 - Mean length of the LCA is 7.50 +/- 2.98mm with a range of 3-13mm
 - Branching pattern of LCA was noted and 70% of specimens had bifurcation of LCA, in the remainder it trifurcated.
 - The mean diameter of the LCA at origin was 3.95 +/-0.67mm with a range of 2.5 – 5.0mm.
 - The mean diameter of the LCA at bifurcation was 4.28+/- 0.73mm. With a range of 3.0-5.0mm.
- 4 Posterior inter ventricular (descending) artery:
 - Posterior inter ventricular (descending) artery arose from RCA in 85% of the specimens and from LCA in rest of the 15% of the specimens.
 - The point of termination of Posterior inter ventricular (descending) artery, provided by RCA was noted and it was 1/4th way down the Posterior inter ventricular sulcus in 47.05 % of the specimens, ½ way down in 23.52% specimens, 3/4th way down in 5.88% specimens, and at the apex in 23.52% specimens.
 - In this study, Posterior inter ventricular (descending) artery was provided by LCA in 3 out of 20 specimens, and the point of termination was noted to be ½ way down in all these three specimens.
 - The mean diameter of PIVA at origin was 1.53+/- 0.66mm with a range of 0.5 – 2.5mm.
- 5 Anterior Inter ventricular (descending) artery:
 - The Anterior Inter ventricular (descending) artery arose from LCA in all the specimens studied.
 - The termination of Anterior Inter ventricular (descending) artery was at anterior apex in 40% of the specimens and at the posterior apex in 45% specimens and in the PIVS in rest of the 15% specimens.
 - The mean diameter of the Anterior Inter ventricular (descending) artery at origin was 2.80+/- 0.50mm with a range of 2.0-4.0mm.
- 6 Left Circumflex Artery:
 - Left Circumflex Artery had its origin from LCA in all the specimens.
 - The termination of circumflex artery was before the crux in 80% of the specimens, and at the crux in 5 % specimens and beyond the crux in 15% specimens.
 - The mean diameter of the circumflex artery at origin was 2.63+/-0.67 mm with a range of 2.0-4.0mm.

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Picture Showing PIVA Arising from LCA
PIVA- Posterior Inter Ventricular (Descending) Artery,
Cx- Circumflex Artery,
LCA – Left Coronary Artery



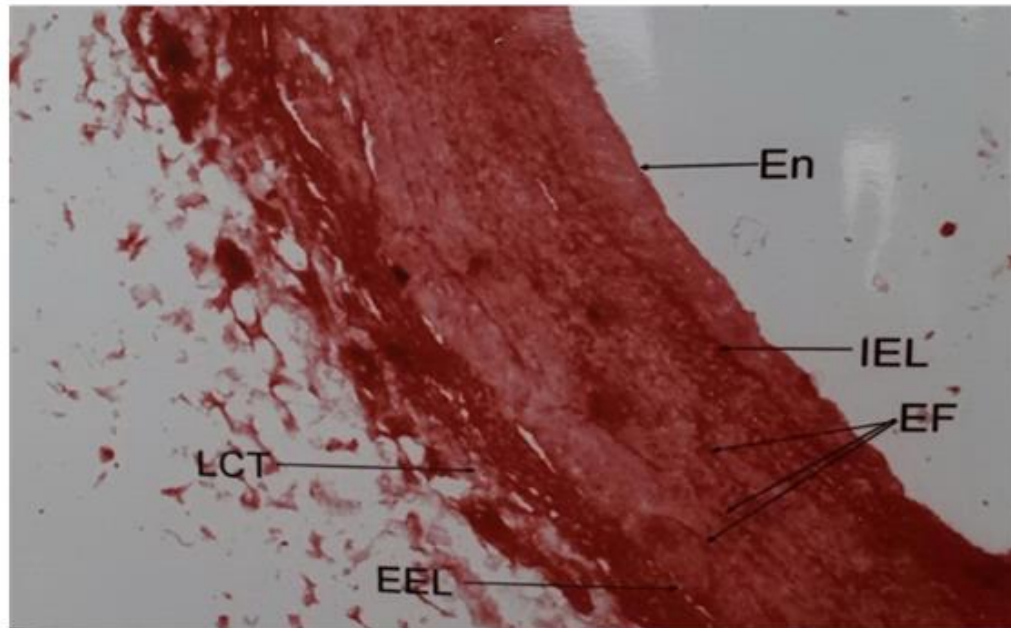
Picture Showing Third Coronary Artery Arising from the Aorta
AO- Aorta, TCA- Third Coronary Artery,
RCA- Right Coronary Artery

Histology

The sections from the right and left arteries showed internal elastic lamina which was wavy, split fragmented and distinctly visible in few areas in the tunica intima.

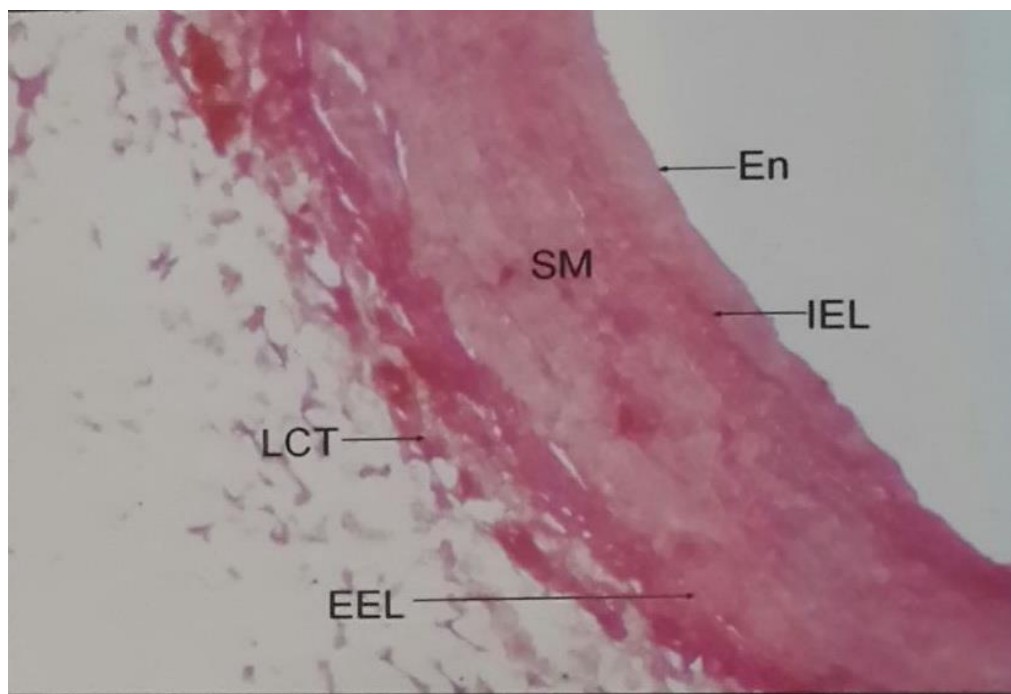
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Very few fine elastic fibres were seen scattered in the tunica media. The external elastic lamina was not very conspicuous but where ever seen, was in form of thin wavy structure which was interrupted and discontinuous.



Right Coronary Artery (Orcein Stain High Power)

En – Endothelium, IEL – Internal Elastic Lamina, EF- Elastic Fibers, EEL- External Elastic Lamina, LCT- Loose Connective Tissue



Right Coronary Artery (H/E Stain High – Power),

En-Endothelium, IEL- Internal Elastic Lamina, SM- Smooth Muscle, EEL- External Elastic Tissue

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