A STUDY OF CORONARY DOMINANCE IN THE POPULATION OF ASSAM

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ABSTRACT

With the ever increasing load of coronary heart disease, an in-depth study of the coronary arteries has been felt by the medical fraternity. Coronary arteries show wide variations among different populations. These region based variations have not been dealt with enough in the standard books. The knowledge of these variations are of paramount importance when considering various surgical interventions. This study therefore aims to focus on the pattern of coronary dominance in Assam which is ethnically unique from the rest of India. Seventy cadaveric hearts were studied. The population under study included the population of Assam. The coronary arteries were examined by gross dissection and analyzed statistically. The modes of termination of the right coronary artery and the circumflex artery were described with the help of five points: at the right border, between the right border and the crux, at the crux, between the crux and the left border and at the left border. Origin of the posterior interventricular artery was taken as the basis of dominance. Right dominance was found in 70%, left dominance was found in 18.57% while balanced pattern was observed in 11.43% hearts. The results of the study were compared with other authors and variations were noted.

KEYWORDS: Coronary artery, dominance, right dominant, left dominant, balanced, posterior interventricular artery

INTRODUCTION

Coronary heart disease is a leading cause of mortality and morbidity worldwide, particularly in developed countries. The prevalence in India had increased rapidly from 1% in 1960 to 9.7% in 1995 in urban population[1]. Even in the rural population, the prevelance has doubled in the last decade. Studies done in India had shown prevelance of 11.6% in Siliguri, 11% in Chennai and 12.63% in Tirupati[1]. With the rising disease burden, an in-depth study of the coronary arteries have become imperative for better understanding of the coronary pathophysiology and better management of coronary heart disease.

The term 'Coronary' comes from the Latin term "Corona" meaning "Crown". The heart is normally supplied by two coronary arteries: Right coronary artery (RCA) and left coronary artery (LCA). Coronary arteries are known for their wide variations with regard to origin, course, termination and branching pattern. There are also wide regional variations which have not been dealt with enough in the standard books. The present study is focused on the population of Assam, which is derived from the Mongoloid race and thus ethnically unique from the rest of India. The Mongoloids are characterized by wide and short face, projecting cheek bones, low broad nose and short stature[2]. Thus a region specific study of the coronary arteries would help both cardiac surgeons and radiologists in dealing better with the coronary heart disease.

Variability in the origin of the posterior interventricular artery (PIVA) is expressed by the term "Dominance". The term right or left "Coronary Preponderance" or "Dominance" was used to show which coronary artery irrigates the heart's diaphragmatic surface, based on the origin of the posterior interventricular artery (PIVA)[3]. Origin of the PIVA from the RCA was termed 'right dominance'; from the circumflex artery was called 'left dominance'. Origin from both the RCA and the circumflex artery was known as balanced pattern. The same parameters had been used in this study to determine dominance. Various terminologies were used such as 'right', 'mixed' and 'left inferior'[4]. The terms 'right', 'symmetrical' and 'left' were also proposed[5]. Standring S[6] preferred the use of the term 'Dominance'.

The results of the study were compared with other authors and analysed statistically with some of them.

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MATERIALS AND METHODS

A total of 70 hearts without any obvious pathology were collected from the cadavers in the department of Anatomy and unclaimed dead bodies in the department of Forensic Medicine, Gauhati Medical College, Assam.

The hearts were preserved in 10% Formalin [Formalin= 40% solution of Formaldehyde in water. 10% Formalin= 10 parts formalin+ 90 parts water] and dissected at a convenient time later. Visceral pericardium and subepicardial fats were removed. The coronary arteries and their branches were carefully dissected out and followed till their termination. The arteries were painted with red fabric colour to enhance contrast. Photographs were taken. Relevant data were recorded and analyzed statistically (manually).

RESULTS

70 hearts were examined. The RCA was found to terminate at the right border in 3 hearts (4.26%), between the right border and the crux in 6 hearts (8.57%), at the crux in 13 hearts (18.57 %), between the crux and the left border in 41 hearts (58.57 %) and at the left border in 7 hearts (10 %) [Table I]. The circumflex artery was found to terminate at the obtuse border in 12 hearts (17.4 %), between obtuse border and crux in 37 hearts (52.86 %), at crux in 13 hearts (18.57%) and between the crux and acute border in 8 hearts (11.43 %) [Table II].
In hearts where the RCA or the circumflex artery terminates at the crux, it was observed that the artery made an L- shaped turn and continued along the posterior interventricular sulcus as the posterior interventricular artery (PIVA). In specimen where the main artery crosses the crux, the posterior interventricular artery was seen to arise as a side branch.

Site	Male	Female	Total (%)
(i) Right border	2	1	3 (4.26 %)
(ii) Right border – crux	5	1	6 (8.57 %)
(iii) Crux	8	5	13 (18.57 %)
(iv) Crux- left border	30	11	41 (58.57 %)
(v) Left border	5	2	7 (10 %)
Total	50	20	70

Table I: Termination of RCA

Site	Male	Female	Total (%)
Acute /Right Border	0	0	0 (0 %)
Crux-acute border	6	2	8 (11.43 %)
Crux	8	5	13 (18.57 %)
Obtuse border – crux	28	9	37 (52.86 %)
Obtuse / left border	8	4	12 (17.14 %)
Total	50	20	70

Table II: Termination of Circumflex Artery

Dominance pattern	Male	Female	Total(%)
Right dominance	36	13	49 (70%)
Left dominance	9	4	13(18.57%)
Balanced	5	3	8(11.43%)
Total	50	20	70

Table III: Origin of Posterior Interventricular artery (Dominance)

Authors	Right dominance	Left dominance	Balanced
Schelesinger(1940)	48 %	18%	34%
James(1961)	90%	10%	-
Cavalcanti(1995)	69.09%	11.82%	19.09%
Bezbaruah NK(2003)	76%	20%	4%
Kalpana R (2003)	89%	11%	-
Present study	70%	18.57%	11.43%

Table IV: Dominance pattern compared with other authors
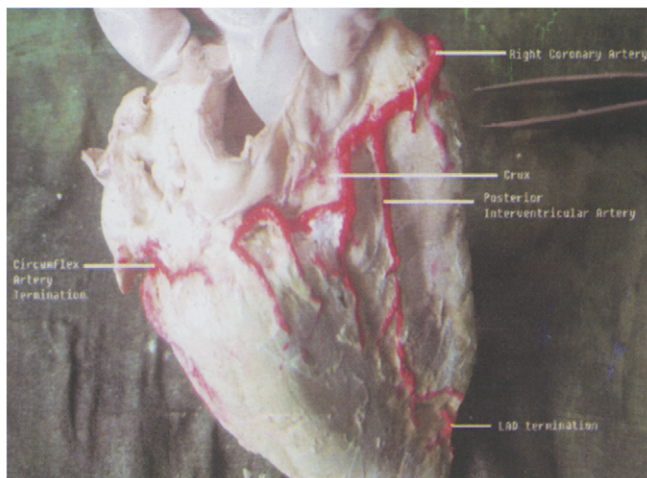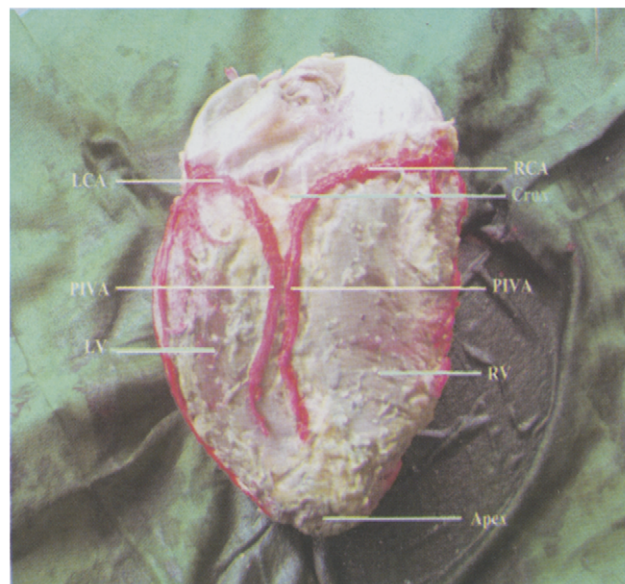

Figure 1: Specimen of heart showing right dominance
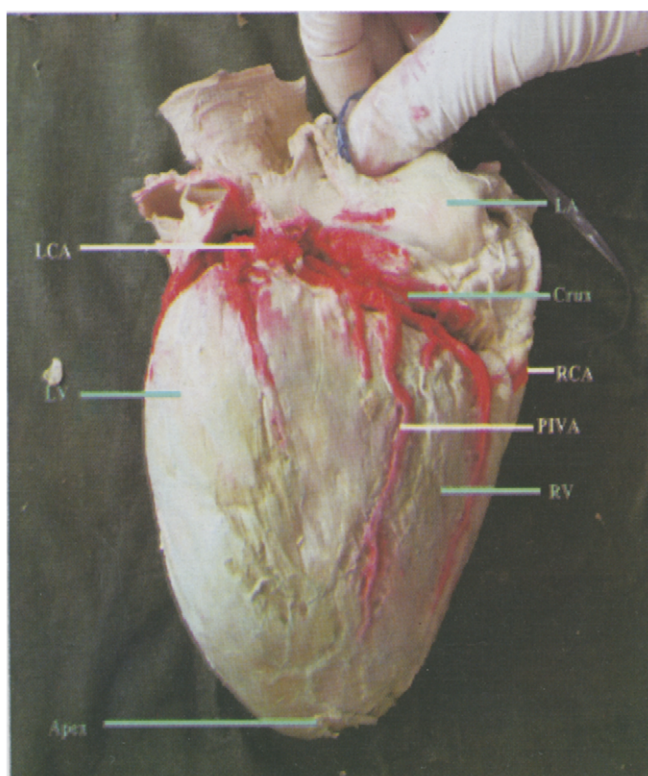

Figure 2: Specimen of heart showing left dominance

Figure 3: Specimen of heart showing balanced pattern

The posterior interventricular artery continued forward for variable distance along the posterior interventricular sulcus towards the apex. It usually terminated by anastomosing with the terminal part of the anterior interventricular artery.

The posterior interventricular artery was found to arise from the right coronary artery in 49 specimens (70%). These were called 'right dominant' (Fig 1). It arose from the circumflex artery in 13 specimens (18.57%), called 'left dominant' (Fig.2). In 8 specimens (11.43%), it arose from both the RCA and the circumflex arteries. These hearts were called 'balanced' [Table III]. In balanced pattern, we could thus see two posterior interventricular arteries (Fig. 3).

DISCUSSION

Dominance pattern of heart has important clinical significance. Left dominance was found to have significantly higher mortality than right dominance and mixed types[7]. Dominance also showed a role in left anterior descending (LAD) artery

stenosis. It was observed that in left dominance, the LAD usually wraps around the apex of the heart, supplying major portion of the myocardium. In contrast, in right dominance, it was the posterior interventricular branch of the right coronary artery that supplied most of the myocardium. As such, lesions in LAD would have more profound clinical importance in a left dominant heart than in a right dominant one[8].

Dominance also plays an important role in inferior infarcts of the heart. Inferior wall infarcts although less extensive than anterior infarcts are more important as they can cause various degrees of atrioventricular block in approximately 30 % of cases. The dominant RCA usually supplies the atrioventricular (AV) node. Therefore an inferior wall infarct caused by occlusion of the RCA will have higher risk of AV block[9].

Five points of termination of the right coronary artery and the circumflex artery were used in this study. As the right coronary artery approaches the crux, it branches out into one to three posterior interventricular rami but only one of these, running in the interventricular sulcus, is called the 'posterior interventricular artery'[6]. The RCA supplies an average of 1.8 arteries to the posterior aspect of the left ventricle[10]. During its course in the coronary sulcus, the circumflex artery gives off branches to the inferior (or diaphragmatic) surface of the left ventricle[11]. The branches supplying the inferior surface of the left ventricle are also referred to as "left posterolateral (marginal) arteries"[12].

Almost all authors have reported higher percentages of right dominance [Table IV]. Even in the present study, right dominance was more common (70%). This was comparatively less than the findings of some foreign authors[13-15]. However Schelesinger[3] found a lower percentage for right dominance (48%). Likewise, left dominance in this study (18.57%) were similar to those found by some authors3,15 but varied from some other authors[13,16].

Balanced pattern however showed wide variations. Some authors[13] found a 0% prevalence while some authors3 found prevalence as high as 34%

Statistical comparisons of our results were done randomly with one Indian author14 and one foreign author[16]. When compared with Cavalcanti[16] (n=110), the results were found to be statistically insignificant [right dominance (z=0.13, p>0.05), left dominance (z=1.2, p>0.05), balanced (z=1.43, p>0.05)]. Comparison with Kalpana R[14] (n=100) showed left dominance to be statistically insignificant [z=1.34,

p>0.05]; while right dominance [z=3.01, p<0.05] and balanced pattern [z=3.01, p<0.05] were found to be statistically significant.

The above results prove that there are wide regional variations in dominance pattern. These variations should always be borne in mind for better cardiac care.

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