

## Coronary Dominance in Fetuses of Manipuri Origin

Bidyarani Yumnam<sup>1</sup>, Aribam Jaishree Devi<sup>2</sup>,  
Nongthombam Saratchandra Singh<sup>3</sup>.

1: Postgraduate student, 2: Associate professor, 3: Professor, Department of Anatomy,  
Regional Institute of Medical Sciences, Imphal, Manipur, India.

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**Abstract:** The cardiovascular system is the first organ system of an embryo to reach a functional state. The heart is supplied by the right and left coronary arteries which arise from the ascending aorta. The artery giving off the posterior interventricular branch is defined as the dominant artery. **Materials and method:** Thirty fetal hearts ranging from gestational age of 17 wks to 40 wks are studied. **Results and observation:** Right dominance in 70%, left dominance in 20% and co dominant in 10%. Myocardial bridges are also a common finding in the course of the arteries. **Conclusion:** This study provides potentially useful information for the preoperative evaluation of the newborn.

**Keywords:** coronary artery, fetal hearts, dominance, co dominant or balanced, myocardial bridges.

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### I. Introduction

The cardiovascular system is the first major system to function in the embryo. The primordial heart and vascular system appear in the middle of the third week.<sup>1</sup> The normal coronary vasculature of the embryonic human heart begins as a group of epi-cardial blood islands, endothelium-lined cysts filled with nucleated erythrocytes, in the apical interventricular sulcus. Coronary artery arises normally only from the juxtapulmonary aortic sinuses.<sup>2</sup>

The right and left coronary arteries arise from the ascending aorta. The right coronary artery gives off the conus artery as its first branch. The right marginal artery is long enough to reach the apex in most hearts. As the right coronary approaches the crux of the heart, it normally produces one to three posterior interventricular branches (occasionally there are none). One, of them lies in the interventricular groove as the posterior interventricular artery. The left coronary divides into two or three main branches. The anterior interventricular artery is commonly described as the continuation of left coronary artery. The left diagonal artery reach the rounded (obtuse) left border. The circumflex artery, comparable to the anterior interventricular artery in calibre, curves left in the atrioventricular groove, continuing round the left cardiac border into the posterior part of the groove and ending left of the crux in most hearts, but sometimes continuing as a posterior interventricular artery.<sup>3</sup> The artery giving off the posterior interventricular branch is defined as the dominant artery. In a balanced circulation, branches of both arteries run in or near the posterior interventricular groove.<sup>4</sup> The dominant artery is usually the right in 67% of the population. In approximately 15% of hearts the left coronary artery is dominant in that the posterior interventricular artery is a branch of the circumflex artery. There is co-dominance in approximately 18% of people, in which branches of both the right and left coronary artery reach the crux of the heart and give rise to branches that course in or near the posterior interventricular groove.<sup>5</sup> Anastomoses between right and left coronary arteries are abundant during fetal life, but are much reduced by the end of the first year of life.<sup>3</sup>

The situation of coronary arteries is usually subepicardial, but can delve into the myocardium and then reappear on the surface of the heart. Thus the bundle of myocardial fibre which overlaps one segment of coronary artery is defined the myocardial bridge.<sup>6</sup>

Knowledge of the normal and variant anatomy and anomalies of coronary circulation is an increasingly vital component in the management of congenital and acquired heart diseases. Congenital, inflammatory, metabolic and degenerative diseases may involve the coronary circulation and increasingly complex cardiac surgical repairs demand enhanced understanding of the basic anatomy to improve the operative outcomes.<sup>7</sup>

### II. Materials And Method

Thirty fetuses of gestational age of 17 weeks to 40 weeks are collected from the department of Obstetrics and Gynaecology, RIMS. Prior to collection of fetuses permission is sought from the Institutional Ethics Committee. The fetuses are categorised into 4 groups randomly depending on their gestational age as group 1, group 2, group 3 and group 4 ranging from 17 weeks to 22 weeks, 23 weeks to 28 weeks, 29 weeks to 34 weeks and 35 weeks to 40 weeks of gestation respectively (Fig 1). The fetuses are then fixed in 10% formalin. The thorax is opened to remove the heart. Gross anatomy of the heart is studied and the coronary arteries are traced to their termination. Photographs of relevant areas are taken.

### III. Results And Observation

In group 1, right dominance is observed in 2 specimens and co-dominance in 1 specimen. In group 2, right dominance is seen in 2 specimens and 3 specimens show left dominance. In group 3, right dominance is seen in 8 specimens, 2 specimens shows left dominance and 1 shows co-dominance. In group 4, right dominance is seen in 9 specimens, 1 specimen shows left dominance and 1 shows co-dominance. Out of the total 30 fetal heart specimens right dominance is observed in 21, left dominance in 6 and co-dominance in 3 of the specimens (Fig 2, Fig 3, Fig 4).

The site of the termination of right coronary artery is also taken into consideration and it is observed that the artery terminates at the right acute border in 16.6% (5 no.), between the right border and crux in 3.3% (1 no.), at the crux in 13.3% (4 no.), between the crux and left obtuse border in 43.3% (13 no.) and at the left obtuse border in 23.3% (7 no.).

Myocardial bridge is also a very common observation in many of the fetal hearts in the present study (Fig 5). It is seen in 36.6% (11 no.) of the heart specimen.

### IV. Discussion

The present study observes 70%, 20% and 10% respectively of right dominance, left dominance and co-dominance in the fetal heart specimens. It is also observed that the right coronary artery crosses crux of the heart and lie near or at the obtuse border in 66.6% of the study sample.

In a study done by Kandregula J et al it was seen that the percentage incidence of dominance based on the origin of posterior interventricular branch in a sample of aborted fetuses were 56%, 38% and 6% respectively for right, left and balanced dominance.<sup>8</sup> In their findings left dominance was reported higher as compared to the present study. This is the only available study done on fetuses regarding cardiac dominance, other studies are done on adults.

Right coronary dominance was found to be the most frequently observed in studies conducted by most of the authors. Shukri IG et al reported that 65% was right dominant circulation, 27% mixed circulation and 8% were left dominant circulation.<sup>9</sup> In a study done by Kalpana R, the Right coronary artery was the dominant artery in 89% and the Left in 11% of the specimens.<sup>7</sup> Fazliogullari Z et al reported that coronary dominance of all hearts were 42%, 14% and 44% respectively of right dominance, left dominance and equal dominance.<sup>10</sup> They reported a higher incidence of equal dominance as compared to the present study. In an Assamese population, Das H et al reported 70% were right dominant, 18.5% and 11.43% were left dominant and co-dominant respectively.<sup>11</sup> The findings of Das H et al are closer to the findings of present study. Reddy VJ et al reported that in a South Indian population right dominance was 86.25%, left dominance was 11.26% and co-dominant was 2.5%.<sup>19</sup>

The overall prevalence of the myocardial bridging was found to be 70% in the study sample of Swaroop N et al. They reported that myocardial bridges were distributed more over left coronary artery in right dominant hearts. The anatomical relation of the myocardial fibres in those with long and deep myocardial bridges can distort the coronary artery that can be identified angiographically. The possibility of bridges should be borne in mind in individuals with ischemia but no evidence of coronary atherosclerosis.<sup>12</sup>

The possible clinical implications of myocardial bridging may vary from protection against atherosclerosis to systolic vessel compression and resultant myocardial ischaemia as reported by Loukas M et al. The coronary dominance of all of the hearts in their study was as follows: 55% were right dominant, 33% left dominant and 12% codominant; 66.6% of the hearts with bridges were left dominant.<sup>13</sup>

Myocardial bridging has been associated with angina, myocardial infarction, and sudden death. Ironically, the bridged segment is rarely affected by atherosclerosis and can easily go unrecognised on cine arteriography as what otherwise appears to be a normal coronary artery.<sup>14</sup>

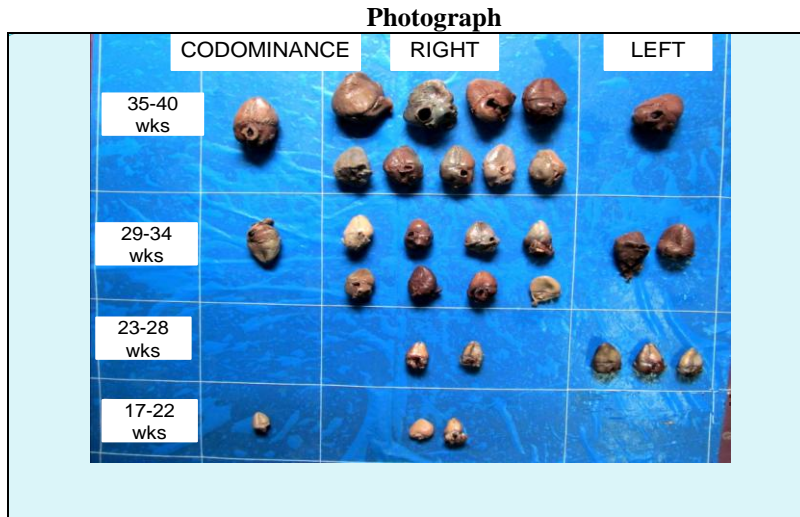
Kura GG et al also reported a case of myocardial bridge in the branches of left coronary artery, which showed a trifurcation of anterior interventricular, left circumflex and median artery.<sup>15</sup>

Abuchaim DCS et al also reported 72%, 20% and 8% of right dominant, left dominant and codominant respectively. He also reported that no anastomosis were present between the two coronary system in their study sample.<sup>16</sup>

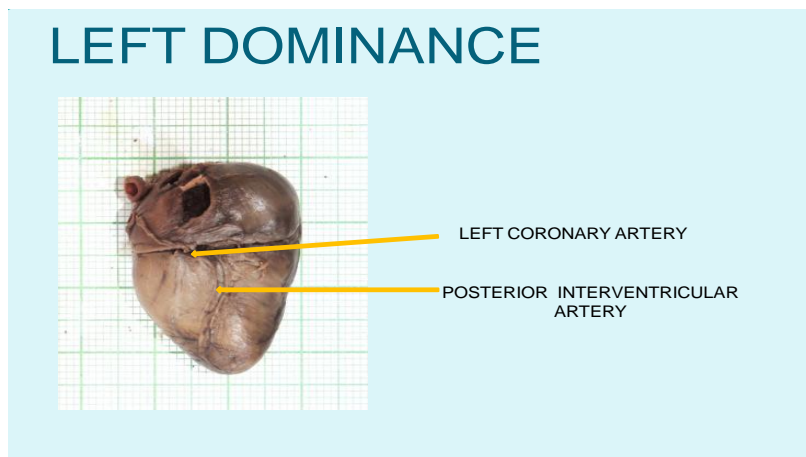
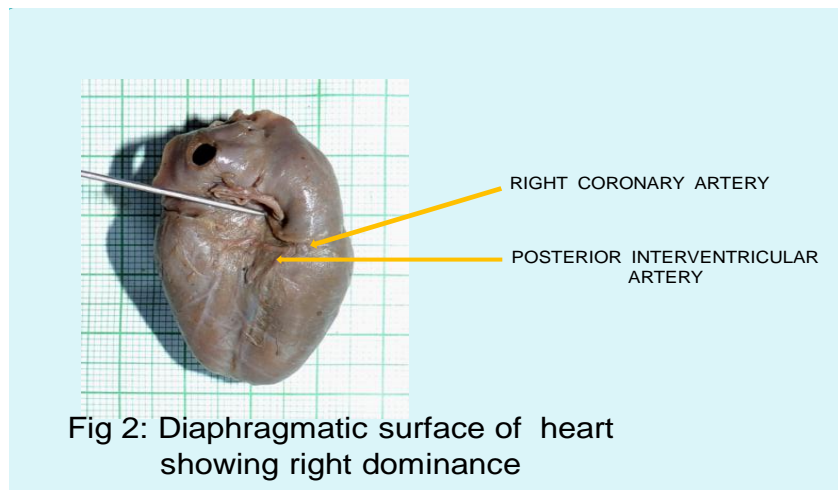
In patients referred for Computed tomography coronary angiography a left dominant coronary artery system was identified as a significant risk factor for myocardial infarction and death. Particularly in the subgroup of patients with significant coronary artery disease on computed tomography coronary angiography, those patients with a left dominant coronary artery system had a strongly increased risk of events compared with patients with a right dominant coronary artery system. Therefore, the potential indication for intensive treatment could be more prominent in patients with a left dominant coronary artery system.<sup>17</sup>

**V. Conclusion**

The present study concludes that in fetuses of Manipuri origin which is ethnically and racially different from the mainland Indians, in the majority of the heart i.e in 70% of the sample the right coronary artery is the dominant artery. However further studies are suggested in a larger study sample and the association of myocardial bridges in the course of coronary artery. This study will be of value to surgeons while undergoing coronary intervention in the newborn.



**Fig 1:** specimens of fetal heart arranged according to gestational age



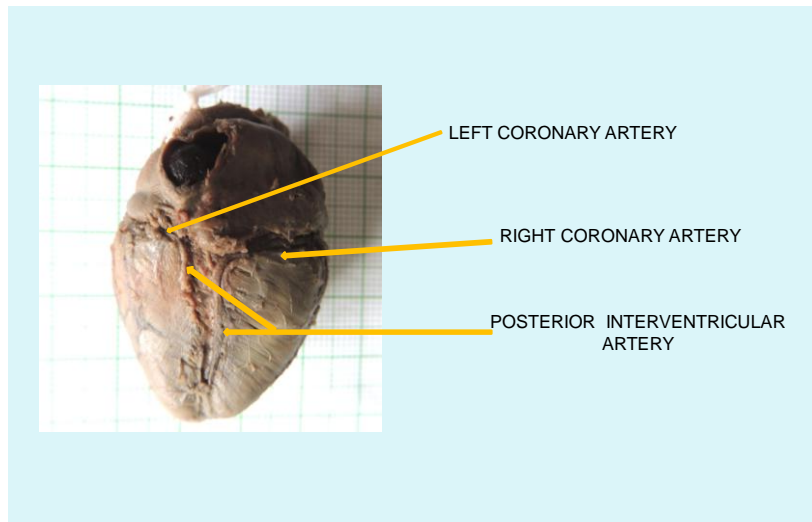


Fig 4: Balance pattern

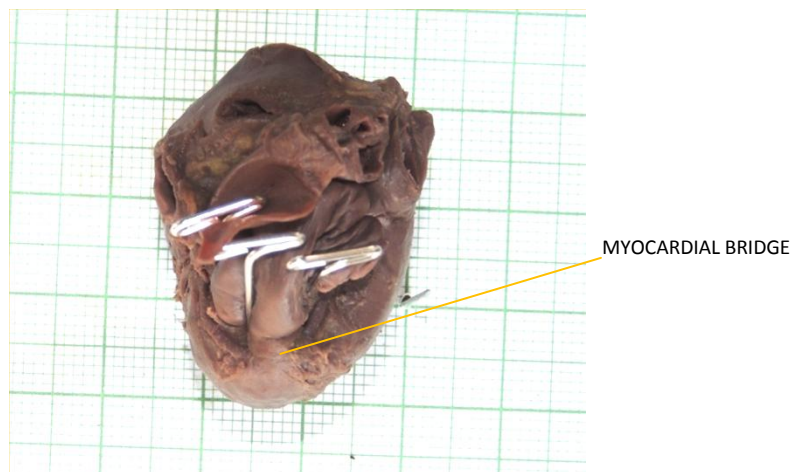


Fig 5: Myocardial bridge in the course of right coronary artery

RESULTS			
GESTATIONAL AGE IN WEEKS	RIGHT DOMINANT	LEFT DOMINANT	BALANCED PATTERN
17-22	2	-	1
23-28	2	3	-
29-34	8	2	1
35-40	9	1	1

Table1: Result of the present study

COMPARISONS WITH THE RESULT OF OTHER AUTHOR			
STUDY	RIGHT DOMINANCE	LEFT DOMINANCE	BALANCE PATTERN
PRESENT	70%	20%	10%
JAMES <sup>18</sup>	95.34%		
FISS DM <sup>14</sup>	85%	8%	7%
ABUCHAIM DCS <sup>16</sup>	72%	20%	8%
DAS H <sup>11</sup>	70%	18.57%	14.43%
FAZLIOGULL ARI SZ <sup>10</sup>	42%	14%	44%
REDDY VJ <sup>19</sup>	86.25%	11.26%	2.5%
SHUKRI IG <sup>9</sup>	65%	27%	8%
KALPANA R <sup>7</sup>	89%	11%	
LOUKAS M <sup>13</sup>	55%	33%	12%

Table 2: Table showing the comparison of the present study with other study

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