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Original Article

Anatomy Section

Morphological Insights into the Posterior Interventricular Artery in Relation to Cardiac Dominance in Adult Human Cadaveric Hearts: An Observational Study from Karnataka, India

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ABSTRACT

Introduction: Cardiac dominance is determined by the origin of Posterior Interventricular Artery (PIVA) which commonly originates from Right Coronary Artery (RCA) (right dominance), it can also arise from Left Circumflex Artery (LCXA), the branch of Left Coronary Artery (LCA) (left dominance) and from both called balanced dominance. It supplies the posterior 1/3rd of interventricular septum and inferior wall of the heart. The PIVA exhibits significant variations that may affect cardiac dominance and influence the outcome of cardiac procedures.

Aim: To determine the origin, course, termination of PIVA and to estimate the cardiac dominance in adult cadaveric hearts.

Materials and Methods: The present observational study was conducted on 40 formalin-fixed cadaveric hearts from the Department of Anatomy, ESIC Medical College and PGIMSR, Bengaluru, Karnataka, India. PIVA was dissected following the guidelines from Cunningham manual. The origin, course, and termination pattern of the PIVA were identified and noted, and relevant photographs were taken. All observations were entered into Microsoft Excel sheet, which was used for statistical analysis.

Results: In the present study, the PIVA originated from the RCA in 32 (80%) specimens, while in 7 (17.5%) specimens it arose from the LCXA, the branch of LCA. In one specimen (2.5%), the PIVA was absent from the posterior interventricular sulcus and was replaced by a Right Posterior Diagonal Artery (RPDA) arising from the RCA, as the posterior interventricular region was supplied by a branch of the RCA, this specimen was also included under right coronary dominance. Overall, right coronary dominance was observed in 33 (82.5%) hearts, while left coronary dominance was observed in 7 (17.5%) hearts. No specimen demonstrated co-dominance.

Conclusion: The findings of the present study provide important insights into variations in coronary arterial anatomy. Right coronary dominance was observed in 82.5% of the hearts. A thorough understanding of these variations may aid clinicians in accurate diagnosis, interventional planning, and surgical procedures, thereby helping to minimise procedural complications and improve clinical outcomes.

Keywords: Anatomic variations, Cadaver, Coronary vessels, Inferior wall of the heart

INTRODUCTION

The Ischaemic Heart Disease (IHD) affects approximately 126 million people, accounting for 1.72% of the world's population (1,655 per 100,000), and is responsible for nearly nine million deaths per annum [1]. In 2022, the global prevalence of Coronary Artery Disease (CAD) was estimated at 315 million cases [2]. Understanding the anatomical variability of coronary vessels is a key for clinical practice, as it aids in interventional planning and minimises procedural complications.

The heart is supplied by the right and left coronary arteries and their branches. The RCA typically gives rise to the conus branch, sinoatrial nodal branch, right marginal artery, atrioventricular nodal branch, and the posterior interventricular (posterior descending) artery [3]. The LCA usually divides into the anterior interventricular {Left Anterior Descending (LAD)} artery and the circumflex artery [3]. These arteries provide septal and diagonal branches, marginal and atrial branches, thereby contributing significant vascular supply of the myocardium [3]. Among these vessels, the PIVA demonstrates notable variations that can influence cardiac dominance and affect subsequent interventional outcomes [3,4].

Schlesinger MJ first introduced the term dominant artery, defining cardiac dominance is based on the origin of the PIVA [5]. Cardiac dominance is determined by the origin of the PIVA from the RCA, indicating right dominance; from the LCA, via its branch, the LCXA, indicating left dominance; or from both, indicating balanced (co-dominant) circulation [3]. After its origin, the PIVA courses within the posterior interventricular groove and supplies the posterior one-third of the interventricular septum and the inferior wall of the heart. Finally end by anastomosing with the left anterior interventricular artery commonly at apex of heart [3,4]. In some cases, the PIVA may be short or absent, in these cases its role is taken over either by the RPDA, arising from the RCA or by LAD artery from LCA and supplying the posterior ventricular surface [5,6]. When the RPDA originates directly from the RCA, it may functionally replace the distal PIVA [6].

Clinically, the PIVA has significant importance because it supplies the posterior part of the interventricular septum, ventricular walls, and components of the cardiac conduction system. Occlusion of this artery may lead to inferior wall myocardial infarction, conduction disturbances, or atrioventricular block [3,4]. However, anatomical studies describing rare variations such as the two or more branches of PIVA and absence of the PIVA, its replacement by alternative arterial branches are limited in the literatures [7,8]. Therefore, the present study was undertaken to provide additional anatomical data on the origin and variations of the PIVA in the studied population.

Thus, the present study aimed to determine the origin, course, termination of PIVA and to estimate the cardiac dominance in adult cadaveric hearts.

MATERIALS AND METHODS

The present observational study was conducted in Department of Anatomy, ESIC MC & PGIMSR and Model Hospital, Bengaluru, Karnataka, India from September 2025 to February 2026 (6 months). The study was conducted after obtaining approval from Institutional Ethical Committee (No.532/L/11/12).

Inclusion and Exclusion criteria: Heart specimens with well-preserved vascular structures were included for the study. The damaged heart specimens were excluded.

Sample size calculation: A convenience sampling technique was used. The sample size was calculated using the formula:

$$n = \frac{Z^2\, pq}{e^2}$$

Where, n=minimum required sample size, Z=1.645 at 90% confidence interval, p=69%8 (prevalence of right coronary dominance is taken since right is the highest) p=0.69, rounded to 0.7, q=1–p=30% and e=12% margin of error

$$n = \frac{(1.645)^2 \times 0.70 \times 0.30)}{(0.12)^2}$$

$$n = 39.46$$

The minimum required sample size was approximately 40 heart specimens.

Study Procedure

Methodology: PIVA was dissected in 40 formalin fixed adult cadaveric heart specimens, following the guidelines of Cunningham manual [9]. The origin, course, termination pattern of PIVA was identified and variations in it were noted. The relevant photographs of the specimens were taken.

STATISTICAL ANALYSIS

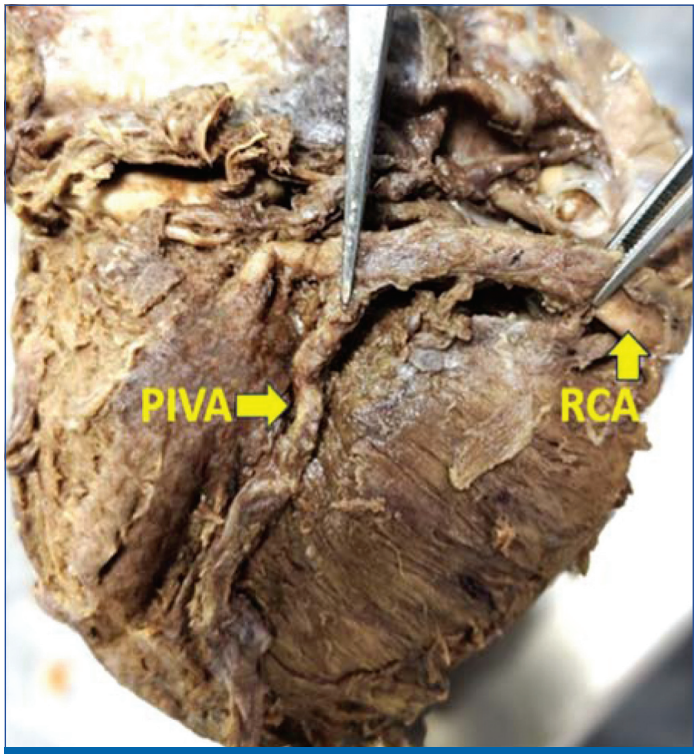
All observations were entered into Microsoft Excel, which was used for statistical analysis. Descriptive statistics was applied, and categorical data was expressed as percentages and presented in the form of tables and charts.

RESULTS

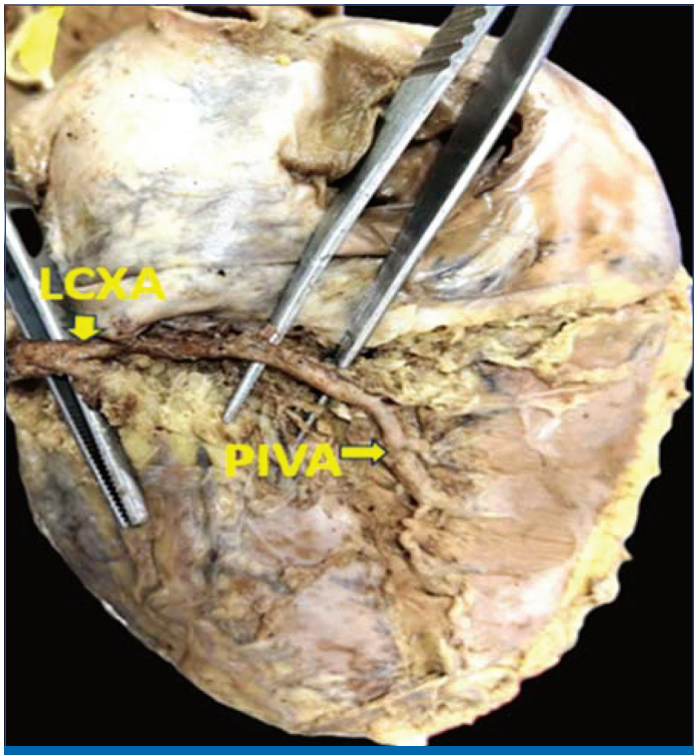
Origin of Posterior Interventricular Artery (PIVA) and cardiac dominance: The PIVA originated from the RCA in 32 (80%) specimens [Table/Fig-1], while in 7 (17.5%) specimens it arose from the LCXA, the branch of LCA [Table/Fig-2]. The PIVA was absent from posterior interventricular sulcus in one (2.5%) specimen and replaced by a RPDA arising from the RCA and the posterior interventricular region was supplied by it [Table/Fig-3]. This one specimen was also included under right coronary dominance since RPDA was a branch from RCA. Overall, right coronary dominance was observed in 33 (82.5%) hearts, while left coronary dominance was observed in 7 (17.5%) hearts. No specimen demonstrated co-dominance [Table/Fig-4].

Course and termination of Posterior Interventricular Artery (PIVA): The termination of PIVA was in the upper one-fourth of the posterior interventricular sulcus in four specimens (10.2%), in the middle half in 20 specimens (51.3%), in the lower three-fourths in eight specimens (20.5%), and at the apex in seven specimens (17.9%) [Table/Fig-5-9]. When the PIVA terminated in the upper, middle, or lower portions of the posterior interventricular sulcus, the remaining segments was supplied either by a RPDA arising from the RCA or by the LAD artery, which reached the area by winding around the apex. The RPDA was observed in 5 (12.5%) specimens only in which the PIVA was absent or hypoplastic (thin calibre) [Table/Fig-10].

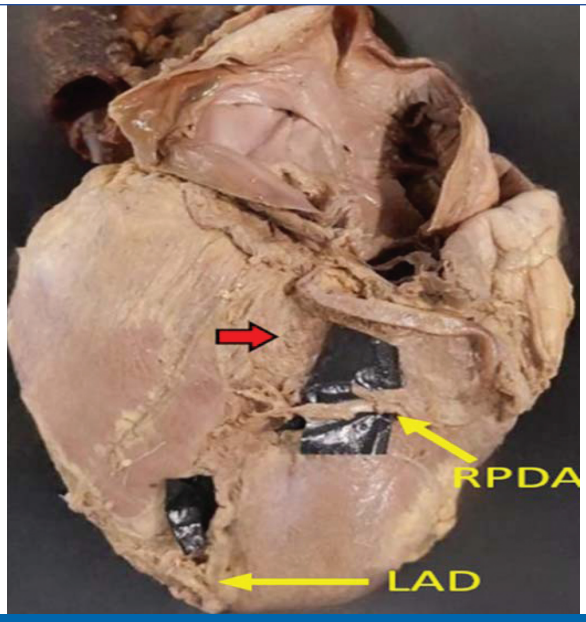
Two or more PIVA: In the present study, double PIVA was observed in six specimens (15%), of which four originated from the RCA and two from the Left circumflex [Table/Fig-11,12]. Among these, in one specimen both branches terminated at the apex; in one specimen both terminated at the lower three-fourths of the sulcus; and in four specimens, one branch extended up to the lower three-fourths of the sulcus while the other reached the middle half of the sulcus. Additionally, more than two PIVAs were identified in three specimens (7.5%) [Table/Fig-13]. Of these, two originated from the RCA and one from the LCXA given in [Table/Fig-14]. In these specimens, one branch extended up to the lower three-fourths of the sulcus, while the remaining branches were confined to the upper one-fourth of the sulcus.



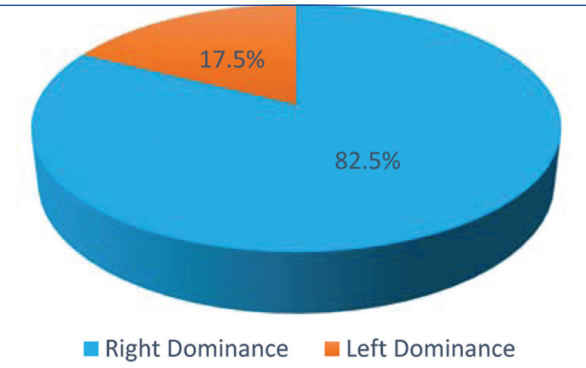
[Table/Fig-1]: Shows PIVA originating from RCA.
PIVA: Posterior interventricular artery; RCA: Right coronary artery



[Table/Fig-2]: Shows PIVA originating from LCXA branch of LCA
LCXA: Left circumflex artery; PIVA: Posterior interventricular artery



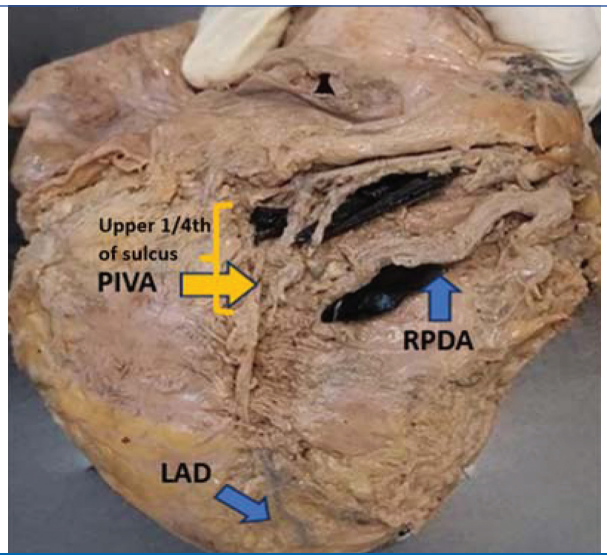
[Table/Fig-3]: Gross anatomical specimen showing the absence of the posterior interventricular artery (PIVA) (red arrow), compensated by the right posterior diagonal artery (RPDA) and the left anterior descending artery (LAD).
RPDA: Right posterior diagonal artery; LAD: Left anterior descending
➡ Red arrow indicates absence of PIVA



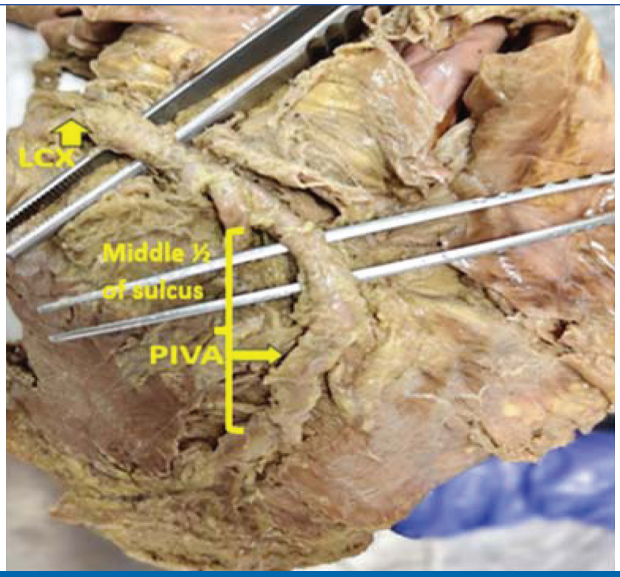
[Table/Fig-4]: Coronary dominance.

Termination of PIVA in sulcus	Specimens (N=40)	Percentage
Upper 1/4th	4	10.2%
Middle ½	20	51.3%
Lower 3/4th	8	20.5%
Apex	7	17.9%

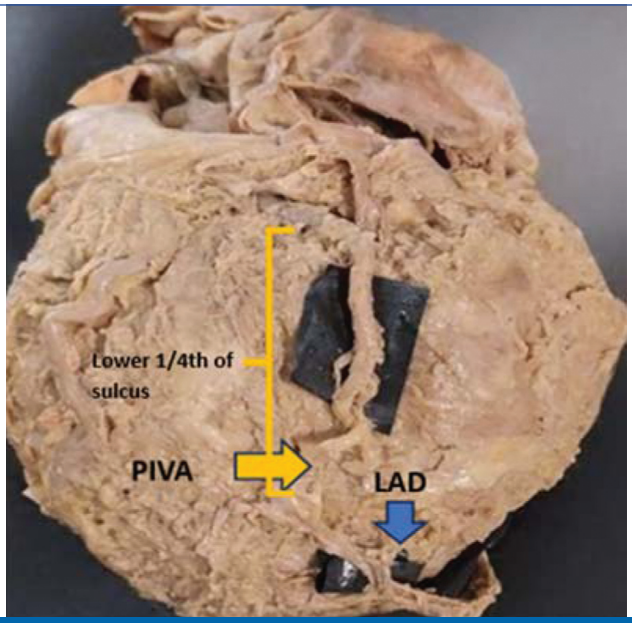
[Table/Fig-5]: PIVA termination in Posterior interventricular sulcus.



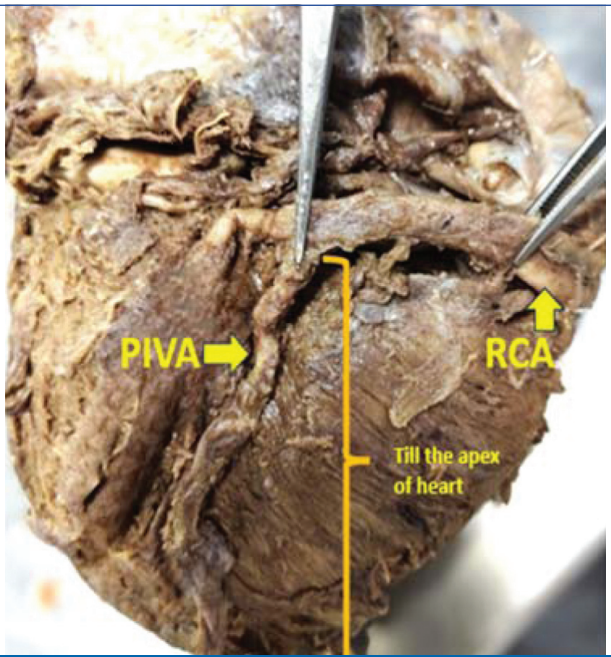
[Table/Fig-6]: Shows termination of PIVA in upper 1/4th of sulcus.
PIVA: Posterior interventricular artery; RPDA: Right posterior diagonal artery; LAD: Left anterior descending



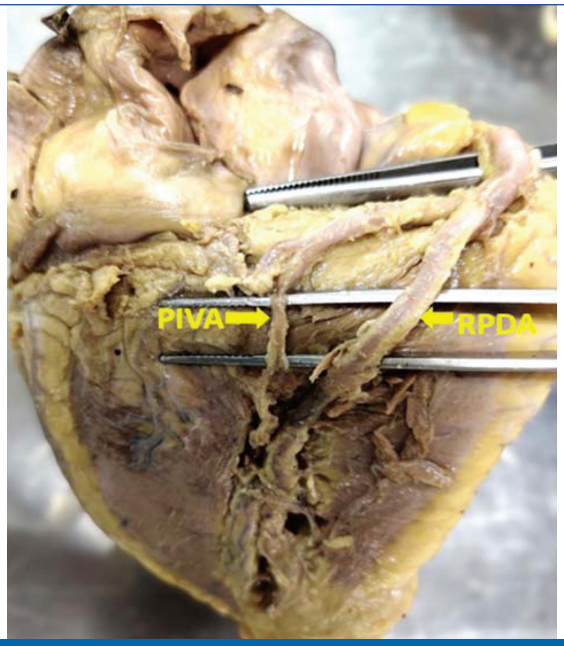
[Table/Fig-7]: Shows termination of PIVA in middle ½ of sulcus.
PIVA: Posterior interventricular artery



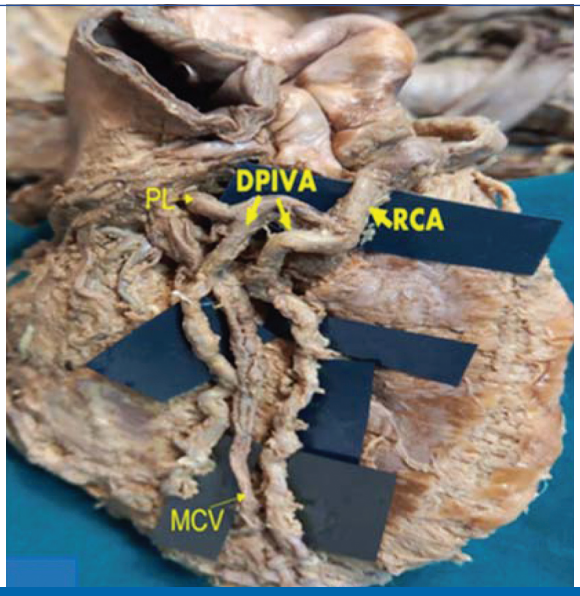
[Table/Fig-8]: Shows termination of PIVA in Lower 1/4th of sulcus.
PIVA: Posterior interventricular artery; LAD: Left anterior descending



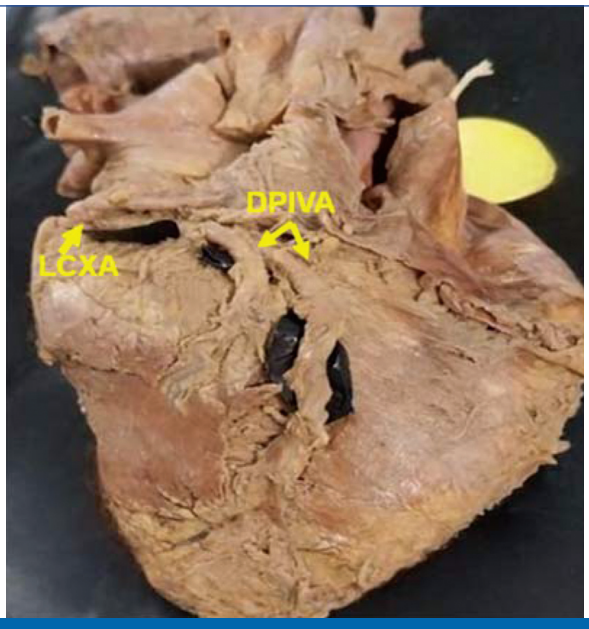
[Table/Fig-9]: Shows termination of PIVA in Apex of sulcus.
PIVA: Posterior interventricular artery; RCA: Right coronary artery



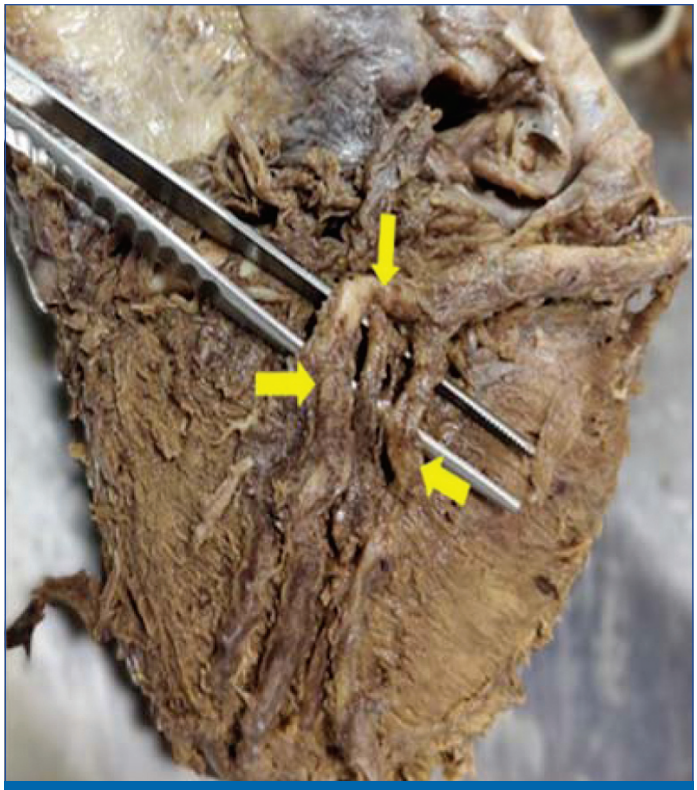
[Table/Fig-10]: Shows thin PIVA and a RPDA
PIVA: Posterior interventricular artery; RPDA: Right posterior diagonal artery



[Table/Fig-11]: Shows double PIVA from RCA
DPIVA: Double Posterior interventricular Artery; RCA: Right coronary artery; MCV: Middle cardiac vein



[Table/Fig-12]: Shows double PIVA from LCA
DPIVA: Double Posterior interventricular Artery; LCXA: Left Circumflex artery Artery;



[Table/Fig-13]: Shows more than 2 PIVA from RCA, pointed by yellow arrows.

Finding	Total Specimen (n=40) (%)	From RCA (n)	From LCA (n)
Double PIVA	6 (15%)	4	2
More than two branches of PIVA	3 (7.5%)	2	1

[Table/Fig-14]: Two or more PIVA.

DISCUSSION

Coronary arteries develop from epicardial blood islands and undergo angiogenesis. After they attach to the aorta, the small vascular plexus remodels into larger muscular arteries [3,9]. This process is guided by blood flow-related shear stress. It is controlled by molecular signals such as VEGF-C, CXCL12/CXCR4, Notch, FGF, TGF-β/BMP, HIF-1α and PDGF pathways [10]. Alterations in any of these mechanisms may lead to variations in PIVA development. Anatomical differences of PIVA may influence the extent of myocardial perfusion and collateral circulation in cases of coronary artery obstruction [3]. Differences in ethnicity and population characteristics may also explain variations among studies. Such differences can significantly influence the normal origin, caliber, branching pattern, and termination of the PIVA [11]. A review by Wu Bovey et al., (2024) highlighted that coronary dominance is associated with differences in myocardial perfusion, arrhythmogenic risk, and susceptibility to adverse cardiovascular outcomes [12].

In the present study, right coronary dominance was observed in 82.5% of specimens, while left dominance was noted in 17.5%, with no cases of co-dominance. These findings are consistent with previously published research. Agrawal R et al., (2016), in a study of 50 cadaveric hearts, reported right dominance in 86%, left dominance in 8%, and co-dominance in 2% of specimens [4]. Similarly, Chaudhary D et al., (2017) examined 30 cadaveric hearts and documented 86.6% right dominance and 13.3% left dominance, with no cases of co-dominance [13]. Shah CD et al., (2024) also observed a comparable pattern, with 85% right dominance, 13.3% left dominance, and 1.7% co-dominance [14]. In contrast, Charushila BV et al., (2025) reported a slightly lower incidence of right dominance (74%) and a higher prevalence of left dominance (18%), along with 8% co-dominance [15].

Evidence from studies in other populations further supports this pattern. Fazliogullari Z et al., (2010) examined 50 cadaveric hearts from the Turkish population and found that the posterior interventricular branch originated from the RCA in 43 hearts (86%) and from the left circumflex branch in two hearts (4%) [16].

Apart from cadaveric studies, Hussein FA et al., (2012), studied angiography in 657 patients, reported right coronary dominance in 502 patients (76.4%), left circumflex dominance in 83 patients (12.6%), and co-dominance in 72 patients (11%) [17]. Overall, the findings reinforce that right coronary dominance is the most prevalent pattern across different populations given in [Table/Fig-15] [4,13-17]. Gebhard C et al.,(2015) in a coronary CT angiography study of 6,382 patients with 3.5 years follow-up period, reported right dominance in 91% and left dominance in 9% of cases and found that although overall outcomes were similar between dominance patterns, left dominance was associated with a significantly higher risk of adverse cardiovascular events and even death in patients with left main CAD [18]. The RPDA was present in 12.5% of the hearts examined, which is lower than the incidence reported by Agrawal R et al., who observed its presence in approximately 26% of cases [4].

Author/ year	Place of study	Sample size	Right dominance	Left dominance	Co-dominance
Present study (2025-26)	Bengaluru, India	40 hearts	33 (82.5%)	7 (17.5%)	-
Agrawal R et al., 2016 [4]	Bhopal, India	50 cadaveric hearts	43 (86%)	4 (8%)	1 (2%)
Chaudhary D., 2017 [13]	Nepal	30 cadaveric hearts	26 (86.6%)	4 (13.3%)	-
Shah CD et al., 2024 [14]	Karnataka, India	60 cadaveric hearts	85%	13.3%	1.7%
Charushila BV et al., 2025 [15]	Miraj, India	50 cadaveric hearts	37 (74%)	9 (18%)	4 (8%)
Fazliogullari Z et al., 2010 [16]	Turkey	50 Turkish cadaveric hearts	21 (42%)	7 (14%)	22 (44%)
Hussein FA et al., 2012 [17]	Iraq	657 angiography of patients	502 (76%)	83 (12.6%)	72 (10%)

[Table/Fig-15]: Comparison of coronary dominance with other studies [4,13-17].

In the present study, the PIVA most commonly terminated in the middle half of the interventricular septum (51.3%), followed by the lower three-fourths (20%), apex (15%), and upper one-fourth (15%). These findings are comparable with earlier studies. Agrawal R et al., (2016) reported that the PIVA terminated in the upper one-fourth in 18% of specimens, middle half in 28%, lower three-fourths in 36%, and at the apex in 16% [4]. Similarly, Lekshmy Vijay VG et al., (2019) observed termination in the upper one-fourth in 9.8%, middle half in 37.5%, lower three-fourths in 34%, and apex in 18.7% of hearts [19]. Overall, both previous research and the present study highlight that the middle half and lower segments of the interventricular septum are the most frequent termination sites of the PIVA, reinforcing the variability but general pattern of its course and termination [Table/Fig-16].

Termination of PIVA in Sulcus	Present study (n=40 specimens) Bengaluru, India	Agrawal R et al., (2016) (n=50 specimens) Bhopal, India [4]	Lekshmy Vijay VG et al., (2019) (n=112 specimens) Tamil Nadu, India [19]
Upper 1/4th	4 (10.2%)	9 (18%)	11 (9.8%)
Middle ½	20 (51.3%)	14 (28%)	42 (37.5%)
Lower 3/4th	8 (20.5%)	18 (36%)	38 (34%)
Apex	7 (17.9%)	8 (16%)	21 (18%)

[Table/Fig-16]: Comparison of termination of PIVA in sulcus with other studies [4,19].

The present study identified double PIVA in six specimens (15%), with four originating from the RCA and two from the LCA. Additionally, more than two branches of the PIVA were observed in three specimens (7.5%), of which two arose from the RCA and one from the LCA. These findings are consistent with previous study done by Bheemesh P and Venkateshwar RM (2016) of 110 cadaveric hearts, a single Posterior Descending Artery (PDA) arising from the RCA was reported in 80% of specimens, whereas two or three PDA branches originating from the RCA were present in the remaining 20% [20]. Together, these results highlight that although a single PIVA is the most common pattern, multiple branches may occur and frequently arise from the RCA. Since left coronary dominance and co-dominance is known to increase the risk of complications and mortality during procedures for acute coronary syndromes, understanding these variations is clinically important [21].

Limitation(s)

The present study has limitations in its small sample size, which may not adequately represent the full spectrum of anatomical variations. Additionally, morphometric analysis was not performed because arterial pathologies can alter normal morphometric parameters, and identifying such pathologies in formalin-fixed cadaveric specimens is often difficult.

CONCLUSION(S)

The PIVA exhibits marked variability in its origin, course, and branching architecture in the present study. The right coronary dominance 82.5%, the left dominance is 17.5% and in some cases, PIVA appeared in duplication, or absent. These differences, along with the varied blood supply to the distal region, highlight the complexity of coronary circulation. PIVA anatomy has been shown to vary among different populations may be due to genetic and environmental influences. Better anatomical knowledge of these patterns can improve diagnosis and help to guide safer and more effective cardiac interventions.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
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- Manual Googling: Jun 17, 2026
- iThenticate Software: Jun 23, 2026 (8%)

ETYMOLOGY: Author Origin

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