Dominance Patterns of the Coronary Arteries in Normal Adult Bangladeshis: Insights from an Anatomical Assessment

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Abstract: *Background:* Coronary artery dominance, defined by the artery supplying the posterior descending artery (PDA), is a key anatomical feature that influences myocardial perfusion and has important clinical implications. This study aims to evaluate the prevalence and patterns of coronary artery dominance among normal adult Bangladeshis. *Methods:* This cross-sectional, analytical study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka, from January to December 2020, involving 35 adult Bangladeshi males and 35 adult Bangladeshi females aged 20 to 70 years. All data were analysed using SPSS version 26.0. *Result:* Right coronary artery (RCA) dominance was the most common pattern, observed in 64.3% of participants, while left circumflex artery (LCx) dominance occurred in 22.9% and co-dominance in 12.9%. Age-wise analysis showed that RCA dominance remained predominant across all age groups, with a slight increase in LCx dominance and co-dominance in the 40–59 years group. Gender-wise comparison revealed no significant differences between males and females in coronary dominance patterns. *Conclusion:* Right coronary artery dominance is the most prevalent pattern among normal adult Bangladeshis, while left circumflex dominance and co-dominance are less common. The dominance pattern did not differ significantly between males and females, and age-wise distribution showed consistent predominance of right dominance across all age groups.

Keywords: Dominance Patterns, Coronary Arteries, Adult Bangladeshi, Anatomical Assessment.

INTRODUCTION

Coronary artery dominance refers to the artery that gives rise to the posterior descending artery (PDA) and supplies the inferior interventricular septum. In right dominance, the PDA originates from the right coronary artery (RCA), whereas in left dominance, it arises from the left circumflex artery (LCx). In co-dominance, both arteries contribute to the supply of the inferior part of the heart. This anatomical variation has important clinical relevance, as it influences perfusion of the atrioventricular (AV) node, the inferior wall of the left ventricle, and can impact the severity and outcomes of coronary artery disease.[1,2] Globally, right dominance is the most common pattern, followed by left dominance and co-dominance. However, prevalence rates vary between populations and study methodologies, with reported right dominance ranging between 70–90%, left dominance 5–12%, and co-dominance 4–18%.[1,3–5] Variations may arise due to ethnic differences, environmental influences, and the imaging techniques used—whether autopsy,

invasive coronary angiography, or coronary computed tomography angiography (CCTA).[2–4] Autopsy-based studies have suggested that the prevalence of left and co-dominance decreases with age, possibly due to higher cardiovascular risk and earlier mortality in individuals with left dominance.[3] Beyond anatomical description, the dominance pattern can have prognostic implications. Left dominance has been associated with larger myocardial territories at risk, and in patients with acute coronary syndromes (ACS), it may be linked to more extensive infarction and worse outcomes.[4–7] Several studies have reported that left dominance is associated with increased periprocedural myocardial infarction after percutaneous coronary intervention (PCI) and higher mortality after coronary artery bypass grafting (CABG).[6–8] Conversely, right dominance has been linked in some studies to a higher prevalence of triple-vessel disease, possibly due to differences in vessel calibre and perfusion demand.[9–11] The relationship between coronary dominance and the distribution of atherosclerosis has also been explored. Some angiographic studies have shown that right dominance is associated with greater involvement of the RCA, while left dominance may result in more extensive disease in the left coronary system.[9, 10] CCTA studies have further examined the relationship between dominance and coronary calcification, though results have been variable.[4, 5] In the context of acute myocardial infarction, particularly inferior wall infarction, dominance plays a role in determining infarct size, left ventricular function, and clinical prognosis. Patients with left dominance and inferior myocardial infarction often have larger areas of jeopardised myocardium and may experience poorer outcomes compared to those with right dominance.[8, 11] Knowledge of the dominance pattern is therefore important not only in diagnostic interpretation but also in planning revascularisation strategies, selecting bypass grafts, and predicting procedural risk.[2, 7, 9] Although there is extensive global literature on coronary dominance, studies focusing on South Asian populations are limited. In Bangladesh, only a few anatomical and angiographic studies have assessed dominance patterns, often with small sample sizes. Establishing accurate baseline prevalence data in normal adult Bangladeshis is important, as ethnic and anatomical variations may influence both dominance distribution and its clinical implications.[3–5,11] The present study aims to determine the prevalence and patterns of coronary artery dominance in normal adult Bangladeshis.

METHODS

This cross-sectional, analytical study was conducted in the Department of Anatomy, Dhaka Medical College, Dhaka, from January to December 2020, involving 35 adult Bangladeshi males and 35 adult Bangladeshi females aged 20 to 70 years. Participants were selected from patients attending the Radiology & Imaging Department of the National Heart Foundation Hospital and Research Institute, Mirpur, Dhaka, who were undergoing coronary CT angiography for the evaluation of ischemic heart disease and were found to have normal angiographic findings. Informed written consent was obtained from each subject, with the assurance of confidentiality and the right to withdraw from the study at any time. All CT angiograms were performed using a 64-slice multidetector computed tomography (MDCT) scanner (Philips Brilliance 64 CT Scanner System). Each patient was clinically evaluated by a cardiologist and underwent a thorough clinical examination, standard blood tests, 12-lead electrocardiography (ECG), two-dimensional echocardiography (2D ECHO), and chest X-ray (postero-anterior view). Coronary artery measurements were taken at end-diastole using magnified source images or curved multiplanar reformatted images, utilizing the standard RadiAnt DICOM Viewer software provided with the scanner. All images were magnified at 100% and saved to compact discs (CDs), from which various dimensions and anatomical characteristics of the epicardial coronary arteries, including the origin of the posterior descending artery (PDA), were measured and analyzed. All data were analysed using SPSS version 26.0.

RESULTS

Table 1: Demographic Profile of Study Subjects (N=70)

Characteristic	Male (n=35)	Female (n=35)	Total (N=70)
Age (years), mean ± SD	45.8 ± 10.2	46.7 ± 11.1	46.3 ± 10.6
Age group (years)			
20–29	5 (14.3%)	4 (11.4%)	9 (12.9%)
30–39	8 (22.9%)	7 (20.0%)	15 (21.4%)
40–49	10 (28.6%)	11 (31.4%)	21 (30.0%)
50–59	7 (20.0%)	8 (22.9%)	15 (21.4%)
≥60	5 (14.3%)	5 (14.3%)	10 (14.3%)

The study included equal numbers of males and females, with most participants aged 40–49 years. The mean age was similar between genders. [Table 1]

Table 2: Distribution of Coronary Dominance by Artery Supplying PDA (N=70)

Artery Supplying PDA	n	%
Right coronary artery	45	64.3%
Left circumflex artery	16	22.9%
Contribution from both RCA and LCx (co-dominance)	9	12.9%
Total	70	100%

The posterior descending artery originated most frequently from the right coronary artery (64.3%). Left circumflex contribution was observed in 22.9% of cases, and co-dominance was seen in 12.9%, which is consistent with findings in similar populations. [Table 2]

Table 3: Age-wise Distribution of Coronary Artery Dominance (N=70)

Age group (years)	RCA dominance n (%)	LCx dominance n (%)	Co-dominance n (%)
20–29	6 (66.7%)	2 (22.2%)	1 (11.1%)
30–39	10 (66.7%)	3 (20.0%)	2 (13.3%)
40–49	13 (61.9%)	5 (23.8%)	3 (14.3%)
50–59	9 (60.0%)	4 (26.7%)	2 (13.3%)
≥60	7 (70.0%)	2 (20.0%)	1 (10.0%)

Right coronary artery dominance was most common across all age groups. Left circumflex dominance and co-dominance occurred more frequently in middle-aged adults, though differences were not statistically significant. [Table 3]

Table 4: Comparison of Dominance of Coronary Circulation Between Males and Females (N=70)

Dominance (%)	Male (n=35)	Female (n=35)	p value
Right dominance (n=45)	22 (62.9%)	23 (65.7%)	0.808 ns
Left dominance (n=16)	7 (20.0%)	9 (25.7%)	0.572 ns
Co-dominance (n=9)	6 (17.1%)	3 (8.6%)	0.291 ns

Table 4 compares the dominance patterns of coronary circulation between males and females. Right dominance was the most common in both groups, seen in 62.9% of males and 65.7% of females. Left dominance was observed in 20.0% of males and 25.7% of females, while co-dominance was present in 17.1% of males and 8.6% of females. None of these differences were statistically significant ($p > 0.05$). [Table 4]

DISCUSSION

This study found that right coronary artery (RCA) dominance was the commonest pattern in our cohort of 70 normal adult Bangladeshis (45/70; 64.3%), while left circumflex artery (LCx) dominance was observed in 22.9% (16/70) and co-dominance in 12.9% (9/70). These proportions differ in important ways from many large series and merit careful comparison. Large CCTA and angiographic cohorts most often report a markedly higher prevalence of right dominance—Erol *et al.*, in a 2,096-patient CCTA series, documented right dominance in 86.6%, left dominance in 9.6% and balanced circulation in 3.8%; similarly, a large post-mortem angiographic series reported right dominance in ~81% with left and codominant patterns around 9–10% each and showed that left/codominance declined with increasing age.[1, 3] Compared with those datasets, our study shows a relatively lower proportion of right dominance and a substantially higher proportion of LCx dominance and mixed circulation. A previously published Bangladeshi postmortem study also reported markedly high right-dominance proportions (≈85–91% in different age/sex strata) the discrepancy between that postmortem work and our results likely reflects differences in methodology (postmortem dissection/angiography versus the approach used here), sampling frames, and sample size.[2] Methodological differences are central: CCTA and large angiographic registries sample patients referred for cardiac imaging (often older and with suspected CAD), autopsy series sample deceased populations (introducing survivorship/selection biases), and small single-centre anatomical or imaging studies—like ours—are more sensitive to random variation and local anatomical heterogeneity. Age-structure and selection also matter: Knaapen *et al.*, showed a decline in left/codominance with advancing age, plausibly because left dominance may confer greater mortality after occlusion of a dominant left system; if our cohort skews younger or healthier in ways different from comparison populations, that could raise apparent LCx dominance proportion.[3] Regional and ethnic variation may also play a role—several South Asian series report right-dominance prevalences that vary widely (roughly 60–86% in the literature), indicating that geographic differences are real and that Bangladeshis may cluster differently from East Asian or Western cohorts.[2, 4, 6] Clinically, the higher relative frequency of LCx dominance observed here is important because multiple prognostic and procedural studies have associated left dominance with larger myocardial territories at risk and with worse periprocedural and long-term outcomes in certain settings: cohort analyses and registry work have identified left dominance as an independent predictor of adverse events and mortality after revascularisation, the TWENTE trial analysis demonstrated an increased incidence of periprocedural myocardial infarction in left-dominant patients undergoing PCI, and a meta-analysis reported greater mortality after PCI among patients with left dominance.[4, 6-8] Moreover, case-control and observational studies have linked dominance pattern to the location and severity of infarction (for example, association with acute inferior MI) and to measures of left ventricular dysfunction in ACS cohorts.[11]

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

This study demonstrates that right coronary artery dominance is the most prevalent pattern among normal adult Bangladeshis, while left circumflex dominance and co-dominance are less common. The dominance pattern did not differ significantly between males and females, and age-wise distribution showed consistent predominance of right dominance across all age groups.

Recommendation

It is recommended that clinicians and cardiologists in Bangladesh consider the predominance of right coronary artery dominance, while remaining aware of the notable proportion of left circumflex and co-dominant patterns when interpreting coronary imaging or planning interventions. Further large-scale, multicentre studies using standardized imaging techniques are advised to confirm these findings and to better understand regional anatomical variations and their clinical implications.

Conflict of Interest: None declared

REFERENCES

1. Erol C, Seker M. The prevalence of coronary artery variations on coronary computed tomography angiography. Acta Radiologica. 2012 Apr;53(3):278-84.

2. Hussain MA, Nahar A, Ara S. The Dominance Pattern of Coronary Artery of Adult Bangladeshi People-A Postmortem Morphological Study. Cardiovascular Journal. 2008;1(1):21-5.

3. Knaapen M, Koch AH, Koch C, Koch KT, Li X, van Rooij PC, Tijssen JG, Peters RJ, van der Wal AC, Damman P, de Winter RJ. Prevalence of left and balanced coronary arterial dominance decreases with increasing age of patients at autopsy. A postmortem coronary angiogram study. Cardiovascular Pathology. 2013 Jan 1;22(1):49-53.

4. Veltman CE, de Graaf FR, Schuijf JD, van Werkhoven JM, Jukema JW, Kaufmann PA, Pazhenkottil AP, Kroft LJ, Boersma E, Bax JJ, Schalij MJ. Prognostic value of coronary vessel dominance concerning significant coronary artery disease determined with non-invasive computed tomography coronary angiography. European Heart Journal. 2012 Jun 1;33(11):1367-77.

5. Mastrocola LE, Amorim BJ, Vitola JV, Brandão SC, Grossman GB, Lima RD, Lopes RW, Chalela WA, Carreira LC, Araújo JR, Mesquita CT. Update of the Brazilian guideline on nuclear cardiology-2020. Arquivos brasileiros de cardiologia. 2020 Mar 20;114:325-429.

6. Lam MK, Tandjung K, Sen H, Basalus MW, van Houwelingen G, Stoel MG, Louwerenburg J, Linssen GC, Saïd SA, Nienhuis MB, de Man FH. Coronary artery dominance and the risk of adverse clinical events following percutaneous coronary intervention: insights from the prospective, randomised TWENTE trial. EuroIntervention. 2015 Feb 28;11(2):180-7.

7. Abu-Assi E, Castiñeira-Busto M, González-Salvado V, Raposeiras-Roubin S, Abumuaileq RR, Peña-Gil C, Rigueiro-Veloso P, Ocaranza R, García-Acuña JM, González-Juanatey JR. Coronary artery dominance and long-term prognosis in patients with ST-segment elevation myocardial infarction treated with primary angioplasty. Revista Española de Cardiología (English Edition). 2016 Jan 1;69(1):19-27.

8. Khan MS, Usman MS, Akhtar T, Raza S, Deo S, Kalra A, Nasim MH, Yadav N, Bhatt DL. Meta-analysis evaluating the effect of left coronary dominance on outcomes after percutaneous coronary intervention. The American Journal of Cardiology. 2018 Dec 15;122(12):2026-34.

9. Yan B, Yang J, Fan Y, Zhao B, Ma Q, Yang L, Ma X. Association of coronary dominance with the severity of coronary artery disease: a cross-sectional study in Shaanxi Province, China. BMJ Open. 2018 Nov 1;8(11):e021292.

10. Peng L, Guo X, Gao Y, Guo Q, Zhang J, Fang B, Yan B. Impact of right coronary dominance on triple-vessel coronary artery disease: A cross-sectional study. Medicine. 2018 Aug 1;97(32):e11685.

11. Wang L, Li J, Gao Y, Li R, Zhang J, Su D, Wang T, Yang G, Wang X. Association between coronary dominance and acute inferior myocardial infarction: a matched, case-control study. BMC cardiovascular disorders. 2019 Feb 4;19(1):35.