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Original Article

Influence of Coronary Artery Dominance on Right Ventricular Function in the Absence of Coronary Lesions: A Comprehensive Echocardiographic Study in Individuals with Normal Coronary Angiography

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ABSTRACT

Background: Coronary arterial dominance, determined by the vessel supplying the posterior descending artery (PDA), significantly influences myocardial perfusion. Although extensively studied in the context of acute myocardial infarction, the relationship between coronary dominance and right ventricular (RV) function in individuals with normal coronary angiography remains underexplored. This study aims to investigate RV functions across varied types of coronary dominance in the absence of coronary lesions. **Methods:** A cross-sectional study enrolled 75 individuals with angiographically normal coronary arteries, categorized into right (N=55) and left (N=20) coronary dominance groups. Participants underwent comprehensive clinical assessments, and coronary dominance was determined based on the artery supplying the PDA. Transthoracic echocardiography assessed RV function, and statistical analyses were performed using appropriate tests. **Results:** Demographic characteristics did not statistically significantly differ between right and left coronary dominance groups ($p>0.05$). RV function indices, including TAPSE, s' tissue Doppler systolic wave, and RV diastolic parameters, showed no statistical significance based on coronary dominance types ($p>0.05$). **Conclusions**: In the absence of coronary lesions, coronary artery dominance did not significantly impact RV function as assessed by echocardiography. These findings suggest that variations in coronary dominance may not be a primary determinant of RV function in individuals with normal coronary angiography. Larger multicenter studies are needed to validate these results further.

Keywords: Coronary artery dominance, right ventricular function, normal coronary angiography, echocardiography, myocardial perfusion.

INTRODUCTION:

Coronary arterial dominance, defined by the vessel supplying the posterior descending artery (PDA), plays a crucial role in myocardial perfusion. In most hearts (80-85%), the right coronary artery (RCA) supplies the PDA, rendering them right dominant, while about 10% are left dominant, and 20% are co-dominant [1][2]. The implications of coronary dominance are vast,

impacting myocardial ischemia, infarction, coronary artery imaging, and planning for coronary artery bypass grafting [3]. Notably, the systolic-to-diastolic flow ratio in the RCA is diminished in right dominance compared to left dominance, owing to the RCA supplying regions of the left ventricle with higher systolic pressure, resulting in greater systolic flow impediment [4].

However, literature examining the relationship between coronary dominance type and right ventricular (RV) function in individuals with normal coronary angiography is lacking. Therefore, this study aims to investigate RV functions in varied types of coronary dominance in individuals with angiographically normal coronary arteries.

METHODS

This cross-sectional study was conducted in our Hospital's Cardiology department from March 2022 to November 2023. The protocol was approved by the Institutional Review Board, Faculty of Medicine, Zagazig University (ZU-IRB) which confirmed that all methods were performed following the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research. Informed written consent was obtained from all participants. The study group comprised 75 consecutive patients aged 18 years or older with normal coronary angiography who fulfilled the inclusion criteria. Seventy-five individuals with angiographically normal coronary arteries were divided into right coronary dominance (N=55) and left coronary dominance (N=20) groups.

Eligibility Criteria:

Inclusion Criteria: Individuals aged 18 years or older with normal coronary angiography were included in the study.

Exclusion Criteria: Participants with a history of acute coronary syndrome, prior coronary revascularization, coronary artery anomalies, significant valvular lesions, cardiomyopathy, conduction defects, rhythm disturbances, right heart disease, or malignancy were excluded from the study.

Participants meeting the inclusion criteria underwent a thorough clinical examination, and coronary dominance was assessed based on the artery supplying the posterior descending artery [5].

Coronary Dominance Assessment: The determination of coronary dominance relies on the artery supplying the posterior descending artery (PDA). If the PDA is primarily supplied by the right coronary artery (RCA), the coronary circulation is categorized as right-dominant. Conversely, if the PDA is predominantly supplied by the circumflex artery (LCX), the coronary circulation is classified as left-dominant. In cases where the PDA receives contributions from both the right coronary artery and the circumflex artery, the coronary circulation is termed co-dominant [5].

Transthoracic Echocardiography: Echocardiographic examinations were conducted within one week of the coronary angiographic study, adhering to the recommendations of the American Society of Echocardiography. Measurements were derived from three consecutive cardiac cycles at a horizontal sweep speed of 100 mm/s. Tissue Doppler Echocardiography (TDE) involved placing a 4–5-mm sample volume at the lateral and septal annuli of the tricuspid valve. The assessment of right ventricular (RV) systolic function included Tricuspid Annular Plane Excursion (TAPSE) and the s' tissue Doppler systolic wave [6]. Evaluation of RV diastolic function utilized trans-

tricuspid flow velocity-derived indices from the apical 4-chamber view (4–5 mm). This included measuring peak early and late diastolic trans-mitral velocities (E&A) and E-wave deceleration time. Additionally, the myocardial performance index of the RV (tei RV) was determined [7].

Statistical analysis:

All data underwent meticulous collection, tabulation, and rigorous statistical analysis utilizing IBM SPSS Statistics for Windows, Version 23.0 (Armonk, NY: IBM Corp. 2015). Quantitative data were presented as both the mean ± SD and the median (range), while qualitative data were expressed as numbers and percentages. The t-test was employed for comparing two groups of normally distributed variables, whereas the Mann-Whitney U test was utilized for non-normally distributed variables across two groups. Percentages of categorical variables underwent comparison through the Chi-square test. Pearson or Spearman correlation coefficients were calculated to assess the relationships among various study variables. A positive sign indicated a direct correlation, while a negative sign indicated an inverse correlation. Additionally, values approaching 1 signified a robust correlation, while those nearing 0 indicated a weaker correlation. All statistical tests were two-sided, with a *p*-value < 0.05 deemed statistically significant, and a *p*-value ≥ 0.05 considered statistically non-significant (NS) .

RESULTS:

The study encompassed 75 individuals with angiographically normal coronary arteries, stratified into two distinct groups: the Right Coronary Dominance group (N=55) and the Left Coronary Dominance group (N=20). The mean age of the entire cohort was 50.25±11.03 years, spanning from 23 to 75 years. Among the participants, 46 individuals (61.3%) were female. The past clinical history exhibited a distribution with 72% of patients being diabetic, 57.5% presenting with hypertension, 60% identified as smokers, and 58.9% having dyslipidemia.

Analysis revealed no discernible distinctions in demographic and general characteristics across various coronary artery dominance types, with a *p*-value greater than 0.05 (refer to Table 1). Moreover, the assessment of right ventricular function did not yield any statistical significant differences based on coronary artery dominance, as indicated by a *p*-value exceeding 0.05 (refer to Table 2). Further, no statistically significant correlation was observed between right ventricular function and age, sex, or coronary dominance type, with all *p*-values surpassing 0.05 (refer to Table 3).

Table (1): Demographic and general characteristics of studied population.

Variables	Total N.75	Right dominance N=55	Left dominance N=20	t	*p*
Age per years Mean ±SD Median(range)	50.25±11.03 50(23-75)	48.83±10.98 47(23-73)	54.15±10.45 54(39-75)	1.87	0.065
	N (%)	N (%)	N (%)	χ 2	*p*
Sex n (%) Males females	29 (38.7) 46 (61.3)	21 (38.2) 34 (61.8)	8 (40.0) 12 (60.0)	0.02	0.882
DM n (%) yes no	54 (72.0) 21 (28.0)	41 (76.1) 15 (23.9)	13 (65.0) 7 (35.0)	0.663	0.416
HTN n (%) yes no	43 (57.3) 32 (42.7)	34 (61.8) 21 (38.2)	9 (45.0) 11 (55.0)	1.69	0.193
Smokers n (%) yes no	45 (60.0) 30 (40.0)	34 (61.8) 21 (38.2)	11 (55.0) 9 (45.0)	0.284	0.594

N=number; SD =standard deviation, t= student t test, χ 2 Chisquare test; HTN: hypertension; DM: Diabetes mellitus; *p*>0.05 was considered non-significant.

Table (2): Right ventricular functions in relation to coronary arteries dominance:

Variables	Total N.75	Right dominance N=55	Left dominance N=20	t	*p*
RV tapse Mean ±SD Median (range)	21.67±2.28 22 (11-31)	21.72±1.32 22 (18-24)	21.51±3.92 21.5 (11-31)	0.353	0.725
RV S Mean ±SD Median (range)	0.158±0.058 0.14 (0.1-0.51)	0.16±0.04 0.14 (0.1-0.41)	0.16±0.019 0.14 (0.11-0.51)	0.458	0.649
TV E/A Mean ±SD Median (range)	0.7±0.19 0.73 (0.12-1.17)	0.69±0.21 0.74 (0.12-1.17)	0.74±0.08 0.73 (0.66-0.99)	1.122	0.266
tie RV	0.44±0.097 0.44 (0.16-0.67)	0.44±0.11 0.45 (0.16-0.67)	0.41±0.05 0.42 (0.25-0.48)	1.214	0.229

RV=Right ventricle, tie RV= RV myocardial performance index; *p*>0.05 was considered non-significant.

Table (3): Correlation of RV-TAPSE and RV-S with other variables

Variables	RV-TAPSE		RV-S	
	r	***p***	**r**	***p***
Age	-0.028	0.814	-0.122	0.297
Sex	-0.032	0.782	0.008	0.948
Coronary dominance	-0.192	0.099	0.176	0.131

r= correlation coefficient

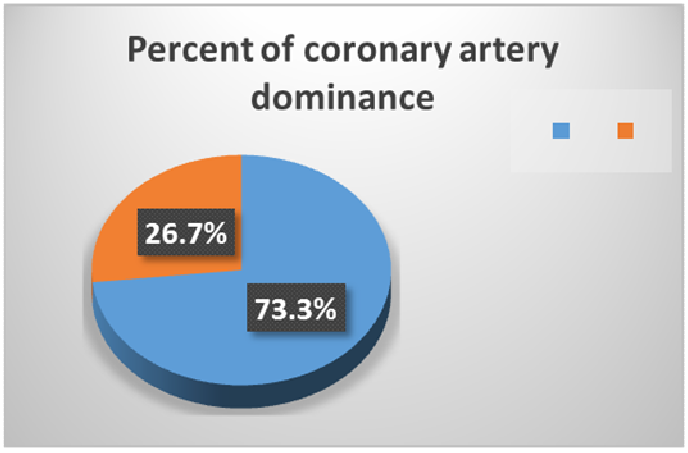

Figure 1: Coronary artery dominance distribution of the studied population with normal coronary angiography

DISCUSSION:

Coronary dominance has been extensively explored as a prognostic marker in acute ST-elevation myocardial infarction (STEMI) **[4]**. **Abu Assi et al. (2016) [8]** reported that left dominance carries a higher risk of death in reinfarction compared to right dominance, suggesting its potential utility in prognostic stratification. In contrast, **Mikaeilvand et al. (2020) [9]** found no significant differences in the mortality rates between right and left dominance, both in-hospital and at one-year follow-up.

Data on the influence of coronary dominance on right ventricular (RV) function in individuals with normal coronary angiography are limited. Consequently, our study aimed to investigate RV function across various types of coronary dominance in individuals with angiographically normal coronaries.

While cardiac magnetic resonance imaging (CMR) is considered the gold standard for assessing RV function, its limited availability, high cost, and time-consuming nature make it less feasible. Hence, echocardiography emerges as a practical alternative. Tricuspid Annular Plane Excursion (TAPSE) was notably correlated with CMRI-derived RV ejection fraction (RVEF) [10].

Lemarie et al. (2015)[11] explored the accuracy of conventional echocardiographic parameters in assessing RV function after acute myocardial infarction (AMI) compared to cardiac magnetic resonance imaging (CMR). Their findings indicated that conventional echocardiographic parameters exhibited suboptimal performance.

In our study, we observed a statistical non-significant difference between right and left coronary dominance groups concerning demographic data and risk factors. This aligns with the findings of **Ozkan et al. (2022)[12]**

who similarly reported no statistically significant differences in demographic data, hypertension, and hyperlipidemia based on coronary dominance.

A key finding of our study was the lack of statistically significant differences in RV function indices between right and left coronary dominance. This echoes the conclusion of **Ozkan et al. (2022) [12]** who asserted that coronary artery dominance, in the absence of other conditions, did not impact RV function as assessed by echocardiography. This lack of impact was attributed to the absence of coronary lesions that might otherwise impair ventricular function.

Limitations of the study: Several limitations were inherent in our study that warrant acknowledgment. Firstly, the sample size was relatively small, potentially introducing bias in patient selection and influencing the overall results. Consequently, there is a need for larger prospective and randomized controlled trials to validate and generalize the findings more robustly.

Additionally, it is important to note that speckle tracking echocardiography, recognized as a highly robust tool for assessing right ventricular (RV) function with good correlation to CMR-RVEF, was not incorporated into our study. This limitation highlights a potential avenue for future research to enhance the comprehensive evaluation of RV function. Implementing speckle-tracking echocardiography could provide additional insights and strengthen the overall validity of the study's outcomes.

CONCLUSIONS:

In conclusion, our study indicates that coronary artery dominance, in the absence of any concurrent conditions, does not exert a significant impact on right ventricular (RV) function as assessed by echocardiography. These findings underscore the importance of considering the broader clinical context and suggest that variations in coronary artery dominance may not be a primary determinant of RV function in individuals with normal coronary angiography.

To further strengthen and validate these results, larger multicenter studies are warranted. Conducting extensive investigations involving diverse populations will provide a more comprehensive understanding of the relationship between coronary artery dominance and RV function. Such endeavors will contribute to refining our knowledge and enhancing the clinical implications of these findings.

Conflicts of Interest

The authors report no conflicts of interest.

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None declared

REFERENCES:

1. **Young PM, Gerber TC, Williamson EE, Julsrud PR, Herfkens RJ.**: Cardiac imaging: Part 2, normal, variant, and anomalous configurations of the coronary vasculature. AJR Am J Roentgenol. 2011 Oct; 197(4):816-26.
2. **Goel A, Reddy BN, Viswamitra S**. Radiological Review of Coronary Artery **Anomalies**. In CT and MRI in Congenital Heart Diseases. Springer, Singapore. 2021:185-211.
3. **Tomar S, Manik P, Sharma PK, Kumar M. PDA** (Posterior Descending Artery) & Coronary Dominance - A MDCT Coronary Angiographic Analysis of Anatomic Variations and Clinical Importance. Academia Anatomica International. 2018 Nov 25; 4(2):21-27.
4. **Mynard JP, Smolich JJ**. Influence of anatomical dominance and hypertension on coronary conduit arterial and microcirculatory flow patterns: a multiscale modeling study. Am J Physiol Heart Circ Physiol. 2016 Jul 1;311(1):H11-23.
5. **Roman AC, Silva DD, Santos LD, Spiazzi LB.** Most common anatomic anomalies of coronary arteries. J Transcat Interven. 2020;28:eA20190027.
6. **Awad EM, Mahmoud AH, Maghrby KS, Taha NM, Ibrahim AM**. Short-term prognostic value of TAPSE, RVFAC and Tricuspid **S'wave** peak systolic velocity after first acute myocardial infarction. BMC Res Notes. 2020 Dec;13:1-6.
7. **Badran HM, Ibrahim WA, Alaksher T, Soltan G**. Impact of the left anterior descending artery wrapping around the left ventricular **apex** on cardiac mechanics in patients with normal coronary angiography. Egyptian Heart J. 2020 Dec;72:1-3.
8. **Abu-Assi E, Castiñeira-Busto M, González-Salvado V, Raposeiras-Roubin S, Abumuaileq RR, Peña-Gil C, and et al.** Coronary **artery** dominance and long-term prognosis in patients with ST-segment elevation myocardial infarction treated with primary angioplasty. Rev Esp Cardiol (Engl Ed). 2016 Jan 1;69(1):19-27.

9. **Mikaeilvand A, Firuozi A, Basiri H, Varghaei A, Izadpanah P, Kojuri J, and et al**. Association of coronary artery dominance and mortality rate and complications in patients with **ST**-segment elevation myocardial infarction treated with primary percutaneous coronary intervention. J Res Med Sci. 2020 Nov 26;25:107.
10. **Spruijt OA, Di Pasqua MC, Bogaard HJ, van der Bruggen CEE, Oosterveer F, Marcus JT, and et al.** Serial **assessment** of right ventricular systolic function in patients with precapillary pulmonary hypertension using simple echocardiographic parameters: A comparison with cardiac magnetic resonance imaging. J Cardiol. 2017 Jan;69(1):182-188.
11. **Lemarié J, Huttin O, Girerd N, Mandry D, Juillière Y, Moulin F, et al(2015).** Usefulness of Speckle-Tracking Imaging for Right Ventricular Assessment after Acute Myocardial Infarction: A Magnetic Resonance Imaging/Echocardiographic Comparison within the Relation between Aldosterone
12. **Eyüp Özkan, Ahmet Oğuz Baktır, Erkan Demirci, Hüseyin Odabaş, Ahmet Tok, Engin Dondurmacı,and et. al. (2022).** The Correlation Between Right Ventricular Function and Dominance of Right Coronary Artery. Koşuyolu Heart Journal, 25(2), 208-212. doi:10.51645/khj.2022.m279

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