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ORIGINAL RESEARCH

Usefulness of Coronary Angiography in Patients With Left Ventricular Systolic Dysfunction In The Absence Of Prior Ischemia And Its Relation To Risk Factors

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ABSTRACT

Background: Diagnosing the cause of left ventricular systolic dysfunction (LVSD) is key in heart failure management, but the use of coronary angiography varies due to limited evidence of its benefits. **Aim**: The present study aims to evaluate the diagnostic effectiveness of coronary angiography in patients with LVSD without a prior history of ischemic heart disease. **Methods**: This retrospective cohort study analyzed adult patients with LVSD (EF < 50%) who underwent coronary angiography between March 2022 and July 2024. **Results**: Of the 53 participants, 39 had non-significant coronary stenosis and 14 had significant stenosis. The mean age was 52.3 years, with no significant age difference between groups ($p = 0.309$). Smoking ($p = 0.003$) and diabetes mellitus ($p < 0.001$) were significantly more common in the significant stenosis group, while no differences were observed for hypertension ($p = 0.853$) or history of heart failure ($p = 0.694$). ECG findings showed no significant differences, but the significant stenosis group had a significantly lower left ventricular ejection fraction ($p < 0.01$), indicating reduced heart function. **Conclusion**: The present study concludes that in patients with left ventricular systolic dysfunction, the risk stratification of coronary disease can be established using information from the clinical history, electrocardiogram, and echocardiography.

Key words: Left ventricular systolic dysfunction, Heart failure, LVEF, Echocardiography

INTRODUCTION

Accurately diagnosing the underlying cause of left ventricular systolic dysfunction (LVSD) is crucial in managing patients with heart failure. While the treatment approaches for heart failure may be similar across different etiologies, identifying ischemia as the underlying cause of ventricular dysfunction can significantly impact clinical decision-making [1,2]. Coronary angiography is a widely used diagnostic tool for detecting coronary artery disease (CAD) and is particularly useful in confirming ischemic causes of ventricular dysfunction[3]. Despite its established role in diagnosing CAD, current clinical practice guidelines provide a Class IIb indication with Level B evidence for its use in LVSD, indicating that its benefits in this specific context are not thoroughly substantiated by targeted studies [1].

There is substantial variability in the application of coronary angiography among patients with LVSD or heart failure, largely due to a lack of definitive data demonstrating the clear benefits of this diagnostic procedure in such populations [4-6]. Our study aims to address this gap by evaluating the diagnostic performance of coronary angiography in patients with LVSD and no history of prior ischemic heart disease. We also seek to identify clinical variables and risk factors that predict the presence of CAD in these patients. We hypothesize that coronary angiography should be selectively utilized based on the presence of risk factors, rather than being universally applied.

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MATERIALS AND METHODS

Study Design and Population

This retrospective cohort study analyzed data from adult patients who underwent diagnostic coronary angiography between March 2022 and July 2024, with a diagnosis of LVSD (ejection fraction (EF) < 50%) identified via echocardiography. Patients were selected from the Catheterization Laboratory database. Those with a known history of ischemic heart disease were excluded from the study. Figure 1 summarizes the study population.

Data Collection

We collected the following data from patient records:

- **Demographics**: Age, sex,
- **Cardiovascular Risk Factors**: Smoking status, hypertension, diabetes mellitus.
- **Clinical History**: Previous diagnosis of heart failure.
- **Electrocardiographic Findings**: Presence of atrial fibrillation, pathological Q waves, or interventricular conduction disturbances.
- **Echocardiographic Data**: EF and segmental changes in myocardial contractility.

Coronary Angiography Analysis

All coronary angiography studies were reviewed retrospectively by an expert interventional cardiologist. The evaluation focused on:

- **Presence of CAD**: Identifying significant coronary lesions (≥50% stenosis) in the left main coronary artery or in one, two, or three vessels.

Group Classification

Patients were divided into two groups based on the presence of significant coronary stenosis:

- **Group 1**: No significant coronary stenosis.
- **Group 2**: Presence of significant coronary stenosis.

Sample Size and Statistical Analysis

Sample size estimation was based on the prevalence of risk factors in the initial cohort of 50 patients, leading to a target sample size of 53 patients.

Statistical Methods

- **Descriptive Statistics**: Categorical variables were summarized as counts and percentages. Continuous variables were described using median and interquartile range.
- **Comparative Analysis**: Categorical variables were compared using chi-squared or Fisher's exact tests. Continuous variables were analyzed using the Mann–Whitney U test.
- **Regression Analysis**: Univariate and multivariable logistic regression analyses were conducted to identify predictors of significant coronary stenosis. The multivariable model included clinically relevant variables identified from the univariate analysis: age ≤50 years, female sex, smoking status, hypertension, diabetes mellitus, atrial fibrillation/flutter. The backward stepwise procedure was used for model selection.

Statistical Significance

- Statistical significance was set at $p < 0.05$. Analysis was performed using AI software.

RESULTS

Of the 53 participants, 39 had non-significant coronary stenosis, while 14 had significant stenosis. The mean age was 52.3 years, with no notable age difference between the groups ($p = 0.309$). Majority of the participants were female (49%). In terms of cardiovascular risk factors, smoking was significantly more common in the significant stenosis group ($p = 0.003$). Diabetes mellitus also had significantly higher prevalence in this group ($p < 0.001$). However, there were no significant differences between the groups for hypertension ($p = 0.853$) or a history of heart failure ($p = 0.694$). (Table 1)

The ECG findings, including atrial fibrillation/flutter and bundle branch blocks, showed no significant variation between the groups. On echocardiography, the significant stenosis group had a lower left ventricular ejection fraction ($p < 0.01$), indicating reduced heart function in this group.

Table 1: Baseline characteristics by non-significant and significant coronary stenosis

Variable	Overall (N = 53)	Non-Significant Coronary Stenosis (N = 39)	Significant Coronary Stenosis (N = 14)	*p* Value (40.31)
Demographics				
Age, years	52.3	53.2	51.64	0.309
Age ≤ 50 years	27	19	8	
Female sex	26	18	8	0.694
Cardiovascular risk factors				
Past or current smoker	19	9	10	0.003
Hypertension	16	11	5	0.853
Diabetes mellitus	15	3	12	<0.001
Medical history				
Heart failure	27	21	6	0.694

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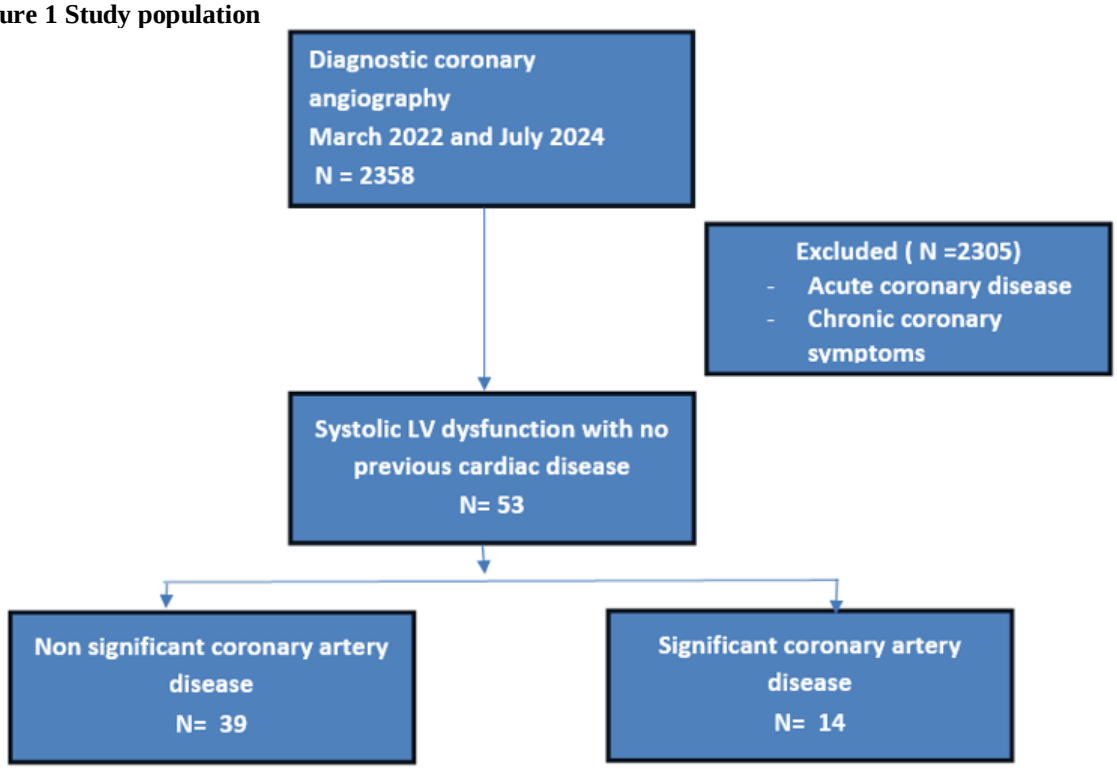
ECG				
Atrial fibrillation/flutter	2	2	0	0.963
Left bundle branch block	9	4	5	0.20
Right bundle branch block	4	3	1	0.68
Echocardiography				
Left ventricular ejection fraction (%)	37.7	40.31	30.8	<0.01

Figure 1 Study population



DISCUSSION

Our study reveals that the diagnostic yield of coronary angiography in detecting significant CAD in patients with systolic LVSD and no prior ischemic heart disease is low when the procedure is applied indiscriminately. We identified specific clinical variables that help in identifying patients with a higher likelihood of significant coronary disease, thus refining the selection criteria for coronary angiography.

Patients with a high riskfactors exhibited a greater probability of significant coronary stenosis and should be evaluated by coronary angiograph. Conversely, those with a low risk factors are at a lower risk of significant stenosis and may avoid coronary angiography, given its low diagnostic yield in this group.

The classification of ventricular dysfunction causes is not standardized, leading to considerable overlap among potential etiologies. Many patients might present with multiple pathologies, both cardiovascular and non-cardiovascular, that contribute to ventricular dysfunction. Notably, patients with ischemic ventricular dysfunction often have a history of myocardial infarction or revascularization. Although coronary angiography is widely considered the gold standard for diagnosing CAD in patients with ventricular dysfunction[7], it does not always establish causation. For example, in a study by Deschroche et al., coronary lesions identified by angiography were more common in patients with myocardial scars detected by cardiac resonance imaging, which had a high negative predictive value and a moderate positive predictive value for detecting coronary lesions [8]. Therefore, coronary angiography alone cannot definitively diagnose ischemic cardiomyopathy.

Similarly, in the DANISH study, non-ischemic cardiomyopathy was diagnosed based on normal coronary angiograms, normal coronary CT angiograms, or the absence of ischemic changes in perfusion studies. The study also considered non-ischemic cardiomyopathy in patients with limited coronary disease if it did not fully explain the observed ventricular dysfunction [9]. Our study found that 26.4% of patients with significant coronary stenosis.However, without additional clinical history or imaging, these findings do not necessarily confirm ischemic cardiomyopathy.

Our findings highlight the value of integrating clinical variables, ECG data and echocardiographic results to estimate the probability of CAD in patients with LVSD. This approach can help clinicians decide when to avoid coronary angiography, thus optimizing

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resource use and patient management. Previous studies with smaller cohorts have attempted to identify predictors of CAD in LVSD [10,11,12], with some finding that variables such as age, hypertension, diabetes, smoking, and specific ECG changes were useful in predicting coronary heart disease [13]. In line with our results, Smilowitz found a higher prevalence of left bundle branch block in non-ischemic cardiomyopathy compared to ischemic cardiomyopathy.

Our study supports the European Society of Cardiology guidelines, which recommend coronary angiography (Class IIb) for patients with reduced ejection fraction who have an intermediate to high pre-test probability of CAD and positive results from non-invasive ischemia tests[1]. However, the evidence base for this recommendation remains limited. For instance, the STICH trial and 10 year follow up later, which assessed the impact of revascularization versus medical therapy in patients with reduced ejection fraction and CAD, did not specifically evaluate coronary angiography's performance in detecting coronary stenosis or propose a predictive score for CAD [14]. Despite this, the study's extension highlighted that surgical revascularization could benefit select patients by reducing mortality and cardiovascular events.

Investigating the ischemic cause in patients with LVSD is crucial for several reasons. Demonstrating coronary disease through any diagnostic method necessitates rigorous cardiovascular prevention strategies, including antiplatelet and high-intensity lipid-lowering therapies. Furthermore, patients with LVSD and ischemic origins who meet certain criteria are eligible for implantable cardioverter defibrillators (ICDs) as per current guidelines, unlike those with non-ischemic cardiomyopathy [1].

Our study has limitations, including its single-center design, which may affect the generalizability of the results. Additionally, the analysis was constrained by the number of variables and the absence of internal or external validation for the proposed risk score. Finally, the presence of coronary lesions, especially with single-vessel disease, does not necessarily confirm ischemic cardiomyopathy.

CONCLUSIONS

Our study demonstrates that data from clinical history, ECG, and echocardiogram can be used to determine the risk stratification of coronary disease in patients with left ventricular systolic dysfunction. Its our study suggest based on risk factors help us to identify patients who should avoid coronary angiography and those who could benefit from it. Thus, our results support, with objective data, the Class IIb indication forcoronary angiography in the current clinical practice guidelines of the European Society of Cardiology.

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