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General Medicine

STUDY OF EJECTION FRACTION IN PATIENTS WITH ISCHEMIC HEART DISEASES

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ABSTRACT **Background** Left ventricular ejection fraction (EF) serves as an independent utility predictor of outcomes in patients with ischemic heart diseases (IHD). Despite its importance, there is a lack of comprehensive data regarding the patterns and factors influencing EF over time. This study sought to outline the demographic trends and determinants of EF in patients with IHD **Method** This observational prospective study involved 150 adult patients diagnosed with IHD who underwent coronary angiography. Study was carried over a period of 2-years at tertiary care hospital at Aurangabad, Maharashtra. Left ventricular EF was measured using transthoracic echocardiography. **Results** Out of 150 patients in the study, maximum cases pertained to age interval of more than 60 years (35.3%) with male preponderance(64.7% males). Majority of patients had co-morbidities like Diabetes(31.3%), previous history of ischemic heart disease(19.3%), hypertension(53.3%), cerebrovascular accident(4.7%), hypothyroidism(1.3%) and were addicted to tobacco consumption(53.3%), and alcohol(32%). 41.3% patients had preserved ejection fraction. We could establish statistical significant correlation between spectrum of all EF categories with the CAG findings (P value =0.007) and single, double, triple vessel diseases (P value= 0.034). **Conclusions** Key non-modifiable risk factors, such as male gender and age, play a significant role in the development of IHD. Additionally, the study highlighted that many patients presented with clusters of multiple risk factors, suggesting a need for more proactive management strategies to control these risks in IHD patients. The identification of factors associated with a reduced likelihood of left ventricular EF improvement in patients with initially significantly reduced left ventricular EF (≤ 35%) after AMI can aid in risk stratification and patient management.

KEYWORDS : Coronary Angiography, Ischemic Heart Disease, Left Ventricular Ejection Fraction

INTRODUCTION

The annual incidence of sudden cardiac death (SCD) is approximately 1 per 1,000 people. Most instances of SCD are linked to coronary artery disease (CAD), often occurring due to ventricular tachyarrhythmias following a prior myocardial infarction (MI). 1 CAD remains a leading cause of global mortality and morbidity. As of 2020, it was the foremost cause of death worldwide. In the United States alone, over 1.5 million individuals are affected annually. Globally, a CAD-related event occurs approximately every 29 seconds, with a death occurring every minute. 2,3 Epidemiological data reveals that CAD was responsible for 82,307 deaths, making it the leading cause of mortality. 4 The majority of SCD cases are related to CAD, with most of these incidents occurring due to ventricular tachyarrhythmias following a prior MI. 5 Ischemic heart disease frequently leads to heart failure (HF) due to left ventricular dysfunction (LVD) stemming from myocardial ischemia or infarction, as well as from prevalent risk factors like hypertension and diabetes. The prognosis for patients with HF coupled with flow-limiting obstructive coronary artery disease is generally unfavourable. 6 While left ventricular ejection fraction (EF) is a robust independent predictor of mortality in patients with heart failure, its prognostic significance should be considered alongside other established risk factors. The current guidelines from the American College of Cardiology and American Heart Association advocate for the regular assessment of LVEF to inform treatment decisions. However, these guidelines do not specify a direct correlation between left ventricular EF and patient prognosis. 7 The presence of IHD due to flow-limiting obstructive coronary atherosclerosis, such as CAD, is often associated with a worse prognosis in HF patients compared to those with HF due to nonischemic cardiomyopathy. 8 This adverse prognosis linked to obstructive CAD has been corroborated by data from multiple HF clinical trial cohorts. For example, patients with left ventricular EF of 35% or less who participated in the SOLVD (Studies of Left Ventricular Dysfunction) trial and had a history of myocardial infarction experienced a two-fold increase in hospitalization rates for decompensated HF and a four-fold increase in mortality compared to patients without prior myocardial infarction. 9 Non-invasive imaging techniques have been developed to address limitations of traditional methods, such as the low sensitivity and specificity of exercise testing and difficulties in assessing ischemia in patients with impaired mobility or left bundle branch block. 10,11 Coronary angiography remains the gold standard for detecting coronary artery stenosis and is essential for guiding percutaneous coronary interventions. It is also the preferred diagnostic tool for patients with systolic ventricular dysfunction, providing critical information on the number of affected vessels and the extent of stenosis. 12 This study aims to explore and correlate ejection fraction in patients of myocardial infarction with coronary angiography results.

METHODOLOGY

This observational cross-sectional study included 150 adult patients with IHD undergoing coronary angiography at tertiary care teaching hospital between September 2022 to September 2024. After initial screening, the data regarding age, gender, diagnosis were recorded in the case record form. Further, these patients were subjected to physical examination for evaluating the clinical signs. Left ventricular EF was measured using transthoracic echocardiography. It was performed by the cardiologist using iE 33, Philips medical system, Andover , MA USA. Wall thickness and dimensions of the left ventricle in diastole (left ventricular end-diastolic dimension) and systole (left ventricular end-systolic dimension) were assessed in 2D presentations from the parasternal long-axis view. Left ventricular volumes and EF were calculated using the biplane Simpson method in the apical four-chamber and two-chamber views. According to baseline EF, patients were categorized as having reduced EF (EF < 40%), mildly reduced EF (EF 41–50%), or preserved EF (EF > 50%). All patients were posted for CAG. CAG was done in Siemens Cath lab through trans-radial access using a low osmolar non-ionic contrast agent (Omnipaque). Multiple views were taken and quantitative analysis was done using medical imaging system and CMS analysis software. The statistical analysis was performed using the SPSS© for windows™ (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM corp). Frequency was used for nominal and ordinal variables. Mean and standard deviation were used for continuous variables. Chi-square test or Fisher exact test was used to analyse the association between 2 categorical variables and student t test was used to assess the association between 2 continuous variables. A significance level of $p < 0.05$ was used to determine statistically significant findings.

RESULTS

Table 1: Demographic and clinical characteristics(n=150)

Parameter	No of patients	Percentage (%)
Age (Years)		
>60	53	35.3
51-60	34	22.7
41-50	51	34
≤ 40	12	8

Gender		
Male	97	64.7
Female	53	35.3
Co-morbidities		
Diabetes	47	31.3
Hypertension	80	53.3
Previous History of IHD	29	19.3
CVA	7	4.7
Hypothyroidism	2	1.3
Addictions		
Tobacco	80	53.3
Alcohol	48	32
Ejection Fraction		
≥50	62	41.3
40-49	42	28
<40	46	30.7

Table 1 showed that there was bimodal distribution of patients. Majority of the patients belong to age category of > 60 years and 41-50 years followed by patients in the age group. The mean and standard deviation of the age of the patients are 55.9 and 12.4 years respectively. Nearly 2/3rd of the patients were males. 47 patients had diabetes mellitus, 80 patients had hypertension, 29 patients had previous history of IHD, 7 patients had CVA and 2 patients had hypothyroidism. More than half of the patients were users of smoke or smokeless tobacco, while nearly one-third of the patients were alcohol users. Moreover, 62 patients had preserved ejection fraction followed by reduced Ejection fraction in 46 patients. The mean and standard deviation of the Ejection fraction were 46% and 11% respectively

Table 2: Correlation of Ejection fraction category with CAG findings (n=150)

EF category	Normal N=17	Mild CAD N=9	SVD N=48	DVD N=32	TVD N=44	Total
<40	14	0	1	16	15	46
40-49	5	2	4	18	13	42
≥ 50	13	7	12	14	16	62

Table 2 showed the co-relation of ejection fraction category with the CAG findings. P value was found to be 0.007 and it was significant.

Table 3 Correlation of Ejection fraction with the Vessel Disease (n=150)

EF category	SVD (N=48)	DVD(N=32)	TVD(N=44)
<40	1	16	15
40-49	4	18	13
≥ 50	12	14	16

Table 3 showed that there was significant difference between Single Vessel Disease, Double Vessel Disease and Triple Vessel Disease with the EF. P value was found to be 0.034 and significant.

DISCUSSION

Left ventricular EF is a well known prognostic marker for cardiovascular events. The elevated risk of SCD in MI patients with reduced left ventricular EF has been corroborated by various studies. Approximately 70% of HF cases are linked to underlying IHD. Despite significant efforts to mitigate the primary risk factors for IHD, the rates of HF hospitalizations have remained relatively stable and are expected to increase. Ischemia is crucial in the onset and progression of both, heart failure with reduced ejection fraction (HFrEF) and heart failure with preserved ejection fraction (HFpEF). Individuals with obstructive epicardial stenosis, such as CAD, are more likely to develop HFrEF due to acute ischemic events leading to MI and scar tissue formation. [8] The impact of CAD on HF differs by geographic region. CAD contributes to about 10% of HF cases in Sub-Saharan Africa, while it accounts for 50% to 70% of HF cases in the United States and Europe, and 30% to 40% of cases in Asia and Latin America. [13] Evidence from HF treatment trials indicates that approximately two-thirds of HF cases are linked to obstructive CAD. However, this might not fully capture the prevalence of CAD or IHD in HF patients, as many trials did not include individuals with recent MI, angina, or signs of ischemia. [14] Studies such as the Framingham Heart Study (FHS) and the Olmstead County Study (OCS) support these findings. In the FHS cohort, which included 118,000 person-years of follow-up, about 25% of patients had a prior MI before developing HF, while only 5% developed HF without a previously recognized ischemic event. [15] Conversely, all participants in the OCS had a history of MI but no prior HF; after an average follow-up of 7 years, 41% developed new-onset HF. Among those with HF in the OCS, approximately 45% had HFrEF (EF<50%), 18% had HFpEF (EF≥50%), and the remaining patients did not undergo left ventricular function assessment within 60 days of their HF diagnosis. [16] In present study, 41.3% patients had preserved EF followed by reduced EF in 30.7% patients. The mean and standard deviation of the EF were 46% and 11% respectively. Liu et al., reported that among 10,724 consecutive patients with CAD, 125 had a reduced EF of less than 40%, 396 had an EF ranging from 40% to 50%, and the majority of patients had an EF greater than 50%. [17] Mochmann et al., observed that 63% of patients had preserved EF, 14.8% had an EF between 40% and 65%, and 22.2% had severely reduced EF. [18] Saraf et al., found that 16% of patients had an EF below 30%, 60% had an EF between 30% and 50%, and the remaining 24% had an EF above 50%. Notably, the largest group of patients (60%) had an EF between 30% and 50%. [19] In present study, we could appraise statistical significant correlation between spectrum of all EF categories with the CAG findings (P value =0.007) We could enlighten on our findings that patients with spectrum of spectrums of EF had more chances of having vessel disease. We could find significant difference between Single Vessel Disease, Double Vessel Disease, Triple Vessel Disease with the spectrums of EF in present study (P value= 0.034). Saraf et al., reported that among patients with mildly reduced EF, SVD was the most prevalent, affecting 53.33% of the cohort. In contrast, among patients with preserved EF, the majority had no significant obstruction (58.33%), followed by SVD (41.66%). For patients with reduced ejection fraction, TVD was most common, affecting 75% of them. [19] Betriu et al., observed similar patterns, noting that TVD was most frequently found in patients with reduced EF. [20] In present study, while evaluating demographic parameters we found that, the mean age of the participants was 55.9 ± 12.4 years with maximum cases pertaining to age interval of more than 60 years (35.3%). Gender wise evaluation revealed male preponderance with 97 cases of males (64.7%) and 53 females (35.3%). Martínez-Losas et al., in their study found 62.9 ± 14 years as mean age in their participants.[21] Chang et al., also appraised the group's mean age as 62 ± 14 years, with 59% of males. [22] This was in accordance to our study findings. The study participants had a sample mean age of 59.46 ± 10.83 years in another study by Meda et al., which further supported our study findings, but they found females sex predilections with 52.23% females, which was contradictory to our study data. The authors explained further that the number of females who suffered from CAD were higher in older patients that may be related to protective role of sex hormones (Estrogen and Progesterone) in young women.[23] Age is a recognized independent risk factor for non-communicable diseases, including IHD. The higher prevalence of CAD in men compared to women is influenced by several factors. One significant contributor is the increased prevalence of risk factors for IHD among men, such as higher rates of smoking and alcohol consumption, which are more common in the male population. [24] The prevalence of CAD has been observed to be higher in men and increases with age, aligning with findings from studies conducted in other regions. This trend is supported by global data analyses reported by Shehu MN et al., and Khan MA et al. [25,26] Moshar et al., also found that of total 112 patients who underwent CAG had mean age of 63 ± 8.5 years with male predominance, supporting our study data.[27]

CONCLUSION

We can conclude that the identification of factors that are linked with a lower probability of improvement in left ventricular EF in patients with IHD who undergo invasive treatment. Key factors included the presence of hypertension, and tobacco addictions. These findings have important implications for clinical practice, as recognizing these factors can enhance risk stratification and patient management for individuals with significantly reduced left ventricular EF with IHD. Neglecting to evaluate left ventricular EF can be linked to diminished hospital composite quality of care. However, larger studies are necessary to confirm these results and improve management strategies. A more detailed examination of the relationship between risk factor profiles and CAG findings is essential for developing targeted public health interventions in preventive cardiology.

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