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Echocardiographic and Angiographic Prevalence of Ischemic Mitral Regurgitation

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Abstract

Background and Objectives: Ischemic mitral regurgitation is defined as regurgitation associated with significant stenosis of one or more of the coronary arteries and the absence of organic mitral valve disease. It is common sequela of coronary artery disease especially post-myocardial infarction. The aim of this study was to determine the prevalence of mitral regurgitation in patients with significant coronary artery stenosis using echocardiography and left ventricular angiography.

Patients and methods: this study included patients attending Azadi Heart Center/Duhok/Iraq from 1st march 2018 to 1st march 2019 who underwent diagnostic coronary angiography and proved to have stenosis of 70% or more in at least one coronary branch, echocardiography, and left ventricular angiography were performed to detect mitral regurgitation.

Results: Three hundred twelve patients were included in this study with a mean age of 60+2.06 years, 255 patients (81.7%) were male, and 57 patients (18.3%) were female. The prevalence of ischemic mitral regurgitation by echocardiography was statistically higher (33.7 %) compared to angiographic prevalence (20.1%; p<0.001). Mitral regurgitation was significantly more common in patients with multi-vessel disease, among 96 patients with multi-vessel diseases; 69 patients (71.8%) had ischemic mitral regurgitation (p<0.001).

Conclusion: Ischemic mitral regurgitation is a relatively common complication of coronary artery disease, especially in those with multi-vessels disease and its frequency varies according to the method used for detection. Echocardiography is more sensitive than left ventricular angiography for detecting ischemic mitral regurgitation.

Keywords: Mitral regurgitation, Coronary artery disease, Echocardiography, Left ventricular angiography.

Introduction

Ischemic mitral regurgitation (IMR) is defined as regurgitation associated with stenosis of 70% or more in at least one coronary branch and normal mitral valve morphology.[1,2] Ischemic mitral regurgitation is one of the common complications of ischemic heart disease which occur either in the acute or chronic phase. The acute IMR can occur due to infarction and rupture of the papillary muscle which can leads to acute cardiogenic shock, while chronic IMR develops as a result left ventricle dilatation and dysfunction and not due to pathology at the valve per se.[2] Ischemic mitral regurgitation can occur specially in patients with history of myocardial infarction that cause permanent damage to the papillary muscle or adjacent myocardium. MR also can occur in the setting of acute coronary syndrome, where the MR typically resolves after termination

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of the ischemia.[3] Chronic IMR is defined as MR occurring more than 16 days after myocardial infarction, significant coronary artery stenosis with one or more LV segmental wall motion abnormalities; and structurally normal mitral valve (MV) leaflets and chordae tendinae, the last criterion is important to exclude patients with organic MR and associated coronary artery disease (CAD) .[2] The mechanism of IMR was previously attributed to papillary muscle dysfunction; however, further studies revealed that ischemia of papillary muscles alone will not produce significant MR without presence of significant damage of the underlying myocardial wall.[4] Accordingly the pathophysiologic theory of IMR has evolved through many hypotheses before reaching the conclusion that IMR is generated by an integration of several mechanisms each have a different role in generating MR.[5]

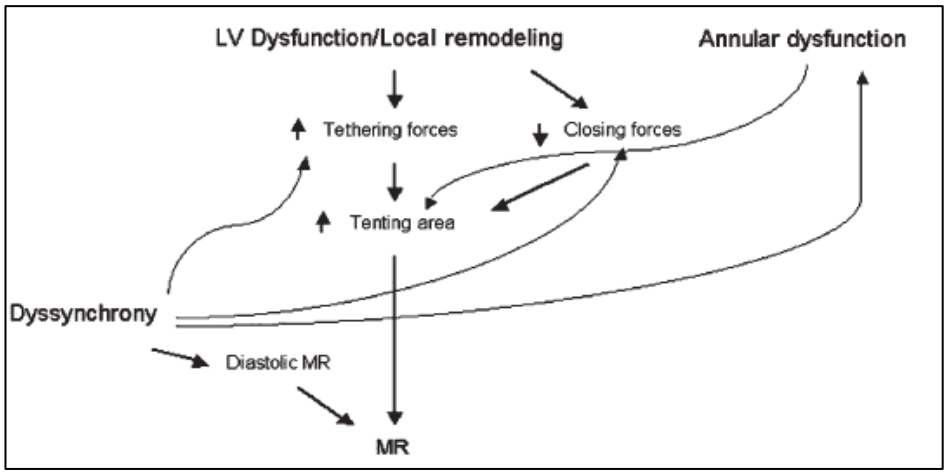

Figure (1): Pathophysiology of Ischemic mitral regurgitation

Left ventricular remodeling is the most important factor for the initial development of MR which will leads to change in the geometrical relationship between the ventricle and valve apparatus causing a restricted leaflet motion, termed 'incomplete mitral leaflet closure.[6] Left ventricular dysfunction, mechanical dyssynchrony of left ventricle and mitral annular dilation and/or dysfunction have additional roles as modulating factors of the degree of MR.[7] Therefore, there are multiple factors that interact in causing regurgitation Figure (1). The aim of this study was to determine the prevalence of mitral regurgitation in patients with significant coronary artery stenosis using echocardiography and left ventricular angiography.

Patients and methods

Three hundred twelve patients attending Azadi Heart Center in Duhok city/Iraq who underwent coronary angiography and had significant coronary artery disease (stenosis of 70% or more in at least one coronary branch) from 1st march 2018 to 1st march 2019 were included, echocardiography and left ventricular angiography was performed in patients having significant coronary artery diseases. The inclusion criteria were patients with stenosis of 70% or more in at least one coronary branch and normal mitral valve morphology. The exclusion criteria were patient with non-significant coronary artery stenosis, patients with organic mitral valve disease, patients with MR and aortic valve or congenital heart disease. Echocardiography performed for measurement of left ventricle and left

atrium dimensions using M-mode echocardiography, guided by 2D imaging. LV Ejection fraction (EF) was estimated by teichholz technique in all patients. Presence and degree of MR was determined by color flow Doppler, then the direction of jet of MR were determined as either eccentric or centric and the degree of MR was determined with quantitative measurements using Pulsed Doppler quantitative flow methods mitral and aortic stroke volumes also were calculated: (SV = CSA*VTI = 0.785 d2 * VTI), and regurgitant volume (RVol) was the difference between these 2 stroke volumes: Regurgitant Volume = SV_{Mitral}-SV_{Aortic}. The effective regurgitant orifice (ERO) area was the ratio of RVol to regurgitant time velocity integral (TVI) :[10] EROA= Regurgitant Volume / VTI_{RegJet} EROA <0・20 cm^2 is regarded as mild MR, 0.20 – 0.39 cm^2 as moderate MR and ≥0・40 cm^2 as severe MR.[10] Coronary angiography was performed through femoral artery approach with and Salinger technique. Significant coronary stenosis was defined as ≥ 70% stenosis in at least one coronary branch and ≥ 50% in the left main coronary artery.LV-angiography were performed in all patients and MR was assessed in the right anterior oblique projection, and graded on a scale of 1+ to 4+.[11] The general information of the patients was presented in number (percentage) or mean (Standard. deviation). The prevalence of IMR using both echocardiography and left ventricular angiography was determined in number (percentage). The association of IMR prevalence with cardiac parameters was examined in a Pearson Chi-squared test. The statistical calculations were performed by using IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp. Ethical approval was obtained from the ethical committee/Directorate of health / Duhok.

Results

This study included three hundred twelve patients with a mean age of 60 years (SD: 2.06) and a range between 39 -68 years. Male patients were (255, 81.7%) and females (57, 18.3%). The prevalence of IMR by echocardiography was 33.7 % (n=105 patients). Most of the patients with IMR were males (80.0%) while females constituted only (20.0%). Figure (2).

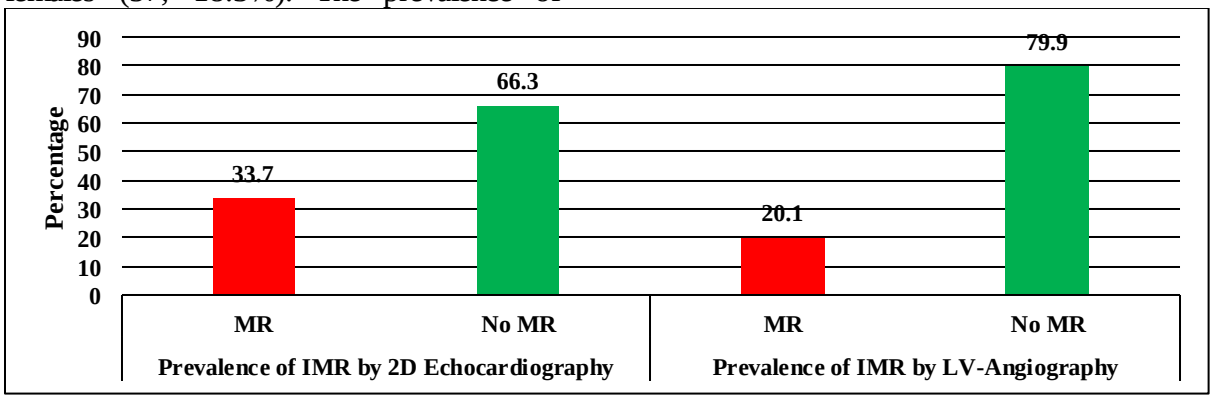

Figure (2): Prevalence of Ischemic Mitral Regurgitation

Severity of MR as determined by echocardiography was as follow: mild MR in 63 patients (60%), moderate in 36 patients (34.3%) and severe MR in 6 patients (5.7%). The direction of jet of MR was most commonly eccentric than centric direction (72 patients versus 33 patients) as shown in Table (1).

Table (1): Distribution and direction of jet of MR according to severity by echocardiography

Severity of MR (=105)	Frequency distribution	
	No.	%
Mild	63	60
Moderate	36	34.3
Severe	6	5.7
Direction of jet	No.	Direction of jet
Centric	33	Centric
Eccentric	72	Eccentric

The majority of the patients with IMR; 38 patients (35.9%) had a severe left ventricular dysfunction with LVEF <35%. In contrast normal left ventricular function was found in most of the patients without MR; 96 patients vs. 12 patients with IMR; p value < 0.001), Table (2).

Table (2): Ejection fraction in patients with and without IMR

LV-EF %	IMR (n=105)	No IMR (n=207)	p-value
50% and more	12 (11.4)	96 (46.3)	< 0.001
45-49%	27 (25.4)	77 (36.7)	
35-44%	28 (27.1)	33 (16.1)	
<35%	38 (35.9%)	1 (0.7%)	

In this study the patients with MR were more likely to have 2 vessels (70.0%) and three vessels (72.7%) in contrast to one vessel disease in patients without MR (83.3%; p<0.001, also it showed that patients with multi-vessel disease were more likely to have MR (71.9%) compared to single vessel who mostly has no MR, In patients with single vessel involving LAD, most of them have no MR (79.5%; p<0.001) Table (3).

Table (3): Relation between severity of CAD vessel affected and presence of MR

Vessel Disease	Presence of IMR by echo No (%)		Total	p-value
	MR	No MR		
1 VD	36 (16.7)	180 (83.3)	216	p<0.001
2 VD	21 (70.0)	9 (30.0)	30	
3 VD	48 (72.7)	18 (27.3)	66	
Total	105 (33.7)	207 (66.3)	312	
Vessel Affected	Presence of IMR by echo No (%)		Total	p-value
	MR	No MR		
LAD	27 (20.5)	105 (79.5)	132	p<0.001
LCX	0 (0.0)	36 (100)	36	
RCA	9 (18.8)	39 (81.3)	48	
Multi-VD	69 (71.9)	27 (28.1)	96	
Total	105 (33.7)	217 (66.3)	312	
Pearson Chi-squared test was performed for statistical analysis.				

Discussion

In this study 105 (33.7%) patients of total 312 patients included had evidence of IMR by echocardiography, while 63 (20.1%) patients had MR by LV-angiography, this discrepancy between the echocardiographic and angiographic

detection of IMR may possibly due to the fact that most of cases of IMR were mild in severity which are barely detected by LV-angiography it may be due to technical aspects of LV-angiography including the site of catheter and amount of contrast injected to visualize the left ventricle. This variation in the echocardiographic and angiographic prevalence of IMR was observed in many other studies and was ranging from 8% to 74% by echocardiography, and 1.6% to 19.4% by LV-angiography.[12-15] and in some studies the angiographic prevalence was more than 30% as in Gahl, et al study.[16] in which 127 patients with severe angina not responding to medical treatment were included and subjected to coronary and LV angiography, among these 127 patients, 39 (31%) had MR by LV-angiography. While in another study by Gregory G, et al.[5] the IMR was evident angiographically in 13.6% of patients. Lamas et al,[2] reported that MR was detected by LV-angiography in 141 patients (19.4%) of total 722 patients, 2 weeks after acute coronary syndrome (ST-Elevation Myocardial Infarction). Echocardiographic prevalence of IMR was also variable among many studies, in a study by Sadip et al,[17] 94 patients of acute coronary syndrome, admitted and managed in the intensive care unit, underwent color doppler echocardiographic quantification of IMR within 10 days of admission, among them, 61(64.89%) patients had ischemic MR. de Isla,[18] Caliafore[19] conducted a study which included 279 patients discharged from hospital in NYHA functional classes I and II after a first non-ST-segment elevation acute coronary syndrome, the IMR was detected by echocardiography in 40.1% during the first week after the event. In a study by Fazlinezhad A, et al,[20] 4226 patients with significant coronary artery disease and EF exceeding 0.30 referred for coronary artery bypass grafting were assessed preoperative by echocardiography; IMR was found in 1421 patients (33.6%).In this study the majority of the patients with IMR; 38 patients (35.9%) had a severe left ventricular systolic dysfunction with LVEF <35% (significant p value < 0.001). In contrast, most of the patients without MR had a normal left ventricular ejection fraction 96 patients vs. 12 patients with IMR; p value < 0.001), this was similar to the findings of a studs by Fazlinezhad A et al[20].In this study, among 96 patients with multi-vessel diseases: 69 patients (71.8%) had IMR with significant p-value. Although LAD disease was relatively more common compared with RCA and LCX diseases, this was not statistically important. These findings were consistent with those obtained from other studies; In Gahl et al study,[16] there was a relative preponderance of RCA- and LAD-diseases compared with left circumflex disease. The incidence of mitral regurgitation was equally distributed in the various patterns of coronary disease. However, there was a tendency to more severe degrees of coronary arterial disease in patients with mitral regurgitation than in those without (p < 0.05). In Nunez Gil et al study,[21] patients with ischemic IMR had more extensive coronary artery disease with significant P-value (p= 0.003) and there was a greater rate of LAD disease but without significant p-value (p= 0.063). Lamas et al[2] reported that patients with IMR had more extensive coronary disease than in those without MR (MR versus no MR: single-vessel disease, 36.9% versus 52.2%; multi-vessel disease, 63.1% versus 47.8%; p<.001). Gregory ET al,[5] also reported that the severity of MR was strongly associated with multi-vessel disease.

Conclusions

Ischemic mitral regurgitation was relatively common in patients with significant coronary artery disease; its frequency varies according to the method

used for detection. Echocardiography was more sensitive than LV-angiography in detection of ischemic mitral regurgitation.

Conflicts of interest

The author reports no conflicts of interest.

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