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# SONOGRAPHIC EVALUATION OF SEVERITY OF NATIVE MITRAL VALVULAR REGURGITATION AMONG HEART FAILURE PATIENTS

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## ABSTRACT
Mitral regurgitation (MR) may develop in patients with heart failure without organic mitral valve disease and contribute to worsening symptoms and survival. It has long been recognized as an important cause of morbidity and mortality. The objective of this study was to evaluate the anatomy of mitral valve and the blood flow in the mitral valve in patient with heart failure. 180 patients (26 female and 118 male) with heart failure sign were enrolled. Their ages ranged between (20 – 85) years. The study was conducted at Khartoum state in Echocardiography department of Omdurman military hospital and modern medical center in the period from November 2015 to September 2017. Two-dimensional and M-mode, echocardiograms were recorded using ultrasound machine HDI 4000 scanner (Philips Medical Systems) equipped with a commercially available 8-13 MHz linear transducer with color and power Doppler capability. The result of the study showed that MR was severe in 23 (12.8%), moderate in 29 (16.1%), mild in 69 (38.3%), trivial in 25 (13.9%), and absent in 28 (15.6%). The remaining was mitral stenosis. In addition, the severity of MR correlated with the severity of systolic dysfunction. Ejection fraction (EF) reduced with the severity of the MR. small color flow jets are seen in roughly 38% of study sample and therefore large color flow jets are seen in roughly 12.8% of study sample. The incidence of mild regurgitation tends to increase with age. Regurgitation may present a challenge for most diagnostic techniques because of the dynamic nature of lesion and its dependence on various hemodynamic and physiologic conditions. For all valvular regurgitation, an integrative approach of 2D and Doppler parameters is recommended to achieve an accurate evaluation of the severity of the lesion and its clinical significance.

**KEYWORDS:** Echocardiography, MR, LVSD, EF.

## 1. INTRODUCTION
Valvular regurgitation has long been recognized as an important cause of morbidity and mortality. Although the physical examination can alert the clinician to the presence of significant regurgitation, diagnostic methods are often needed to assess the severity of valvular regurgitation and remodeling of the cardiac chambers in response to the volume overload state (Zoghbi et al., 2003). Echocardiography with Doppler has recently emerged as the method of choice for the non-invasive detection and evaluation of the severity and etiology of valvular regurgitation (Bonow et al., 1998). The examination provides a dynamic interpretation of cardiac great vessel anatomy and, when combined with the Doppler technique, yields information regarding cardiac and great vessel blood flow (hemodynamics) as well. Because of the high frame rates inherent in ultrasonography, echocardiography can image the heart in a dynamic real-time fashion, so that the motion of cardiac structures can be reliably evaluated. Echocardiography is useful in assessing ventricular function, valvar heart disease, myocardial disease, pericardial disease, intracardiac masses, and aortic abnormalities. With Doppler technology, cardiac chamber function, valvar function, and intracardiac shunts frequently seen in congenital heart disease can be assessed. However, this technique is technically challenging and requires a great deal of operator expertise. Also, a small percentage of patients have poor acoustic windows that can severely degrade image quality. This disadvantage can be avoided by placing the sonographic probe in the esophagus, a procedure called Trans-esophageal echocardiography (TEE).

Trans-esophageal echocardiography yields consistently excellent images of the heart and great vessels, but involves a small amount of discomfort and risk to the patient. More recently, echocardiography has been combined with stress-testing modalities to assess inducible myocardial ischemia using wall motion analysis of left ventricular function (Soongswang et al., 2000). The present study aimed to evaluate the anatomy

of mitral valve and the blood flow in the mitral valve as well as the mechanism of mitral regurgitation by using high frequency ultrasound.

## 2. MATERIALS AND METHODS

### 2.1 Subjects

In this cross-sectional study, 180 patients (26 female and 118 male) with heart failure sign were enrolled. Their ages ranged between (20 – 85) years. The study was conducted at Khartoum state in Echocardiography department of Omdurman military hospital and modern medical center in the period from November 2015 to September 2017. Study variables include (Age, Sex, Clinical history and echocardiogram findings). Data was collected using data collection sheet and analyzed using SPSS software, descriptive statistic as well as correlation were performed.

### 2.2 Echocardiogram Techniques

Two-dimensional and M-mode, echocardiograms were recorded using ultrasound machine HDI 4000 scanner (Philips Medical Systems) equipped with a commercially available 8-13 MHz linear transducer with color and power Doppler capability and GE medical system LOQIC5 Expert, manufactured by Yocogama medical systems –JAPAN – model 2302650.

Trans-thoracic Echocardiogram (TTE) in the long axis view is obtained by placing the ultrasound transducer in the left apicosternal position and provides detailed images of the left ventricle, aorta, left atrium, mitral and aortic valves. Angling the beam towards the right also allows assessment of the right atrium, right ventricle and tricuspid valves. Rotating the transducer by 90 degrees in the clockwise direction produces the short axis view, which allows assessment of the left ventricle, papillary muscle, chordae tendinae and mitral valves.

The four-chamber view demonstrates the ventricles, atria and mitral and tricuspid valves. Rotation of the transducer allows two- chambers views of the heart and more detailed assessment of the aorta and aortic valves will be demonstrated.

The ejection fraction (EF) and volumes were measured with 2D-biplane Simpson's method, 2D-triplane and 3-dimensional echocardiography (3DE) by two investigators blinded to any clinical data. By using the protocols of echo which was established by British Society of echocardiography Education Committee which state that for viewing the Heart Failure a long – axis view is used which obtained by placing the echo transducer (probe) in the left apicosternal position and provides detailed images of many parts of heart specially the left ventricle, aorta, left atrium and mitral and aortic valves.

## 3. RESULTS

**Table 1: Frequency distributions of echo findings of mitral valve among the sample of study.**

| | Frequency | Percent |
|---|---|---|
| Normal | 28 | 15.6 |
| Trivial Regurgitation | 25 | 13.9 |
| Mild Regurgitation | 69 | 38.3 |
| Moderate Regurgitation | 29 | 16.1 |
| Severe Regurgitation | 23 | 12.8 |
| Mild Stenosis | 3 | 1.7 |
| Moderate Stenosis | 3 | 1.7 |
| Total | 180 | 100.0 |

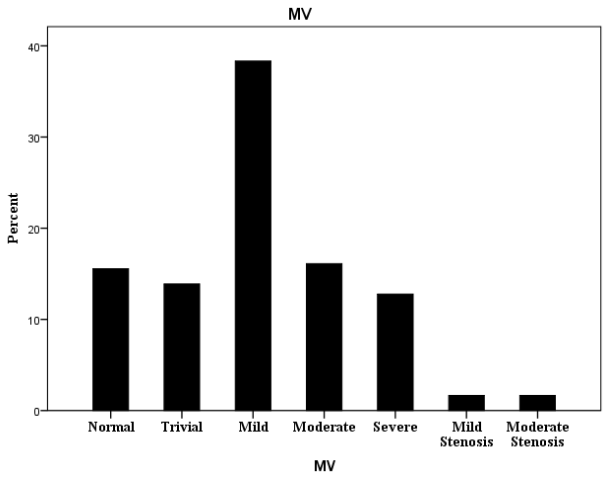


**Figure 1: Mitral valve findings distribution.**

**Table 2: Ejection fraction in different types of Mitral valve regurgitation.**

| | MV | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| EF | Trivial | 25 | 40.6000 | 9.13783 | 1.82757 |
| | Mild | 69 | 39.4493 | 9.04976 | 1.08946 |
| | Moderate | 29 | 34.0000 | 10.80344 | 2.00615 |
| | Severe | 23 | 33.6957 | 8.42310 | 1.75634 |

**Table 3: Cross tabulation of echo findings with mitral valve regurgitation.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | **Normal** | **Trivial** | **Mild** | **Moderate** | **Severe** | **Total** |
| Echo Findings | Mild LVSD | Count | 8 | 9 | 17 | 3 | 2 | 40 |
| | | % within Echo Findings | 20.0% | 22.5% | 42.5% | 7.5% | 5.0% | 100.0% |
| | Moderate LVSD | Count | 6 | 7 | 18 | 8 | 6 | 48 |
| | | % within Echo Findings | 12.5% | 14.6% | 37.5% | 16.7% | 12.5% | 100.0% |
| | Severe LVSD | Count | 2 | 4 | 12 | 9 | 6 | 33 |
| | | % within Echo Findings | 6.1% | 12.1% | 36.4% | 27.3% | 18.2% | 100.0% |
| | DCM | Count | 1 | 1 | 2 | 2 | 3 | 9 |
| | | % within Echo Findings | 11.1% | 11.1% | 22.2% | 22.2% | 33.3% | 100.0% |
| | CCF | Count | 0 | 0 | 3 | 1 | 1 | 5 |
| | | % within Echo Findings | .0% | .0% | 60.0% | 20.0% | 20.0% | 100.0% |
| | Mild LVDD | Count | 5 | 3 | 4 | 1 | 1 | 14 |
| | | % within Echo Findings | 35.7% | 21.4% | 28.6% | 7.1% | 7.1% | 100.0% |
| | LVH | Count | 1 | 0 | 1 | 1 | 2 | 6 |
| | | % within Echo Findings | 16.7% | .0% | 16.7% | 16.7% | 33.3% | 100.0% |
| | Moderate LVDD | Count | 1 | 0 | 0 | 2 | 1 | 4 |
| | | % within Echo Findings | 25.0% | .0% | .0% | 50.0% | 25.0% | 100.0% |
| | Severe LVDD | Count | 0 | 0 | 2 | 1 | 0 | 3 |
| | | % within Echo Findings | .0% | .0% | 66.7% | 33.3% | .0% | 100.0% |
| Total | | | 28 | 25 | 69 | 29 | 23 | 180 |

## 4. DISCUSSION

Evaluation of the anatomy of the mitral valve apparatus by 2D echocardiography is critically important in the assessment of severity of mitral regurgitation (MR). The mitral apparatus includes the leaflets, chordae tendineae, annulus, and the papillary muscles with their supporting left ventricular (Galliano et al.) walls. Careful evaluation of these structures should be able to define the mechanism of MR and yield clues to its severity. This study was conducted on 180 patients with heart failure using echocardiogram to characterize MR, 118 cases (65.6%) were male and 62 cases (34.4%) were female.

Mitral regurgitation is commonly observed in patient with heart failure, Mitral valve repair or replacement to restore valve competency is a well-established procedure when there are symptoms of heart failure and the primary disease is of the valve leaflets (Koelling et al., 2002). However, recent interest has focused on functional or secondary mitral insufficiency in which the valve leaflets are anatomically normal but do not fully adapt because of annular dilatation and restricted leaflet motion secondary to increased ventricular size and sphericity. In this study mitral regurgitation was observed in the majority of heart failure patient but it severity was mild in 38 % of the cases, the remaining were sever and moderate. This result was in line with the previous studies which stated that the mild regurgitation was observed in the majority of heart failure patient (O'Brien and Fishbein, 2005).

In patients with MR in the setting of LV dilatation and/or systolic dysfunction, it is important to determine whether MR is functional (i.e. due to LV dilatation) or primary (i.e. due to an abnormality of the valve apparatus) Table 3 showed sever LVSD lead to 36.4% with mild mitral regurgitation, 27.3% with moderate mitral regurgitation and 18.2%with sever mitral regurgitation. This functional mitral regurgitation is due to systolic dysfunction, also patients with LVH (left ventricular hypertrophy) the severity of regurgitation increases to 33.3%. This result is agreed with the previous study (Kainuma et al., 2012). In functional MR, the leaflets are usually tethered by outward displacement of the LV walls and papillary muscles, with or without annular dilation (Otsuji et al., 1997).

Color Doppler flow mapping is widely used to screen for the presence of mitral regurgitation. Importantly, small color flow jets are seen in roughly 38% of study sample and therefore large color flow jets are seen in roughly 12.8% of study sample. The incidence of mild regurgitation tends to increase with age (Sun et al., 1990).

Regurgitant jet area. As a general rule, large jets that extend deep into the LA represent more MR than small thin jets that appear just beyond the mitral leaflets. Patients with acute severe MR, in whom blood pressure is low and LA pressure is elevated may have a small eccentric color flow jet area, whereas hypertensive patients with mild MR may have a large jet area. Furthermore, the same regurgitant flow will produce larger or smaller jets depending on the size of the atrium, which has led to indexing for atrial area (Helmcke et al., 1987).

## 5. CONCLUSION

Echocardiography with Doppler has become the first line approach to the evaluation and management of valvular heart disease. While 2D echocardiography provides an assessment of valvular structure, mechanism of

regurgitation and adaptation to the volume overload state, Doppler allows in the same setting, a comprehensive evaluation of the severity of regurgitation using qualitative and quantitative methods from Color flow and spectral Doppler. In general, regurgitation may present a challenge for most diagnostic techniques because of the dynamic nature of lesion and its dependence on various hemodynamic and physiologic conditions. For all valvular regurgitation, an integrative approach of 2D and Doppler parameters is recommended to achieve an accurate evaluation of the severity of the lesion and its clinical significance.

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