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Echocardiographic Pattern of Rheumatic Heart Disease In Makurdi Nigeria.

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Abstract:
Background: *Rheumatic heart disease (RHD) remains a major cause of acquired heart disease in children and adults in developing countries. Sub-Saharan Africa has been described as the major hotspot for acute rheumatic fever and rheumatic heart disease. However reported echocardiographic features are limited to a few countries in this region. We report the prevalence and pattern of valve involvement in RHD using echocardiography from our centre.*
Methods: *The register of the echocardiography unit of the Benue State University Teaching hospital form May 2013 to April 2017 served as basis for data collection in this retrospective study. Transthoracic echocardiography data were reviewed and patients with a diagnosis of rheumatic heart disease selected. Information obtained from the records included the age, gender, clinical indication for echocardiography and echocardiographic diagnosis.*
Results: *During the four year period under review, 231 echocardiograms were selected and 36(15.6%) of these had an echocardiographic diagnosis of rheumatic heart disease. There were 10 males and 26 females (ratio 1:2.6) with an age range of 5 to 81 years and a mean age of 46.61 ± 19.6 years. The commonest rheumatic lesion was isolated mitral regurgitation in 10 subjects(27.8%) followed by combined mitral and aortic valve disease in 7 subjects (19.4%) and then mixed aortic valve in 5 subjects (13.9%). Others included aortic regurgitation in 4 subjects(11.1%), 4 subjects with aortic stenosis (11.1%), mixed mitral valve disease in 3 subjects (8.3%) and isolated mitral stenosis in 3 subjects (8.3%). Complications of RHD documented included valvular cardiomyopathy (33.3%), secondary pulmonary hypertension (27.1%), atrial fibrillation (20.8%), functional tricuspid regurgitation (16.7%) and infective endocarditis(2.1%).*
Conclusion: *RHD is still an important cause of cardiac morbidity and mainly involves the mitral and aortic valves with resultant life threatening complications. There is urgent need to implement a national control programme to reduce morbidity and mortality from this disease.*
keywords: *Rheumatic heart disease, echocardiography, Makurdi.*

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I. Introduction

Rheumatic heart disease (RHD) remains a public health issue in developing countries[1]. RHD accounts for a major proportion of all cardiovascular disease in children and young adults in African countries and by extension the world, because 80% of the world's population live in developing countries where the disease is still rampant. The disease has the potential to undermine national productivity since it affects the most productive part of the population[2].Rheumatic heart disease develops in at least half of those affected with acute rheumatic fever (ARF) with carditis subsequent to group A streptococcus throat infections. The major determinants of ARF and RHD are overcrowding, poor hygiene, malnutrition and poverty.According to World Health Organization (WHO), ARF/RHD affects about 15.6 million people worldwide, with 282 000 new cases and 233 000 deaths each year[3]. There are 2.4 million affected children between 5 and 14 years of age in developing countries, one million of whom live in sub-Saharan Africa, making the continent the major ARF/RHD hot spot[4]. Up to 1% of school children in Africa, Asia, the eastern Mediterranean region and Latin America show signs of RHD[5]. There are about two million people with RHD requiring repeated hospitalization and one million likely to require surgery globally. These are conservative estimates and the true disease burden is likely to be substantially higher.

Over the past century, as living conditions have become more hygienic and less crowded, and nutrition and access to medical care have improved, ARF and RHD have become rare in developed countries and are now largely restricted to developing countries.In Africa, reports on RHD originate mainly in a few countries and not so many have described the echocardiographic pattern of rheumatic valve lesions[6-9]. Studies in Nigeria on this

subject are also few[10 – 11]. The mitral valves are traditionally more affected followed by the aortic and rarely the tricuspid and pulmonary valves. It is unclear whether this same pattern applies to all countries in sub-Saharan Africa and all parts of Nigeria or whether there are some distinctive features in certain areas yet to be determined.

In our study we sought to determine the echocardiographic pattern of RHD in Makurdi, Benue State located in North Central Nigeria over a period of 4 years being May 2013 to April 2017. Knowledge of this pattern will assist policy makers in planning for management of this condition at primary, secondary and tertiary levels.

II. Materials And Method

The Benue State University Teaching Hospital (BSUTH) where the study was carried out is located in Makurdi the Capital city of Benue state and receives referrals from surrounding states. In this retrospective study, transthoracic echocardiographic (TTE) data collected over a 4 year period from May 2013 to April 2017 was reviewed. Patients with echocardiographic diagnosis of rheumatic heart disease were selected.Ethical approval was obtained from the ethical review committee of BSUTH.Information obtained from the records included age, gender, clinical indication for echocardiography and echocardiographic findings. Clinical examination included weight, height and blood pressure measurements.

2.1 Echocardiography

The echocardiography machine used was Philips HD 11 XE. Echocardiographic modalities applied included M-mode, two-dimensional (2D) and Doppler studies. Echocardiography was done with a 2.5 MHz transducer. Complete 2D echocardiographic examination was done according to the recommendations of the American Society of Echocardiography (ASE)[12]. M-mode echocardiograms were derived from 2D images. The M-mode cursor on the 2D scan was moved to specific areas of the heart to obtain measurements, according to the recommendations of the committee on M-mode standardization of the ASE[13]. Doppler indices of left ventricular (LV) diastolic filling were obtained. Complete Doppler studies were done according to the recommendations of ASE[14].Indices of left ventricular function were derived from M-mode measurements. These included left ventricular mass, cardiac output, ejection fraction and fractional shortening. Echo examination also included left atrial size; left ventricular size and function; a semiquantitative estimate of the severity of valvular regurgitation using colour Doppler echocardiography, size and function of the right ventricle; and evidence of pulmonary arterial hypertension.Mitral stenosis was diagnosed on the presence of thickening with or without calcification, diastolic doming, and restriction of mitral valve leaflet motions.

Mitral regurgitation was diagnosed in the presence of thickened valves, dilated mitral valve annuli, left atrial and left ventricular dilatation and lack of coaptation of the mitral valve leaflets in systole. Colour Doppler echocardiographic analysis, identified the presence and severity of the mitral and tricuspid valves.

Thickened and calcified aortic valve leaflets with reduced leaflet motion (aortic cusp separation less than 9mm) suggested aortic stenosis. In addition, there could be concentric left ventricular hypertrophy and decreased LV ejection fraction.

Aortic regurgitation was diagnosed when echocardiography with Doppler interrogation of the aortic valve showed the spatial extent of the colour Doppler aliasing in the out flow tract and was used as a rough guide of the severity of the aortic regurgitation[15]. A semi-quantitative scale of mild, moderate and severe regurgitation was predicted primarily on the area of the jet of disturbed flow in the outflow tract and, to a lesser extent, on the depth to which the jet penetrated towards the apex of the left ventricle.

The presence of vegetations was considered to suggest infective endocarditis. This was however limited by the fact that TTE could only detect vegetations ≥ 5mm in diameter[16]. Valvular cardiomypathy was characterised by ventricular dilatation with normal or decreased wall thickness and reducedsystolic function (defined as ejection fraction < 40%)[17] in the presence of established valvular disease.Echocardigraphic findings associated with pulmonary hypertension included dilated pulmonary artery, dilatation and hypertrophy of the right ventricle (RV), functional tricuspid regurgitation, diastolic flattening of the interventricular septum and Doppler evidence of pulmonary hypertension[18].

III. Statistical Analysis

Data was analysed using IBM Statistical Packages for Social Sciences (SPSS) version 20 statistical soft ware. Qualitative variables were presented as percentages. Quantitative variables were presented as means and standard deviations and compared using Student t-test. Values of $p< 0.5$ were considered statistically significant.

IV. Results

4.1 Demographic characteristics and referral for echocardiography

A total of 36 participants out of 231(15.6%) met the criteria for RHD. There were 10 males with a mean age of 58.00 ± 12.68 years and 26 females with a mean age of 42.23 ± 19.88 years. There was significant

difference in the mean age of the two groups (p = 0.009). The mean age of the population was 46.61 ± 19.36 years with an age range of 5 to 81 years. Table 1 shows the age and gender distribution of the subjects. The highest prevalence was in the 45 – 54 years age group.The clinical indications for referral for echocardiography included : Hypertensive heart disease (38.9%), rheumatic heart disease (25.0%), dilated cardiomyopathy (11.1%), congenital heart disease (2.8%), congestive cardiac failure(16.7%), ischemic heart disease (5.6%). The accuracy of clinical diagnosis of RHD in this study was 25.0%.

4.2 Pattern of rheumatic valvular diseases in the participants

The commonest rheumatic lesion was isolated mitral regurgitation in 10 subjects (27.8%) followed by combined mitral and aortic valve disease in 7 subjects (19.4%) and then mixed aortic valve disease in 5 subjects (13.9%). Others included aortic regurgitation in 4 subjects (11.1%), 4 subjects with aortic stenosis (11.1%), mixed mitral valve disease in 3 subjects (8.3%) and isolated mitral stenosis in 3 subjects (8.3%). Table 2 shows the pattern of rheumatic valvular diseases by gender while Figure 1 shows the pattern of rheumatic valvular diseases in the subjects. Figures 2 and 3 are examples of documented cases.

4.3 Complications of rheumatic heart disease seen at echocardiography

Most of the participants had one complication of rheumatic heart disease or the other. The commonest complication was valvular cardiomyopathy seen in 16 subjects (33.3%) followed by pulmonary hypertension in 13 subjects (27.1%) and atrial fibrillation in 10 subjects (20.8%). Other complications seen were functional tricuspid regurgitation in 8 subjects (16.7%) and infective endocarditis in 1 subject (2.1%). These are shown in Table 3. No case of left atrial or left ventricular thrombus was documented.

V. Discussion

The major determinants of acute rheumatic fever and chronic rheumatic valvular heart disease are poverty, malnutrition, overcrowding, poor housing and shortage of health care resources. These are still prevalent in sub-Saharan Africa where Nigeria is located. No wonder sub-Saharan Africa is said to be the 'hot spot' for RHD[4]. Rheumatic heart disease was found to account for 15.6% of heart diseases found at echocardiography in this study. This is higher than the 9.2% found in Port Harcourt[19] Nigeria and the 9.8% found in Kano, Nigeria[20]. It is however closer to the 11% found by Freers et a[21] among 500 patients referred for echocardiography in Uganda and much lower than those of Hakim et al[22] working in Zimbabwe, who found 25.1% of 1153 patients referred for echocardiography had RHD.

All these findings are higher than the WHO documented RHD prevalence of 5.7/1000 patients in sub-Saharan Africa[3]. This is probably because all five studies considered all age groups, where as the WHO study considered children 5 to 14 years old. In addition, these studies are echocardiographically based; such referred patients have a high chance of having an abnormal heart, hence the high prevalence.The peak prevalence of RHD in this study was in the 45 -54 age group. This is due to the fact that majority of the referrals for echocardiography came from the adult population.

This study showed that 25.0% of the patients were suspected of having RHD clinically. This shows a fairly low index of suspicion for the disease clinically. At the ARF stage when chronic valvular damage can be prevented by adequate antibiotic treatment, ARF is hardly considered by many doctors in developed countries[23]. In the developing countries where it remains a daily challenge, there is still poor physician/patient awareness of ARF with low penicillin usage militating against the control of ARF and prevention of chronic RHD.The trend in many populations is that ARF and RHD are commoner in females than males. This has been shown in this study affecting 27.8% males and 72.2% females. Whether this trend is a result of innate susceptibility, increased exposure to group A streptococcus because of greater involvement of women in child rearing, or reduced access to preventive medical care for girls and women remains unclear.Isolated mitral regurgitation was the commonest echocardiographic diagnosis in this study seen in 27.8% of the participants.This was followed by combined mitral and aortic valve disease in 19.4% and then mixed aortic valve disease in 13.9%. This mirrors those in previous studies both in developed and developing countries where the order of involvement is mitral followed by aortic with tricuspid and pulmonic valves being rarely involved[10,24 – 26]. Isolated mitral stenosis was seen in 8.3% of the patients and all were females. This is similar to the finding of Sani et al[20] in Kano, Nigeria who found 7.8% with isolated mitral stenosis but lower than the 26% documented by Jaiyesemi et al amongst children[27].Most patients with aortic valve disease had it in combination with mitral valve disease. Isolated aortic stenosis and regurgitation were seen in 11.1% of patients each.Aortic regurgitation was commoner in males. Functional tricuspid regurgitation may accompany mitral valve disease. This was seen in 8 patients (16.7%) in this study.

Valvular cardiomyopathy was seen in sixteen (33.3%) of our patients. This is a specific dilated cardiomyopathy produced by valvular lesions of numerous aetiologies. It was the commonest complication in our study. Typically, defects that produce volume overload are more likely to cause cardiomyopathy than lesions associated with pressure overload. A large number of our patients had this complication probably

because more of them had valvular regurgitation than stenosis. It is associated with a decreased systolic function (ejection fraction < 40%) and a tendency to thrombus formation. However no case of left ventricular thrombus was documented.

Pulmonary hypertension, possibly a result of a rise in left atrial pressure and increase in pulmonary vascular resistance was seen in thirteen (27.1%) of our patients. In mitral and aortic valve disease, the left ventricle (LV) becomes hypertrophic and less distensible, leading to increased LV end diastolic pressure. This coupled with the stenosis or regurgitation causes increased work of the left atrium (LA), leading to hypertrophy and enlargement of the LA. The output of the left atrium decreases, left atrial pressure rises and pulmonary hypertension develops. Pulmonary hypertension leads to right ventricular hypertrophy and dilatation, functional tricuspid regurgitation and right heart failure. Functional tricuspid regurgitation has already been mentioned above.Atrial fibrillation(AF) may complicate LA enlargement and was seen in ten(20.8%) of our patients in this study. AF leads to loss of organised mechanical activity of the LA and increases the tendency to develop spontaneous echo contrast and thrombus formation. None of our patients had left atrial thrombus. This might be an understatement as TTE has limitations in detecting the presence of left atrial thrombi, and transesophageal echocardiography (TEE) is more valuable, especially if thrombi occur in the left atrial appendage[28].The presence of vegetations in patients with established valvular heart disease suggests infective endocarditis. This was seen in one (2.1%) of our patients. RHD is a known predisposing condition for infective endocarditis. It has been shown to be the pre-existing lesion in 66% of cases of infective endocarditis in two studies in different parts of Nigeria[29,30].The Awareness, Surveillance, Advocacy, Prevention (ASAP) proposal is a comprehensive programme for the control of ARF and RHD that was adopted at the first All-African Workshop on ARF and RHD in the Drakensberg, South Africa, convened by the Pan-African Society of Cardiology (PASCAR)[31]. The objective of developing ASAP was to create a simple, modular but comprehensive model for control of ARF/RHD in Africa, based on interventions of proven efficacy, which could be adopted in part or in total by national departments of health or non-governmental organisations with a commitment to reducing the burden of disease attributable to ARF/RHD in Africa[32].

Several studies including this study have now almost unanimously highlighted the superiority of echocardiography over clinical examination for the diagnosis of both clinical or subclinical RHD lesions[33,34]. Cardiac ultrasound should therefore become the gold standard in diagnosing RHD in resource poor settings like Nigeria.

VI. Conclusion

Rheumatic heart disease detected by echocardiography represents a sizable proportion of cardiac morbidity in our environment. There is a lack of primary, secondary and tertiary (medical and surgical treatment) programmes in Nigeria and many other countries in sub-Saharan Africa. There is urgent need for all African countries to implement a national ASAP programme as suggested by the Drakensberg declaration to control and reduce morbidity and mortality from this disease.

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Tables And Figures

Table 1 – Age and gender distribution of the subjects

Age group(years)	**Male** **n = 10**	**Female** **n = 26**	**Total** **n = 36**
5 – 14	0	2	2
15 – 24	0	5	5
25 – 34	0	3	3
35 – 44	1	3	4
45 – 54	4	4	8
55 – 64	2	5	7
≥ 65	3	4	7

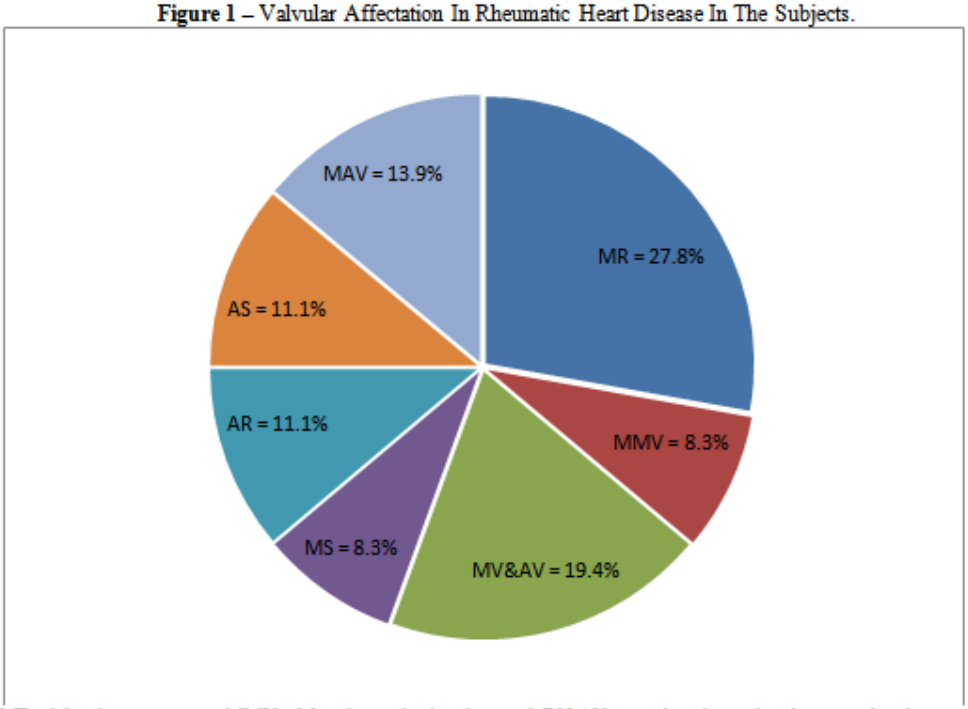
Table 2- Distribution of rheumatic valvular diseases by gender

Valvular lesion	**Male**	**Female**	**Total**	**Percentage(%)**
MR	2	8	10	27.8
MMV	0	3	3	8.3
MV&AV	2	5	7	19.4

MS	0	3	3	8.3
AR	3	1	4	11.1
AS	2	2	4	11.1
MAV	1	4	5	13.9

MR = Mitral regurgitation, MMV = Mixed mitral valve disease, MV&AV = combined mitral and aortic valve disease, MS = Mitral stenosis, AR = Aortic regurgitation, AS = Aortic stenosis, MAV = mixed aortic valve disease.

Figure 1 – Valvular Affectation In Rheumatic Heart Disease In The Subjects.



MR = Mitral regurgitation, MMV = Mixed mitral valve disease, MV&AV = combined mitral and aortic valve disease, MS = Mitral stenosis, AR = Aortic regurgitation, AS = Aortic stenosis, MAV = mixed aortic valve disease.

Table 3 – Complications of RHD seen at echocardiography

Complication	**Number**	**Percentage (%)**
Valvular cardiomyopathy	16	33.3
Pulmonary hypertension	13	27.1
Functional tricuspid regurgitation	8	16.7
Infective endocarditis	1	2.1
Atrial fibrillation	10	20.8

Figure 2 – Colour Doppler echocardiography showing isolated mitral regurgitation

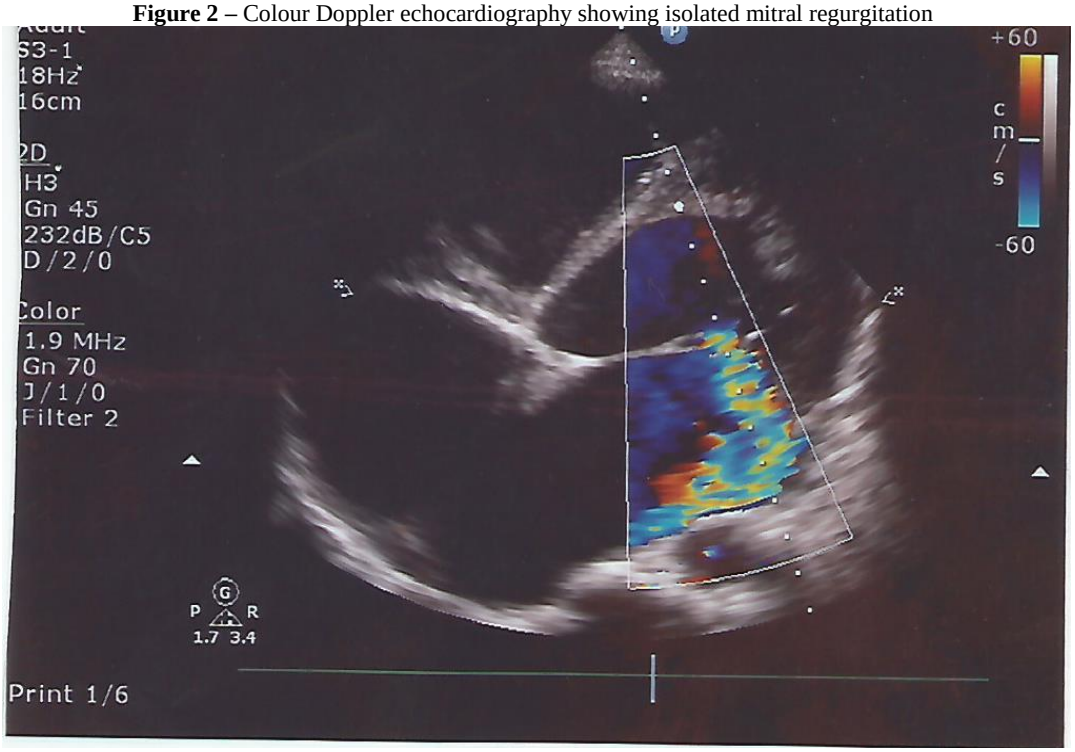
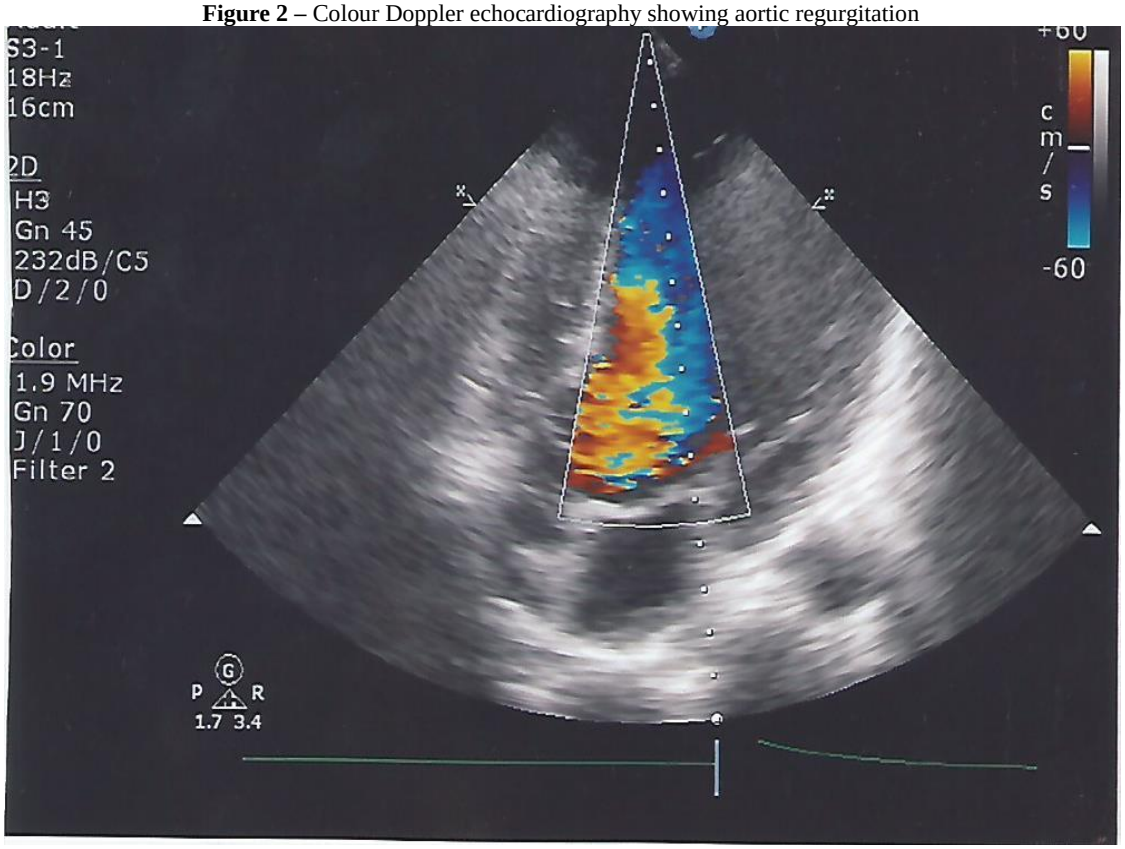


Figure 2 – Colour Doppler echocardiography showing aortic regurgitation



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