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Transesophageal Echocardiograph Findings in Patients with Cardiovascular Disorders at Al-Thawrah General Hospital, Sana'a, Yemen

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ABSTRACT

Objectives: To determine the frequency distribution of different cardiovascular disorders and to describe their associated morphological abnormalities by transesophageal echocardiography among patients referred to the Transesophageal Echocardiography Laboratory of Al-Thawrah General Hospital, Sana'a, in the period 2009–2011.

Methods: This was a retrospective descriptive study of 856 patients with suspected cardiovascular disorders and referred for transesophageal echocardiography over a two-year period. Data about patients' sex, their referral site and transesophageal echocardiography findings were collected and analyzed according to the type of cardiovascular disorders, valvular affections and lesions, complications and recommended treatments.

Results: Of the 856 patients, 63.4% were females and 36.6% were males. The majority of patients diagnosed by transesophageal echocardiography (82.4%) were referred from outpatient departments. Rheumatic heart disease was the most frequent cardiovascular disorder (87.1%), followed by tricuspid valve lesions (62.8%), of which 54% (329/606) were tricuspid regurgitation and 62.6% (114/182) were aortic valve regurgitation. Regarding the type of valvular lesions detected, mitral valve disease was the most frequent, being found in 69.2% (214/309) of patients. Regarding the severity of valvular lesions, 73.1% (19/26) of mitral valve stenosis cases were severe while 83.3% (35/62) of aortic stenosis cases were mild. Moderate pulmonary hypertension was seen mostly secondary to rheumatic heart disease. The majority of cardiovascular disorder patients (33.6%; 284/844) were recommended for balloon mitral valvotomy. Mitral valve surgery was the most frequently performed surgical intervention for affected valves of patients with cardiovascular disorders; being used for the treatment of 31.4% (80/255) of valvular lesions.

Conclusions: Transesophageal echocardiography revealed that rheumatic heart disease is the most frequent cardiovascular disorder among Yemeni patients and poses a major health problem. In addition, a high proportion of patients with cardiovascular disorders have valvular lesions of the mild degree that require surgical intervention.

Keywords: Transesophageal echocardiography, Cardiovascular disorder, Rheumatic heart disease, Valvular lesion, Yemen

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1. Introduction

Cardiovascular disorders (CVDs) are a major cause of morbidity and mortality worldwide (1–5). Economic and sociocultural changes contribute to a considerable extent in the global impact of CVDs because these changes have resulted in increased risk factors for CVDs (1–5). A major contribution to the dramatic increase in CVDs worldwide is attributed to the changes occurring in developing countries (1).

In comparison to high-income countries, low- and middle-income countries (LAMIC) are the most afflicted with mortality rates because of CVDs, particularly among younger age groups (2–5). By 2020, annual estimates of about 6 million deaths and 35 million disability-adjusted life years (DALYs) in developed countries compared to about 19 million deaths and 170 million DALYs in developing countries may occur because of CVDs (6).

The prevalence rate of coronary heart disease (CHD) is 4.1 per 1000 live births in Oman, 3 per 1000 live births in Nigeria and 2 per 1000 live births in Sudan, accounting for 3.9% of hospital admissions for CVDs; however, a higher prevalence rate of 11.5 per 1000 live births has been reported from Lebanon (7). CVDs are responsible for about 12.4% of all deaths in Yemen in 1970 compared to 47% of deaths in 1998. However, there is a lack of data on heart failure in Yemen (8).

Rheumatic heart disease (RHD) and consequent valvular diseases are very common in LAMIC, including Yemen, with social, economic and medical consequences (5, 9–13). Mitral regurgitation (MR) is the most common cardiac manifestation while obstructive valvular disease is distinctly rare in under five-year-old age groups (14). In Africa, RHD represents a major health problem that predominantly affects females more than males (with a ratio of 13:4), necessitating appropriate early detection together with other general preventive programs (12). RHD and its valvular affection are still epidemic in Asia not only due to the limited availability of penicillin but also due to their poor socioeconomic conditions such as overpopulation, overcrowding, poverty and poor access to medical care (15). The prevalence rate of RHD among Yemeni children was reported to be 36.5/1000, with MR being detected in 49% and combined MR and aortic regurgitation (AR) in 17.8% of children (16). In southern Yemen governorates, females were affected with RHD more than males (52.4% and 47.6%, respectively). Valvular damage, especially regurgitation, was commonly found in the mitral valve; mainly due to a single lesion. However, pulmonary hypertension (PH) was the most common complication of RHD, being detected in 80.4% of patients (17).

Early detection is thus highly needed to maximize case detection of subclinical RHD in LAMIC (18, 19). Auscultation of the heart for early diagnosis of RHD lacks sensitivity and specificity while transesophageal echocardiography (TEE) of the heart is a feasible and excellent non-invasive method for assessing heart structure, function and hemodynamic status (18, 20). Moreover, TEE improves the case detection rate of RHD to up to ten times greater than clinical examination alone (5, 18, 20–23). Given that TEE improves the detection of subclinical RHD, and therefore prevents the progress of disease, there is a need for the evidence-based criteria for TEE-based diagnosis. Therefore, subclinical valvular lesions should be considered as possible RHD until confirmed otherwise, and secondary rheumatic fever prophylaxis is recommended to affected children (1, 4, 18, 20, 22, 24). TEE was first applied to evaluate the left ventricular (LV) size and function. Echocardiographic de-

termination of global and regional LV function has witnessed great improvements (3, 4, 25).

The introduction of TEE to the operating room is effective for the clinical follow-up and hemodynamic management of patients undergoing general anesthesia and during cardiac procedures (26). Secondary prevention by the early detection of subclinical rheumatic heart disease by TEE is vital and has important public health implications. Moreover, it can potentially prevent their progression to serious valve diseases (4, 5, 22, 27, 28).

In Yemen, the use of TEE in the diagnosis and follow-up of acute rheumatic fever and for the secondary prevention of subclinical cardiac disease has not been reported yet. However, the clinical impact of TEE is not well defined, with scarcity of available data about its benefit in screening and early case detection (21, 24, 29–31). In contrast to other non-communicable diseases, only a very few multi-center trials on the application of TEE have been performed. Thus, the limitation of routine TEE use could be attributed to the current inadequacy of outcome data, the absence of training facilities and its high cost. In this study, we aimed to determine the frequency of CVDs as detected by TEE, to describe their morphological abnormalities and to formulate recommendations on their management.

2. Methods

The present study was a retrospective search through all medical files of adult patients clinically diagnosed as CVD cases and referred to the TEE Laboratory of the Non-invasive Diagnostic Cardiac Unit of Al-Thawrah General Hospital (AGH), Sana'a, in the period from Jan. 2009 to Jan. 2011. It is the only unit for referral of cases from the outpatient departments (OPDs) and inpatient departments (IPDs) and even from other hospitals in the country. A total of 856 medical records of adult patients with CVDs, who underwent TEE, were included and strictly reviewed. CVD cases were identified based on the diagnosis by the attending physicians during patients' discharge from the unit. The TEE assessment is done according to the American Association for Heart Diseases Criteria (32).

Patients who were diagnosed for the first time using TEE were only included in this study. The exclusion criteria included patients with significant valvular heart disease. The data derived from patients' medical files including sex, TEE findings and TEE recommendations were entered into computer by the investigators themselves who made the TEE investigations. Data were then analyzed using SPSS version 10 (SPSS, Inc., Chicago, IL, USA). In this study, the valvular lesion disease was defined as an inflammatory valvular lesion due to endocarditis while other valvular lesions such as valvular stenosis and regurgitation were defined as malformations of the valve or congenital anomalies.

Ethical considerations: An ethical approval was obtained from the hospital administration prior to the study. Patients' data were treated without names and kept confidentially.

3. Results

3.1. Referral site and sex of CVD patients

Out of 856 patients admitted to the TEE unit in the period from Jan. 2009 to Jan. 2011, 82.5% were referred from the OPDs compared to 17.5% from the IPDs. Males represented 63.4%, while females represented 36.6% of the total patients with CVDs admitted to the TEE unit.

3.2. CVD patterns of patients as diagnosed by TEE

Table (1) shows the different patterns of CVDs as diagnosed by TEE among patients referred to the TEE Laboratory of the AGH during the period of the study. Of the total number of referred cases, 98.6% of patients showed CVDs whereas 1.4% of patients were normal by TEE. RHD was the most predominant clinical pattern, being present among 87.1% of referred CVD patients. Those with congestive heart failure represented only 7.2% of the total number of referred cases, with minimal, comparable percentages of about 2.0% being observed in patients with PH and other CVDs.

Table 1. Frequency distribution of CVD patients by TEE diagnosis in AGH, Sana'a (2009–2011)

Cardiovascular disorders	No. (%)*
Rheumatic heart disease	745 (87.1)
Congestive heart failure	62 (7.2)
Pulmonary hypertension	20 (2.3)
Other cardiovascular dysfunctions	17 (2.0)
Total	**844 (98.6)**

*12 patients (1.4%) were normal.

3.3. Types of valves affected in CVD patients as diagnosed by TEE

Table (2) shows the types and frequency distribution of affected valves as diagnosed by TEE among the 844 CVD patients with valvular abnormalities. The majority of patients (62.8%) had triple valve damage followed by those having a combined damage in the mitral and aortic valves (21.0%). The combined damage in the mitral and tricuspid valves was present in 9.0% of patients while the damage to the mitral valve alone was present in only 6.6% of patients. The least affected valve among patients with valvular abnormalities was the aortic valve, with only less than 1.0% of patients showing damage in this type of valve.

Table 2. Frequency distribution of affected valves of CVD patients diagnosed by TEE in AGH, Sana'a (2009–2011)

Affected valve	No. (%)
Triple valve	530 (62.8)
Mitral and aortic valves	177 (21.0)
Mitral and tricuspid valves	76 (9.0)
Mitral valve	56 (6.6)
Aortic valve	5 (0.6)
Total	**844 (100.0)**

3.4. Valvular lesion distribution according to the type of valve affected as diagnosed by TEE

Table (3) shows the distribution of different types of valvular lesions according to the type of affected valve(s) as diagnosed by TEE among patients with valvular abnormalities. The mitral valve disease was the most frequent condition among patients with valvular abnormalities, with 69.2% of patients showing this type of valvular lesion. However, mitral stenosis (MS) was present among only 8.0% of patients. Regarding the aortic valve, aortic stenosis (AS) and regurgitation were the most frequent types of lesions, being 23.1% and 62.6%, respectively. On the other hand, the most frequent lesions in the tricuspid valve were the tricuspid regurgitation (54.0%) and the tricuspid valve disease (46.0%).

Table 3. Frequency distribution of valvular lesions according to the types of affected valves among CVD patients diagnosed by TEE in AGH, Sana'a (2009–2011)

Type of valvular lesions	Type of valve affected* No. (%)		
	Mitral valve (*n*=309)	Aortic valve (*n*=182)	Tricuspid valve (*n*=606)
Disease	214 (69.2)	16 (8.8)	279 (46.0)
Stenosis	26 (8.0)	42 (23.1)	0 (0.0)
Post-surgery repair	35 (11.3)	10 (5.5)	0 (0.0)
Regurgitation	34 (11.0)	114 (62.6)	329 (54.0)

*Some patients had more than one valvular lesion.

3.5. Valvular lesion distribution according to their severity as diagnosed by TEE

Table (4) shows the distribution of valvular lesions among patients by their grades of severity as diagnosed by TEE. Regarding the mitral valve lesions, most MS cases (73.1%) were severe, with the moderate-to-severe and mild cases representing 19.2% and 7.7% of cases, respectively. In contrast, more than a half of MR, AS and AR cases were of the mild type, being 58.8%, 83.3% and 45.5%, respectively (Table 4).

Table 4. Frequency distribution of valvular lesions by the grade of severity among CVD patients diagnosed by TEE in AGH, Sana'a (2009–2011)

Valvular lesion*	Grades of severity No. (%)				
	Mild	Moderate to severe	Severe	Mild to moderate	Moderate
Mitral stenosis	2 (3.2)	5 (45.5)	19 (73.1)	0 (0.0)	0 (0.0)
Mitral regurgitation	20 (32.2)	4 (36.4)	3 (11.5)	5 (55.5)	2 (40)
Aortic stenosis	35 (56.5)	1 (9.1)	3 (11.5)	1 (11.1)	2 (40)
Aortic regurgitation	5 (8.1)	1 (9.1)	1 (3.8)	3 (33.3)	1 (20)
Total	**62**	**11**	**26**	**9**	**5**

*Some patients had more than one valvular lesion.

3.6. Management recommendations for CVD patients diagnosed by TEE

Table (5) presents the different management recommendations for CVD patients. All CVD patients diagnosed by TEE were recommended for another line of treatment. The majority of patients were recommended for balloon mitral valvotomy (BMV) and valvular surgical intervention; being recommended for 33.6% and 30.2% of them, respectively. Follow-up option and a two-month anticoagulant therapy were recommended for 19.8% and 16.4% of patients, respectively.

Table 5. Frequency distribution of recommendations for management of CVDs diagnosed by TEE in AGH, Sana'a (2009–2011)

Recommendation	No. (%)
Balloon mitral valvotomy	284 (33.6)
Surgery	255 (30.2)
Follow-up	167 (19.8)
Two-month anticoagulant therapy	138 (16.4)
Total	**844 (100)**

3.7. Surgical interventions adopted for affected valves as diagnosed by TEE

Table (6) shows the frequency of different surgical interventions adopted for treating the affected valves of CVD patients with valvular lesions. Mitral valve surgery was the most frequent intervention, being performed for treating 31.4% of valve lesions. This was followed by corrective surgery and double-valve replacement (DVR), being performed in 20.4% and 18.4% of valves, respectively. Mitral valve thrombectomy was the least performed intervention, being used in 4.3% of valves.

Table 6. Frequency distribution of affected valves by surgical intervention of CVD patients diagnosed by TEE in AGH, Sana'a (2009–2011)

Surgical intervention	Affected valves (*n* = 255) No. (%)
MV surgery	80 (31.4)
Corrective surgery	52 (20.4)
DVR	47 (18.4)
MV/TV repair	24 (9.4)
DVR/TV repair	22 (8.6)
AV surgery	19 (7.5)
MV thrombectomy	11 (4.3)
Total	**255 (100)**

4. Discussion

RHD is an important health problem in developing countries, including Yemen, and can cause permanent functional and morphological impairment (1–7). Some researchers have suggested that up to 90% of patients may be presented with valvular insufficiency even in the absence of clinical signs. In contrast, MR and AR are more likely due to RHD in endemic areas (5, 13, 21, 28–30, 32). They suggested that the most effective preventive method for controlling CVD is secondary prevention by using TEE, where it can also avoid both over- and underdiagnosis of cardiac diseases. Therefore, TEE should be used as a diagnostic criterion for better visualization of the vegetation shape and size in addition to the adjacent tissues, severity of valvular regurgitation and associated hemodynamic states (3, 13, 27, 28, 31, 32). Our study reveals that adult females were more prone to develop CVD, which is probably due to an increase in their susceptibility and exposure to group A β-hemolytic *Streptococcus* infection of the throat; a finding that has been observed in other countries (15, 32).

Patients referred to the TEE unit were mostly from the OPDs, suggesting that they were probably new cases that had not been confirmed yet. Most patients with CVDs diagnosed by TEE had RHD complicated with valvular lesions and prominently mild AR, which were suggestive of greater rheumatic activity processes (29, 30).

Our results are in agreement with the findings of previous studies (7, 15, 28). Tricuspid valve insufficiency was involved in the great majority of patients with CVD. Tricuspid regurgitation is the result of the dilatation of the right ventricle following the PH that complicates MS. Other studies (5, 19, 23–25, 27, 28) had drawn different conclusions from those in our study regarding the type of valve most affected, which is the mitral valve. This difference is probably due to the different methods for diagnosing cardiac disease rather than to the differences in the personal characteristics or to the place and time of the study initiation. In our study, most cases appeared to be at a lower risk for developing valvular abnormalities, but the mitral valves were permanently affected.

In the present study, PH did not have an important role in the patients' conditions, except for its complications. In fact, PH is considered a serious outcome of CVD, and prevention of its complications is a major principle of management (27). Most patients in our study had moderate PH that was mostly combined with RHD. These findings were consistent with what has been reported in the literature (27). The participants were mostly recommended for invasive BMV and mitral valve surgical treatment. This is in agreement with previous studies (27, 32).

5. Conclusions

TEE diagnosis of Yemeni patients with CVDs reveals that females are more prone to RHD and valvular dysfunctions, particularly aortic valve insufficiency. PH was quite common while valvular vegetation was uncommon in patients with CVDs. The present study also reveals that patients with RHD frequently require BMV and non-surgical treatment. Therefore, TEE criteria should be considered for detecting subclinical CVD. It should be compared with alternative treatment strategies in prospective randomized studies. TEE is recommended to assess echocardiographic features in suspicious clinical situations.

Competing interests

The author declares that he has no competing interests associated with this article.

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