Spectrum of Heart Diseases at a Referral Tertiary Care Hospital in Somalia, Mogadishu: An Echocardiographic Study

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Abstract

Background: To investigate the frequencies and patterns of cardiovascular diseases (CVD), including rheumatic and congenital heart diseases, assessed by echocardiographic examinations in the only referral tertiary care hospital in Mogadishu, the capital of Somalia.

Methods: This retrospective, descriptive registry reviewed the pathological echocardiographic findings of 1140 patients aged 0-100 years who were admitted to the cardiology outpatient clinic in a tertiary training hospital in Mogadishu.

Results: Hypertensive heart disease (HHD) 454 (39.8%) and degenerative valvular disease 395 (34.6%) were the most common comorbidities. Congenital heart diseases (CHD) were detected in 151 (13.2%) of the patients, with the most common ones including atrial septal defect (ASD) 37 (3.2%) and ventricular septal defect (VSD) 26 (2.3%). Rheumatic heart disease (RHD) was detected in 84 (7.4%) patients, among whom the most common age range was 16-30 years (40.5%), followed by 31-45 years (31%) and 0-15 years (15.5%).

Conclusion: In the present study, we found that HHD was the most common comorbidity, followed by degenerative valvular disease, Heart failure with reduced ejection fraction (HFrEF), and Ischemic heart disease (IHD). Moreover, the most common valvular disease was mitral insufficiency and the most common CHD was ASD.

Introduction

Cardiovascular diseases (CVDs) are the leading cause of death worldwide[1]. Its frequency, treatment options, subgroups including congenital heart diseases (CHDs), and outcomes have been well documented in developed countries so far. However, there are still serious concerns regarding the quality and reliability of available data in low-middle-income countries. According to the World Health Organization, CVDs are the second most common cause of overall mortality in Africa, and further supporting this conclusion, 1.2 million people worldwide died from CVDs in 2015[2]. In addition to CHDs, which have a relatively similar distribution all over the world, rheumatic heart disease (RHD), secondary to non-communicable diseases, is also naturally preventable and another leading cause of poor outcomes in low-middle income developing countries[3]. Every year, 291,000 deaths, accounting for 2% of CVD deaths, occur due to RHD[4].

Even though echocardiography is an easy-to-use, inexpensive, non-invasive, and reliable ultrasound-based modality, its use in many parts of Africa is still highly limited[5]. Therefore, there is a lack of reliable data on diagnosis, follow-up, treatment, and prevention of CVDs in those regions. Moreover, this drawback is considered to be a crucial and noteworthy challenge in reducing preventable non-communicable diseases in low-middle-income countries. To this end, the present study sought to address the frequency and pattern of CVDs assessed by echocardiographic examinations in Mogadishu, the capital of Somalia.

Patients And Methods

Study population and design

This retrospective, descriptive and observational registry reviewed the echocardiographic findings of patients aged 0-100 years who were presented to our outpatient cardiology clinic at a tertiary training hospital in Mogadishu, between January 1, 2019, and January 1, 2020. Overall, 6782 subjects admitted to the hospital were reviewed. 5642 individuals who had incomplete, unreliable data and/or those with completely normal echocardiographic findings were extracted from the study. Accordingly, a total of 1140 patients with pathological echocardiographic findings were enrolled in the study. Demographic characteristics and echocardiographic parameters including ejection fraction (EF), interventricular septum (IVS) thickness, left ventricular (LV) diastolic dysfunction grade, mitral valve insufficiency/stenosis, and degenerative, rheumatic, and congenital heart diseases were analyzed for each participant. Echocardiographic evaluations were performed by experienced echocardiographers who were licensed in Turkey using a Toshiba Aplio™ ultrasound system (TUS-A500, Shimadzu, Japan) in accordance with the American Society of Echocardiography guidelines[6]. Those aged 15 and under were defined as a child. Age- and gender-based distributions of acquired, congenital, and rheumatic heart diseases were evaluated. Those with active tuberculosis or a history of TB were evaluated together, regardless of whether they received treatment or not. The study was conducted according to the Helsinki Declaration. Ethical approval was obtained from the local ethics committee (date: 17.02.2021, decision no: 323). The need for informed consent was waived due to the retrospective nature of the study.

Hypertensive heart disease (HHD) was diagnosed in the presence of signs of heart failure or criteria for left ventricular hypertrophy (LVH) on electrocardiography (ECG) or echocardiography, considered not to be caused by valvular heart disease (VHD) and/or ischemic heart disease (IHD), for known or newly diagnosed hypertensive patients (TA > 140/90 mmHg), regardless of systolic or diastolic dysfunction.

Valvular heart disease (VHD) was defined as an obvious function and size abnormality, insufficiency/stenosis, abnormal thickening of valve leaflets or cusps, coaptation failure, calcification, and loss of normal contour detected by echocardiography in at least one of the heart valves.

Rheumatic heart disease (RHD) was diagnosed in accordance with the 2012 World Heart Federation (WHF) criteria for echocardiographic diagnosis of RHD[7].

Ischemic heart disease (IHD) was diagnosed in patients with a history of angina pectoris or a history of myocardial infarction, or an ECG feature indicating a previous myocardial infarction and a regional wall motion abnormality suggestive of myocardial infarction detected on echocardiography.

Dilated cardiomyopathy (DCM) was defined as left ventricular or biventricular systolic dysfunction and dilatation (left ventricular end-diastolic diameter > 58mm for males and > 52mm for females), not explained by abnormal filling conditions or coronary artery disease, regardless of being primary or secondary[8].

Hypertrophic cardiomyopathy (HCM) was defined as unexplained maximal wall thickness > 15 mm in any left ventricular myocardial segment or presence of left ventricular septal/posterior wall thickness ratio > 1.3 in normotensive patients and > 1.5 in hypertensive patients[9, 10]. Since HCM patients in our study were adults, both thresholds were applied to all of them.

Pericardial effusion (PE) was diagnosed in the presence of an echo-free space between the visceral and the parietal pericardium. The classification was as follows: mild (< 10mm), moderate (10-20mm), and severe (> 20mm).

Constrictive pericarditis was diagnosed in the presence of echocardiographic signs of constriction characterized by a thickened, fibrotic pericardium, limiting the heart's ability to function normally.

Heart failure with reduced EF (HFrEF) was diagnosed in the presence of clinical signs of heart failure, along with a reduced EF of < 50% assessed by echocardiography.

Pulmonary arterial hypertension was defined as the presence of systolic pulmonary artery pressure (SPAP) ≥ 2.8 m/sec or ≥ 36 mmHg on echocardiography, in addition to symptoms and other findings that are associated with pulmonary hypertension(11).

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics for Windows Version 20.0 (Armonk, NY: IBM Corp.). The normality of continuous variables was assessed by analytical (Kolmogorov-Smirnov test) and visual methods (histograms and probability plots). Continuous variables were expressed as median (interquartile range [IQR]) only due to the presence of abnormal distribution for all. Categorical variables were expressed as numbers (n) and percentages (%). Continuous variables were compared using the Mann-Whitney U test and categorical variables were compared using the χ^2 – test or Fisher's exact test, where appropriate. A two-tailed *p*-value of < 0.05 was considered significant throughout the study.

Results

Out of the study population with a total of 1140 participants, 646 (56.7%) were male, the median age was 60 (IQR; 42–70) years and 113 (9.9%) were children. Children were more likely to be female (*p* = 0.045). HHD was found to be the most common comorbidity 454 (39.8%), followed by VHD 395 (34.6%), HFrEF 351 (30.8%), and IHD 278 (24.4%). RHD was detected in 84 (7.4%) patients. The most observed age range in patients with RHD was 16–30 years 461 (40.5%), followed by 31–45 years 387 (31%), and 0–15 years 176 (15.5%) (Fig. 2). While the number of patients with a history of tuberculosis or active tuberculosis was 202 (17.7%), 9 (0.8%) subjects were diagnosed with constrictive pericarditis due to any reason. Of the participants, 244 (21.4%) had DCM. Detailed demographic characteristics of the study population are listed in Table 1.

Table 1
Demographic characteristics of the study population by gender

<i>Variables</i>	<i>All</i>	<i>Male</i>	<i>Female</i>	<i>p-value</i>
Age, years	60 (42–70)	61 (47–71)	60 (35–70)	0.002
Child, n (%)	113 (9.9)	54 (8.4)	59 (11.9)	0.045
Diabetes mellitus, n (%)	263 (23.1)	183 (28.3)	80 (16.2)	0.021
Hypertensive heart failure, n (%)	454 (39.8)	274 (42.4)	180 (36.4)	0.035
Current smoker, n (%)	57 (5)	26 (4.0)	31 (6.3)	0.404
Ischemic heart disease, n (%)	278 (24.4)	206 (31.9)	72 (14.5)	< 0.001
Heart failure with reduced EF, n (%)	351 (30.8)	237 (36.7)	114 (23.1)	< 0.001
Valvular heart disease, n (%)	395 (34.6)	161 (32.6)	234 (36.2)	0.199
Rheumatic heart disease, n (%)	84 (7.4)	30 (4.6)	54 (10.9)	< 0.001
Congenital heart disease, n (%)	151 (13.2)	71 (10.9)	80 (16.2)	0.009
Pulmonary arterial hypertension, n (%)	260 (22.8)	150 (23.2)	110 (22.3)	0.745
COPD, n (%)	66 (5.8)	13 (2)	53 (10.7)	0.004
Dilated cardiomyopathy, n (%)	244 (21.4)	173 (26.8)	71 (14.4)	< 0.001
Constrictive pericarditis, n (%)	9 (0.8)	7 (1.1)	2 (0.4)	0.202
Peripartum cardiomyopathy, n (%)	21 (1.8)	-	21 (1.8)	-
Tuberculosis, n (%)	202 (17.7)	104 (16.1)	98 (19.8)	0.438

Median EF was 60% (IQR:40–65). There were 182 (15.9%) subjects with grade II–IV diastolic dysfunction. Mitral insufficiency 541 (47.5%) was detected as the most common VHD, followed by aortic insufficiency 437 (38.3%), and tricuspid insufficiency 264 (23.2%) and mitral valve stenosis 39 (3.4%) was the least common VHD (Table 2). On the other hand, 151 (13.2%) patients had CHDs, of which 23 (15.2% of CHDs) were cyanotic CHDs. The most frequent CHD was atrial septal defect (ASD) 37 (3.2%), followed by ventricular septal defect (VSD) 26 (2.3%) and patent ductus arteriosus (PDA) 25 (2.2%) (Fig. 1a). ASD was observed to be more common in females, whereas VSD and PDA had a similar frequency across genders (Fig. 1b). The most frequent age group with CHD cases was 0–15 years 770 (67.5%), followed by 16–30 years 219 (19.2%) (Table 3).

Table 2
Echocardiographic findings of the study population by gender

<i>Variables</i>	<i>All (n:1140)</i>	<i>Male (n:646)</i>	<i>Female (n:494)</i>	<i>p</i>
Ejection fraction, %	60 (40–65)	55 (35–60)	60 (55–65)	< 0.001
Interventricular septum thickness, mm	11 (10–14)	13 (10–14)	11 (10–14)	0.001
LV diastolic dysfunction and grades, n (%)	668 (58.6)	416 (64.4)	252 (51.0)	< 0.001
Grade I	486 (42.6)	289 (44.7)	197 (39.9)	
Grade II	141 (12.4)	99 (15.3)	42 (8.5)	
Grade III	34 (2.9)	23 (3.6)	11 (2.2)	
Grade IV	7 (0.6)	5 (0.8)	2 (0.4)	
Aortic valve insufficiency, n (%)	437 (38.3)	260 (40.2)	177 (35.8)	0.233
Mild	340 (29.8)	209 (32.4)	131 (26.5)	
Moderate	81 (7.1)	42 (6.5)	39 (7.9)	
Severe	16 (1.4)	9 (1.4)	7 (1.4)	
Aortic valve stenosis, n (%)	87 (7.6)			0.118
Mild	52 (4.6)	25 (3.9)	27 (5.5)	
Moderate	9 (0.8)	5 (0.8)	4 (0.8)	
Severe	26 (2.3)	20 (3.1)	6 (1.2)	
Mitral valve insufficiency, n (%)	541 (47.5)	322 (49.8)	219 (44.3)	0.135
Mild	263 (23.1)	150 (23.2)	113 (22.9)	
Moderate	254 (22.3)	154 (23.8)	100 (20.2)	
Severe	24 (2.1)	18 (2.8)	6 (1.2)	
Mitral valve stenosis, n (%)	39 (3.4)	13 (2.0)	26 (5.3)	0.003
Mild	18 (1.6)	9 (1.4)	9 (1.8)	
Moderate	8 (0.7)	1 (0.2)	7 (1.4)	
Severe	13 (1.1)	3 (0.5)	10 (2.0)	
Tricuspid valve insufficiency, n (%)	264 (23.2)	153 (23.7)	111 (22.5)	0.880
Systolic pulmonary artery pressure, mmHg	20 (15–30)	22 (15–30)	18 (20–30)	0.776
Valvular vegetation, n (%)	2 (0.2)	1 (0.2)	1 (0.2)	0.677
Left ventricular thrombus, n (%)	5 (0.4)	5 (0.8)	0 (0)	0.074
Permeant pacemaker lead, n (%)	6 (0.5)	5 (0.8)	1 (0.2)	0.244
Pericardial effusion, n (%)	125 (10.9)	70 (10.8)	55 (11.1)	0.326
Mild	114 (10.0)	65 (10.1)	49 (9.9)	
Moderate	8 (0.7)	4 (0.6)	4 (0.8)	
Severe	3 (0.3)	1 (0.2)	2 (0.4)	
Data are presented as numbers and percentages (%), or median (interquartile range). P-value was calculated using the Mann-Whitney U-test for continuous variables and the Chi-Square test or the Fisher's exact test for categorical variables as appropriate. P value < 0.05 was considered significant.				

Table 3
Age-based distribution of CHDs of the study population

<i>Age category</i>	<i>Non-compaction n(%)</i>	<i>ASD n(%)</i>	<i>AVCD n(%)</i>	<i>PDA n(%)</i>	<i>Congenital PS n(%)</i>	<i>Dextrocardia n(%)</i>	<i>ToF n(%)</i>	<i>HCMP n(%)</i>	<i>Myxoma n(%)</i>	<i>TGA n(%)</i>	<i>VSD n(%)</i>	<i>Subaortic membrane n (%)</i>
0–15	0 (0)	25 (2.2)	5 (0.4)	23(2.0)	7 (0.6)	0 (0)	15 (1.3)	0 (0)	0 (0)	8 (0.7)	18 (1.6)	1 (0.1)
16–30	1(0.1)	8 (0.7)	1 (0.1)	2 (0)	3 (0.3)	0 (0)	4 (0.4)	4 (0.4)	0 (0)	0 (0)	5 (0.4)	1 (0.1)
31–45	0 (0)	1 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.1)	1 (0.1)	1 (0.1)	0 (0)	2 (0.2)	0 (0)
46–60	3 (0.3)	2 (0.2)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	4 (0.4)	1 (0.1)	0 (0)	1 (0.1)	0 (0)
61–75	1 (0.1)	1 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
+75	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	5 (0.4)	37 (3.2)	6 (0.5)	25(2.2)	10 (0.9)	1 (0.1)	20 (1.8)	9 (0.8)	2 (0.2)	8 (0.7)	26 (2.3)	2 (0.2)

Discussion

To the best of our knowledge, this is the first echocardiographic study to evaluate comprehensively such a large cohort of patients in Somalia. Given inadequate healthcare services in Somalia, which is an active war zone, we consider that this study is of high value. In our investigation, HHD was the most frequent comorbidity (39.8%), followed by degenerative valvular disease (34.6%), HFrEF (30.8%), and IHD (24.4%), RHD (7.4%). Additionally, 13.2% of the study population were diagnosed with CHD, with the most common being ASD, VSD, and PDA, respectively.

Somalia's total population is estimated at 15.4 million, of whom about 4.5 million are children under the age of 14. Health institutions in Somalia often provide rather limited facilities for individuals with chronic illnesses and those in need of advanced care and unfortunately, no tertiary healthcare centers exist in Mogadishu and surrounding provinces, except for the region where this study was conducted. All these deficiencies prevent timely diagnosis by appropriate detection modalities, increasing the likelihood of poor outcomes in such populations. Moreover, delayed hospital admission, advanced maternal age, high rates of consanguineous marriage, and the presence of many infectious diseases that have not been eradicated nationwide may result in an increased incidence and prevalence of both acquired and congenital heart diseases. Yet, unfortunately, there are very few studies in the literature reporting the risk factors, profile, and echocardiographic characteristics of the African population. For instance, in an echocardiographic study conducted in Nigeria, Ogah et al [12] detected HHD in 56.7% of the patients. In another echocardiographic study, Raphael et al [13] evaluated 815 adults and 59 children aged ≤ 15 years and reported that normal echocardiographic findings were detected in only 44% of the patients and that the most common comorbidities were HHD (41%), VHD (18%), coronary artery disease (18%), and peripartum cardiomyopathy (7%) in adults, while CHD were the most common comorbidities in children (34%). In our study, HHD was the most common echocardiographic finding (39.8%), which could be related to the excessive salt consumption by inhabitants in this region and also to some other factors such as difficult and delayed diagnosis, inadequate medication, and insufficient follow-up.

Despite the decrease in the incidence of rheumatic fever/RHD over the last few decades, it remains an acquired health problem, especially in low-middle-income countries [14]. In an investigation conducted on patients with structural and functional valve abnormalities, 24% of the subjects had a valvular abnormality, with the most common abnormality being mitral valve insufficiency (59%), and approximately one-third (36%) of the patients were diagnosed with RHD [15]. In the present study, the most frequent valvular abnormality was mitral insufficiency (47.5%), consistent with the former, and a high rate of RHD was diagnosed. As noted above, RHD is a vital health issue in many African countries, including Somalia, mostly due to inadequate healthcare in both diagnosis and treatment. Further comprehensive studies are needed to overcome this problem and raise social awareness and cultural knowledge. Additionally, it is an inevitable requirement to develop inadequate healthcare services and patient follow-up approaches to reduce the incidence of RHD associated with autoimmune pathophysiology.

The prevalence of CHDs is relatively similar worldwide, ranging from 4 to 85 per 1000 births [3, 16, 17]. Although VSD is generally the most common CHD, studies with a higher frequency of ASD have also been reported, which is compatible with ours [18, 19]. This discordance may be related to the following conditions; (i) inter-regional genetic variation, (ii) the overwhelming majority of the participants in our study population is adults and we acknowledge that some small VSDs might close spontaneously with age, and (iii) diagnosis by transthoracic echocardiography alone may cause some VSDs to be overlooked. Besides, factors such as excessive use of herbal medicines, alcohol-cigarette consumption, inadequate control of chronic diseases, and inadequate vaccination against infectious diseases may be associated with the high prevalence of

CHDs in Somalia[20]. While the prevalence of CHDs in adults increases in developing countries nowadays, it is relatively less common in adults because of high morbidity and mortality in countries with many health system defects, such as Somalia. Similarly, in our study, we have reached a conclusion consistent with the former assumption by determining that 67.5% of individuals with CHD were 15 years or younger.

Conclusion

In the present study, we found that HHD was the most common comorbidity (39.8%), followed by degenerative valvular disease (34.6%), HFrEF (%30.8), and IHD (24.4%). Moreover, the most common valvular disease was mitral insufficiency (47.5%) and the most common CHD was ASD (3.2%). Further comprehensive studies with prospective design are warranted to improve the insufficient healthcare services and raise public awareness in Somalia, a war zone where financial and healthcare opportunities are highly limited.

Abbreviations

CVD: Cardiovascular diseases; HHD: Hypertensive heart disease; CHD: Congenital heart diseases; ASD : Atrial septal defect ; VSD: Ventricular septal defect ; PDA : Patent ductus arteriosus ; RHD: Rheumatic heart disease; EF: Ejection fraction ; IVS : Interventricular septum ; LV : Left ventricular ; VHD : Valvular heart disease ;IHD: Ischemic heart disease ; DCM : Dilated cardiomyopathy ; HCM : Hypertrophic cardiomyopathy ; PE : Pericardial effusion ; HFrEF: Heart failure with reduced ejection fraction ; IQR: interquartile range.

Declarations

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Authors' contributions

GA carried out the studies, participated in collecting data, and drafted the manuscript. GA and ÖG performed the statistical analysis and participated in its design. GA participated in the acquisition, analysis, or interpretation of data and draft the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used or/and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study was approved by the Independent Ethics Committee of Somalia Mogadishu Training And Research Hospital (Mogadishu, Somalia)

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

Figure 1

a: Distribution of various patterns of congenital heart diseases Abbreviations: PDA, Patent ductus arteriosus; HCM, Hypertrophic cardiomyopathy; ASD, Atrial septal defect; VSD, Ventricular septal defect; ToF, Tetralogy of Fallot; TGA, Transposition of the Great Arteries; CHD, congenital heart disease b: Distribution chart of congenital heart diseases by gender Abbreviations: TGA, Transposition of the Great Arteries; HCM, Hypertrophic cardiomyopathy; ToF, Tetralogy of Fallot; PDA, Patent ductus arteriosus; VSD, Ventricular septal defect; ASD, Atrial septal defect.

Figure 2

Distribution of rheumatic valvular disease by age category Abbreviations: RVD, Rheumatic valvular disease