Original Research Article

Epidemiological and Clinical Characteristics of the Yemeni Patients Underwent Cardiac Surgery in India

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ABSTRACT

Background: Cardiovascular diseases are a group of disorders of the heart and blood vessels. Cardiac surgery has become a routine practice for many heart conditions.

Objective: To highlight on the epidemiological and clinical characteristics of the study patients underwent cardiac surgery.

Materials and Methods: This retrospective observational study included Yemeni patients who underwent cardiac surgery in selected Indian hospitals between January 2016 and December 2023. Inclusion criteria were patients aged > 20 years underwent cardiac surgeries.

The collected data were analyzed using SPSS version 17. Descriptive statistics were presented as means ± standard deviations for continuous variables and frequencies with percentages for categorical variables.

Results: The study sample included 843 Yemeni patients with CVD diseases treated in India between January 2016 and December 2023.

They were (67%) males and (33%) females and their mean age was 52.6 years (standard deviation SD = ± 13).

The patients of the age group 51 – 60 years were predominant with (33.6%) followed by the age group > 60 years old with (30.5%).

Hypertension was (57.5%) and diabetes mellitus was (45.1%). Dyslipidemia found in (30%) patients, smoking history in (22%) and prior myocardial infarction in (14%).

We found the predominance of Coronary Artery Bypass Grafting (CABG) surgeries, which represented (54%), followed by valve replacement (29%) and combined surgeries with (17%).

The perioperative outcomes (Complication Rate) 9.5%, in-hospital mortality rate: 2.1%, average hospital stay: 9.2 ± 2.5 days and intensive care unit stay (ICU Stay): 3.8 ± 1.2 days. Their satisfaction level was (52%) excellent, followed by good with (37%).

Conclusion: Yemen is a country with the highest regional burden of CVDs. Effective preventative strategies and education programs are crucial in to reduce the risk of CVD morbidity.

Keywords: Cardiovascular diseases, Clinical Characteristics, Yemeni patients, cardiac surgery, India

INTRODUCTION

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels, including coronary artery disease, cerebrovascular disease, rheumatic heart disease, and other conditions.

The high burdens of CVDs in the developing countries are attributable to the increasing

incidence of atherosclerotic diseases, perhaps due to urbanization and higher risk factor levels (such as obesity, diabetes, dyslipidemia, hypertension, etc.) [1]. The relatively early age at which they manifest, the large sizes of the population, and the high proportion of individuals who are young adults or middle-aged in these countries [1]. The burden of cardiovascular diseases (CVDs) globally is escalating and 30% of all deaths worldwide are caused by cardiovascular conditions [2].

CVDs are the leading cause of death worldwide, with above 70% in low- and middle-income nations [3].

Cardiac surgery is a medical specialty focused on the surgical treatment of heart and thoracic aorta pathologies. This surgery has become a routine practice for many heart conditions, with the median sternotomy approach remaining the gold standard for most open-heart procedures. Since the 19th century, the field has seen significant advancements, including the development of cardiopulmonary bypass (CPB), coronary artery bypass grafting (CABG), valve repairs, and minimally invasive techniques [4,5].

Recently, death rate due to cardiovascular diseases in least developed countries has been increased substantially especially in Yemen [6,7]. United nation to statistical information, indicates that Yemen is one of the youngest population countries in the world in as much as more than 50 percent of its population is less than 30 years of age [8]. Over the past three decades, many religious, geographical, historical, and economic obstacles have caused harsh divisions in Yemen, resulting in a civil war that started in 2014 and continues today. This conflict has led to an unprecedented humanitarian crisis, including extensive violations of humanitarian law and the Geneva Convention by combatants from all factions [9]. Attacks and airstrikes that began in March 2015 have included strikes on hospitals and medical facilities – an egregious violation of international, humanitarian, and human rights laws [10].

As a result of the ongoing conflict and deteriorating healthcare infrastructure have forced many citizens to seek advanced medical care abroad, particularly for complex procedures like cardiac surgeries. India has emerged as a leading destination due to its high-quality, cost-effective healthcare services.

Objectives: To highlight on the epidemiological and clinical characteristics of the study patients underwent cardiac surgery, to evaluate the outcome and to describe the satisfaction of the study patients.

MATERIALS AND METHODS

This retrospective observational study included Yemeni patients who underwent cardiac surgery in selected Indian hospitals between January 2016 and December 2023. Inclusion criteria were patients aged > 20 years underwent cardiac surgeries, including CABG, valve surgeries, and combined procedures.

The collected data were from the medical records of the patients, preoperative assessments, postoperative follow-up reports, patient interview and satisfaction survey.

The collected variables were Age, gender, residence area in Yemen, hypertension, diabetes mellitus, dyslipidemia and smoking status, type of surgery, duration of hospital stay, and intensive care unit stay (ICU stay). In addition to that the complication, mortality, satisfaction rates.

The data were analyzed using SPSS version 17. Descriptive statistics were presented as means ± standard deviations for continuous variables and frequencies with percentages for categorical variables.

RESULTS

The final study sample included 843 Yemeni patients with CVD diseases treated in India between January 2016 and December 2023. They were 565 males (67%) and 278 (33%) females with a male to female ratio 2.03:1 (Table 1). The mean age of the patients was 52.6 years and (standard deviation SD = ± 13) and (range: > 20 – 70 years).

The patients of the age group 51 – 60 years were predominant with 283 (33.6%) followed by the age group > 60 years old with 257 (30.5%), and the age group 41 – 50 years with 176 (20.8%), as shown in Table 1. Most of the patients 719 (85.3%) were from urban areas, Table 1.

Table 1: Characteristic variables of the patients with cardiovascular diseases (n = 843)

Variables	Ratio	Range	Mean ± SD	No	%
Sex:					
Male				565	67
Female				278	33
Sub total				843	100
Male to female:	2.03: 1				
Age range (years):		>20- >60			
Mean age ± SD (years):			52.6 ± 13		
Age groups (years):					
21 – 30				62	7.4
31 – 40				65	7.7
41 – 50				176	20.8
51 – 60				283	33.6
> 60				257	30.5
Residency:					
Urban				719	85.3
Rural				124	14.7

SD = standard deviation

In Table 2 and Figure 1, we found hypertension in 685 (57.5%) patients and diabetes mellitus in 380 (45.1%) patients. Dyslipidemia was found in 253 (30%) patients, smoking history in 186 (22%) patients and prior myocardial infarction in 118 (14%) patients.

Table 2: The clinical risk factors common in the Yemeni study patients (n = 843)

Risk factors	No	%
Hypertension:		
Yes	485	57.5
No	358	42.5
Diabetes Mellitus:		
Yes	380	45.1
No	463	54.9
Dyslipidemia:		
Yes	253	30
No	590	70
Smoking history:		
Yes	186	22
No	657	78
Prior myocardial infarction:		
Yes	118	14
No	725	86

Figure 1: Proportions of the clinical risk factors common in the Yemeni study patients
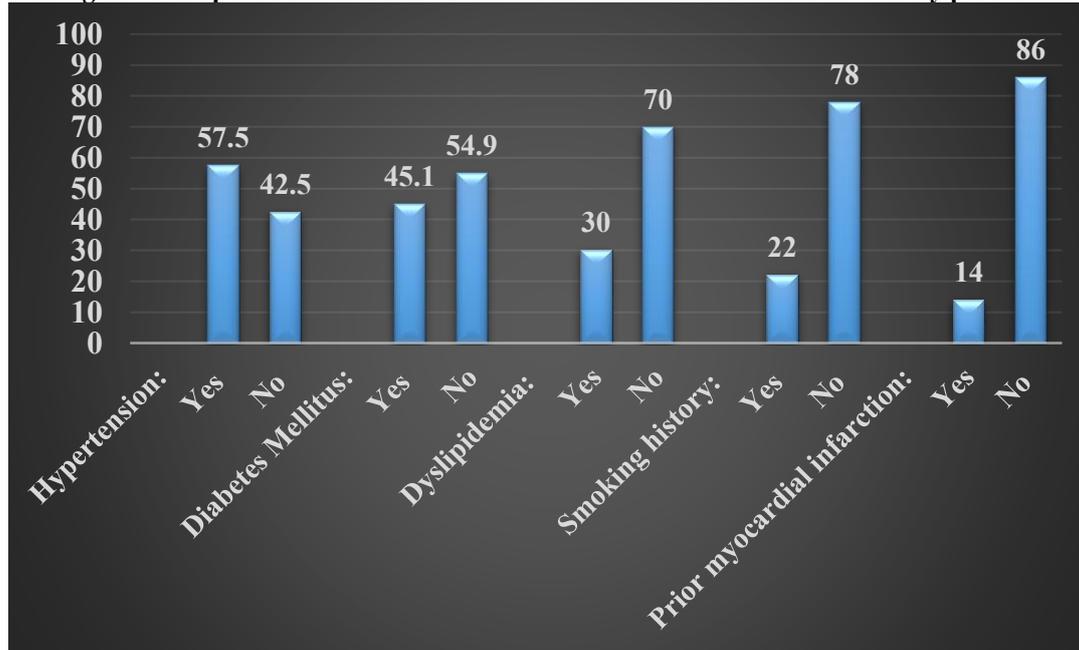

Table 3 shows the predominance of CABG surgeries which represented 456 (54%), followed by valve replacement 244 (29%) and combined surgeries with 143 (17%).

Table 3: Distribution of surgery types for Yemeni patients in India (n = 843)

Surgery Type	No	%
CABG	456	54
Valve Replacement	244	29
CABG + Valve Repair	143	17
Total	*843*	*100*

**CABG = Coronary Artery Bypass Grafting,
CABG + Valve Repair = Combined Surgeries**

Table 4 reveals the perioperative outcomes (Complication Rate) 9.5%, in-hospital mortality rate: 2.1%, average hospital stays: 9.2 ± 2.5 days and intensive care unit stay (ICU Stay): 3.8 ± 1.2 days.

**Table 4: Rates and averages distribution of perioperative outcomes**

Variables	Rate	Average (days)
Complication	9.5	
In-Hospital Mortality	2.1	
Hospital Stay		9.2 ± 2.5
ICU Stay		3.8 ± 1.2

Table 5 and Figure 2 illustrated the distribution of satisfaction level of the study patients towards the surgical outcomes of their health problems. Four hundred thirty-eight (52%) of the study patients reported with excellent, followed by 312 (37%) of the patients reported with good, then 76 (9%) answered with fair, and only 17 (2%) their satisfaction level was poor.

Table 5: Distribution of the study patients' satisfaction

Satisfaction Level	No	(%)
Excellent	438	52
Good	312	37
Fair	76	9
Poor	17	2
Total	843	100

Figure 2: Proportions of the study patients' satisfaction.
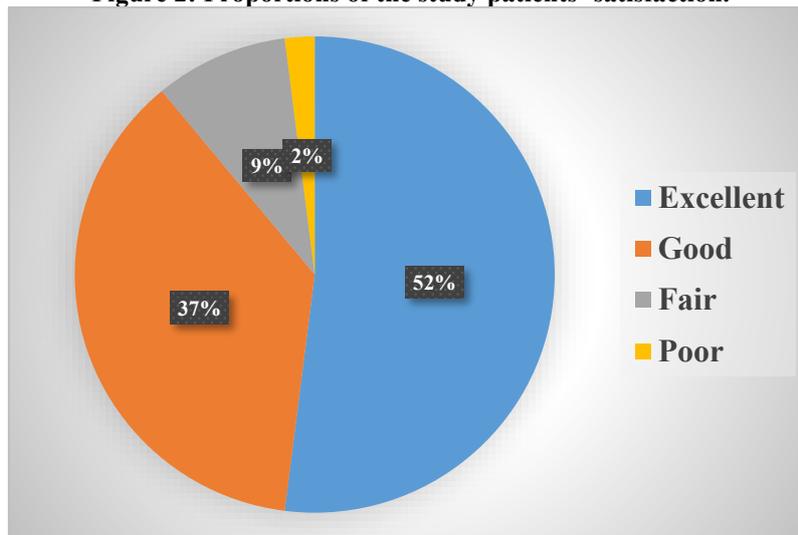
DISCUSSION

CVD is a highly prevalent condition and a major contributor to health loss. CVD remains the leading cause of global mortality, representing more than 30% of global deaths in 2015 [11]. According to the World Health Organization (WHO), an estimated 17.9 million people died in 2016 from CVDs, representing 31% of all deaths worldwide. Notably, 85% percent of these deaths are due to heart attack and stroke, and over three-quarters of CVD deaths occur in low- and middle-income countries [12]. The Institute for Health Metrics and Evaluation (IHME) has shown that the top leading cause of death in the Arab world is CVDs [13]. Also, risk factors for CVD, such as obesity and diabetes mellitus, are common, and they have been on growth throughout the world [14]. Noticeably, CVD exacts a heavy burden not only on the patients but also on their families and the governments [15,16].

In 2019 alone, an estimated 18.6 million lives were lost to cardiovascular diseases, constituting a significant 32% of global mortalities, making CVD the leading cause of death worldwide and a major cause of life-crippling morbidity [17,18,19]. Unfortunately, the majority of these deaths occur in low- and middle-income countries, particularly in regions such as countries in the Middle East and North Africa (MENA) or sub-Saharan Africa [19].

In our present study, the total study patients were 843. Five hundred sixty-five (67%) of the patients were males and 278 (33%) were females. (Male: female ratio was 2.03: 1).

In our study, males were dominant in most of the procedures. This is in line with reports of the Global Burden of Disease Study 2019 on the CVDs [19]. There have been conflicting results in terms of sex differences in cardiac surgeries. It has been suggested that there is no male–female difference in the aortic valve surgery [20].

However, a nationwide cohort study in the Netherlands reported a substantial difference in presentations and the predominance of males and females [20].

Suman et al [21] reported that the majority of cardiovascular diseases develop at an after age for women compared to men, while men are about 3–4 times more likely than women to suffer from ST-elevation myocardial infarction (STEMI) or non-STEMI. These gender differences between men and women are due to differences in gene expression from the sex chromosomes and differences in sex hormones.

In the present study, we found the mean age of the patients was 52.6 years and (standard deviation SD = ± 13) and (range: > 20 – 70 years).

Roth et al [19] reported in their study that the CVDs occur mainly in middle and older adulthood. However, the onset of certain cardiovascular diseases has tended to occur

at younger ages in recent years. For example, the prevalence of specific heart diseases such as rheumatic heart disease peaks between the ages of 20 and 29 years.

In the current study, the patients of the age group 51 – 60 years were predominant with (33.6%) followed by the age group > 60 years old with (30.5%) and the age group 41 – 50 years with (20.8%).

Most of the study patients (85.3%) were from urban areas, while patients from rural areas were (14.7%).

Liu et al [22] mentioned that a research team funded by the National Institutes of Health (NIH) uncovered higher rates of heart disease and worse heart health affecting adults living in rural communities compared to urban areas and the factors that likely drive these differences. They found adults living in rural areas were more likely than those living in large cities to have heart disease (7% vs. 4%), high blood pressure (37% vs. 31%), high cholesterol (29% vs. 27%), obesity (41% vs. 30%), and diabetes (11% vs. 10%). Across all age groups, the differences in high blood pressure, obesity, and diabetes were largest among adults ages 20–39 living in rural areas vs. cities.

Another important issue to highlight is the common belief that the risk of developing CVD is higher in individuals living in urban vs rural areas [23]. Findings from the global PURE cohort from high-income countries reported a similar INTERHEART risk score between populations in rural and urban areas [24]. However, the PURE Saudi study showed that the rural population had higher prevalence of CVD risk factors, particularly diabetes, hypertension, and obesity, compared to the urban population.

This higher prevalence might be related to what some researchers have called the "urbanization of rural life" [25,26,27].

In the present study, we found hypertension in (57.5%) patients and diabetes mellitus in (45.1%) patients. Dyslipidemia was found in (30%) patients, smoking history in (22%) patients and prior myocardial infarction in (14%) patients.

The prevalence of CVDs and their associated risk factors in the Middle East reaches up to 10.1%. Moreover, the most common risk factors include dyslipidemia (43.3%), hypertension (26.2%), and diabetes (16%) [28]. Additionally, many Arab countries exhibit some of the world's highest rates of smoking among the adult population, ranging from 15.3% in Morocco to 53.9% in Lebanon, which is higher than the worldwide average [29], the prevalence of obesity [30], smoking, dyslipidemia, hypertension, diabetes, and other environmental risk factors such as poor air quality [31,32], alongside the relatively low social development index (SDI) scores [33], genetic, and cultural factors [34].

In our present study, we found predominance of CABG surgeries which represented (54%), followed by valve replacement (17%).

Tajdini et al [35] reported in their published study, that the trends of 54,418 cardiac surgeries, including isolated CABG (84.5%), valve surgeries (9.9%), and CABG + valve surgeries (5.6%).

The number of surgical revascularization (CABG) is different among different regions of the world and at the country-to-country level [36].

In the current study, the perioperative outcomes (Complication Rate) 9.5%, in-hospital mortality rate: 2.1%, average hospital stay: 9.2 ± 2.5 days and intensive care unit stay (ICU Stay): 3.8 ± 1.2 days.

Cardiac surgery remains a cornerstone treatment for advanced cardiovascular disease; however, postoperative outcomes—particularly intensive care unit (ICU) stay and in-hospital mortality—are critical indicators of patient recovery and healthcare resource utilization. Prolonged ICU stays have been documented in 4% to 11% of cardiac surgery patients, with some studies reporting rates as high as 36% [37].

Despite continuous advancements in surgical techniques and perioperative management, the identification of reliable intraoperative predictors that can forecast adverse postoperative outcomes remains challenging.

Several factors—ranging from preoperative comorbidities to intraoperative variables—have been implicated in influencing outcomes due to their roles in inducing myocardial ischemia and systemic inflammatory responses [38].

Moreover, recent advances in predictive modeling have provided important insights into risk stratification before cardiac surgery [39].

The European Multicenter Study on Coronary Artery Bypass Grafting (E-CABG) registry [40] analyzed over 7000 patients undergoing isolated coronary artery bypass grafting to develop a nomogram incorporating ten preoperative factors to predict prolonged ICU stay. Although such preoperative models are valuable for early risk assessments, their exclusive reliance on preoperative data limits the potential for real-time intraoperative decision-making. In another population-based cohort, pragmatic clinical models showed excellent discrimination for hospital length of stay [41].

In our present study, we found the patients' satisfaction level of the study patients towards the surgical outcomes of their health problems. (52%) of the study patients reported with excellent, followed by (37%) of the patients reported with good, then (9%) answered with fair, and only (2%) their satisfaction level was poor.

Mani et al [42] found in their study, a high rate of overall post-surgical satisfaction (86%); 71% of respondents reported an improvement in physical health, 45% in mental health and 70% in their quality-of-life. The usefulness of information provided by the National Health Service varies across different stages of the patient experience. Although approximately 90% of respondents found the information provided at each stage at least 'somewhat' helpful, the proportion who found the information 'very' helpful was lower (68% for pre-procedure; 55% for post-discharge). The majority (79%) said that they felt prepared for their operation.

CONCLUSION
Yemen is a country with the highest regional burden of CVDs. Effective preventative strategies and education programs are crucial in to reduce the risk of CVD morbidity. Additionally, it is crucial to understand the epidemiological features of CVDs and their etiological factors to prioritize further researches.

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