Original Article

Surgical Management of Valvular Heart Diseases: Morphological Spectrum, Surgical Techniques and Post-Operative Outcomes in a Tertiary-Level Hospital of Bangladesh

Muhammad Hasan Zaman[1], Md. Abdul Hannan[1], Mohammad Ashfaqur Rahman[2], Md. Imran Hasan Chowdhury[1], Rajmoni Umme Asha[1]

[1]Department of Cardiovascular and Thoracic Surgery, Combined Military Hospital (CMH), Dhaka, Bangladesh; [2]Department of Unit: HQ:[99] Composite Brigade, Padma Cantonment (ADS, Mawa, Munshiganj.

Abstract

Introduction: Valvular heart disease (VHD) remains a major cause of cardiovascular morbidity and mortality, particularly in developing countries where rheumatic etiology predominates. This study aimed to evaluate the morphological spectrum, surgical techniques, and postoperative outcomes of VHD in a tertiary-level hospital in Bangladesh.

Methods: This descriptive cross sectional study was conducted from January 2024 to December 2025 in the Department of Surgery at the Cardiovascular Surgery Centre, Combined Military Hospital (CMH), Dhaka, Bangladesh, including 45 patients with VHD selected by purposive and convenient sampling; diagnoses were confirmed by echocardiography and relevant investigations, surgeries comprised mitral valve replacement (MVR), aortic valve replacement (AVR), double valve, valve plus coronary artery bypass grafting (CABG), and complex procedures, outcomes included intensive care unit (ICU) stay, hospital stay, complications and mortality.

Results: In 45 patients (mean age 39.4 ± 15.4 years), the majority were aged 21–60 years (77.8%) and were female (55.6%). Mitral valve disease was the most common lesion (57.8%, n = 26). MVR was the leading surgical procedure (40.0%, n = 18). Postoperatively, 62.2% (n = 28) of patients had an (ICU) stay of ≤3 days and 66.7% (n = 30) had a hospital stay of ≤10 days. Arrhythmia was the most frequent complication (22.2%, n = 10). The in-hospital mortality rate was 6.7% (n = 3). Pure valvular surgery accounted for the majority of cases (84.4%, n = 38).

Conclusion: VHD predominantly affects younger to middle-aged patients with mitral involvement, and while isolated valve surgery remains the mainstay, combined procedures and acceptable postoperative outcomes highlight the need for comprehensive surgical care in tertiary centers.

Keywords: valvular heart disease, surgical techniques, postoperative outcomes.

[JNHFB 2026; 15 (2) : 71-76] doi.10.61819/jnhfb.v15i2.62

Introduction

Valvular heart disease (VHD) encompasses abnormalities of one or more cardiac valves that may present as stenotic, regurgitant, or combined lesions [1]. Globally, VHD is recognized as a major contributor to cardiovascular morbidity and mortality, ranking just below coronary artery disease (CAD), hypertension, and heart failure [2]. It continues to impose a substantial health burden across diverse populations worldwide.

The prevalence of VHD is considerably higher in developing countries (0.3%–18.6%) compared to developed nations (0.7%–2.5%) [3-5]. Rheumatic fever and its sequelae, particularly rheumatic heart disease (RHD), continue to play a significant role in causing morbidity and premature mortality among socioeconomically disadvantaged, working-age populations in developing countries [6,7]. Similar to other developing nations, Bangladesh continues to experience a substantial burden of rheumatic heart disease, making it an important public health issue. The occurrence of RHD and acute rheumatic fever (ARF) is higher in environments characterized by overcrowding, poor nutritional status, low socioeconomic conditions, and inadequate hygiene. Individuals affected in such settings are often younger, belong to lower socioeconomic groups, have limited education, and face restricted access to healthcare services. Although there has been a declining trend in the incidence of ARF over the past three decades, along with increased life expectancy, chronic

Corresponding Author
Lt Col Dr. Muhammad Hasan Zaman
Classified Specialist in Cardiovascular Surgery
Department of Cardiovascular and Thoracic Surgery
Combined Military Hospital (CMH), Dhaka, Bangladesh

RHD persists as a significant health challenge in the country [8]. In rural areas of Bangladesh, the prevalence of rheumatic mitral valve disease has been reported to be approximately 1.3 per 1000 population [9].

Over time, surgical management of VHD has undergone remarkable advancements, particularly through improved risk stratification and identification of high-risk patients using refined noninvasive diagnostic techniques. These developments have enabled earlier and safer surgical interventions, including valve repair and replacement, even during asymptomatic stages of the disease, resulting in favorable long-term outcomes[10]. Despite these advancements, the surgical management of rheumatic valvular lesions remains technically more complex and challenging compared to degenerative valve disease. Rheumatic VHD continues to be highly prevalent in certain regions, where valve repair, although feasible, is frequently associated with increased rates of failure and the need for reoperation [11,12].

Despite considerable advances in the diagnosis and surgical management of VHD, there remains a relative paucity of comprehensive data from developing countries, particularly in Bangladesh, regarding the morphological spectrum of valvular lesions in surgically treated patients. Additionally, limited studies have simultaneously evaluated the relationship between disease patterns, surgical techniques, and postoperative outcomes within a single cohort. Variations in patient characteristics, disease etiology, and resource availability in tertiary-level and military healthcare settings may further influence surgical approaches and outcomes, yet these factors remain underexplored. Therefore, the present study aimed to evaluate the morphological spectrum of valvular heart disease, assess the surgical techniques employed, and analyze the postoperative outcomes among patients undergoing surgical management in a tertiary-level hospital in Bangladesh.

Materials and methods

This descriptive cross sectional study was conducted from January 2024 to December 2025 in the Department of Surgery at the Cardiovascular Surgery Centre, Combined Military Hospital (CMH), Dhaka, Bangladesh, including 45 patients with VHD who underwent surgical management based on predefined inclusion and exclusion criteria. Patients included in the study were those undergoing surgical intervention for isolated or multiple valvular heart diseases, with or without associated congenital heart disease and/or ischemic heart disease (IHD), confirmed by echocardiography, computed tomography (CT) angiography, coronary angiography, or cardiac catheterization.

Patients with VHD associated with irreversible physiological changes contraindicating surgery (e.g., end-stage pulmonary hypertension), those with a history of previous open heart surgery, and those with severe comorbidities such as uncontrolled diabetes mellitus (persistent elevated HbA1c), end-stage renal disease (ESRD), and heart failure with reduced ejection fraction (HFrEF<35%) were excluded from the study. Demographic variables were: age, gender, comorbidities {hypertension, diabetes mellitus and chronic kidney disease (CKD)}. Clinical variables were: symptoms including dyspnea {New York heart association (NYHA) classification}, palpitations, fatigue/reduced effort tolerance, orthopnea/paroxysmal nocturnal dyspnea (PND), and chest pain. VHD was diagnosed by cardiologists at CMH or referring institutions and confirmed upon admission. All patients underwent detailed re-evaluation through clinical assessment and relevant investigations.

Investigations included complete blood count (CBC), liver function tests (LFT), coagulation profile, biochemical tests, transthoracic echocardiography, coronary angiography, CT angiography, and cardiac catheterization when indicated.

Preoperative hemodynamic changes and thromboembolic manifestations were assessed based on clinical findings and investigative results. Surgical procedures were categorized as mitral valve replacement (MVR), aortic valve replacement (AVR), double valve surgery, combined valve surgery with coronary artery bypass grafting (CABG), and complex cardiac surgical procedures. Postoperative outcomes were: intensive care unit (ICU) stay duration, hospital stay duration, postoperative complications and in-hospital mortality. Postoperatively, valvular function, paravalvular leakage and thrombus formation were assessed by echocardiography. Follow up was done after 3 months of surgery with echocardiogram.

Data were collected using a structured data collection sheet. All relevant variables were recorded prospectively during the perioperative and hospital stay periods. Ethical approval was obtained from the relevant institutional review board. Written informed consent was obtained from all participants. Confidentiality of patient data was strictly maintained, and participation did not interfere with clinical management. Patients were informed that participation was voluntary and that they could withdraw at any time without affecting their treatment.

Data were analyzed using SPSS version 25.0. Categorical variables were expressed as frequency and percentage, while continuous variables were presented as mean ± standard deviation. Results were presented in tables and figures.

Results

The majority of patients were aged 21–40 years (18 patients, 40.0%), followed closely by those aged 41–60 years (17 patients, 37.8%), while both the 1–20 years and >60 years age groups each comprised 5 patients (11.1%). The mean age was 39.4 ± 15.4 years. Female slightly predominated (25 patients, 55.6%) compared to males (20 patients, 44.4%).

Regarding comorbidities, 18 patients (40.0%) had no associated conditions, while hypertension was the most common comorbidity (14 patients, 31.1%), followed by diabetes mellitus (9 patients, 20.0%) and CKD (4 patients, 8.9%). In terms of clinical presentation, dyspnea was the predominant symptom, observed in 42 patients (93.3%), followed by fatigue or reduced effort tolerance (28 patients, 62.2%), palpitations (20 patients, 44.4%), orthopnea or paroxysmal nocturnal dyspnea (15 patients, 33.3%), and chest pain (8 patients, 17.8%). Preoperatively, thromboembolic manifestations were uncommon (3 patients, 6.7%), while all patients' demonstrated hemodynamic changes consistent with underlying valvular pathology (Table 1).

Table 1: Demographic and baseline clinical characteristics of the study population (n = 45)

Variables		Frequency (n)	Percentage (%)
Age (years)	1–20	5	11.1
	21–40	18	40.0
	41–60	17	37.8
	>60	5	11.1
	Mean ± SD	39.4 ± 15.4	
Sex	Male	20	44.4
	Female	25	55.6
Comorbidities	None	18	40.0
	Hypertension	14	31.1
	Diabetes Mellitus	9	20.0
	CKD	4	8.9
Preoperative Hemodynamic Changes	Present	45	100.0
	Absent	0	0.0
Thromboembolic Manifestations	Present	3	6.7
	Absent	42	93.3
Presenting Symptoms	Dyspnea (NYHA II–IV)	42	93.3
	Palpitations	20	44.4
	Fatigue / Reduced effort tolerance	28	62.2
	Orthopnea / PND	15	33.3
	Chest pain	8	17.8

SD: standard deviation; CKD: chronic kidney disease; NYHA: New York heart association; PND: paroxysmal nocturnal dyspnea.

Mitral valve disease was the most prevalent lesion, observed in 26 patients (57.8%) followed by aortic valve disease in 10 patients (22.2%). Multivalvular involvement was noted in 6 patients (13.3%), while 3 patients (6.7%) had valvular heart disease associated with CAD (Figure 1).

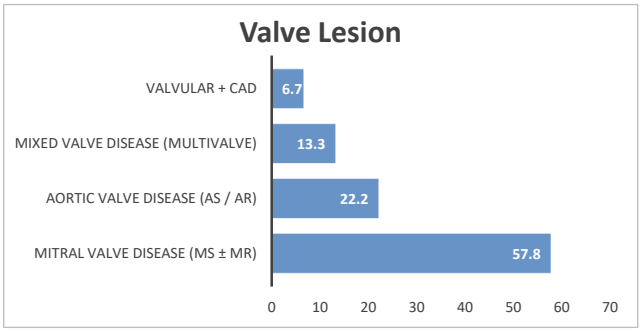


Figure 1: Distribution of morphological spectrum of VHD (n = 45)

CAD: coronary artery disease; AS: aortic stenosis; AR: aortic regurgitation; MS: mitral stenosis; MR: mitral regurgitation; VHD: valvular heart disease.

MVR was the most commonly performed procedure, accounting for 18 cases (40.0%), followed by AVR in 12 patients (26.7%). Double valve replacement (DVR) was performed in 6 patients (13.3%). Combined procedures involving valve surgery with CABG were carried out in 6 patients (13.3%), while valve surgery associated with congenital cardiac lesions was performed in 3 patients (6.7%) (Table 2).

Table 2: Types of surgical procedures performed for VHD (n = 45)

Procedure Type	Frequency (n)	Percentage (%)
MVR	18	40.0
AVR	12	26.7
DVR	6	13.3
Valve + CABG Combined	6	13.3
Valve + Congenital	3	6.7
Total	**45**	**100.0**

VHD: valvular heart disease; MVR: mitral valve replacement; AVR: aortic valve replacement; DVR: double valve replacement; CABG: coronary artery bypass grafting.

Among the 12 patients who underwent combined or complex cardiac surgical procedures (Table 3), the most frequently performed operations were CABG with AVR (3 cases) and CABG with MVR (3 cases). Other procedures included AVR with ventricular septal defect (VSD) closure (2 cases), AVR with atrial septal defect (ASD) closure (1 case), Bentall procedure (1 case), aortic sinoplasty with AVR (1 case), and ASD with tricuspid valve repair (1 case).

Table 3: Distribution of combined and complex cardiac surgical procedures (n = 12)

Procedure	Frequency (n)
CABG + AVR	3
CABG + MVR	3
AVR + VSD closure	2
AVR + ASD closure	1
Bentall procedure	1
Aortic Sinoplasty + AVR	1
ASD + TV repair	1
Total	**12**

CABG: coronary artery bypass grafting; AVR: aortic valve replacement; MVR: mitral valve replacement; VSD: ventricular septal defect; ASD: atrial septal defect; TV: tricuspid valve.

The majority of patients had an ICU stay of ≤3 days (28 patients, 62.2%), while 17 patients (37.8%) required prolonged ICU care (Table 4). Hospital stay was ≤10 days in 30 patients (66.7%) and exceeded 10 days in 15 patients (33.3%). The most common post-operative complication

was arrhythmia (10 patients, 22.2%), followed by bleeding (6 patients, 13.3%), wound infection (5 patients, 11.1%), and stroke (2 patients, 4.4%). Notably, 22 patients (48.9%) experienced no complications. The in-hospital mortality rate was 6.7% (3 patients), with 42 patients (93.3%) surviving to discharge. Post-operative follow-up with echocardiography demonstrated normally functioning valves without evidence of paravalvular leakage, and anticoagulation was maintained with warfarin according to standard protocols.

Table 4: Post-operative outcomes and complications following valvular heart surgery (n = 45)

Outcome Variable	Frequency (n)	Percentage (%)
ICU Stay		
≤3 days	28	62.2
>3 days	17	37.8
Hospital Stay		
≤10 days	30	66.7
>10 days	15	33.3
Complications		
Arrhythmia	10	22.2
Bleeding	6	13.3
Wound infection	5	11.1
Stroke	2	4.4
None	22	48.9
Mortality		
In-hospital death	3	6.7
Survival	42	93.3

ICU: intensive care unit.

The majority of patients underwent isolated valvular surgery (35 cases, 77.8%), while 6 patients (13.3%) required combined valve surgery with CABG (Table 5). Valve surgery associated with congenital cardiac lesions was performed in 3 patients (6.7%). A small proportion of patients (1 case, 2.2%) underwent complex aortic surgery in the form of a Bentall procedure.

Table 5: Overall distribution of surgical categories among study patients (n = 45)

Category	Frequency (n)	Percentage (%)
Pure Valvular Surgery	35	77.8
Valve + CABG Surgery	6	13.3
Valve + Congenital Surgery	3	6.7
Complex Aortic Surgery (Bentall)	1	2.2
Total	45	100.0

CABG: coronary artery bypass grafting.

Discussion

In this descriptive cross-sectional study conducted at the Cardiovascular Surgery Centre, CMH, Dhaka, a predominance of young to middle-aged patients with VHD was observed, with a mean age of 39.4 ± 15.4 years and a slight female predominance. Mitral valve disease emerged as the most common morphological pattern, and mitral valve replacement was the most frequently performed surgical procedure. Most patients presented with advanced symptomatic disease, particularly dyspnea, with universal preoperative hemodynamic involvement. Despite this, postoperative outcomes were generally favorable, with the majority experiencing shorter ICU and hospital stays, a moderate complication rate, and acceptable in-hospital mortality, highlighting the effectiveness of surgical management in this setting.

In the present study, patients were predominantly young to middle-aged, with a mean age of 39.4 ± 15.4 years, and most were within the 21–60 years age group (77.8%), reflecting the typical demographic pattern of VHD in developing countries where rheumatic etiology remains predominant. This finding is consistent with Aluru et al.[13], who reported that RHD primarily affects younger populations in low- and middle-income settings, and is further supported by Kanagasingam et al.[14], who observed a strong predominance of patients in the 12–40 years age group with a comparatively lower mean age, indicating earlier disease onset in similar populations. The slightly higher mean age observed in the present study may be explained by delayed referral, late diagnosis, or progression of disease prior to surgical intervention. A modest female predominance was noted (55.6%), which aligns with the known increased susceptibility of female to rheumatic valvular involvement, particularly affecting the mitral valve. Regarding comorbidities, a substantial proportion of patients had no associated conditions (40.0%), while hypertension (31.1%) and diabetes mellitus (20.0%) were the most common comorbidities, with CKD being relatively infrequent. This lower burden of systemic comorbidities further supports a predominantly rheumatic etiology in the study cohort, as degenerative valvular disease is more commonly associated with older age groups and multiple cardiovascular risk factors.

In the present study, the morphological spectrum of VHD demonstrated a clear predominance of mitral valve involvement, accounting for 57.8% (26 patients), followed by aortic valve disease (AVD) in 22.2% (10 patients), multivalvular involvement in 13.3% (6 patients), and VHD associated with CAD in 6.7% (3 patients). This distribution closely aligns with the findings of Manjunath et al.[15], who reported mitral valve involvement as the most common lesion (60.2%), followed by AVD, with more than one-third of patients exhibiting multivalvular involvement. Similarly, Shafi et al.[16] also demonstrated mitral valve disease as the predominant lesion in more than 55% of cases, with AVD as the second most frequent and a notable proportion of patients presenting with mixed or combined valvular lesions. The consistency between the present study and these published reports reinforces the persistent

predominance of mitral valve pathology, particularly in RHD–endemic regions, while also highlighting the significant burden of multivalvular involvement and the relatively lower but clinically important contribution of aortic and ischemic-associated valvular disease patterns.

In the present study, MVR was the most frequently performed procedure, accounting for 40.0% (18 patients), followed by AVR in 26.7% (12 patients), DVR in 13.3% (6 patients), valve surgery combined with CABG in 13.3% (6 patients), and valve surgery associated with congenital cardiac lesions in 6.7% (3 patients). This pattern is consistent with the findings of Bartus et al.[17], who reported that isolated AVR constituted a substantial proportion of procedures, while a notable percentage of patients underwent combined AVR with CABG and other concomitant valve interventions. Similarly, Sakornpantet al.[18] demonstrated that isolated mitral valve surgery remains the predominant surgical category in mitral valve disease, with combined procedures representing a significant subgroup, particularly in patients with associated comorbid conditions. The present study findings closely mirror these reports, reinforcing that isolated valve replacement—particularly MVR—remains the most common surgical approach in VHD, while combined procedures, including valve plus CABG and valve with congenital repair, constitute an important and clinically relevant proportion of cases, reflecting the complexity of disease presentation in tertiary care settings.

In the present study, combined and complex cardiac surgical procedures were observed in 12 patients, including CABG with valve replacement (CABG + AVR in 3 cases and CABG + MVR in 3 cases), AVR with VSD closure (2 cases), AVR with ASD closure (1 case), aortic sinoplasty with AVR (1 case), Bentall procedure (1 case), and ASD with tricuspid valve repair (1 case). This pattern is consistent with the findings of Lee et al.[19], who reported that patients undergoing valve surgery frequently required concomitant procedures, including CABG and additional repairs such as ASD closure, reflecting the high prevalence of multilesion cardiac pathology in surgical cohorts. Similarly, Sakornpantet al.[18] highlighted that multiple valve interventions and combined cardiac procedures represent a significant subgroup of cardiac surgery patients, particularly in advanced or late-stage disease where isolated surgery is often insufficient. The present study findings closely mirror these observations, demonstrating that complex surgical combinations—including valve surgery with coronary revascularization and congenital defect repair—are a substantial component of tertiary-level cardiac surgical practice, underscoring the multifaceted nature of valvular and structural heart disease in real-world clinical settings.

In the present study, postoperative outcomes following valvular heart surgery demonstrated that the majority of patients had an ICU stay of ≤3 days (62.2%) and a hospital stay of ≤10 days (66.7%), reflecting relatively early postoperative recovery in most cases. However, a considerable proportion of patients required prolonged ICU and hospital stay, likely reflecting the complexity of combined and high-risk surgical procedures. These findings are consistent with those of Yan et al. [20], who reported an average ICU stay of approximately 2–4 days and hospital stay ranging from 10–15 days following valvular and combined cardiac procedures. In the present study, arrhythmia was the most common complication (22.2%), followed by bleeding (13.3%), wound infection (11.1%), and stroke (4.4%), which closely aligns with previously reported literature where postoperative atrial fibrillation occurs in approximately 20–30% of patients and is recognized as the most frequent complication after valve surgery, while bleeding and stroke rates typically range from 5–10% and 1–3%, respectively. The in-hospital mortality rate of 6.7% observed in this study is also comparable to published data, where mortality ranges from 4–9% in isolated mitral valve replacement and increases up to approximately 9–12% in combined or complex surgical procedures. Overall, the present findings are consistent with established evidence indicating that valvular heart surgery is associated with acceptable but significant perioperative morbidity and mortality, particularly in patients undergoing complex or combined interventions.

In the present study, the majority of patients underwent pure valvular surgery (77.8%), while 13.3% required combined valve surgery with CABG2, 6.7% underwent valve surgery associated with congenital cardiac lesions, and a small proportion (2.2%) underwent complex aortic surgery in the form of a Bentall procedure. This distribution is consistent with the findings of Tajdiniet al. [21], who reported that isolated cardiac surgical procedures predominate, with combined CABG and valve surgeries representing a smaller but consistent proportion. Likewise, Zilli et al.[22] demonstrated that isolated valve procedures, particularly aortic and mitral valve replacements, are the most frequently performed operations, while combined procedures such as valve surgery with CABG are regularly encountered in patients with coexisting CAD. The present study findings closely mirror these reports, reinforcing that isolated valvular surgery remains the dominant surgical category in valvular heart disease management, whereas combined procedures—including valve with CABG and valve with congenital repair—form important secondary subgroups, and complex aortic surgeries such as Bentall procedures remain relatively uncommon but clinically significant in tertiary cardiac surgical practice.

The study had a few limitations: i) Small sample size, which may limit the generalizability of the findings; ii) Single-center study, restricting applicability to other healthcare settings and iii) Lack of long-term follow-up, preventing assessment of long-term surgical outcomes and survival.

Conclusion

VHD remains a significant cardiovascular burden requiring timely surgical intervention in specialized cardiac centers. This study shows a predominance of mitral valve involvement in a younger to middle-aged population, consistent with a rheumatic etiology. Management was mainly based on isolated valve surgery, particularly MVR, although a proportion of patients required combined procedures with CABG and congenital repairs. Postoperative outcomes were generally favorable, with short ICU and hospital stays and acceptable complication rates, with arrhythmia being the most common. The in-hospital mortality rate was 6.7%. Overall, while isolated valve surgery remains the mainstay, combined and complex procedures are increasingly encountered, highlighting the need for comprehensive surgical expertise in tertiary care settings.

References

1. Rajbanshi BG, Elefteriades JA. The prevention and treatment of cardiovascular diseases –Management of Valvular Heart Disease – Surgical Perspective. In: Chang PF (eds), The Prevention and Treatment of Cardiovascular Diseases. EOLSS Publishers.
2. Nwafor IA, Eze JC, Nwafor MN. Surgical treatment of valvular heart disease in Nigeria: a 6-year experience. Texas Heart Institute Journal. 2021;48(5):e197080.
3. Danbauchi SS, Alhassan MA, David SO, Wammanda R, Oyati IA. Spectrum of rheumatic heart disease in Zaria, Northern Nigeria. Annals of African Medicine. 2004;3(1):17-21.
4. World Health Organization. Rheumatic fever and rheumatic heart disease: report of a WHO study group [meeting held in Geneva from 30 March to 4 April 1987]. Geneva: World Health Organization; 1988. Available from: https://apps.who.int/iris/handle/10665/40051
5. Massell BF, Chute CG, Walker AM, Kurland GS. Penicillin and the marked decrease in morbidity and mortality from rheumatic fever in the United States. New England journal of medicine. 1988;318(5):280-286.
6. Nkomo VT. Epidemiology and prevention of valvular heart diseases and infective endocarditis in Africa. Heart. 2007;93(12):1510-1519.
7. Antunes MJ. Challenges in rheumatic valvular disease: Surgical strategies for mitral valve preservation. Global Cardiology Science and Practice. 2015;2015(1):9.
8. Islam AM, Majumder AA. Rheumatic fever and rheumatic heart disease in Bangladesh: a review. Indian heart journal. 2016;68(1):88-98.
9. Ahmed J, Zaman M, Hassan MM. Prevalence of rheumatic fever and rheumatic heart disease in rural Bangladesh. Tropical doctor. 2005;35(3):160-161.
10. Allard M, Boutin C, Burwash IG, Butany J, Cartier PC, de Varennes B, et al. Surgical management of valvular heart disease 2004. Can J Cardiol. 2004;20(Suppl E):7E-120E.
11. Kuwaki K, Kiyofumi M, Tsukamoto M, Abe T. Early and late results of mitral valve repair for mitral valve regurgitation: significant risk factors of reoperation. Journal of Cardiovascular Surgery. 2000;41(2):187.
12. Braunberger E, Deloche A, Berrebi A, Abdallah F, Celestin JA, Meimoun P, et al. Very long-term results (more than 20 years) of valve repair with Carpentier's techniques in nonrheumatic mitral valve insufficiency. Circulation. 2001;104(12):8-11.
13. Aluru JS, Barsouk A, Saginala K, Rawla P, Barsouk A. Valvular Heart Disease Epidemiology. Med Sci (Basel). 2022;10(2):32.
14. Kanagasingam A, Francis GR, Komagarajah B, Ladchumanan D, Sivapramyan A, Packiyarajah P, et al. Pattern of Rheumatic valvular involvement and its contribution towards valvular malfunction in young adults. Ceylon Med J. 2019;64(3):91-97.
15. Manjunath CN, Srinivas P, Ravindranath KS, Dhanalakshmi C. Incidence and patterns of valvular heart disease in a tertiary care high-volume cardiac center: a single center experience. Indian Heart J. 2014;66(3):320-326.
16. Shafi MJ, Nasrin S. Incidence & pattern of valvular heart disease in patients attended in Echo Lab at a tertiary care hospital: a single centre study. Cardiovascular Journal. 2021;13(2):144-153.
17. Bartus K, Sadowski J, Litwinowicz R, Filip G, Jasinski M, Deja M, et al. Changing trends in aortic valve procedures over the past ten years-from mechanical prosthesis via stented bioprosthesis to TAVI procedures-analysis of 50,846 aortic valve cases based on a Polish National Cardiac Surgery Database. J Thorac Dis. 2019;11(6):2340-2349.
18. Sakornpant P, Kojaranjit V. First National Adult Cardiac Surgical Database Report: Demonstrating "practice of adult cardiac surgery in Thailand: measuring performance and outcome". The Society of Thoracic Surgeons of Thailand; 2011. ISBN-13: 978-974-496-444-1
19. Lee S, Chang BC, Yoo KJ. Surgical management of coexisting coronary artery and valvular heart disease. Yonsei Med J. 2010;51(3):326-331.
20. Yan W, Shah P, Hiebert B, Pozeg Z, Ghorpade N, Singal RK, et al. Long-term non-institutionalized survival and rehospitalization after surgical aortic and mitral valve replacements in a large provincial cardiac surgery centre. Interact Cardiovasc Thorac Surg. 2018;27(1):131-138.
21. Tajdini M, Behnoush AH, Pashang M, Jameie M, Khalaji A, Sadeghian S, et al. Heart surgery over two decades: what we have learned about results and changing risks. BMC Cardiovascular Disorders. 2024;24(1):195.
22. Zilli AC, Guizilini S, Rocco IS, Santo JADE, Berwanger O, Kalil RAK, et al. Valve Heart Surgery in Brazil - The BYPASS Registry Analysis. Braz J Cardiovasc Surg. 2020;35(1):82-90.