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Valvular Heart Diseases in Women: Surgical Outcomes and Gender Differences

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ABSTRACT

Objective: To describe the pattern of Valvular Heart Disease (VHD) and evaluate gender-based differences in surgical outcomes among patients undergoing Valvular heart surgery at a tertiary cardiac care center.

Study Design: Quasi Experimental study.

Place and Duration of Study: Cardiac Surgery Department, Armed Forces Institute of Cardiology/National Institute of Heart Diseases, Rawalpindi Pakistan, from Jan 2023 to Dec 2025.

Methodology: Data from 965 patients aged >18 years, of both genders, were retrospectively collected using consecutive sampling. The cohort included individuals who underwent elective or emergency valvular heart surgeries either single or multiple valve repair or replacement, with or without concomitant CABG, performed through conventional or minimally invasive approaches. Those patients whose data were incomplete or missing were not included in the study. Patients were classified by gender for the comparisons in baseline demographics, operative variables, and early postoperative outcomes.

Results: Out of the 965 patients, 387(40.1%) were female and 578(59.9%) were male. Males underwent more aortic valve replacements (77.16% vs. 22.8%, $p<0.001$). However, mitral valve replacements were performed more often on females (61.6% vs. 38.93%, $p<0.001$). Males had more complex combined procedures, contributing to their longer bypass and cross-clamp times (174 vs. 157 minutes; 128 vs. 112 minutes; $p<0.001$). Early postoperative mortality was slightly higher in females (3.6%) than in males (2.8%) but difference was insignificant ($p>0.05$).

Conclusion: Gender-based variations were evident in procedural profiles and perioperative characteristics in VHD patients. Recognizing these differences may help optimize preoperative evaluation and tailor surgical strategies to improve overall outcomes.

Keywords: Aortic Valve, Degenerative, Heart Valve Diseases, Mitral Valve, Treatment Outcome.

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INTRODUCTION

Valvular heart disease (VHD) significantly contributes to cardiovascular morbidity, mortality, and disability, making an understanding of its epidemiology crucial for guiding therapeutic and public health strategies.[1] Recent advances have transformed VHD management, offering treatment options even for previously inoperable patients.[2] As the population ages, VHD is projected to double in prevalence by 2040 and triple by 2060, earning it the title of the next cardiac epidemic.[3] Its presentation has evolved markedly over the past six decades,[4] with notable global variation in degenerative and functional disease dominating in high-income regions, while rheumatic heart disease, affecting nearly 41 million people, remains most prevalent in low- and middle-income countries.[5]

VHD prevalence rises sharply with age, with most cases occurring after 65 years, and studies show that over half of adults above this age have some degree of VHD.[6] Although, overall risk is similar in men and women, sex-specific patterns vary, and women remain underrepresented in major studies which leads to delayed referrals and poorer postoperative outcomes.[5,6] In Pakistan, VHD is more common in women and presents at younger ages, with aortic valve disease predominating in men and mitral valve disease in women; rheumatic heart disease remains the leading cause of left-sided VHD.[7] Bhatti *et al.*,[8] emphasized the need for a multidisciplinary valve team, with the NICVD Heart Valve Team Registry marking a major step toward improving VHD care and outcomes national.

Research shows significant gender-based differences in VHD, including variations in disease frequency, symptom perception, diagnostic accuracy, and treatment response, underscoring the need for tailored rather than uniform management strategies.[7,8] AFIC/NIHD, a leading national cardiac center, handles a large and increasing VHD burden particularly among younger, however local data on

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gender disparities are scarce. Given the high referral and surgical volumes, assessing demographic patterns and gender-specific outcomes is essential. Therefore, the aim of this study was to describe the pattern of VHD and evaluate gender-based differences in surgical outcomes to support more informed, gender-sensitive management approaches.

METHODOLOGY

This Quasi Experimental Study was conducted at the Cardiac surgery department, Armed Forces Institute of Cardiology/National Institute of Heart Diseases, Rawalpindi from Jan 2023 - Dec 2025. The study was approved by the Institutional Ethical Review Board (Ltr#9/2/R&D/2025/ 383; Dated: 16th Oct, 2025). Data was collected through non probability consecutive sampling technique.

Keeping the 26.6% prevalence of postoperative complications[9] with 5% margin of error, 80 % power of the study and 95 % confidence interval, sample size was calculated to be 301. However, data of 965 patients was collected after securing institutional ethical approval, and was collected retrospectively from the cardiac surgery database of the hospital.

Inclusion Criteria: Patients >18 years who underwent all elective and emergency VHD surgeries, single or multiple Valvular repair /replacement in isolation or with CABG and Conventional and minimal invasive approaches irrespective of their gender were included in this study.

Exclusion Criteria: Patients with incomplete or missing data were excluded from the study.

Retrospective data were obtained from patients meeting the criteria who underwent VHD surgery at AFIC/NIHD. Data were obtained from the institutions electronic and paper based medical records in accordance with a predesigned data collection framework. Variables captured were demographic and baseline characteristics (age, sex, weight, height, body mass index [BMI], co-morbid conditions and ejection fraction), preoperative clinical and functional assessments, type of operation, Canadian Cardiovascular Society (CCS), American Society of Anesthesiologists (ASA) classification, duration of angina, New York heart Association (NHYA) functional class, and details of the surgery (involvement of the aortic, mitral and tricuspid valves, type of valve implants, duration of cardiopulmonary bypass, cross clamping, use of intra-aortic balloon pump, inotropes and along with postoperative outcomes of ICU stay, duration of mechanical ventilation, inotropes, postoperative chest drainage, blood product transfusion: packed red blood cells, fresh frozen plasma, platelets, cryoprecipitate, re-exploration, bleeding, Permanent pacemaker(PPM), stroke, Transient ischemic attack, bradycardia, atrial fibrillation, heart block and mortality and total length of stay in the hospital) were captured. Data were anonymized and stored as per the institutions privacy policy to ensure confidentiality and integrity of data as well as patients. Detail patient flow diagram is shown in Figure-1.

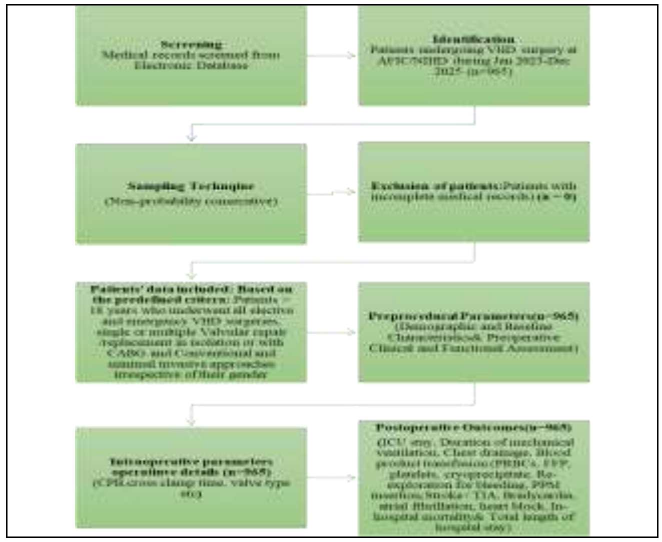

Figure: Patient flow diagram

Data were entered and analyzed using Statistical Package of social sciences (SPSS) version 23.0 Continuous variables were tested for normality using the Shapiro-Wilk test. Variables that were not normally distributed including body mass index, ejection fraction, cardiopulmonary bypass time, cross-clamp time, inotropes duration, chest drainage, ICU stay, ventilation time, and hospital stay were reported as median with interquartile range (IQR) and compared between genders using the Mann-Whitney U test. Categorical variables (age category, CCS class, ASA class, NYHA class, hypertension status, diabetes mellitus status, smoking status, valve procedure type, valve repair/replacement status, and valve implant type) were presented as frequencies and percentages and compared using the Chi-square test or Fisher's exact test, as appropriate. For subgroup analyses, one way ANOVA tests were applied to continuous variables within procedure-specific groups. A *p*-value of ≤0.05 was considered statistically significant.

Table-I: Gender-Based Comparison of Baseline, Perioperative Characteristics & post-operative complications (n=965)

Variables		Female [n (%)] (n=387)	Male [n (%)] (n=578)	*p*-value
Age Category (years)	14–33	75(19.4%)	102(17.6%)	0.007
	34–53	170(43.9%)	208(36.0%)	
	54–73	138(35.7%)	249(43.1%)	
	74–93	4(1.0%)	19(3.3%)	
CCS Class	Class I	169(43.7%)	274(47.4%)	0.69
	Class II	181(46.8%)	256(44.3%)	
	Class III	35(9.0%)	45(7.8%)	
	Class IV	2(0.5%)	3(0.5%)	
ASA Class	Class I	207(53.5%)	328(56.7%)	0.043
	Class II	97(25.1%)	143(24.7%)	
	Class III	76(19.6%)	106(18.3%)	
	Class IV	7(1.8%)	1(0.2%)	
Angina Duration	< 1 Week	24(6.2%)	30(5.2%)	0.76
	1–6 Weeks	196(50.6%)	270(46.7%)	
	7–12 Weeks	46(11.9%)	81(14.0%)	
	3–6 Months	29(7.5%)	50(8.7%)	
	7–12 Months	9(2.3%)	14(2.4%)	
	1–5 Years	5(1.3%)	5(0.9%)	
	6–10 Years	1(0.3%)	1(0.2%)	
	> 10 Years	1(0.3%)	0(0.0%)	
	Asymptomatic	76(19.6%)	127(22.0%)	
NYHA Class	Class I	70(18.1%)	128(22.1%)	0.03
	Class II	231(59.7%)	352(60.9%)	
	Class III	75(19.4%)	93(16.1%)	
	Class IV	11(2.8%)	5(0.9%)	
Hypertension Status	Controlled on medication	114(29.5%)	171(29.6%)	0.84
	Uncontrolled	4(1.0%)	4(0.7%)	
	No hypertension	269(69.5%)	403(69.7%)	
Diabetes Mellitus Status	Insulin therapy	5(1.3%)	8(1.4%)	0.57
	Oral therapy	56(14.5%)	98(17.0%)	
	No diabetes	326(84.2%)	472(81.7%)	
Smoking Status	Ex-smoker (> 8 weeks)	2(0.5%)	120(20.8%)	<0.001
	Still smoking (< 8 weeks)	1(0.3%)	50(8.7%)	
	Non-smoker	384(99.2%)	408(70.6%)	
Variable		**Median [IQR]**		
Body Mass Index (kg/m²)		25.39 (24.89–26.48)	24.61 (24.22–25.10)	0.006
Ejection Fraction (%)		52.00 (51.00–55.00)	52.00 (51.00–55.00)	0.03
Cardiopulmonary Bypass Time (min)		157.00 (151.00–166.00)	174.00 (167.00–183.00)	<0.001
Cross-Clamp Time (min)		112.00 (105.00–120.00)	128.00 (123.00–134.00)	<0.001
Inotropes Duration (hours)		31.00 (24.00–39.00)	26.00 (23.00–33.00)	0.23
Chest Drainage (mL)		305.00 (280.00–350.00)	430.00 (400.00–460.00)	<0.001
ICU Stay (hours)		40.00 (35. .00–43.00)	39.00 (37.00–42.00)	0.79
Ventilation Time (hours)		6. 00 (5.50–7.50)	6.00 (5.50–7.50)	0.73
Hospital Stay (days)		6.00 (6.00–7.00)	6.00 (6.00–7.00)	0.99
Complications		**Frequency (%)**		
Bleeding	Yes	27(7.0%)	61(10.6%)	0.06
	No	360(93.0%)	517(89.4%)	
PPM required	Yes	11(2.8%)	14(2.4%)	0.68
	No	376(97.0%)	564(97.6%)	
CVA	Yes	7(1.8%)	11(1.9%)	0.90
	No	380(98.2%)	367(97.1%)	
TIA	Yes	9(2.3%)	7(1.2%)	0.18
	No	378(97.7%)	571(98.7%)	
Bradycardia	Yes	72(18.6%)	128(22.1%)	0.22
	No	315(81.4%)	450(77.8%)	
Atrial Fibrillation	Yes	114(29.5%)	140(24.2%)	0.11
	No	273(70.5%)	438(75.7%)	
Heart Block	Yes	36(9.3%)	47(8.2%)	0.59
	No	351(90.6%)	531(91.8%)	
Mortality	Yes	14(3.6%)	16(2.8%)	0.52
	No	373(96.3%)	562(97.2%)	

CCS = Canadian Cardiovascular Society; ASA = American Society of Anesthesiologists; NYHA = New York Heart Association; CABG = Coronary Artery Bypass Grafting; VHD = Valvular Heart Disease; ICU = Intensive Care Unit; BMI = Body Mass Index; EF = Ejection Fraction; IQR = Interquartile Range,; CVA=Cerebrovascular Accident; TIA=Transient Ischemic Attack

RESULTS

A total of 965 patients were studied, of which male (n=578) patients, in all categories, were reported to have undergone more procedures than female (n=387) patients. During the procedures, the males had CBP times [174.00 (167.00–183.00) min vs. 157.00 (151.00–166.00) min, $p<0.001$] and cross-clamp times [128.00 (123.00–134.0) min vs. 112.00 (105.00–120.00) min, $p<0.001$] that were significantly longer than females indicating that males had more complex procedures. Males also had (430.00 [400.00–460.00] mL vs. 305.00 [280.00–350.00] mL, $p<0.001$) higher post-chest drain volumes which further support the idea that hemostasis was more problematic with prolong pump time in males. With respect to postoperative complications by gender,male patients demonstrated slightly higher rates of bleeding (10.6% vs. 7%), CVA (1.9% vs. 1.8%), and bradycardia (22.1% vs. 18.6%), while male patients had higher rates of mortality (3.6% vs. 2.8%) comprised of TIA (2.3% vs. 1.2%), atrial fibrillation (29.5% vs. 24.2%), and heart block (9.3% vs. 8.2%).All data have been included in Table-I.

The distribution of valve procedures shows that isolated and combined AVR was more common in males 267/346 (77.1%) than females 79/346 (22.8%), while MVR was predominantly performed in females [160/262 (61.1%) vs. 102/262 (38.9%)]. Bentall procedures were performed mainly in males [36/43 (83.7%) vs. 7/43 (16.2%)] in females. Details of all procedure are shown in Table-II.

Mechanical prosthetic valves were predominantly used across all valve positions in both genders. In AVR, mechanical valves accounted for 94.0% of procedures in both females and males, while MVR comprised of 96.7% females and 95.4% males as shown in Table–III.

Postoperative outcomes and operative parameters varied significantly among procedures. Mortality was highest in complex surgeries such as MVR, DVR and Bentall, while PPM implantation and re-exploration were relatively low. CPB and cross-clamp times, as well as ICU stay, ventilation, and hospital duration, were longer in combined or complex procedures compared to isolated AVR, MVR, or MV repair ($p<0.001$). Arrhythmias, CVA, and TIA also differed significantly between procedure types ($p<0.001$), whereas EF% remained largely preserved across groups as shown in Table-IV.

Table-II: Distribution of Valve Procedures by Gender in VHD Patients (n=965)

Type of Procedures		Female [n(%)] n=387	Male [n(%)] n=578
Isolated and Combined AVR (n=346)		**(n=79)**	**(n=267)**
AVR		52(65.8%)	152(56.9%)
AVR(Mini Sternotomy)		-	1(0.4%)
AVR (Minimal Invasive)		1(1.3%)	14(5.2%)
AVR Combined with	Aortoplasty	-	2(0.7%)
	Root Enlargement (including Konno)	3(3.8%)	1(0.4%)
	Interposition Graft	2(2.5%)	2(0.7%)
	CABG	21(26.6%)	92(34.7%)
	CABG + ASD Closure / Aneurysm / Coarctation Repair	-	3(1.1%)
Isolated and Combined MVR (n=354)		**(n=195)**	**(n=159)**
Isolated MVR		160(82.1%)	102(64.2%)
MVR (Minimally Invasive)		4(2.1%)	5(3.1%)
MVR combined with	ASD Closure	1(0.5%)	2(1.3%)
	LA Myxoma Excision/ LA Appendage Closure/ LA Reduction	4(2.1%)	2(1.3%)
	Tricuspid Commissurotomy	-	1(0.6%)
	TV Repair (De Vega/RA Mass Excision/ASD Closure)	6(3.1%)	6(3.8%)
	CABG	18(9.2%)	40(25.2%)
	CABG + ASD Closure	-	1(0.6%)
	CABG +TV Repair	2(1.0%)	-
Isolated and Combined DVR(n=150)		**(n=74)**	**(n=76)**
DVR		61(82.4%)	62(81.6%)
DVR combined with	De Vega TV Repair	2(2.7%)	-
	Aortic Root Extension (including Konno)	2(2.7%)	1(1.3%)
	LA Reduction	1(1.4%)	-
	Tricuspid Commissurotomy	-	1(1.3%)
	TV Repair (including K-Repair)	4(5.4%)	4(5.3%)
	VSD Closure	-	1(1.3%)
	CABG	4(5.4%)	7(9.2%)
Bentall Procedures (n=43)		**(n=7)**	**(n=36)**
Bentall		5(71.4%)	31(86.1%)
Bentall with	Hemi-Arch Replacement	-	1(2.8%)
	AVR	-	1(2.8%)
	CABG	1(14.3%)	3(8.3%)
	CABG + Septal Myectomy	1(14.3%)	-
Redo Procedures (n=30)		**(n=18)**	**(n=22)**
AVR		5(27.8%)	10(45.5%)
Bentall		1(5.6%)	1(4.5%)
DVR		3(16.7%)	2(9.1%)
MVR		7(38.9%)	8(36.4%)
TVR		2(11.1%)	1(4.5%)
Emergency Procedures (n=14)		**(n=06)**	**(n=08)**
De-clotting (MV/AV)		2(33.3%)	2(25.0%)
DVR + Bentall		2(33.3%)	3(37.5%)
MVR		1(16.7%)	2(25.0%)
MVR + LA & IVC Repair		1(16.7%)	-
CABG + AV De-clotting		-	1(12.5%)
Miscellaneous procedures (n=18)		**(n=08)**	**(n=10)**
Aortic Arch / Root / Hemi Arch Repairs		4(50.0%)	3(30.0%)
TVR		1(12.5%)	2(20.0%)
TV Repair		-	1(10.0%)
PVR		1(12.5%)	-
VSD Closure + AVR + Myectomy		-	1(10.0%)
Aneurysm / Other Repairs		2(25.0%)	3(30.0%)

AVR = Aortic Valve Replacement; MVR = Mitral Valve Replacement; DVR = Double Valve Replacement (Aortic + Mitral); TVR = Tricuspid Valve Replacement; TV Repair = Tricuspid Valve Repair; CABG = Coronary Artery Bypass Grafting; ASD = Atrial Septal Defect; VSD = Ventricular Septal Defect; LA = Left Atrium; IVC = Inferior Vena Cava; RA = Right Atrium; MV = Mitral Valve; AV = Aortic Valve; PVR = Pulmonary Valve Replacement; Bentall Procedure = Composite Aortic Root Replacement (including aortic valve and ascending aorta with coronary reimplantation); LA Myxoma Excision = Left Atrial Myxoma Removal; LA Appendage Closure = Left Atrial Appendage Ligation; LA Reduction = Left Atrial Size Reduction; Root Enlargement = Aortic Root Enlargement (including Konno Procedure); Aortoplasty = Aortic Wall Repair; Interposition Graft = Graft Placement Between Aortic Segments; De Vega TV Repair = De Vega Annuloplasty for Tricuspid Valve; K-Repair = Kay's Tricuspid Annuloplasty; Septal Myectomy = Resection of Hypertrophied Interventricular Septum; Hemi-Arch Replacement = Partial Aortic Arch Replacement; Aortic Root Extension including Konno = Left Ventricular Outflow Tract Enlargement;Declotting (MV/AV) = Removal of Thrombus from Mitral or Aortic Valve Prosthesis

Table-III: Gender-wise distribution of mechanical prosthetic valves across aortic, mitral, and tricuspid positions (n=965)

Aortic Valve Procedure	Female (n=167)	Male (n=389)
Aortic Repair	1 (0.6%)	5(1.28%)
Aortic Replacement	166(99.4%)	384(98.7%)
	Female (n=166)	**Male (n=384)**
Mechanical Valve	157 (94.0%)	361 (94.0%)
Bioprosthetic Valve	9 (5.4%)	22(5.7%)
(c) Homograft	-	1(0.26%)
Mitral Valve Procedure	**Female (n=284)**	**Male(n=250)**
Mitral Repair	5(1.76%)	6(2.4%)
Mitral Replacement	279 (98.2%)	244 (97.6%)
	Female (n=279)	**Male(n=244)**
(a) Mechanical Valve	270 (96.7%)	233 (95.4%)
(b) Bio prosthetic Valve	9 (3.2%)	11 (47.2 %)
Tricuspid Valve Procedure	**Female(n=20)**	**Male (n=14)**
Tricuspid Repair	16(80.0%)	10 (71.4%)
Tricuspid Replacement	4 (20.0%)	4 (28.5%)
	Female(n=4)	**Male (n=4)**
Mechanical Valve	2(50%)	4(100%)
Bio prosthetic Valve	2(50%)	-

DISCUSSION

This study evaluates gender-related differences in patient populations receiving valve heart surgeries in demographic distribution, operative characteristics, and outcomes after surgery in a patient demographics study. The analysis highlighted differences in the types of procedures, changes in operative times, and early outcomes differences across the spectrum of cases, pointing out the intricate biological and clinical decision-making factors surrounding outcomes in VHD surgery. Regardless of the advancement in surgical interventions and perioperative management, there is a persistent risk of increased morbidity and mortality in women after several types of cardiac operations.

Women undergoing aortic valve replacement are, on average, older and have greater comorbidities compared to men, as well as greater intraoperative complication risks, but lower mortality risks in mid and long-term outcomes compared to men.[10,11] Recent studies and reviews demonstrate higher short term (30-day) mortality following valvular surgery, though differences in long-term survival are less pronounced. Literature enlisted some of the explanations as older age, higher degrees of frailty, greater risk scores at presentation, and subsequently, women being more likely to have referral at an advanced stage of VHD. Current findings showing higher mortality in women (3.6% vs. 2.8%) are consistent with this pattern.[12-14]

In the current investigation, the sample population predominantly consisted of male patients, which amounted to 59.9%. This aligns with the literature, wherein aortic surgical valve replacement procedures are reported to occur more frequently within the male population as opposed to the female population, possibly due to a higher prevalence of degenerative aortic valve disease and earlier onset of coronary artery disease in males. In meta-analysis focusing on isolated aortic valve replacements, EI *et al.,* documented that women had considerably greater 30-day mortality compared to men (5.2% compared to 3.6%, $p<0.05$). This is primarily explained by older age, smaller aortic annuli, and greater surgical complexity.[15] Furthermore, it was noted that women may have less favorable outcomes in the perioperative period due to structural and functional differences, specifically smaller valve sizes and disproportionate left ventricular hypertrophy.[6]

In line with our findings of a higher prevalence of AF in females (29.5% vs. 24.2%), several recent studies also document a higher incidence of pre- or postoperative atrial fibrillation in women who have valve surgery.[16,17] Numerous investigations illustrate that redo surgeries and combined procedures lead to extension of CPB and ischemic times, which subsequently enhances the likelihood of bleeding. This is consistent with our findings where the males had higher CPB and cross-clamp times as well as greater chest-drain volumes due to the increased number of combined aortic procedures and redo surgeries.[18,19] Men more commonly undergo aortic valve and combined procedures, whereas women are disproportionately represented in mitral valve surgeries and often present later in the disease course. Our findings align with these trends, with male predominance in aortic valve replacement and female predominance in mitral valve surgery, possibly reflecting regional etiological differences such as rheumatic versus degenerative disease.[14,19]

Variations in the manifestation, presentation, and treatment of a disease and consequently the impact of a disease on a patient can be attributed to differences in the epidemiology of the disease based on gender, as well as the differences in the response of the valves and ventricles to pressure and volume overload.[20] In our cohort, the incidence of postoperative PPM implantation was slightly higher in females (2.8%) compared to males (2.4%), without reaching to significant differences ($p>0.05$). But highlighting that advanced disease with calcification is more common in females than males. This aligns with the international literature regarding the common occurrence of conduction disturbances necessitating PPM after valvular surgeries, albeit findings relating to male-female variations remain inconsistent.[21]

Table-IV: Perioperative parameters and post-operative c across complications across different surgical procedures (n=965)

PERIOPERATIVE PARAMETERS

Procedure	EF%	CPB Time (mins)	Cross-clamp Time (mins)	ICU Stay (hours)	Ventilation time(hours)	Hospital Stay (days)
	(Mean ± SD)			Median(IQR)		
AVR	51.45±10.50	146.67±47.40	112.18±39.49	22.00 (20.00–45.00)	4.00 (3.00–7.00)	6.00 (5.00–7.00)
MVR	53.52±9.44	137.98±46.29	93.13±37.27	27.00 (21.00–53.00)	5.00 (3.50–11.50)	6.00 (5.00–8.00)
DVR	52.44±8.46	238.02±80.63	186.38±66.20	44.00 (25.00–83.00)	9.50 (3.50–17.00)	7.00 (6.00–10.00)
Bentall	52.17±8.10	293.63±108.53	221.60±57.79	54.00 (39.00-88.50)	13.50 (8.30–20.00)	8.00 (6.00–10.00)
AVR + CABG	51.02±10.59	222.10±78.16	163.18±48.74	23.00 (20.00–64.00)	7.00 (4.00–13.50)	6.00 (5.00–8.00)
MVR + CABG	49.34±10.70	222.40±58.46	150.09±40.26	68.50 (38.00–140.00)	13.00 (6.50–47.00)	7.00 (5.00–10.00)
DVR + CABG	47.00±6.34	292.82±71.65	231.36±59.63	91.00 (27.00–139.00)	13.50 (6.00–36.50)	11.00 (5.00–20.00)
MV Repair	57.73±12.14	203.91±32.54	143.64±26.20	43.00 (20.00–73.00)	5.00 (3.50–10.50)	5.00 (4.00–6.00)
MVR + TV Repair	54.25±7.06	179.08±80.20	107.17±34.96	130.50 (52.50–253.00)	22.50 (7.00–59.50)	10.00 (7.00–13.00)
DVR + TV Repair	47.75±4.20	214.75±46.54	159.13±42.81	125.00 (83.50–167.00)	20.00 (13.00–33.80)	8.00 (7.00–11.00)
Other	51.10±9.20	227.43±117.00	145.93±71.91	63.00 (39.00–126.00)	16.50 (6.50–48.00)	8.00 (5.00–12.00)
***p*-value**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

COMPLICATIONS

Procedure	PPM		Re-exploration		Mortality	
	Frequency (%)					
	(n=940)	(n=25)	(n=88)	(n=877)	(n=935)	(n=30)
	No	Yes	Yes	No	No	Yes
AVR	222(23.6%)	8(32.0%)	17(19.3%)	213(24.28%)	225(24.06%)	5(16.7%)
MVR	279(29.7%)	4(16.0%)	21(23.9%)	262(29.88%)	275(29.41%)	8(26.7%)
DVR	128(13.6%)	3(12.0%)	13(14.7%)	118(13.45%)	124(13.27%)	7(23.3%)
Bentall	42(4.46%)	1(4.0%)	8(9.1%)	35(3.99%)	37(3.96)	6(20.0%)
AVR + CABG	113(12.0%)	3(12.0%)	8(9.1%)	108(12.31%)	114(12.20%)	2(6.7%)
MVR + CABG	58(6.17%)	-	8(9.1%)	50(5.70%)	58(6.20%)	-
DVR + CABG	9(0.95%)	2(8.0%)	1(1.13%)	10(1.14%)	11(1.18%)	-
MV Repair	11(1.17%)	-	1(1.13%)	10(1.14%)	11(1.18%)	-
MVR + TV Repair	12(1.27%)	-		12(1.37%)	12(1.28%)	-
DVR + TV Repair	8(0.85%)	-	2(2.27%)	6(0.68%)	8(0.86%)	-
Other	58(6.17%)	4(16.0%)	9(10.22%)	53(6.04%)	60(6.42%)	2(6.7%)
***p-value**	0.12		0.12		0.02	

Procedure	CVA	TIA	AF	Heart Block	bradycardia	Sinus Rhythm
	(n=18)	(n=15)	(n=254)	(n=82)	(n=200)	(n=429)
	Frequency (%)					
AVR	2(11.1%)	8(53.3%)	22(8.66%)	23(28.1%)	36(18.0%)	149(34.7%)
MVR	4(22.2%)	4(26.7%)	117(46.1%)	12(14.6%)	32(16.0%)	122(28.4%)
DVR	3(16.7%)	3(20.0%)	25(9.84%)	19(23.2%)	45(22.5%)	42(9.78%)
Bentall	-	1(6.7%)	4(1.57%)	3(3.7%)	17(8.50%)	19(4.43%)
AVR + CABG	-	3(20.0%)	19(7.48%)	9(10.98%)	22(11.0%)	62(14.46%)
MVR + CABG	1(5.6%)	-	40(15.75%)	-	26(13.0%)	10(2.33%)
DVR + CABG	3(16.7%)	2(13.3%)	1(0.39%)	4(36.4%)	6(3.0%)	-
MV Repair	5(27.8%)	-	3(1.18%)	1(9.09%)	8(4.0%)	6(1.4%)
MVR + TV Repair	-	-	2(0.79%)	2(18.18%)	5(2.5%)	3(0.7%)
DVR + TV Repair	-	-	3(1.18%)	1(9.09%)	1(0.5%)	2(0.47%)
Other	-	4(26.7%)	18(7.09%)	8(72.7%)	2(1.0%)	14(3.26%)
***p-value**	<0.001		<0.001			

*Other procedures include tricuspid valve repair (TVR), pulmonary valve replacement (PVR), redo surgeries, emergency procedures, and other uncommon surgeries;*p-vale=depicts significance within the group; PPM = Permanent Pacemaker; CVA = Cerebrovascular Accident; TIA = Transient Ischemic Attack; AF = Atrial Fibrillation; AVR = Aortic Valve Replacement; MVR = Mitral Valve Replacement; DVR = Double Valve Replacement; CABG = Coronary Artery Bypass Grafting; TV Repair = Tricuspid Valve Repair; MV Repair = Mitral Valve Repair*

Based on the more current review, the data indicates that the majority of patients (59.9%) were men. This finding aligns with Al-Zubaidi *et al.*, where 64.8% of patients undergoing mitral valve surgery for degenerative disease were also reported to be men. However, in our cohort, women underwent more mitral valve surgery than men, likely due to a higher prevalence of advanced valve pathology or calcification in women, which limited repair options and necessitated valve replacement more frequently.[17] Both men and women had about the same rate of DVR surgery, while women have been previously reported to be more advanced in disease at the time of presentation and to have more varied multiple valve procedures our data showed no significant difference in the rate of DVR surgery.[4]

Current study shows comparable results with Al-Zubaidi *et al.*, regarding following operative parameters, as men having longer CPB and cross-clamp. This is likely due to the higher prevalence of complex or multiple valve procedures in men, larger body surface area, and more extensive cardiac pathology, which prolong surgical and cardio-pulmonary bypass duration. Early mortality was higher in females across both studies (3.6% vs. 3%), and re-exploration for bleeding was more frequent among men (7% vs. 6%). This reaffirms that despite advances in surgical care, women continue to experience slightly higher early mortality and prolonged recovery, whereas men exhibit longer operative times and increased need for pacemaker implantation following mitral valve surgery.[17] In previous study, mechanical prostheses were implanted in 67.4% of males and 61.9% of females (p=0.19), indicating no significant gender difference. In our cohort, it is also higher 45.5% in males and 35.2% in females. But this difference in values may reflect local surgical practice patterns, patient preference, or differences in age and comorbidity profiles between our population and previously reported cohorts.[22]

Recognizing findings from current study will help with clinical implications VHD gender management improvements. Understanding the different procedures and outcomes for men and women will help with preoperative assessments and strategic perioperative care. The short-term mortality and postoperative complications in females are significant and suggest the need for more timely diagnoses and referrals. This is especially important for cases involving smaller cardiac anatomies and later stage presentations. Although the extra care required for postoperative planning and management for males as a result of the bleeding and operative complexities should not be overlooked. Understanding gender differences as presented in this research is important. This is because there is a need for gendered approaches to be incorporated in the surgical decision process, valve choice, and postoperative care to facilitate and promote optimized recovery and improved clinical outcomes for both gender.

LIMITATIONS OF STUDY

There are several limitations of this study. It was performed in a single tertiary cardiac care center, which may impact the generalizability of the results compared to other populations or settings. From an observational perspective, the study design also does not allow for the dependence of any causal conclusions regarding the variables of gender, and the outcomes. Moreover, short-term postoperative outcomes were reviewed; there was no assessment for the long-term outcomes of survival or durability of the valve to complete the evaluation. Variables such as economic factors, social status, hormonal differences, and gender-related referral bias were not assessed in this study, which may partly explain the observed gender differences.

CONCLUSION

At the time of referral for valvular surgery, female patients were generally older and presented with more advanced mitral valve pathology, whereas male patients more frequently underwent complex aortic procedures. Despite these differences, early postoperative mortality and complications were only modestly influenced by gender. Mechanical prostheses remained the predominant choice in both, though males exhibited longer operative times and higher rates of combined procedures. These findings emphasize the importance of gender-informed preoperative assessment and surgical planning, and highlight the need for further research on gender-specific determinants of outcomes in VHD surgery.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript:

FS & VIP: Concept, study design, drafting the manuscript, approval of the final version to be published.

T & AU: Concept, data acquisition, critical review, approval of the final version to be published.

SA: Data acquisition, data analysis, data interpretation, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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