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Original Article

Evaluation of the Prevalence and Predictive Factors of Coronary Artery Disease in Patients Undergoing Valvular Heart Surgery

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Abstract

Objectives: Many patients undergo open-heart surgery every year due to valvular heart diseases. In a significant number of these patients, coronary angiography is performed to detect potential complications during the perioperative and post-operative treatment periods. In this study, we aimed to investigate the coexistence of coronary artery disease (CAD) in patients undergoing open-heart surgery for valvular disease and the predictive factors.

Methods: Between May 2023 and January 2025, a total of 424 patients who underwent surgery due to valvular pathology were analyzed among 2,500 open-heart surgery patients. The most common types of valvular disease and the presence of CAD were examined based on coronary angiography and echocardiography results.

Results: The average age of the patients was 62 years (interquartile range: 53–68). Aortic stenosis (36.6%) was found to be the most common valvular pathology associated with CAD. Overall, 29.5% of patients were diagnosed with CAD, and 70.8% of these patients underwent coronary artery bypass grafting. Factors predicting CAD in patients undergoing surgery for valvular pathology were advanced age, male gender, presence of diabetes, hyperlipidemia, peripheral artery disease, and low glomerular filtration rate.

Conclusion: Despite advancements in technology, surgical and percutaneous approaches, and changes in indication spectrum, the coexistence of valvular heart disease and CAD remains high. Therefore, the presence of CAD should always be investigated in patients undergoing valvular surgery.

Keywords: Aortic stenosis; coronary artery disease; predictors; valvular heart disease; valvular operation.

Kalp Kapağı Ameliyatı Geçirecek Olan Hastalardaki Koroner Arter Hastalığı Prevalansının ve Predikte Eden Faktörlerin Değerlendirilmesi

Özet

Amaç: Her yıl birçok hasta kapak hastalıkları nedeniyle açık kalp cerrahisi geçirmektedir. Bu hastaların önemli bir kısmında, perioperatif ve postoperatif tedavi dönemlerinde oluşabilecek komplikasyonları tespit etmek amacıyla koroner anjiyografi yapılmaktadır. Bu çalışmada, kapak hastalığı nedeniyle açık kalp cerrahisi geçiren hastalarda koroner arter hastalığı birlikteliğini ve bunu predikte eden faktörleri araştırmayı amaçladık.

Gereç ve Yöntem: Mayıs 2023 ile Ocak 2025 arasında, toplam 2500 açık kalp cerrahisi hastası arasından kapak patolojisi nedeniyle ameliyat edilen 424 hasta analiz edildi. En sık görülen kapak hastalığı türleri ve koroner arter hastalığı varlığı, koroner anjiyografi ve ekokardiyografi sonuçlarına göre incelendi.

Bulgular: Hastaların ortalama yaşı 62 yıl (IQR: 53–68) idi. Koroner arter hastalığı ile en sık birlikte görülen valvüler patolojinin aort darlığı (%36,6) olduğu tespit edildi. Genel olarak, hastaların %29,5'ine koroner arter hastalığı tanısı kondu ve bunların %70,8'i koroner arter bypass greft cerrahisi geçirdi. Kapak patolojisi nedeniyle ameliyat edilecek hastalarda koroner arter hastalığını öngören faktörler ileri yaş, erkek cinsiyet, diyabet varlığı, hiperlipidemi, periferik arter hastalığı ve düşük glomerüler filtrasyon hızı olarak bulundu.

Sonuç: Gelişen teknoloji, cerrahi ve perkütan yaklaşımlardaki ilerlemeler ve değişen endikasyon spektrumuna rağmen, kapak hastalıkları ile koroner arter hastalığının birlikteliği halen yüksektir. Bu nedenle, kapak cerrahisi geçirecek hastalarda mutlaka koroner arter hastalığı varlığı araştırılmalıdır.

Anahtar sözcükler: Aort darlığı; koroner arter hastalığı; prediktörler; kapak hastalığı; kapak cerrahisi.

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Introduction

In contemporary clinical practice, a considerable number of patients require open-heart surgery due to valvular heart disorders. These conditions represent some of the most frequently encountered issues within cardiovascular medicine and are a leading contributor to both illness and death. While mild or moderate valve diseases can be managed through medication or less invasive catheter-based procedures, ongoing developments in pharmacologic treatments and patient monitoring have allowed many individuals to be followed closely without hemodynamic or symptomatic decline until the disease reaches an advanced stage.

Significant progress has been made in medical technology, surgical procedures, and minimally invasive techniques, leading to a broader range of indications for valve interventions. Recently, minimally invasive approaches have been increasingly applied in select groups, particularly in patients with severe aortic stenosis. Despite these advancements, surgical valve replacement remains a cornerstone of cardiac surgical interventions.

According to the ESC/EACTS guidelines, coronary angiography is generally advised for all patients scheduled for valve surgery, except for younger individuals (men under 40 and pre-menopausal women) without risk factors for coronary artery disease (CAD), or in specific cases where the procedure poses a greater risk – such as in aortic dissection, large vegetative infective endocarditis near coronary openings, or unstable hemodynamics from prosthetic valve thrombosis.[1] In scenarios where conventional angiography is not feasible, computed tomography angiography can serve as an alternative for detecting clinically significant coronary lesions.[2]

Numerous studies have examined comorbidities in patients undergoing valve surgery, consistently reporting a variable prevalence of concurrent CAD. While data show considerable heterogeneity, it is evident that the overlap between CAD and different types of valve diseases varies significantly.

The objective of this study is to assess the prevalence of significant CAD in patients undergoing open-heart surgery for valve conditions, particularly in an aging population with evolving surgical indications. As the incidence of rheumatic causes declines and degenerative mechanisms become more prominent, this study aims to evaluate how CAD prevalence changes across valve pathologies and to identify predictive factors.

Materials and Methods

Between May 2023 and January 2025, a total of 424 patients underwent valve surgery at our institution. In our center, coronary angiography is routinely performed in all patients over the age of 40 scheduled for elective cardiac valve surgery. Coronary evaluations were based on cardiology department reports and interpreted collaboratively with cardiovascular surgeons. Significant CAD was defined as ≥50% stenosis in at least one major coronary artery or a history of coronary artery bypass grafting (CABG) or percutaneous coronary intervention.

All patients scheduled for elective valve surgery during the study period were evaluated. However, individuals aged 18–40 were excluded from CAD assessment due to their lower risk profile. In addition, patients undergoing emergency surgery, individuals younger than 18 years, and those undergoing procedures involving left ventricular assist devices were also excluded from the study.

Ethical Considerations

Before initiating the study, ethical clearance was obtained from the institutional clinical research ethics board (approval number: 2025/02/1031), ensuring compliance with the principles outlined in the Declaration of Helsinki. All participants provided informed consent for medical treatment, data usage, and inclusion in scientific research.

Data Collection

Data for this study were compiled from multiple validated and secure sources. The primary dataset was derived from a clinical quality registry established at our hospital approximately 18 months ago, aimed at tracking outcomes and evaluating risk in cardiac surgical cases. This registry includes key pre-operative patient metrics such as height, weight, and body mass index (BMI), along with common comorbidities, such as hypertension, diabetes, and hyperlipidemia. It also captures echocardiographic and coronary angiographic results.

Information is prospectively entered into the system upon patient admission. Historical data concerning prior diagnoses, procedures, and operations were accessed through the national electronic health record system. For any data not available electronically, a thorough review of patient charts and departmental records – including cardiology, internal medicine, pulmonology, and nephrology – was undertaken. These records were then cross-referenced with the electronic database to ensure accuracy.

Statistical Analysis

All statistical analyses were performed using R Studio (version 4.2.2, R Foundation for Statistical Computing, Vienna, Austria). Categorical variables were presented as frequencies and percentages (n [%]), while continuous variables were expressed as means with standard deviations or medians with interquartile range (IQRs) (25^{th} and 75^{th} percentiles), depending on the data distribution. The normality of continuous variables was assessed using the Shapiro–Wilk and Kolmogorov-Smirnov tests.

For comparisons between two independent groups, Student's t-test was used for normally distributed data, while the Mann-Whitney U test was applied for non-normally distributed variables. Categorical variables were compared using the Chi-square or Fisher's exact test, as appropriate. For comparisons involving more than two groups, the Bonferroni correction was applied to adjust the p-values for multiple comparisons. Logistic regression was used to identify independent predictors of CAD. Variables with a $p<0.1$ in univariate analysis were included in the multivariate logistic regression model. The goodness-of-fit of the model was assessed using the Hosmer-Lemeshow test, and a $p<0.05$ was considered statistically significant.

Table 1. Collinearity statistics

Variable	VIF	Tolerance
Gender	1.06	0.939
Age	1.18	0.848
DM	1.08	0.925
HL	1.02	0.980
GFR	1.12	0.896
ECA	1.08	0.930

VIF: Variance inflation factor; DM: Diabetes mellitus; HL: Hyperlipidemia; GFR: Glomerular filtration rate; ECA: Extracardiac arteriopathy.

Table 2. Baseline characteristics of the study population (n=424)

Variables	n	%	Median (Q1–Q3)
Gender (female)	207	48.8	
Age (years)			62 (53–68)
Hypertension	244	57.8	
Diabetes mellitus	120	28.4	
Coronary artery disease	113	29.5	
Hyperlipidemia	205	48.6	
Admission rhythm			
Atrial fibrillation/flutter	110	26.0	
Other rhythms	6	1.4	
Smoking status			
Ex-smoker	51	12.2	
Present smoker	81	19.3	
Ejection fraction (%)			60 (50–65)
Pulmonary artery pressure (mmHg)			40 (30–50)
RVD	51	12.1	
Aortic stenosis	108	25.5	
Aortic regurgitation	75	17.7	
Mixed aortic valve disease	20	4.7	
Mitral stenosis	47	11.1	
Mitral regurgitation	55	13.0	
Mixed mitral valve disease	29	6.8	
Tricuspid regurgitation	120	28.3	

This table summarizes the demographic and clinical characteristics of 424 patients included in the study. Continuous variables are expressed as medians with interquartile ranges (Q1–Q3), while categorical variables are presented as counts and percentages. Clinical data include prevalent comorbidities, functional metrics, and valve disease types, aiming to provide an overview of the patient cohort. Q1–Q3: First quartile (25th percentile) to third quartile (75th percentile); RVD: Right ventricular dysfunction.

Collinearity statistics were calculated using the variance inflation factor (VIF) and tolerance values. All variables demonstrated acceptable collinearity, with VIF values below the commonly accepted threshold of 10. The VIF and tolerance values for variables included in the multivariate logistic regression model are shown in Table 1.

Results

Table 2 presents the baseline characteristics of the 424 participants. The median age of the cohort was 62 years (IQR: 53–68), with 48.8% (207) being female. Hypertension was observed in 57.8% (244) of the participants, while 28.4% (120) had diabetes mellitus and 48.6% (205) had hyperlipidemia. Atrial fibrillation/flutter was found in 26.0% (110), and 19.3% (81) were present smokers. Among the valve pathologies, 25.5% (108) had aortic stenosis, 13.0% (55) had mitral regurgitation, and 28.3% (120) had tricuspid regurgitation. The median ejection fraction was 60% (IQR: 50–65), indicating that cardiac function was relatively preserved across the cohort. Among patients with coronary angiography, 29.5% (113) had CAD, and 70.8% (80) of these CAD-positive patients underwent CABG.

Table 3. Percentage of accompanying coronary artery disease with valvular pathologies

Valvular disease	Concomitant CAD %
Aortic stenosis	36.6
Aortic regurgitation	11.7
Aortic mixed pathology	21.1
Mitral stenosis	20.9
Mitral regurgitation	24.0
Mitral mixed pathology	21.4
Tricuspid regurgitation	22.8

CAD: Coronary artery disease.

Table 3 describes the relationship between valvular pathologies and CAD. Aortic stenosis was the most frequent concomitant pathology, affecting 36.6% of patients, followed by mitral regurgitation at 24.0%.

Table 4 compares the clinical characteristics between CAD-positive and CAD-negative patients. CAD-positive patients were significantly older (median: 64 years vs. 61 years, p=0.002) and had higher creatinine levels (median: 0.94 mg/dL vs. 0.84 mg/dL, p=0.001). Their glomerular filtration rates (GFR) were lower (median: 82 mL/min vs. 88 mL/min, p=0.008). The CAD-positive group also had a higher prevalence of diabetes mellitus (41.6%, 47 vs. 23.5%, 63, p<0.001) and hyperlipidemia (61.9%, 70 vs. 45.5%, 122, p=0.036). Extracardiac arteriopathy (ECA) was more frequent in CAD-positive patients (20.5% vs. 8.2%, p=0.002), suggesting an association between peripheral arterial disease and CAD. In addition, a recent myocardial infarction (within 90 days) was more common in CAD-positive patients (29.2% vs. 3.1%, p<0.001), indicating that recent myocardial injury is strongly associated with CAD in patients undergoing valve surgery.

In univariate logistic regression (Table 5), several factors were significantly associated with CAD. Female gender was associated with a higher risk of CAD (odds ratio [OR]: 2.492, 95% confidence interval [CI]: 1.573–3.948, p<0.001), as was older age, where each additional year increased the likelihood of CAD by 3.9% (OR: 1.039, 95% CI: 1.017–1.062, p<0.001). Diabetes mellitus (OR: 2.317, 95% CI: 1.450–3.703, p<0.001) and hyperlipidemia (OR: 2.139, 95% CI: 1.228–3.725, p=0.007) were significant predictors. Carotid artery disease was also a significant factor, with a risk approximately 3 times higher for CAD (OR: 3.040, 95% CI: 1.604–5.760, p<0.001). A lower GFR was associated with a decreased risk of CAD (OR: 0.988 per mL/min, 95% CI: 0.979–0.998, p=0.015). However, smoking, BMI, pre-operative hemodialysis, and chronic obstructive pulmonary disease (COPD) were not significantly linked to CAD.

Table 4. Comparison of clinical and demographic characteristics between patients with and without coronary artery disease undergoing valve surgery

Variable	Category	CAD (–) (n=270)			CAD (+) (n=113)			p
		n	%	Median (IQR)	n	%	Median (IQR)	
Female	Gender	148	54.8		37	32.7		**<0.001***
BMI (kg/m²)				28.40 (25.18–31.25)			27.78 (25.26–30.85)	0.806***
Age (years)				61 (52–68)			64 (57–70)	**0.002*****
Smoking status	Ex-smoker	34	12.4		13	11.7		0.434*
	Active-smoker	45	16.9		25	22.5		
Diabetes mellitus		63	23.5		47	41.6		**<0.001***
Hypertension		151	56.3		71	62.8		0.241*
Hyperlipidemia		122	45.5		70	61.9		**0.036***
Pre-existing HD		7	2.6		3	2.7		1.000**
Creatinine (mg/dL)				0.84 (0.68–1.03)			0.94 (0.80–1.09)	**0.001*****
GFR (mL/min/1.73m²)				88 (69–99)			82 (65–94)	**0.008*****
COPD		43	16.0		13	11.5		0.258*
ECA		22	8.2		23	20.5		**0.002***
CVD		20	7.2		7	7.4		0.903*
Reduced mobility		15	6.8		7	8.0		0.699*
Admission rhythm	Sinus	185	68.8		87	77.0		0.250**
	A fib/flutter	81	29.3		20	21.3		
	Other	5	1.8		1	1.1		
ICD		8	3.0		1	0.9		0.291**
Previous MI <90 days		7	3.1		26	29.2		**<0.001***

*: Chi-square test; **: Fischer's exact test; ***: Mann-Whitney U test. The bold areas indicate statistically significant parameters. CAD: Coronary artery disease; IQR: Interquartile range; BMI: Body mass index; HD: Hemodialysis; GFR: Glomerular filtration rate; COPD: Chronic obstructive pulmonary disease; ECA: Extracardiac arteriopathy; CVD: Cardiovascular disease; A Fib/flutter: Atrial fibrillation/flutter; ICD: Implantable cardioverter defibrillator; MI: Myocardial infarction.

Table 5. Predictors for coronary artery disease

Variable	Univariate		Multivariate	
	p	OR (95% CI)	p	OR (95% CI)
Gender (female)	**<0.001**	2.492 (1.573–3.948)	**<0.001**	3.196 (1.928–5.298)
Age (years)	**<0.001**	1.039 (1.017–1.062)	0.023	1.029 (1.004–1.056)
BMI (kg/m²)	0.443	0.990 (0.965–1.016)		
Present smoker	0.436			
Ex-smoker	0.965	0.985 (0.492–1.971)		
Active smoker	0.209	1.431 (0.818–2.501)		
DM	**<0.001**	2.317 (1.450–3.703)	**0.004**	2.153 (1.275–3.637)
HT	0.241	1.310 (0.834–2.057)		
HL	0.013		0.026	
Hyperlipidemia (+)	0.007	2.139 (1.228–3.725)	0.008	1.951 (1.068–3.564)
Hyperlipidemia (unknown)	0.563	1.223 (0.619–2.418)	0.361	1.401 (0.680–2.887)
Pre-operative-hemodialysis (pre-HD)	0.972	1.025 (0.260–4.035)		
Pre-creatinine (mg/dL)	0.195	1.140 (0.935–1.390)		
GFR (mL/min)	**0.015**	0.988 (0.979–0.998)	0.541	0.996 (0.985–1.008)
COPD	0.261	0.683 (0.352–1.327)		
Extracardiac arteriopathy	**0.003**		0.053	
PAD	1.000	0.000	1.000	0.000
Carotid artery disease	**<0.001**	3.040 (1.604–5.760)	**0.040**	2.123 (1.036–4.349)
Cerebrovascular disease	0.949	0.949 (0.405–2.222)		
Poor mobility	0.700	1.202 (0.472–3.057)		
Sinus rhythm	0.255			
Atrial fibrillation/flutter	0.133	0.673 (0.401–1.128)		
Other rhythm	0.438	0.425 (0.049–3.695)		
ICD implantation history	0.248	0.291 (0.036–2.357)		

Hosmer-Lemesow test p=0.118. The bold areas indicate statistically significant parameters. OR: Odds ratio; CI: Confidence interval; BMI: Body mass index; DM: Diabetes mellitus; HT: Hypertension; HL: Hyperlipidemia; preHD: Preoperative-hemodialysis; GFR: Glomerular filtration rat; COPD: Chronic obstructive pulmonary disease; PAD: Peripheral arterial disease; ICD: Implantable cardioverter-defibrillator.

In the multivariate regression model, the association of several factors with CAD remained significant after adjusting for potential confounders. Female gender continued to be an independent risk factor for CAD (OR: 3.196, 95% CI: 1.928–5.298, p<0.001). Each additional year of age was associated with a 2.9% increase in CAD risk (OR: 1.029, 95% CI: 1.004–1.056, p=0.023). Diabetes mellitus (OR: 2.153, 95% CI: 1.275–3.637, p=0.004) and hyperlipidemia (OR: 1.951, 95% CI: 1.068–3.564, p=0.008) remained significant independent risk factors. Carotid artery disease continued to be an important predictor (OR: 2.123, 95% CI: 1.036–4.349, p=0.040), while GFR, which was significant in univariate analysis, was no longer associated with CAD (p=0.541). Similarly, smoking, hypertension, and ECA did not remain significant in the multivariate model.

Discussion

The presence of CAD in patients undergoing valvular surgery is of great significance due to its potential impact on mortality and morbidity, as well as its influence on the choice of surgical incision and technique.[3,4] In this study, we evaluated the presence of CAD in patients undergoing open-heart surgery for valvular pathology and investigated the factors predictive of its development. Previous studies have reported varying rates of CAD among patients undergoing valvular surgery, typically ranging from 9% to 41%. In our cohort, with a mean age of 62 years, the prevalence of CAD was identified as 29.5%. The discrepancies observed across studies are likely attributable to differences in screening criteria, angiographic evaluation protocols, or definitions of CAD. These discrepancies may also depend on the population in which the study was conducted, particularly due to the variability in the combination of factors predicting CAD.

In recent years, the prevalence of rheumatic valvular disease has been declining in both developed and developing countries, while the incidence of degenerative valvular disease has been increasing.[5] As is well known, degenerative valvular diseases are more commonly observed in elderly individuals. In studies on CAD, advanced age is also recognized as a natural predictor.[6] Consistent with this, our study demonstrates that advanced age is a significant predictor of CAD in patients with valvular disease which have degenerative origin.

Calcific aortic stenosis is the disease most frequent valvular disease associated with CAD in the literature, as atherosclerosis – one of the key pathophysiological processes underlying its development – plays a crucial role in its pathogenesis.[7] With advancements in percutaneous interventional techniques for the treatment of calcific aortic stenosis, the indication spectrum and algorithms of contemporary guidelines have begun to evolve. Despite all these developments, in line with the literature, our study also observed that CAD remains the most common comorbidity among patients undergoing aortic valve replacement for valvular heart disease.[8–10] In addition, it has been observed that the coexistence of CAD is more frequently associated with mitral regurgitation than with mitral stenosis. As is well known, papillary muscles are highly sensitive to ischemia, and in its presence, they may develop temporary or permanent dysfunction, leading to coaptation defects and mitral regurgitation. This situation further highlights the strong association between mitral regurgitation and CAD, rather than in mitral stenosis.

According to present guidelines and the existing literature, there are some risk factors for CAD in adult patients.[6] In our study, when examining the traditional factors predicting CAD in patients undergoing valvular surgery, we observed that age, male sex, hyperlipidemia, diabetes mellitus (DM), ECA, and carotid artery disease – all of which are well-established CAD risk factors – were present. This finding underscores the necessity of assessing for CAD, particularly in the pre-operative period, for patients within these risk groups. On the other hand, one of the intriguing findings of our study is that smoking, a traditional risk factor for CAD, was not identified as a predictor of CAD in patients undergoing valve surgery.

Our study, in light of present data, has provided valuable insights for clinicians by analyzing the distribution of valvular pathologies, the presence of concomitant CAD, and the factors predicting its presence in patients undergoing valve surgery. However, standardizing these findings through large, multicenter cohort studies may potentially lead to a shift in the approach algorithms for CAD in patients undergoing valve surgery.

Limitations

Our study has a retrospective, single-center design. More comprehensive analyses and improved outcomes could be achieved through multicenter, high-volume studies.

Conclusion

The presence of CAD remains a critical factor in patients undergoing valvular surgery. Despite evolving indications and changing treatment algorithms for valvular surgery and percutaneous interventions due to advancements in technology, as well as updates in degenerative and rheumatic valvular disease prevalence and management across developed and developing countries, the prevalence of significant CAD in surgical valvular patients remains high. Therefore, a thorough pre-operative evaluation for CAD is essential in this patient population.

Disclosures

Ethics Committee Approval: The study was approved by the Kartal Koşuyolu High Specialization Training and Research Hospital Scientific Research Ethics Committee (no: 2025/02/1031, date: 18/02/2025).

Informed Consent: Informed consent was obtained from all participants.

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