

# Coronary Artery Disease among Patients Undergoing Valve Replacement Surgery: A Retrospective Study of Angiographic Profiles and Predictors at a Southern Indian Tertiary Care Centre

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## ABSTRACT

**Introduction:** Coronary Artery Disease (CAD) frequently co-exists with Valvular Heart Disease (VHD). In developing countries like India, the shifting epidemiology from rheumatic to degenerative VHD alters this association. Concomitant CAD drastically dictates surgical strategies, yet local angiographic profile data remains scarce.

**Aim:** To determine the angiographic profile and clinical predictors of CAD in patients undergoing Coronary Angiography (CAG) prior to valve replacement surgery at an Indian tertiary care centre.

**Materials and Methods:** The present retrospective study was conducted at Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu, South India, and analysed data of 200 consecutive patients undergoing preoperative CAG before valve replacement surgery. Demographic profiles, cardiovascular risk factors, echocardiographic parameters, and angiographic findings were reviewed. Patients were stratified into CAD and non CAD cohorts. Obstructive CAD was defined angiographically. Statistical analysis utilised Chi-square and Student's t-tests.

**Results:** The cohort's mean age was 55.6±9.3 years; 127 (63.5%) were males (63.5%). Prevalences of hypertension, diabetes mellitus, dyslipidaemia, and tobacco use were 71 (35.5%), 64

(32%), 30 (15%), and 15 (7.5%), respectively. Patients with CAD were significantly older (mean age: 59.2±8.5 vs 53.8±9.1 years;  $p<0.001$ ) and predominantly males (72 (73.5%) vs. 55 (53.9%);  $p=0.005$ ). Increasing age and diabetes mellitus emerged as independent predictors of CAD in multivariate analysis (OR 1.09, 95% CI 1.05-1.13;  $p<0.001$  and OR 2.49, 95% CI 1.10-5.63;  $p=0.028$ , respectively). No statistically significant association was observed between CAD status and valves involved namely, Mitral Valve Disease (MVD), Aortic Valve Disease (AVD) and combined valve disease or valve surgery performed. AVD showed a non significant trend toward higher prevalence in the CAD group ( $p=0.11$ ). Left Anterior Descending (LAD) artery was the most frequently diseased vessel {49 (50%)}. Left Ventricular Ejection Fraction (LVEF) was marginally lower in the CAD arm (54.2±12.4% vs 57.1±11.3%;  $p=0.05$ ), while Atrial Fibrillation (AF) lacked statistical correlation ( $p=0.89$ ).

**Conclusion:** The CAD in Indian valve replacement candidates was independently associated with advanced age, diabetes mellitus, and standard atherosclerotic risk factors. There was no statistically significant association between presence of CAD and the underlying valve pathology, or the type of surgery performed. Preoperative angiographic screening is critical for precise surgical planning, which should be dictated not only by age but by the presence of cardiovascular risk factors.

**Keywords:** Coronary angiography, Diabetes mellitus, Heart valve disease, Retrospective studies, Risk factors

## INTRODUCTION

CAD commonly co-exists with VHD especially in the elderly with degenerative disease. Degenerative VHD is a significant cause of cardiovascular morbidity and mortality in the developed world [1]. In contrast, rheumatic heart disease remains the predominant cause of VHD in developing countries. CAD tends to develop at a younger age in South Asian populations than in Western populations, with the onset of clinical coronary events occurring approximately 5-10 years earlier than in many high-income countries [2].

Presence of CAD significantly influences the type of surgery performed in VHD. Concomitant coronary artery bypass surgery is frequently performed along with valve surgery in cases of associated significant CAD. CAG is recommended under the guidelines laid down by the American College of Cardiology/American Heart Association (ACC/AHA) and European Society of Cardiology (ESC) in patients with VHD over 40 years, especially men, postmenopausal women and in those with CAD symptoms [3,4]. However, these

recommendations are largely based on Western populations. The age at presentation, aetiology of VHD, and risk factors of CAD are significantly different among Indian population [5].

A few studies from India have reported a prevalence of CAD among patients with VHD that differs from what observed in Western populations [5-7]. However, data from South India regarding the predictors of CAD in VHD patients remains limited, particularly in a relatively younger population with mixed rheumatic and degenerative valvular disease. Addressing this knowledge gap is important for optimising preoperative coronary angiographic screening and surgical planning in the Indian setting. This study aimed to determine the clinical characteristics, angiographic profile, and predictors of CAD in patients undergoing CAG prior to valve replacement surgery.

## MATERIALS AND METHODS

The present retrospective study was conducted at Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu, South India. The medical records of patients who underwent valve replacement

surgery over a period of three years between January 2022 and December 2024 were retrospectively reviewed. Data was collected and analysed during a period of twelve months from January 2025 to December 2025. The study was approved by the Institutional Human Ethics Committee (SMIMS/IHEC No. 1/ Protocol no: 57/2024) prior to commencement of the study.

**Inclusion and Exclusion criteria:** Patients above 40 years of age with primary (non ischaemic) VHD, who underwent CAG prior to valve replacement surgery, were included in the study. Those with previous history of CAD, Percutaneous Coronary Intervention (PCI), or Coronary Artery Bypass Grafting (CABG), those with Ischaemic mitral regurgitation and those with incomplete clinical, angiographic, or surgical records were excluded from the study.

**Sample size:** Since the present study was a retrospective study, all consecutive eligible patients fulfilling the inclusion and exclusion criteria during the study period were included. A total of 200 patients were enrolled for analysis.

Study Procedure

Medical data were reviewed using hospital electronic medical records and surgical case sheets. Demographic characteristics including age and sex were recorded. Clinical variables including hypertension, diabetes mellitus, dyslipidaemia, tobacco use, chronic kidney disease, cerebrovascular accident, and chronic obstructive pulmonary disease were documented. Laboratory investigations including glycated haemoglobin (HbA1c), serum creatinine, and lipid profile were recorded. Electrocardiogram and Holter monitoring findings were reviewed for the presence of AF. Preoperative echocardiographic assessment included evaluation of the type of VHD, including mitral stenosis, mitral regurgitation, Aortic Stenosis (AS), and aortic regurgitation. Left ventricular systolic function was assessed by LVEF calculated using Simpson method. CAG was performed using standard techniques. Coronary angiograms were independently interpreted by two experienced cardiologists. CAD was defined as  $\geq 50\%$  luminal narrowing in at least one major epicardial coronary artery [3,4]. Details of the surgical procedure, including Mitral Valve Replacement (MVR), Aortic Valve Replacement (AVR), Double Valve Replacement (DVR), tricuspid annuloplasty, and concomitant CABG, were recorded. Indications for CABG were based on contemporary ACC/AHA guideline recommendations and included significant left main CAD, left main equivalent disease, multivessel CAD, and selected patients with significant proximal LAD artery disease associated with impaired left ventricular systolic function or demonstrable myocardial ischaemia [3,4,8]. Perioperative and postoperative outcomes were not evaluated in this study.

STATISTICAL ANALYSIS

Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median (range), as appropriate. Categorical variables were expressed as frequencies and percentages. Comparisons between CAD and non CAD groups were performed using the independent Student's t-test for continuous variables and the Chi-square test or Fisher's-exact test for categorical variables, as appropriate. Univariate logistic regression analysis was performed to identify predictors of CAD. Variables with  $p < 0.10$  on univariate analysis, along with established cardiovascular risk factors (including dyslipidaemia), were entered into a multivariate logistic regression model to identify independent predictors of CAD. Adjusted Odds Ratios (ORs) with 95% Confidence Intervals (CIs) were calculated. A two-tailed  $p$ -value  $< 0.05$  was considered statistically significant. Statistical analysis was performed using IBM Statistical package for the Social Sciences (SPSS) Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY, USA).

RESULTS

The total number of patients included in the study was 200, of which 102 patients had normal coronaries and 98 patients had CAD. The

mean age of the study population was  $55.6 \pm 9.3$  years and 127 (63.5%) were males. 71 (35.5%) had history of hypertension, while 64 (32%) had diabetes mellitus, 30 (15%) had dyslipidaemia and 15 (7.5%) had history of tobacco use. There were no cases of chronic kidney disease. The mean HbA1c was  $6.67 \pm 1.69\%$ . The mean LDL cholesterol was  $109.5 \pm 38.5$  mg/dL. AF was present in 20% of the cases. The mean LVEF was  $56.0 \pm 11.8\%$ . The baseline demographic clinical and biochemical parameters are summarised in [Table/Fig-1].

| Variables                                    | Mean $\pm$ SD<br>n (%) (if categorical) |
|----------------------------------------------|-----------------------------------------|
| Age (years)                                  | 55.60 $\pm$ 9.31                        |
| Males                                        | 127 (63.50%)                            |
| Females                                      | 73 (36.50%)                             |
| Hypertension (HTN)                           | 71 (35.50%)                             |
| Diabetes Mellitus (DM)                       | 64 (32.0%)                              |
| Dyslipidaemia (DLP)                          | 30 (15%)                                |
| Tobacco use                                  | 15 (7.50%)                              |
| Chronic Kidney Disease (CKD)                 | 0 (0%)                                  |
| Cerebrovascular Accident (CVA)               | 6 (3.0%)                                |
| Chronic Obstructive Pulmonary Disease (COPD) | 4 (2.0%)                                |
| HbA1c (%)                                    | 6.67 $\pm$ 1.69                         |
| Serum Creatinine (mg/dL)                     | 0.81 $\pm$ 0.22                         |
| LDL (mg/dL)                                  | 109.52 $\pm$ 38.52                      |
| HDL (mg/dL)                                  | 40.61 $\pm$ 12.64                       |
| Triglycerides (mg/dL)                        | 115.71 $\pm$ 59.0                       |
| Atrial Fibrillation (AF)                     | 40 (20.0%)                              |
| LVEF (%)                                     | 56.0 $\pm$ 11.80                        |

[Table/Fig-1]: Baseline demographic characteristics of the study population (N=200).

Among CAD patients, Triple Vessel Disease (TVD) was the most common pattern of involvement {41 (41.84%)} followed by single vessel disease (SVD) in 30 (30.61%). LAD artery involvement was seen in 49 (50.00%). Left main CAD was found in a significant percentage {12 (12.24%)} [Table/Fig-2].

| Number of vessels involved            | n (%)       |
|---------------------------------------|-------------|
| Single vessel disease (SVD)           | 30 (30.61%) |
| Double vessel disease (DVD)           | 27 (27.55%) |
| Triple Vessel Disease (TVD)           | 41 (41.84%) |
| Left main coronary artery (LM)        | 12 (12.24%) |
| Left Anterior Descending artery (LAD) | 49 (50.00%) |
| Right coronary artery (RCA)           | 41 (41.83%) |
| Left circumflex artery (LCX)          | 30 (30.61%) |

[Table/Fig-2]: Angiographic pattern of CAD in the study population (n=98).

The CAD group was significantly older and had a higher proportion of males. Hypertension, diabetes mellitus, and tobacco use were significantly more prevalent in the CAD group (all  $p < 0.05$ ). Although the mean LVEF was slightly lower in CAD patients, the difference was only borderline significant ( $p = 0.05$ ). The AF showed no significant difference between the groups ( $p = 0.89$ ) [Table/Fig-3]. Among the biochemical parameters evaluated, patients with CAD had significantly higher mean HbA1c levels ( $6.94 \pm 1.88\%$  vs.  $6.22 \pm 1.22\%$ ,  $p = 0.001$ ) and triglyceride levels ( $122.21 \pm 66.40$  mg/dL vs.  $104.99 \pm 42.25$  mg/dL,  $p = 0.027$ ) compared with patients without CAD. There were no significant differences in serum creatinine, LDL cholesterol, or HDL cholesterol between the two groups.

Multivariate logistic regression analysis was performed including age, sex, hypertension, diabetes mellitus, dyslipidaemia and tobacco use (Clinical model). HbA1c and triglyceride levels (12 values missing for Triglycerides) were not included in the primary multivariable model because of incomplete data availability of triglycerides and potential

| Variables                       | CAD Group (n=98) | Non CAD Group (n=102) | p-value |
|---------------------------------|------------------|-----------------------|---------|
| Age (years)                     | 59.22±8.51       | 53.84±9.10            | <0.001  |
| Males, n (%)                    | 72 (73.46%)      | 55 (53.92%)           | 0.005   |
| Hypertension, n (%)             | 46 (46.93%)      | 25 (24.50%)           | 0.001   |
| Diabetes mellitus, n (%)        | 42 (42.85%)      | 22 (21.56%)           | 0.001   |
| Dyslipidaemia, n (%)            | 17 (17.34%)      | 13 (12.74%)           | 0.080   |
| Tobacco Use, n (%)              | 13 (13.26%)      | 2 (1.96%)             | 0.004   |
| LVEF (%), Mean±SD               | 54.20±12.43      | 57.14±11.30           | 0.050   |
| Atrial Fibrillation (AF), n (%) | 20 (20.40%)      | 20 (19.60%)           | 0.891   |
| HbA1c (%), Mean±SD              | 6.94±1.88        | 6.22±1.22             | 0.001   |
| Serum creatinine (mg%), Mean±SD | 0.81±0.21        | 0.82±0.24             | 0.586   |
| LDL (mg%), Mean±SD              | 110.57±42.95     | 107.60±29.82          | 0.566   |
| HDL (mg%), Mean±SD              | 41.35±13.34      | 39.33±11.15           | 0.252   |
| Triglycerides (mg%), Mean±SD    | 122.21±66.40     | 104.99±42.25          | 0.027   |

**[Table/Fig-3]:** Comparison of baseline demographic and clinical characteristics between CAD and non CAD patients (N=200).

collinearity with diabetes mellitus. Increasing age and diabetes mellitus emerged as independent predictors of CAD. Each one-year increase in age was associated with a 9% increase in the odds of CAD (adjusted OR 1.09, 95% CI 1.05-1.13;  $p<0.001$ ). Diabetes mellitus independently increased the odds of CAD by approximately 2.5-fold (adjusted OR 2.49, 95% CI 1.10-5.63;  $p=0.028$ ). Male sex demonstrated a trend towards significance (adjusted OR 1.94, 95% CI 0.98-3.84;  $p=0.059$ ). Hypertension, dyslipidaemia and tobacco use were not independently associated with CAD after adjustment [Table/Fig-4].

| Variables         | Univariate OR     | p-value | Multivariate OR   | p-value |
|-------------------|-------------------|---------|-------------------|---------|
|                   | (95% CI)          |         | (95% CI)          |         |
| Age               | 1.08 (1.04-1.12)  | <0.001  | 1.09 (1.05-1.13)  | <0.001  |
| Males             | 2.37 (1.33-4.23)  | 0.005   | 1.94 (0.98-3.84)  | 0.059   |
| Hypertension      | 2.72 (1.50-4.90)  | 0.001   | 1.49 (0.67-3.34)  | 0.331   |
| Diabetes mellitus | 2.73 (1.47-5.06)  | 0.001   | 2.49 (1.10-5.63)  | 0.028   |
| Dyslipidaemia     | 1.44 (0.66-3.15)  | 0.36    | 0.34 (0.02-5.94)  | 0.462   |
| Tobacco use       | 7.65 (1.68-34.90) | 0.004   | 3.33 (0.65-17.10) | 0.151   |

**[Table/Fig-4]:** Logistic regression analysis of Predictors of CAD.

MVD, AVD, and the combined MVD/AVD groups showed no significant difference in prevalence between the CAD and non CAD groups {47 (47.9%) vs. 52 (51%), 32 (32.7%) vs. 22 (21.5%) and 19 (19.4%) vs. 28 (27.5%), respectively}. No statistically significant association was observed between CAD status and type of valvular pathology or type of valve surgery performed. AVD showed a numerical trend toward higher prevalence in the CAD group, but this did not achieve statistical significance ( $p=0.11$ ) [Table/Fig-5]. Patients undergoing AVR and DVR were significantly older compared with the MVR group ( $p=0.006$ ). Hypertension was significantly more common in DVR, and AVR groups compared to the MVR group ( $p=0.046$ ) [Table/Fig-6].

| Variables                             | CAD Group (n=98) | Non CAD Group (n=102) | p-value |
|---------------------------------------|------------------|-----------------------|---------|
| Mitral Valve Disease (MVD)            | 47 (47.96%)      | 52 (50.98%)           | 0.78    |
| Aortic Valve Disease (AVD)            | 32 (32.65%)      | 22 (21.57%)           | 0.11    |
| Combined MVD and AVD                  | 19 (19.39%)      | 28 (27.45%)           | 0.24    |
| Mitral Valve Replacement (MVR), n (%) | 49 (50.00%)      | 54 (52.94%)           | 0.77    |
| Aortic Valve Replacement (AVR), n (%) | 38 (38.78%)      | 38 (37.25%)           | 0.95    |
| Double Valve Replacement, n (%)       | 11 (11.22%)      | 10 (9.80%)            | 0.90    |

**[Table/Fig-5]:** Distribution of valvular lesions among the CAD and non CAD patients (N=200).

| Parameters                        | MVR (n=103) | AVR(n=76)  | DVR(n=21)  | p-value |
|-----------------------------------|-------------|------------|------------|---------|
| Age (Mean±SD)                     | 54.12±8.71  | 58.65±9.20 | 57.30±9.0  | 0.006   |
| Males (%)                         | 57 (55.33)  | 54 (71.05) | 16 (76.19) | 0.06    |
| Hypertension (HTN) (%)            | 27 (26.21)  | 31 (40.78) | 13 (61.90) | 0.046   |
| Diabetes Mellitus (DM) (%)        | 24 (23.30)  | 30 (39.47) | 10 (47.61) | 0.055   |
| Coronary Artery Disease (CAD) (%) | 48 (46.60)  | 38 (50.0)  | 12 (57.14) | 0.83    |
| CABG performed (%)                | 30 (29.12)  | 24 (31.57) | 10 (47.61) | 0.40    |
| Atrial Fibrillation (AF) (%)      | 23 (22.33)  | 11 (14.47) | 6 (28.57)  | 0.29    |

**[Table/Fig-6]:** Comparison of clinical parameters across valve surgery types (MVR, AVR, DVR) (N=200). values are presented in n (%)

Among the 98 patients with CAD, 64 (65.3%) underwent concomitant CABG based on contemporary ACC/AHA guideline recommendations. This was because grafting was done only to major epicardial vessels with more than 70% stenosis. Valve surgeries were performed 5-21 (mean 11) days after clinical evaluation including coronary angiogram.

## DISCUSSION

The present retrospective study demonstrates that, the patients with CAD undergoing valve replacement surgery were significantly older and had a higher proportion of males. Conventional cardiovascular risk factors such as hypertension, diabetes mellitus, and tobacco use were significantly more prevalent in the CAD group. Similar observations were reported in a study by Morrison GW et al., and other subsequent studies, which showed that atherosclerotic risk factors remain reliable predictors of obstructive CAD even in patients primarily presenting with valvular lesions [1,5]. MVD was the most common valvular lesion in the study population, reflecting the persistent burden of rheumatic heart disease in India.

No statistically significant difference was observed between CAD and non CAD groups with respect to the valves involved or type of valve replacement surgery performed. Although AVD was numerically more frequent among CAD patients, the association did not achieve statistical significance ( $p=0.11$ ). In the Indian/South Asian context, this finding is interesting and important because, most western and several Indian studies report higher CAD prevalence in patients with degenerative AVD because those studies included older populations with predominantly degenerative AVD [9,10]. Degenerative AVD and CAD share common atherosclerotic mechanisms [11]. This study did not show a statistically significant association between AVD and CAD despite a numerical trend. This can be interpreted in the context of South Indian population, younger cohort, higher rheumatic disease burden, and lower proportion of degenerative AS. The findings of the present study suggest that, in relatively younger South Indian valve surgery patients, valvular pathology alone may not be a strong independent predictor of CAD. Instead, cardiovascular risk factors appear more important than valve lesion itself. These findings reinforce the need for comprehensive cardiovascular risk stratification in all patients scheduled for valve surgery regardless of valvular pathology. The LAD artery was the most frequently affected vessel (50%), underscoring the need for careful preoperative coronary angiographic and functional evaluation of LAD lesions.

Unlike degenerative calcific AS, which shares common atherosclerotic mechanisms with CAD, rheumatic valvular disease may not exhibit the same pathophysiological association with coronary atherosclerosis [10,11]. Similar observations have been reported in studies involving younger rheumatic populations from developing countries, where cardiovascular risk factors rather than valve lesion type were stronger predictors of CAD [6,12-15]. A study by Jadhav N et al., found that the traditional risk factors were more important predictors for CAD. But AVD was significantly higher in the CAD group in this study [7]. Similar findings were observed in another Indian study by Karak A et al., which showed higher proportion of

rheumatic AS in CAD patients [16]. Another study by Elameen S et al., found no strong correlation between rheumatic valve disease and CAD. Only CAD risk factors were more predictive [17].

On multivariate analysis, increasing age and diabetes mellitus remained independent predictors of CAD, while hypertension and tobacco use lost statistical significance after adjustment for other covariates. This finding suggests that the observed association of hypertension and tobacco use with CAD on univariate analysis may be partly mediated through their interaction with age and other cardiovascular risk factors. Diabetes mellitus emerged as the strongest modifiable independent predictor of CAD in the study cohort, highlighting the importance of aggressive cardiovascular risk assessment and glycaemic control in patients undergoing valve replacement surgery.

Current ACC/AHA and ESC guidelines recommend routine CAG before valve surgery in men above 40 years, postmenopausal women, and patients with symptoms or risk factors suggestive of CAD [3,4]. The present study findings support the applicability of these recommendations in the Indian setting as well. However, results from the current study suggest that risk-based screening strategies tailored to the Indian population may be warranted.

Although the mean LVEF was slightly lower in CAD patients, the difference was borderline significant. The AF showed no significant difference between the groups. These findings suggest that CAD was not associated with the incidence of AF or LV function abnormalities in those presenting with primary VHDs.

Patients undergoing AVR and DVR were significantly older than those undergoing MVR. This finding is biologically plausible because degenerative calcific AS, the most common indication for AVR, predominantly affects older adults [10,11]. MVR in India is still frequently related to rheumatic heart disease occurring at younger age [18]. Hypertension was significantly more common in DVR, and AVR groups compared to the MVR group. This may reflect greater prevalence of degenerative and atherosclerotic disease in AVR and DVR patients, and the older age distribution in these groups [19,20].

### Limitation(s)

The present study has several limitations. First, the present study was a retrospective single-centre study, which may limit generalisability of the findings to the broader Indian population. Second, the sample size was relatively modest. Third, detailed quantitative angiographic assessment including SYNTAX scoring and severity grading of CAD was not available. Fourth, the study did not evaluate postoperative outcomes or long-term survival following combined valve and coronary revascularisation procedures. Additionally, differentiation between rheumatic and degenerative valvular pathology was not uniformly quantified in all patients.

Future prospective multicentre studies involving larger patient populations are needed to better define the true prevalence and predictors of CAD in Indian patients undergoing valve surgery. Further research should focus on developing risk prediction models specific to the Indian population, incorporating clinical, echocardiographic, and biochemical markers. Long-term follow-up studies evaluating surgical outcomes, survival, and quality of life after combined valve surgery and coronary revascularisation would also provide valuable clinical insights.

### CONCLUSION(S)

In a relatively young South Indian patient population undergoing valve surgery, CAD was associated with increasing age, male sex, hypertension, diabetes mellitus and tobacco use on univariate

analysis. After multivariable adjustment, increasing age and diabetes mellitus remained independent predictors. No statistically significant difference was observed between CAD and non CAD groups with respect to the valves involved or the type of valve replacement surgery performed.

Routine CAG prior to valve replacement surgery remains an essential component of surgical planning, the performance of which should be dictated not only by age but also by the presence of cardiovascular risk factors.

**Role of the funding source:** The study was funded by the Department of Cardiology, Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu. They had a role in study design, including collecting, analysing, and interpreting data.

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PLAGIARISM CHECKING METHODS: [\[Jain H et al.\]](#)

- Plagiarism X-checker: Jun 12, 2026
- Manual Googling: Aug 08, 2026
- iThenticate Software: Aug 10, 2026 (8%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:

- Financial or Other Competing Interests: As declared above
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: Jun 03, 2026  
Date of Peer Review: Jun 30, 2026  
Date of Acceptance: Aug 12, 2026  
Date of Publishing: Nov 01, 2026