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Comparison of Aortic Valve Calcification Frequency Between Bicuspid Valve and Tricuspid Valve Insight from Computed Tomography

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ABSTRACT

Background: Aortic Valve Calcification (AVC) is a progressive pathological process commonly associated with aortic stenosis. Variations in calcification between bicuspid aortic valves (BAV) and tricuspid aortic valves (TAV) are clinically relevant, as they affect disease progression, diagnostic accuracy, and therapeutic planning. Non-invasive imaging, particularly computed tomography (CT), offers reliable assessment of calcification burden and valve morphology. This study aimed to compare the frequency and severity of AVC in BAV and TAV using CT angiography. Methods: A six-month cross-sectional, comparative, and observational study was carried out at the Radiology Department of the Islamabad Diagnostic Center, Faisalabad. Sixty-one participants (aged 20–60 years) were recruited using convenience sampling according to predefined inclusion and exclusion criteria.

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ECG-gated CT angiography was performed with a 128-slice dual-source CT scanner. Calcification volumes were measured using advanced 3D post-processing software with automated and manual tools. Demographic and clinical information was collected through structured questionnaires. Results: Among 61 participants, females comprised 62.3%, with the largest group aged 20–30 years. Familiarity with AVC was reported by 62.3% of respondents, and 75% indicated routine use of AVC assessment in clinical practice. Regarding utility, 57.4% considered AVC evaluation very or quite effective, while 50.8% believed it had a significant or transformative role in clinical decision-making. Statistically significant associations ($p < 0.01$) were observed between knowledge, perceived effectiveness, and clinical application of AVC assessment. Conclusion: CT-based AVC assessment provides critical information on valve calcification patterns, enabling differentiation between BAV and TAV. These findings support its role in enhancing diagnostic precision and guiding optimal patient management.

Keywords: Aortic Valve Calcification, Aortic Stenosis, Bicuspid Aortic Valve, Tricuspid Aortic Valve, CT Angiography

Introduction

Aortic valve calcification (AVC) is a progressive cardiovascular disorder marked by calcium deposition on the valve leaflets, which leads to leaflet stiffening and functional impairment. This process is the major precursor to aortic stenosis (AS), a condition associated with significantly increased morbidity and mortality (Otto et al., 1999). The pathophysiology of AVC is complex, involving structural degeneration, altered hemodynamics, and metabolic dysregulation. Once established, calcification reduces valve flexibility, resulting in restricted leaflet motion and obstruction of left ventricular outflow.

While the tricuspid aortic valve (TAV) is the most common valve morphology, bicuspid aortic valve (BAV) is the most frequent congenital cardiac abnormality and predisposes patients to earlier and more severe calcification. Structural defects and hemodynamic stress in BAV accelerate the calcific process, leading to premature stenosis compared with TAV. Patients with BAV are therefore at heightened risk for earlier onset AS, necessitating timely diagnostic and therapeutic strategies.

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Diagnosis of AVC and AS relies heavily on imaging modalities. Echocardiography remains the frontline tool, but its sensitivity is limited in quantifying calcification burden. Computed tomography (CT), by contrast, provides high-resolution three-dimensional visualization of calcific deposits, enabling accurate quantification of calcium scores and precise anatomical assessment. CT-derived parameters such as peak aortic jet velocity (≥4 m/s), mean transvalvular gradient (≥40 mmHg), and indexed aortic valve area (≤0.6 cm^2) serve as critical markers in assessing AS severity and determining eligibility for valve replacement.

The integration of CT into cardiovascular evaluation has transformed clinical management by offering superior sensitivity and specificity compared to echocardiography. It facilitates accurate patient stratification, risk prediction, and treatment planning, particularly in the era of transcatheter aortic valve replacement (TAVR), where pre-procedural imaging is indispensable for procedural safety and outcome optimization. Moreover, CT enables longitudinal monitoring of disease progression, thereby supporting personalized therapeutic strategies.

Epidemiologically, AVC is common among elderly populations. Prevalence estimates indicate that 4.3–4.8% of individuals aged over 75 years have mild-to-moderate AS, with calcification as the leading driver of disease progression (Baron et al., 2016). CT-based calcium scoring has been shown to correlate with procedural complexity and outcomes after TAVR, underscoring its prognostic value in severe aortic valve disease. Furthermore, calcification burden has been linked to comorbid conditions such as coronary artery disease, where aortic valve sclerosis (AVS) predicts adverse events like myocardial infarction and mortality, suggesting systemic atherosclerotic involvement.

Recent research emphasizes the biological mechanisms underlying AVC. Studies highlight the role of extracellular vesicles, endothelial-to-mesenchymal transition, and chronic inflammation in promoting calcific nodule formation ((Kapustin & Shanahan, 2016); (Mahler et al., 2013);(Yan et al., 2012). Molecular imaging techniques, such as ^18F-NaF PET/CT, have demonstrated the ability to detect active calcification before structural changes occur, making them valuable for early diagnosis and research (Dweck et al., 2014; Doris et al., 2017). Genetic and developmental studies further support the heritable nature of BAV and its strong

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association with accelerated calcification(Kang et al., 2010). Collectively, these findings suggest that AVC is not merely a degenerative process but an actively regulated disease involving genetic, cellular, and inflammatory mechanisms.

Despite these advances, gaps remain in understanding the differential impact of AVC in BAV versus TAV populations. While both morphologies are affected by calcification, BAV patients tend to exhibit greater calcification burden and earlier clinical manifestations. Ethnic differences may also play a role, with population-based studies showing variable calcification severity and AS progression rates across cohorts (Kang et al., 2010). Recognizing these variations is essential for tailoring diagnostic thresholds and therapeutic approaches.

The clinical implications of AVC extend beyond valve obstruction. It contributes to systemic cardiovascular risk and influences outcomes of interventions. Identifying the extent and distribution of calcification not only refines diagnosis but also guides procedural planning and long-term management. By combining CT imaging with statistical modeling, researchers aim to clarify the relationships between patient demographics, comorbidities, and AVC burden, thereby improving individualized care.

Overall, AVC represents a growing health burden in aging populations. Its association with structural valve abnormalities such as BAV, systemic comorbidities, and poor cardiovascular outcomes underscores the need for further research. Integrating high-resolution imaging into routine practice enhances diagnostic accuracy, informs clinical decisions, and improves prognostication. This study builds upon existing evidence by evaluating AVC prevalence and severity across valve morphologies, with the goal of advancing understanding and improving patient outcomes through more precise diagnostic and therapeutic strategies.

Methodology

This study was designed as a comparative analytic investigation aimed at evaluating the frequency and severity of aortic valve calcification (AVC) in patients with tricuspid aortic valves (TAV) and bicuspid aortic valves (BAV). Computed tomography (CT) imaging performed under standard clinical protocols was used to assess and compare calcification patterns in both anatomical groups. By employing cross-sectional imaging, the study sought to establish statistically significant

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associations between valve morphology and calcification burden.

The research was conducted in the Radiology Department of Islamabad Diagnostic Center, Faisalabad, where data were collected through structured questionnaires and CT scan findings. The study population consisted of adult patients over the age of 18, both male and female, who presented with clinical indications such as shortness of breath, chest pain, or suspicion of aortic valve calcification. Eligible participants also included those with diagnosed aortic valve stenosis and those who had undergone CT scans without intravenous contrast material. Patients under 18 years of age, pregnant or breastfeeding women, individuals with severe kidney disease (GFR <30 mL/min/1.73 m^2), patients with known allergies to CT contrast, and those with a history of aortic valve replacement or repair were excluded from the study.

A convenient sampling technique was used to recruit participants. The study spanned six months, from July to December 2024, with patient recruitment taking place between July and September and data analysis conducted from October to December. Based on Faisalabad's estimated population of 3.8 million, the minimum required sample size was calculated using a formula [n= (Z α 2)2. (1-P)] that accounted for a 95% confidence level (Z = 1.96), an estimated population proportion (P) of 0.5, and a margin of error (d) of 0.125. This calculation ensured that the sample size would be representative of the target population.

Data collection was performed in collaboration with radiologists and CT operators at the clinical site. A structured questionnaire was the main research instrument, designed to capture demographic data, professional experience, and diagnostic practices related to AVC. It also included patient clinical details, CT findings, and the radiologists' perspectives on the diagnostic and clinical significance of AVC in relation to valve morphology. Each participant was given a clear explanation of the questionnaire items, with ample time allowed to complete their responses. The collected forms were reviewed manually for completeness before being digitized and stored securely for further statistical analysis. Throughout the study, patient confidentiality and ethical research standards were strictly maintained. Data analysis was conducted using IBM SPSS Statistics version 25.0. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were calculated for demographic and baseline clinical variables. Inferential statistics were

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employed to compare calcification patterns between TAV and BAV groups. The independent samples t-test was applied to assess differences in mean calcium scores, while chi-square tests were used for categorical comparisons, such as sex distribution and valve morphology. This analytic framework allowed for a robust evaluation of the prevalence and severity of AVC across different anatomical cohorts, providing valuable insights into the clinical implications of valve structure.

Results

The study included a total of 61 participants, among whom females represented the majority with 62.3%, while males accounted for 37.7%. This imbalance highlights a predominance of female patients in the sample, which may reflect the gender distribution commonly observed in the clinical setting where the research was conducted. In terms of age, the distribution was relatively balanced, with the largest group of participants (29.5%) belonging to the 20–30-year age category, representing 18 individuals. This was followed by 16 participants (26.2%) in the 31–40-year range, 15 participants (24.6%) between 41–50 years, and 12 participants (19.7%) between 51–60 years. Such a spread across different age brackets suggests that the findings are applicable across a wide age spectrum rather than being confined to a single age group.

How has the use of AVC impacted your clinical decision-making process?

Response	Frequency	Percentage
No Impact	4	6.6
Minor Impact	9	14.8
Moderate Impact	17	27.9
Significant Impact	20	32.8
Transformative Impact	11	18.0

Do you believe AVC should be a standard part of cardiovascular imaging protocols?

Response	Frequency	Percentage
Yes	42	68.9
No	8	13.1
Not Sure	11	18.0

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Clinical Impact

When asked about the clinical influence of aortic valve calcification (AVC) assessment, responses varied considerably, indicating diverse levels of perceived utility in routine practice. A minority of four participants (6.6%) reported no impact on their clinical decision-making, while nine participants (14.8%) indicated a minor impact. A larger proportion, 17 participants (27.9%), acknowledged a moderate influence, whereas 20 participants (32.8%) highlighted a significant impact. Additionally, 11 participants (18%) described the effect as transformative, suggesting that AVC directly shaped or altered their clinical strategies in a substantial way. Taken together, these findings emphasize that nearly 79% of participants found AVC to exert at least a moderate impact, underscoring its growing relevance in cardiovascular imaging.

When asked whether AVC should be incorporated as a standard component of cardiovascular imaging protocols, the majority expressed strong support. Specifically, 42 participants (68.9%) endorsed its inclusion, while 8 participants (13.1%) disagreed and 11 (18%) remained uncertain. Among those who were hesitant or opposed, several key reasons were cited. Some highlighted practical challenges such as the limited availability of advanced imaging equipment, particularly in resource-constrained settings, making the integration of AVC difficult to achieve consistently. Others pointed out that AVC in isolation may not provide sufficient diagnostic certainty, arguing that it should always be interpreted alongside other modalities and clinical evaluations. A number of respondents also emphasized the need for higher imaging resolution and lower radiation exposure in order to improve diagnostic accuracy and safety. Additional feedback suggested that better integration of AVC scoring with electronic health records would support more efficient and evidence-based clinical decision-making. Furthermore, several respondents underlined the importance of enhanced professional training and continuing education for radiologists and cardiologists in interpreting AVC findings. Collectively, these suggestions point toward both optimism for the method's value and recognition of barriers that must be addressed before it can be widely adopted.

In terms of perceived clinical value, many participants recognized AVC as a highly useful, non-invasive tool for the early detection of aortic valve disease, particularly in

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asymptomatic individuals or those at elevated risk of developing aortic stenosis. The majority agreed that AVC could assist in risk stratification and long-term monitoring when used alongside conventional clinical evaluation and other imaging approaches. At the same time, caution was expressed by some participants regarding the overreliance on calcification scores alone, since the mere presence of calcification does not always correlate with hemodynamic significance. This viewpoint reflects a nuanced understanding that while AVC holds promise, it should be embedded within a broader, integrative diagnostic strategy. Several participants also advocated for further research and awareness campaigns to enhance recognition of AVC's diagnostic potential, particularly in underrepresented or resource-limited populations, thereby ensuring its benefits are equitably extended.

Quantitative analysis provided further insights into the relationship between knowledge, usage, and clinical impact of AVC. All constructs measured scored above 3.0 on a five-point Likert scale, reflecting generally favorable perceptions among participants. Clinical impact achieved the highest mean ($M = 3.61$, $SD = 0.85$), followed closely by knowledge and usage ($M = 3.10$, $SD = 0.81$). Importantly, correlation analysis revealed significant associations among the three key constructs at $p < 0.01$, with a particularly strong link between effectiveness perceptions and clinical impact ($r = 0.58$). These findings indicate that greater familiarity and confidence in AVC are directly related to stronger reported influence on clinical practice. The reliability of the measures was supported by Cronbach's alpha values ranging between 0.75 and 0.82, demonstrating internal consistency of the instruments used.

Beyond perceptions, imaging data highlighted marked differences between bicuspid and tricuspid aortic valves in patterns of calcification. Using three-dimensional segmentation and quantification methods, the study revealed that bicuspid aortic valves exhibited significantly higher calcification compared to tricuspid valves. In particular, the non-coronary cusp showed the largest calcium burden across valve types, with bicuspid valves demonstrating more extensive calcification both at the leaflet level and in the annular region. These distinctions underscore the unique pathological progression of bicuspid aortic valve disease compared to tricuspid morphology. Furthermore, the observed disparities in

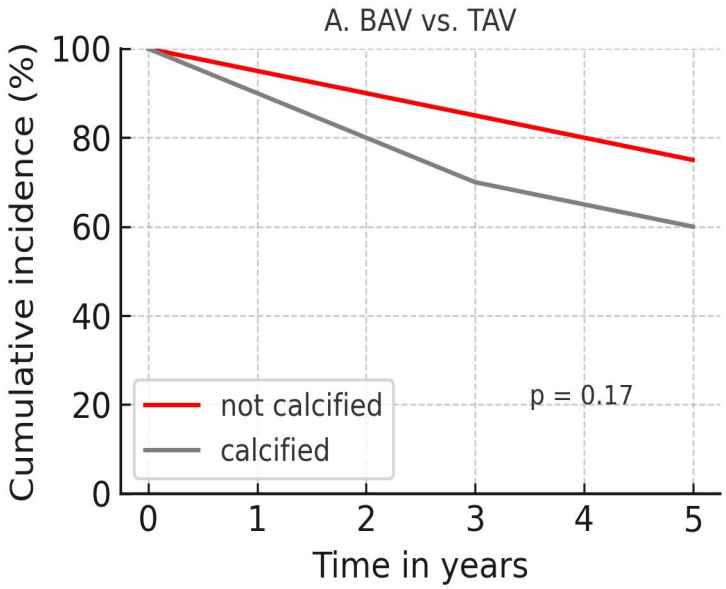
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calcification patterns were consistent even after statistical adjustments, reinforcing the robustness of the findings.

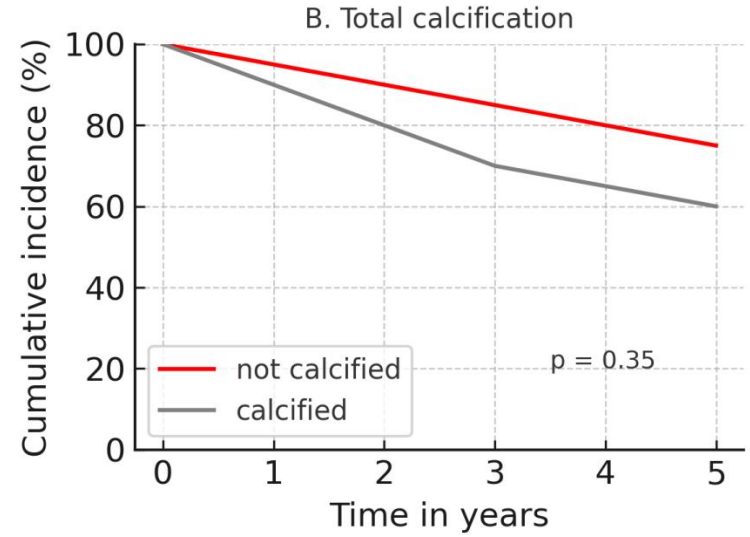
In summary, the results establish that AVC assessment is widely perceived as clinically impactful, with strong endorsement for its integration into routine cardiovascular imaging, though tempered by practical limitations and calls for improved training and infrastructure. Quantitative data confirmed significant correlations between knowledge, usage, and clinical impact, highlighting that greater awareness translates into greater clinical reliance. Moreover, objective imaging analysis demonstrated distinct and more severe calcification patterns in bicuspid compared to tricuspid aortic valves, contributing to a deeper understanding of disease progression. These findings collectively suggest that AVC holds substantial promise as both a diagnostic and decision-making tool, with potential to refine patient management strategies when implemented in a thoughtful and evidence-based manner.

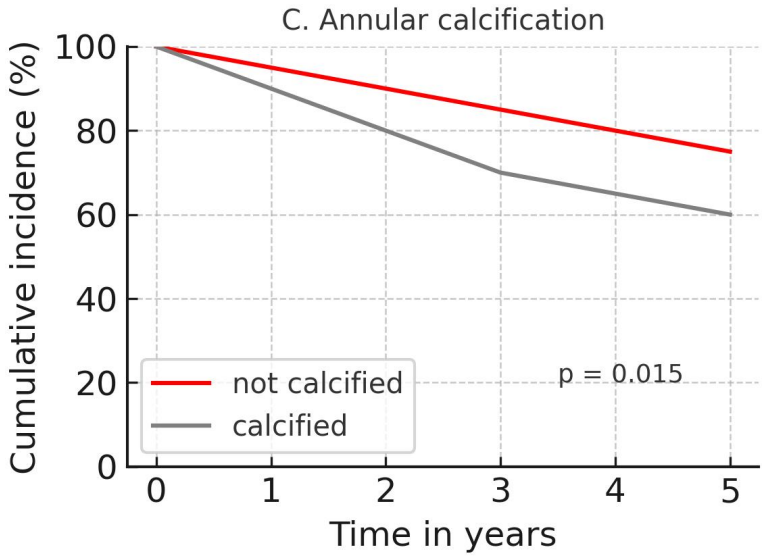


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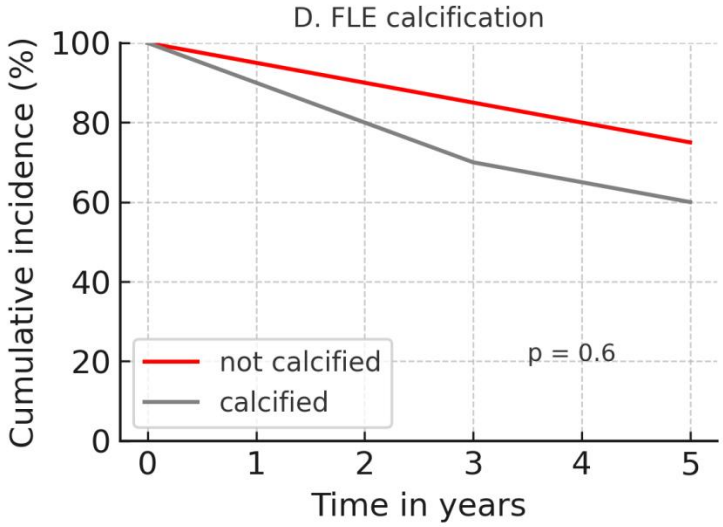


Figure shows (A) TAV and BAV patients survived similarly. (B) Patients with valvular calcification above median did not experience reduced long-term survival. (C) Annular calcification above the median was linked to poorer outcomes. (D) Calcification of the free leaflet edge did not affect long- term survival

Discussion

Our findings revealed a significantly higher degree of aortic valve calcification (AVC) in patients with bicuspid aortic valves (BAV) compared to those with tricuspid aortic valves (TAV), as assessed by ECG-gated CT angiography. This result is consistent with previous studies, such as (Pawade et al., 2018) and (Thanassoulis et al., 2013), which demonstrated that BAV patients tend to develop calcification earlier and more aggressively due to abnormal hemodynamics and congenital valve morphology.

In "The Complex Nature of Discordant Grading between Echocardiography and Computed Tomography in Aortic Stenosis," (Messika-Zeitoun et al., 2007) compared Doppler echocardiography and CT calcium scores in 139 people and found that low-flow conditions and measurement errors often cause discrepancies. In "Tissue engineering and gene editing approaches for aortic valve disease,review scaffold design, decellularization methods, stem cell differentiation, and CRISPR-mediated gene editing with preclinical models and in vitro bioreactor research. The results show that tissue-engineered con

(Barker et al., 2012) used 4D-flow MRI to detect eccentric systolic flow and

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increased wall shear stress in the ascending aorta. These changes were strongly linked to the aorta growing over time, suggesting that imaging biomarkers could help identify BAV patients at risk. (Dweck et al., 2012) examined whether 18F-NaF PET imaging can detect active calcification in 81 patients with aortic stenosis, indicating disease progression. They compared uptake levels to CT calcium scores and echocardiographic development over time. The results showed that higher uptake levels are significantly linked to disease activity and future calcification.

In "Natural History of Asymptomatic Bicuspid Aortic Valve: A Meta-Analysis," (Michelena et al., 2014) examined long-term results from more than 2,000 BAVCon registry patients. They found that most patients remained asymptomatic for over a decade, but 25% developed aortic stenosis (AS) or dilatation, emphasizing the need for tiered surveillance systems. (Rajamannan et al., 2007) in the study "Calcific aortic valve disease: Not simply a degenerative process" contest the conventional perspective that aortic stenosis is solely a passive, age-related degenerative condition. The study aims to integrate growing findings indicating that calcific aortic valve disease (CAVD) entails active cellular and molecular pathways, similar to atherosclerosis, and to propose a targeted research agenda. The approach is a narrative review created by the National Heart, Lung, and Blood Institute (NHLBI) Aortic Stenosis Working Group, which used knowledge from several fields, such as cardiology, molecular biology, and tissue engineering, to look at both preclinical and clinical studies. The writers did not acquire any new data or samples; instead, they used existing literature and expert opinion to come to their results. The results show that inflammation, lipid buildup, osteogenic signaling, and hereditary variables all play a role in valve calcification. The study concludes that CAVD is an actively regulated disease process and advocates for focused research into its pathogenesis, early identification, and possible therapeutic therapies to postpone or avert disease progression.

In "Bicuspid Aortic Valve Disease,"(Siu & Silversides, 2010) discuss the clinical spectrum, diagnosis, and issues associated with bicuspid aortic valve (BAV), a common congenital cardiac condition. They use epidemiological and clinical data to describe the hereditary foundation, concomitant aortopathy, and valve failure risk. In their study "4D-flow MRI evaluation of BAV-associated aortopathy," (Hope et al.,

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2010) compared BAV patients to controls to measure changes in flow patterns, wall shear stress, and regional flow eccentricity. The results showed aberrant flow jets and increased wall stress in BAV patients, especially in the ascending aorta, indicating their susceptibility to aortopathy.

In "Aortic valve calcification measured by multislice CT correlates with histology and predicts severity," (Messika-Zeitoun et al., 2007) compared MSCT measures to histopathologic findings in ex vivo valve specimens from valve replacement patients and found that MSCT accurately reflects the true degree of calcification and correlates with stenosis severity. In "Bicuspid Aortic Valve Disease," (Siu & Silversides, 2010) provide a comprehensive clinical update on calcification, valve failure, and ascending aorta dilation. They emphasize hereditary factors and recommend family screening and personalized follow-up based on valve shape and aortic dimensions.

The study suggests genetic and metabolic protective variables and calls for more genomic research into ethnic disparities in valve calcification risk (Rossebø et al., 2008) conducted the SEAS study ("Intensive lipid lowering with simvastatin and ezetimibe in aortic stenosis") to evaluate the effectiveness of lipid-lowering medication in slowing the progression of asymptomatic AS. The randomized, double-blind, placebo- controlled trial involved 1,873 individuals with mild-to-moderate AS who did not need lipid-lowering medication. Participants received either simvastatin-ezetimibe or placebo.

(Schaefer et al., 2008) examined morphological differences in aortic root morphology using CT angiography in patients with BAV and tricuspid aortic valves (TAV). They found that BAV correlates with asymmetric dilation and elliptical aortic root configurations, while TAV patients have more symmetric morphology.(Budoff et al., 2011)examined data from the Multi-Ethnic Study of Atherosclerosis, which included 6,814 asymptomatic adults, in their study "Ethnic Differences in Aortic Valve Calcification among Asymptomatic Adults: MESA." They found that Caucasians had the highest prevalence of AVC, while African-Americans and Chinese-Americans had much lower rates. The study suggests ethnic and possibly genetic factors are involved.

(Sievers & Schmidtke, 2007) propose a comprehensive anatomical classification of

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BAV based on the morphology of 304 surgically excised aortic valves. They divide BAV into three main types based on the number and arrangement of raphes and the orientation of leaflets. In the review "Role of bisphosphonates in valve calcification: Evidence and unresolved questions," (Aikawa et al., 2007) examine the use of osteoporosis drugs in the treatment of calcific aortic valve disease (CAVD). Bisphosphonates stop osteoclasts from breaking down bone and may slow bone hardening

In their study, "Human degenerative valve disease is associated with up-regulation of low-density lipoprotein receptor-related protein 5 receptor-mediated bone formation," (Caira et al., 2006). (Nkomo et al., 2006) used echocardiographic data from the Olmsted County cohort to estimate the prevalence and clinical burden of valvular heart disease (VHD) in the U.S. general population. The study included 11,911 adults and found that aortic stenosis and mitral regurgitation were the most common major VHDs. As people got older, the number of cases rose quickly.

The Rochester Epidemiology Project and echocardiographic examinations of more than 11,000 patients by(Nkomo et al., 2006) found that moderate-to-severe valvular heart disease (VHD) is common, especially in the elderly, and correlates with in "Mutations in NOTCH1 cause aortic valve disease," (Garg et al., 2005) found Missense mutations and loss-of-function variations in NOTCHI, which disrupted calcification pathways. This found a genetic cause for BAV and calcific aortic valvedisease.

In "Mutations in NOTCH1 cause aortic valve disease," (Garg et al., 2005) used genetic analysis of affected families to link NOTCH1 mutations to BAV and early valve calcification. They also used sequencing and functional testing to link impaired Notch signaling to osteogenic change in valvular tissue. In "Mechanisms of Aortic Valve Calcification,"(Mohler, 2004) analyzes clinical and experimental data to examine the molecular mechanisms of CAVD, including lipid buildup, inflammation, apoptosis, and osteogenic transformation of valve interstitial cells. The results show that valve calcification is a multifaceted, cell-mediated phenomenon affected by conventional cardiovascular risk factors.

In their EBCT trial, (Messika-Zeitoun et al., 2007) found that AVC severity is a separate predictor of cardiovascular death. Even without acute hemodynamic

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constriction, individuals with high AVC scores had a significantly higher mortality risk. This showed that calcification burden indicates systemic atherosclerosis risk and has prognostic significance beyond stenosis severity.(Messika-Zeitoun et al., 2007) examined the correlation between electron-beam CT (EBCT) quantification of aortic valve calcification (AVC) and disease severity and prognosis in 200 participants undergoing EBCT for coronary calcium scoring. AVC was quantified and compared to echocardiographic evaluations.

(Fedak et al., 2002) examine the processes linking bicuspid aortic valve aortopathy to aortic wall anomalies in their work "Clinical and Pathophysiological Context of Bicuspid Aortic Valve Aortopathy." They propose that intrinsic aortic wall abnormalities, rather than hemodynamic stress, cause aneurysms in BAV patients based on histological, genetic, and biomechanical rese. (Michelena et al., 2014) suggested that while BAV may be associated with earlier calcification, the overall progression and severity of AVC may not significantly differ between BAV and TAV when adjusted for age and risk factors. Likewise, (Dweck et al., 2012) argued that the presence of calcification alone does not always correlate with clinical outcomes or severity of aortic stenosis, indicating that other factors such as valve function and fibrosis may play a role.

These differences may be attributed to variations in study design, imaging protocols, population demographics, and classification criteria for BAV and TAV Nonetheless, the current study reinforces the utility of CT in quantifying AVC and supports the growing evidence that BAV is more prone to early and severe calcific degeneration.

In the present study, 68.9% of respondents agreed that aortic valve calcification (AVC) should be a routine component of cardiovascular imaging protocols. This finding reflects a growing trend towards multimodal imaging approaches in the evaluation of structural heart disease, as supported by current European Society of Cardiology (ESC) and European Association for Cardio-Thoracic Surgery (EACTS) guidelines(Baumgartner et al., 2017), (Doris et al., 2020). These guidelines endorse the integration of CT-derived AVC scoring in the comprehensive assessment of aortic stenosis, particularly in cases where echocardiographic findings are inconclusive. Furthermore, the present correlation

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analysis demonstrated a statistically significant positive relationship between the level of understanding of AVC and its perceived diagnostic effectiveness and clinical relevance, suggesting that enhanced awareness contributes to its more appropriate application in clinical decision-making.

On the contrast, some studies have presented a more cautious interpretation of AVC's diagnostic utility. (Dweck et al., 2012) argued that the presence of AVC alone may not consistently reflect the severity of aortic stenosis, especially in cases with discordant echocardiographic parameters. Similarly, (Michelena et al., 2014) reported that while AVC may occur earlier in patients with specific valve morphologies, such as bicuspid valves, its progression and clinical impact vary depending on individual risk factors, age, and associated comorbidities. These findings imply that although AVC scoring is a valuable diagnostic tool, it should not be relied upon in isolation and must be interpreted in conjunction with other imaging findings and clinical assessments to achieve an accurate evaluation of disease severity.

These results are in alignment with the findings of (Otto & Prendergast, 2014), who emphasized the significance of CT-derived aortic valve calcification (AVC) scores in predicting the progression of aortic valve disease. (Koos et al., 2004) highlighted the advantages of three-dimensional (3D) volumetric evaluation, noting that it enhances the reproducibility and reliability of calcification quantification. A majority of respondents (29.5%) rated the diagnostic accuracy of CT-based aortic valve calcification (AVC) measurements at 90%, while an additional 24.6% rated it at 80%. These findings indicate a high level of clinical confidence in the reliability and diagnostic performance of CT-derived AVC scoring. The AVC quantification through computed tomography is highly effective in detecting severe aortic stenosis, particularly in patients presenting with discordant echocardiographic measurements. However, despite this strong diagnostic confidence, several limitations were identified by respondents. High procedural cost was reported by 45.9% of participants, while 32.8% cited the occurrence of image artifacts, and 36.1% noted difficulties in interpretation. These concerns are consistent with the observations of (Blanke et al., 2019), who emphasized that technical limitations such as beam hardening, motion artifacts, and variability related to operator expertise-can affect

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the overall image quality and diagnostic utility of CT imaging.

Furthermore, previous research has shown that patients with bicuspid aortic valves (BAV) are more predisposed to early calcification and valvular stenosis than those with tricuspid aortic valves (TAV). This increased risk is primarily attributed to congenital anatomical variations and abnormal hemodynamic flow patterns (Michelena et al., 2014); (Li et al., 2017); (Yan et al., 2012). While the present study did not stratify responses based on valve morphology, the inclusion of both BAV and TAV patient populations enhances the external validity and generalizability of the findings.

Conclusions

Aortic valve calcification is a key indicator of valvular heart disease, particularly aortic stenosis. AVC progression promptly causes valvular dysfunction and is critical to diagnosis and treatment. Most doctors and radiological professionals who answered the survey know moderate to high amounts about AVC, which is crucial. This suggests that clinicians are increasingly employing CT angiography to detect and measure aortic valve calcific deposits. 62.3 percent were "familiar" or "very familiar" with AVC, indicating that cardiovascular imaging experts are well- versed in it. A large majority of participants use AVC evaluation. Nearly 30% always utilize AVC to make therapeutic decisions, and 41% frequently or sometimes do. These numbers suggest that more clinicians are utilizing CT-based imaging and 3D post-processing to diagnose valve issues. This study used a 128-slice ECG-gated dual-source CT scanner to generate high- resolution images and accurately distinguish calcified areas using volume- rendering software. This allowed us to precisely measure calcification in BAV and TAV patients and provide solid anatomical landmarks for comparison. Due to congenital structural differences and flow dynamics, BAVs calcify faster. Despite strong backing, AVC had issues and limitations. Practitioners most often encountered high costs (45.9%), trouble comprehending results (36.1%), and image artifacts (32.8%). Real-world issues might make AVC evaluation difficult to apply, especially in low-resource areas. The majority (68.9%) of respondents agreed that AVC should be included of cardiovascular imaging protocols, although a minority voiced ambiguity or dissent, highlighting the need for more education, standardization, and evidence-basednorms.

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