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Original Article

Precision in Practice: Assessing Concordance Between Physician Visual Assessment and Quantitative Coronary Analysis for Stenosis Severity in CAD Patients at Shifa International Hospital

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Abstract

Background: Coronary Artery Disease (CAD) is a leading cause of mortality globally, necessitating accurate assessment of stenosis severity for optimal clinical management. Physician Visual Assessment (PVA) is commonly used in practice, but its subjective nature raises concerns about accuracy. Quantitative Coronary Analysis (QCA) offers a more objective method for evaluating stenosis severity. This study investigates the concordance between PVA and QCA in determining stenosis severity among CAD patients at Shifa International Hospital.

Objective: To evaluate the level of concordance between Physician Visual Assessment (PVA) and Quantitative Coronary Analysis (QCA) in assessing the severity of coronary artery stenosis in patients with CAD.

Methods: This retrospective cross-sectional study was conducted at the Cardiac Catheterization Department of Shifa International Hospital over a two-month period. A total of 105 CAD patients undergoing PCI were included. Lesions were evaluated by PVA during coronary angiography and subsequently assessed by QCA using Siemens Artis Zee software. The lesions were categorized into four severity groups: <50%, 50-69%, 70-89%, and 90-99%. Concordance between PVA and QCA was analyzed using independent sample t-tests with a 95% confidence level, and results were processed using SPSS version 25. Ethical approval was obtained from the Institutional Review Board (IRB) of Shifa International Hospital.

Results: The study population comprised 77% males and 23% females, with the majority aged between 51-70 years. The <50% stenosis category showed significant differences between PVA and QCA, with mean stenosis values of 34.66% (SD = 6.7) for PVA and 42.22% (SD = 7.3) for QCA ($p < 0.001$). Similarly, in the 50-69% category, the mean stenosis values were 56.83% (SD = 6.2) for PVA and 63.79% (SD = 4.5) for QCA ($p < 0.001$). However, in the 70-89% and 90-99% categories, the mean differences were not statistically significant, with p-values of 0.36 and 0.21, respectively.

Conclusion: The study revealed low concordance between PVA and QCA in the <50% and 50-69% stenosis categories, suggesting that visual assessment alone may not be sufficient for accurate evaluation in these cases. QCA should be utilized alongside PVA to enhance diagnostic accuracy and improve treatment decisions, particularly for mild to moderate stenosis.

1 Introduction

Coronary artery disease (CAD) remains the leading cause of mortality worldwide, representing a significant public health concern due to its impact on global morbidity and mortality rates. The coronary arteries, which encircle the heart, play a vital role in supplying oxygen-rich blood to the heart muscle, a function that is critical for maintaining cardiovascular health. The pathogenesis of CAD involves the gradual narrowing and hardening of these arteries, a process often exacerbated by the buildup of plaque composed of cholesterol and other substances within the arterial walls—a condition known as atherosclerosis. This progressive narrowing restricts blood flow, depriving the heart muscle of essential oxygen and nutrients, which can lead to angina, myocardial infarction, or sudden cardiac death (1,-3). The urgency of accurate diagnosis and management of stenosis in CAD is underscored by the need to prevent these life-threatening events.

Coronary angiography, the gold standard for evaluating the presence and severity of coronary stenosis, is a critical diagnostic tool in the management of CAD. This imaging technique allows for the detailed visualization of coronary arteries, enabling clinicians to identify

blockages and guide therapeutic interventions. Typically, stenosis severity is assessed through Physician Visual Assessment (PVA) during or shortly after coronary angiography. PVA, while widely used, is subject to variability due to the subjective nature of visual estimation, leading to potential discrepancies in clinical decision-making. Quantitative Coronary Analysis (QCA), an advanced technique that utilizes specialized software for objective measurement of coronary lesions, has emerged as a more precise method for assessing stenosis severity. QCA provides an operator-independent, reproducible quantification of coronary lesions, which is crucial for guiding percutaneous coronary interventions (PCI) and improving patient outcomes (4-6).

The limitations of PVA are well-documented, particularly in its tendency to either overestimate or underestimate stenosis severity. This variability poses significant challenges in the accurate assessment of coronary lesions, particularly in intermediate stenosis cases where treatment decisions hinge on precise measurements. Studies have shown that visual estimation often underestimates stenosis severity in arteries with less than 50% narrowing and overestimates it in those with more than 50% stenosis, leading to potential overuse or underuse of PCI, which carries risks such as in-stent restenosis (ISR) and in-stent thrombosis (IST) (3, 7, 8). The advent of QCA has provided a means to address these limitations by offering a more consistent and accurate assessment of stenosis severity, thereby enhancing the reliability of diagnostic evaluations and reducing the likelihood of unnecessary interventions (10-12, 14).

In this context, the comparison between PVA and QCA has become increasingly relevant, particularly in ensuring that clinical decisions are based on the most accurate data available. Previous studies have highlighted the discrepancies between PVA and QCA, especially in the evaluation of intermediate lesions, where the greatest variability has been observed. The ability of QCA to provide a precise measurement of coronary stenosis has made it an indispensable tool in interventional cardiology, offering a level of accuracy that visual assessment alone cannot match. The importance of integrating QCA into routine clinical practice is underscored by its potential to improve patient outcomes by ensuring that interventions are both necessary and appropriately targeted (9, 10).

This study aims to assess the concordance between PVA and QCA in determining the severity of coronary stenosis among patients at Shifa International Hospital, with a focus on identifying the extent of agreement between these two methods. By examining the differences and similarities in stenosis severity assessments, this research seeks to contribute to the growing body of evidence supporting the use of QCA as a complementary tool to PVA in the management of CAD, ultimately enhancing the precision of treatment decisions and improving cardiovascular care (4, 5).

2 Material and Methods

This retrospective cross-sectional study was conducted in the Cardiac Catheterization Department of Shifa International Hospital, Islamabad, over a period of two months, from April 16th to June 16th, following approval from the Institutional Review Board (IRB) of Shifa International Hospital. The study aimed to assess the concordance between Physician Visual Assessment (PVA) and Quantitative Coronary Analysis (QCA) in determining the severity of coronary artery stenosis in patients diagnosed with coronary artery disease (CAD). The research adhered strictly to the ethical principles outlined in the Declaration of Helsinki, ensuring the protection of participants' rights and the integrity of the research process (1).

The study population comprised patients who underwent coronary angiography within the specified period. A total of 105 patients were included, with a calculated sample size of 103, as determined by the WHO sample size calculator. The inclusion criteria encompassed patients with acute coronary syndrome (ACS) who had lesions evaluated in multiple views during coronary angiography. Patients with chronic total occlusion (CTO), prior coronary artery bypass grafting (CABG), 100% acute occlusion, or overlapping vessels were excluded from the study, as these conditions were either not comparable by both PVA and QCA or represented limitations of the QCA technique.

Data collection was meticulously carried out using a structured approach. Demographic data, including age, gender, and relevant medical history, were recorded for each patient. The coronary angiography was performed using the Siemens Artis Zee system, and the lesions were evaluated by PVA at the time of the procedure by experienced interventional cardiologists. Subsequently, a blinded QCA review of each lesion was conducted by a second operator using the same Siemens Artis Zee system. The QCA was performed independently, with the operator blinded to the PVA results, ensuring an unbiased assessment of stenosis severity. The lesions were classified into four categories based on stenosis severity: less than 50%, 50-69%, 70-89%, and 90-99%.

Data analysis was conducted using SPSS version 25.0, with both qualitative and quantitative variables assessed. Categorical variables, such as gender and lesion location, were presented as percentages, while continuous variables, such as age and the extent of stenosis, were expressed as mean and standard deviation. The concordance between PVA and QCA in the different stenosis categories was evaluated using independent sample t-tests, with a 95% confidence level and a significance threshold set at $p < 0.05$. This statistical analysis was aimed at determining the level of agreement between the two assessment methods and identifying any significant discrepancies.

Throughout the study, the confidentiality and anonymity of the participants were maintained, and all data were securely stored and accessible only to the research team. Participants' informed consent was obtained prior to their inclusion in the study, in accordance with ethical guidelines, ensuring that they were fully aware of the study's purpose and procedures. The study's design and methodology were aligned with best practices in clinical research, ensuring the reliability and validity of the findings (2).

This section outlines the study's methodology with a focus on ensuring that the procedures and ethical considerations adhered to standard practices in medical research.

3 Results

The study included a total of 105 patients who underwent percutaneous coronary intervention (PCI) for 165 coronary lesions. The demographic characteristics of the study population showed that 77% (n=81) of the patients were male, while 23% (n=24) were female. The age distribution revealed that the majority of the patients were within the 51-60 and 61-70 age groups, each accounting for 31% (n=33) of the population, followed by the 41-50 age group at 12% (n=13), and the 81-90 age group at 5% (n=5). Only 4% (n=4) of patients were in the 30-40 age group.

Figure 1: Gender-wise Distribution of Patient

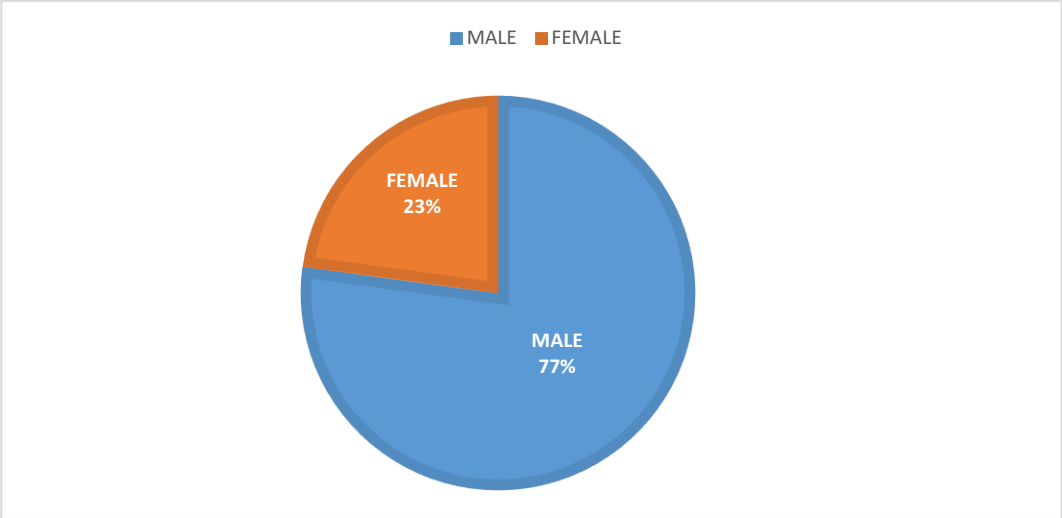


Figure 2: Age-wise Distribution of Patients

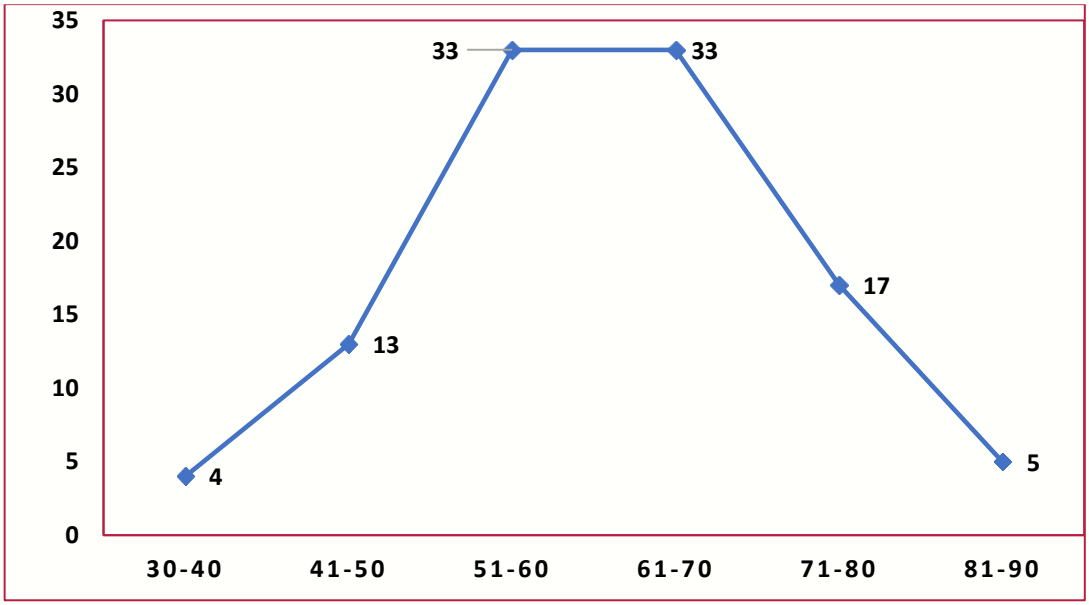


Figure 3: Patients with Prior PCI and Resent PCI

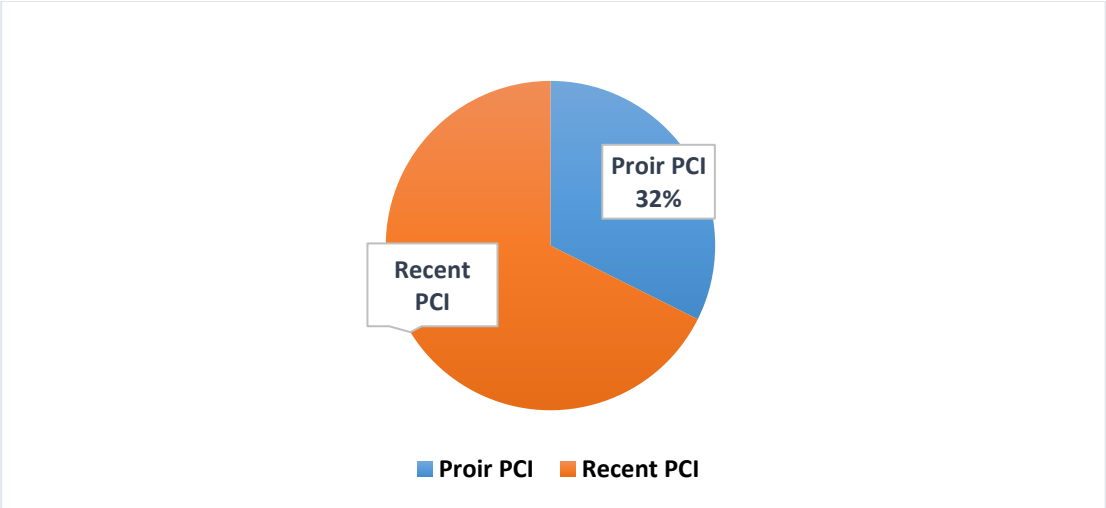


Figure 4: Lesions Location Associated with Patients

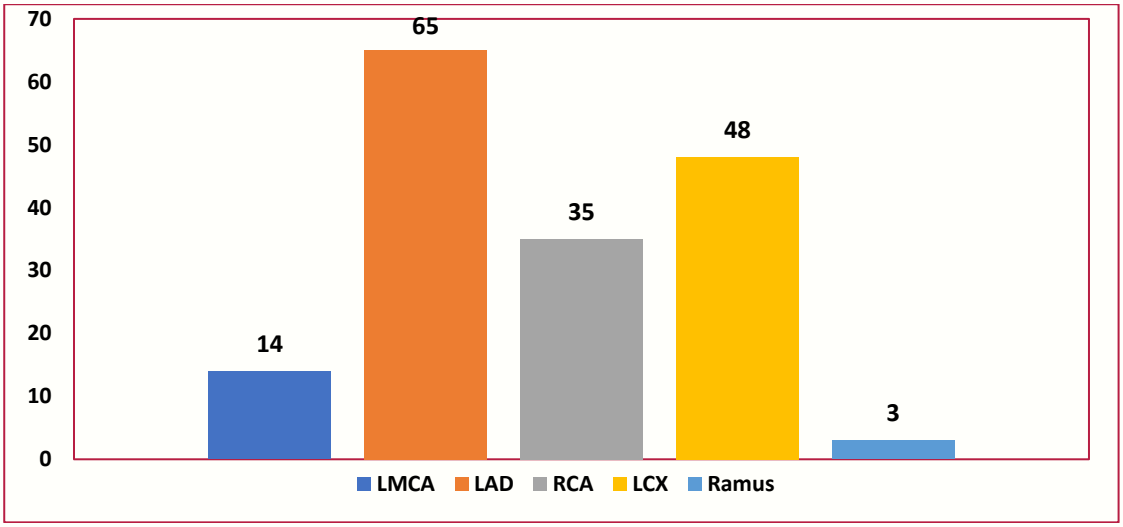
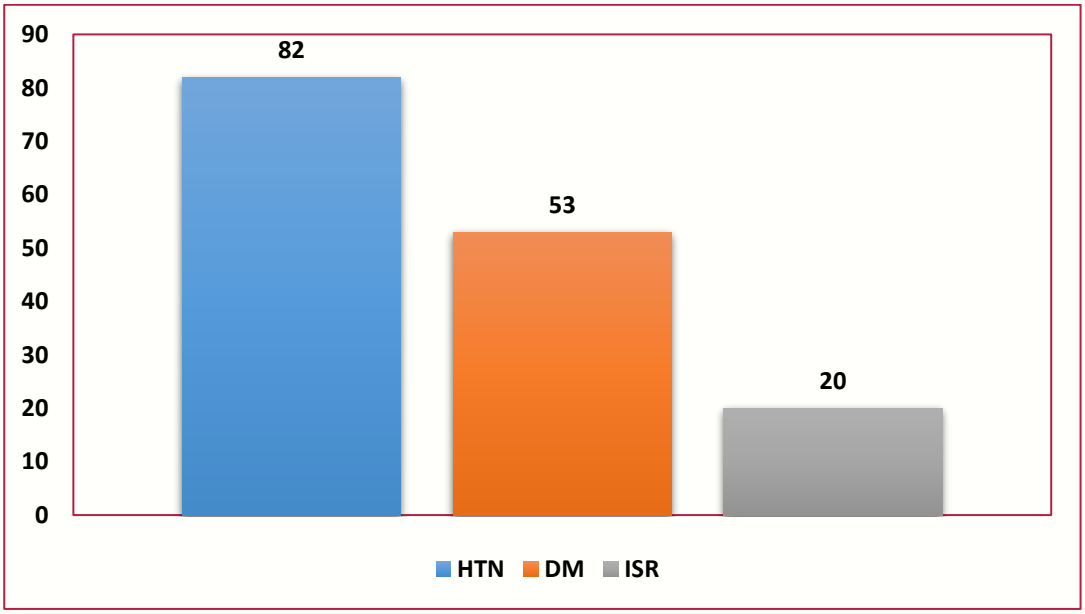


Figure 5: Co-morbidities Associated with Patients



The prevalence of prior PCI was also assessed, with 32% (n=34) of the patients having undergone a previous PCI, while 68% (n=71) were undergoing PCI for the first time. The location of the coronary lesions was predominantly in the left anterior descending artery (LAD), where 39% (n=65) of the lesions were found. The left circumflex artery (LCX) accounted for 29% (n=48), the right coronary artery (RCA) for 21% (n=35), the left main coronary artery (LMCA) for 8% (n=14), and the ramus artery for 3% (n=3).

The co-morbidities associated with the study population were also recorded, with hypertension (HTN) being the most common, present in 78% (n=82) of the patients. Diabetes mellitus was reported in 50.4% (n=53) of the patients, while 19% (n=20) of the patients had in-stent restenosis (ISR).

The main objective of the study was to assess the concordance between PVA and QCA in determining the severity of coronary artery stenosis. Lesions were categorized into four groups based on stenosis severity: <50%, 50-69%, 70-89%, and 90-99%. The findings revealed significant discrepancies between PVA and QCA in the <50% and 50-69% categories, while concordance was higher in the 70-89% and 90-99% categories.

Concordance between PVA and QCA for Lesions <50% and 50-69%

The <50% stenosis category included 35 lesions as assessed by PVA and 49 lesions as assessed by QCA. The mean stenosis for PVA was 34.66% (SD = 6.7), while for QCA, it was 42.22% (SD = 7.3), with a statistically significant difference ($p < 0.001$), indicating low concordance between the two methods. Similarly, in the 50-69% stenosis category, PVA identified 18 lesions, while QCA identified 42 lesions. The mean stenosis for PVA was 56.83% (SD = 6.2), and for QCA, it was 63.79% (SD = 4.5), also showing a significant difference ($p < 0.001$) (Table 1).

Table 1: Concordance Between Physician Visual Assessment (PVA) and Quantitative Coronary Analysis (QCA) for Lesions <50% and 50-69% Stenosis

Lesion Severity	PVA (n)	Mean Stenosis PVA (%)	SD PVA	QCA (n)	Mean Stenosis QCA (%)	SD QCA	p-value
<50%	35	34.66	6.7	49	42.22	7.3	<0.001
50-69%	18	56.83	6.2	42	63.79	4.5	<0.001

As In the 70-89% stenosis category, PVA assessed 49 lesions, while QCA assessed 24 lesions. The mean stenosis for PVA was 78.20% (SD = 4.9), and for QCA, it was 77.75% (SD = 5.7), with no significant difference ($p = 0.36$), indicating good concordance between the two methods. Similarly, in the 90-99% stenosis category, PVA identified 61 lesions, while QCA identified 50 lesions. The mean stenosis for PVA was 92.07% (SD = 2.7), and for QCA, it was 91.07% (SD = 2.1), also showing no significant difference ($p = 0.21$) (Table 2).

Table 2: Concordance Between Physician Visual Assessment (PVA) and Quantitative Coronary Analysis (QCA) for Lesions 70-89% and 90-99% Stenosis

Lesion Severity	PVA (n)	Mean Stenosis PVA (%)	SD PVA	QCA (n)	Mean Stenosis QCA (%)	SD QCA	p-value
70-89%	49	78.20	4.9	24	77.75	5.7	0.36
90-99%	61	92.07	2.7	50	91.07	2.1	0.21

The results clearly indicate that while PVA and QCA show high concordance in the 70-89% and 90-99% stenosis categories, significant discrepancies exist in the <50% and 50-69% categories. This suggests that reliance on PVA alone in these lower stenosis ranges may lead to inaccurate assessments, potentially affecting clinical decision-making and patient outcomes. Quantitative Coronary Analysis should be considered alongside visual assessment to provide a more accurate evaluation of coronary lesions, particularly in cases of mild to moderate stenosis.

4 Discussion

The results of this study underscore the critical importance of employing precise methods for assessing coronary artery stenosis in patients with coronary artery disease (CAD). The comparison between Physician Visual Assessment (PVA) and Quantitative Coronary Analysis (QCA) revealed significant discrepancies in the assessment of stenosis severity, particularly in the <50% and 50-69% categories. These findings align with previous research, which has consistently demonstrated that visual estimation of stenosis is prone to variability and may lead to both overestimation and underestimation of lesion severity (2, 7). The reliance on PVA alone, as observed in this study, raises concerns about the potential for inappropriate clinical decisions, particularly in cases of mild to moderate stenosis where accurate assessment is crucial for determining the necessity and type of intervention.

The lack of concordance between PVA and QCA in the <50% and 50-69% stenosis categories can be attributed to the inherent subjectivity of visual assessments, which are influenced by factors such as operator experience and inter-observer variability. Previous studies have highlighted similar findings, where visual estimation was shown to underestimate stenosis in lesions with less than 50% narrowing and overestimate it in those with greater than 50% stenosis, leading to the risk of unnecessary percutaneous coronary interventions (PCI) and associated complications such as in-stent restenosis (ISR) and in-stent thrombosis (IST) (8, 10). The objective nature of QCA, which uses automated algorithms and precise measurements, offers a more reliable assessment and has been demonstrated to reduce these risks by providing a consistent evaluation of lesion severity.

In contrast, the higher concordance observed between PVA and QCA in the 70-89% and 90-99% stenosis categories suggests that visual assessment may be more accurate in cases of severe stenosis, where the extent of narrowing is more apparent. This finding is supported by earlier research indicating that visual estimation tends to be more reliable when assessing more significant lesions, likely due to the clearer demarcation of severe stenosis (13, 16,17). However, even in these categories, the study recommends the use of QCA to complement visual assessment, ensuring that all cases are evaluated with the highest degree of accuracy, thereby optimizing patient outcomes.

The strengths of this study include its rigorous methodology, the use of a blinded operator for QCA assessments, and the application of standardized statistical analyses, which together contribute to the reliability and validity of the findings. Additionally, the study's focus on a specific population at Shifa International Hospital provides valuable insights into the clinical practices within this setting, potentially guiding improvements in diagnostic accuracy and patient care. However, the study also has limitations, including its retrospective design, which may introduce selection bias, and the relatively small sample size, which may limit the generalizability of the results. Furthermore, the exclusion of certain patient groups, such as those with chronic total occlusion or prior coronary artery bypass grafting, may have excluded cases where the concordance between PVA and QCA could differ.

Despite these limitations, the study provides important recommendations for clinical practice. The findings suggest that QCA should be routinely used alongside visual assessment, particularly in cases of mild to moderate stenosis, to ensure that clinical decisions are based on the most accurate data available. This approach could reduce the risk of unnecessary interventions and associated complications, ultimately improving patient outcomes. Future research should focus on larger, multicenter studies to confirm these findings and explore the potential for integrating QCA into routine clinical workflows, particularly in settings where resources are available to support its widespread use.

In conclusion, this study highlights the critical role of Quantitative Coronary Analysis in enhancing the accuracy of stenosis assessment in patients with coronary artery disease. While visual assessment remains a valuable tool, its limitations, particularly in the evaluation of mild to moderate lesions, underscore the need for complementary techniques such as QCA. By integrating these methods, clinicians can make more informed decisions, ultimately leading to better management of CAD and improved patient care (1, 4, 9).

5 Conclusion

In conclusion, this study highlights the significant discrepancies between Physician Visual Assessment (PVA) and Quantitative Coronary Analysis (QCA) in evaluating the severity of coronary artery stenosis, particularly in lesions classified as <50% and 50-69% stenosis. The findings demonstrate that while PVA may be reliable in cases of severe stenosis (70-89% and 90-99%), it lacks the precision required for accurately assessing mild to moderate stenosis, leading to potential overestimation or underestimation of disease severity. This variability poses a risk of inappropriate clinical decisions, which could result in either unnecessary interventions or missed opportunities for timely treatment. The integration of QCA as a complementary tool to PVA is therefore recommended, as it provides a more objective and consistent measure of stenosis, ultimately leading to better-informed clinical decisions and improved patient outcomes. The study underscores the importance of adopting advanced diagnostic techniques in routine clinical practice, particularly in settings where accurate stenosis evaluation is critical for guiding therapeutic strategies in patients with coronary artery disease. Future research should focus on validating these findings across larger, diverse populations and exploring the practical implementation of QCA in various clinical environments to optimize cardiovascular care.

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Disclaimers

Author Contributions	Laiba Akhtar: Conceptualization, Methodology, Data Curation, Writing - Original Draft; Sajjad Ur Rahman: Formal Analysis, Investigation, Writing - Review & Editing; Atta Ul Wadood: Software, Validation, Data Curation, Visualization; Muhammad Irfan: Supervision, Project Administration, Writing - Review & Editing; Syed Arshad Ullah: Resources, Funding Acquisition, Supervision. All authors have read and approved the final manuscript.
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