Original paper

The role of aortic valve area in the quantitative flow ratio–fractional flow reserve discrepancy in patients with coronary artery disease and severe aortic stenosis

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Adv Interv Cardiol 2025; 21, 1 (79): 80–87
DOI: https://doi.org/10.5114/aic.2025.148118

Abstract

Introduction: The accuracy of fractional flow reserve (FFR) and quantitative flow ratio (QFR) in assessing coronary artery disease in severe aortic stenosis (AS) patients may be affected by the severity of AS.

Aim: We investigated the relationship between aortic valve area (AVA) and the diagnostic performance of QFR in this context.

Material and methods: We analyzed 416 intermediate coronary lesions in 221 severe AS patients using FFR and QFR, categorizing them based on AVA into two groups: AVA < 0.5 cm² and AVA ≥ 0.5 cm².

Results: In all, 47 (21.2%) patients had an AVA < 0.5 cm². The median FFR and QFR values were comparable between groups, with a high agreement rate: interclass coefficient of 0.96 (95% CI: 0.94 to 0.97) for AVA < 0.5 cm² and 0.97 (95% CI: 0.97 to 0.98) for AVA ≥ 0.5 cm². Concordance in detecting significant ischemia was 96.3% for AVA ≥ 0.5 cm² but dropped to 86.5% for AVA < 0.5 cm², with discrepancies mainly in cases where FFR was negative and QFR positive. Multivariable analysis showed AVA and %DS as independent predictors of discordance; AVA ≥ 0.5 cm² had an OR of 0.229 (95% CI: 0.095 to 0.548; $p < 0.001$), and each 1% increase in %DS increased the odds by 1.070 (95% CI: 1.034 to 1.107; $p < 0.001$).

Conclusions: In severe AS, QFR closely correlates with FFR. However, patients with AVA < 0.5 cm² might exhibit a higher incidence of false-positive ischemia detection by QFR.

Key words: aortic stenosis, fractional flow reserve, quantitative flow ratio, functional assessment, discordance.

Summary

This study investigated the relationship between aortic valve area (AVA) and the diagnostic performance of quantitative flow ratio (QFR) compared to fractional flow reserve (FFR) in patients with severe aortic stenosis (AS). The results demonstrated that while QFR closely correlated with FFR, patients with an AVA < 0.5 cm² had a higher likelihood of false-positive ischemia detection by QFR. The findings emphasize the need for cautious interpretation of QFR in such cases and highlight AVA and the percentage of diameter stenosis as independent predictors of diagnostic discrepancies. These insights could refine the physiological assessment of coronary lesions in severe AS patients.

Introduction

Effective diagnosis and management of severe aortic stenosis (AS) are critical, particularly due to its rising prevalence [1]. Aging populations face a greater incidence of concurrent diseases, with coronary artery disease (CAD) being particularly significant [2, 3]. Importantly, CAD is known to negatively impact the outcomes of transcatheter aortic valve implantation (TAVI) and surgical aortic valve replacement (SAVR), highlighting the critical need to assess CAD in this population [2–4]. However, evaluating the significance of intermediate coronary lesions in patients with severe AS is complex due to the multifactorial nature of myocardial ischemia in this group [5, 6].

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Received: 1.01.2025, **accepted:** 2.01.2025, **online publication:** 4.03.2025.

Thus, assessments should extend beyond visual angiographic evaluation to include more precise measures of myocardial ischemia through invasive methods. Physiological assessment of borderline lesions is currently performed through hyperemic techniques, such as fractional flow reserve (FFR), or non-hyperemic techniques, which include the instantaneous wave-free ratio (iFR), resting full-cycle ratio (RFR), and others that vary with the device manufacturer [5, 7, 8]. Additionally, the quantitative flow ratio (QFR), a non-invasive method based on computational fluid dynamics, offers virtual assessments of intermediate lesions from coronary angiograms [7, 9]. Prior studies have verified the robust performance of QFR in CAD patients, including those with severe AS [6, 10–15]. Nevertheless, the efficacy of physiological assessments in patients with severe AS remains controversial, as their accuracy may be compromised by the severity of AS, especially in those with a markedly low aortic valve area (AVA) [5, 15].

Aim

This study aims to examine the influence of AVA on the performance of QFR within the context of severe AS.

Material and methods

This study, conducted from 2018 to 2020, included a cohort of 221 patients diagnosed with severe AS, who were subjected to FFR evaluations for borderline coronary artery lesions of 40–90% diameter stenosis (%DS). Severe AS was defined as AVA < 1.0 cm^2 coupled with a mean aortic valve pressure gradient > 40 mm Hg. The patients were stratified based on their AVA into two groups: those with AVA < 0.5 cm^2 and those with AVA ≥ 0.5 cm^2. This cutoff was selected based on the receiver-operating characteristic (ROC) curve analysis as presented below. Protocols for FFR and QFR assessments are described in detail in previous papers [13, 16–18]. FFR measurements were conducted using an intravenous adenosine infusion at a rate of 140 µg/kg/min. QFR was calculated from three-dimensional quantitative coronary angiography (QCA) data (Medis Suite 2.1.12.2, Medis Medical Imaging System, the Netherlands), without the induction of pharmacological hyperemia. The QFR analysis, incorporating frame count techniques, was conducted on two distinct diagnostic angiographic projections by independent core laboratory analyzers. The selection of QFR pullbacks for analysis was based on optimal image quality, particularly the clarity of contrast flow delineation. Significant ischemia was defined by threshold values of ≤ 0.80 for both FFR and QFR measurements. Discordant results, specifically instances where FFR results were negative (FFR-) in the presence of positive QFR findings (QFR+), and the opposite scenario (FFR+|QFR-), were meticulously identified for further analysis. In addition, metrics from QCA were derived by two experienced analysts who were blinded to the outcomes of the physiological assessments. This analysis was conducted using the CAAS 5.7 QCA (Pie Medical, Maastricht, The Netherlands).

The study received approval (Approval No. 1072.6120.1.2019, issued on 31st January 2018) from the institutional ethical board of the Jagiellonian University Medical College and was conducted in adherence to the principles outlined in the 1975 Declaration of Helsinki. Informed consent was obtained from all study participants.

Statistical analysis

Categorical variables are presented as frequencies (percentages), and differences between groups were evaluated using the χ^2 test or Fisher's exact test, as appropriate. Due to the non-normal distribution of all continuous variables, these are presented as medians along with their interquartile ranges (IQRs), and comparisons across groups were made using the Mann-Whitney *U* test for independent variables. The agreement between FFR and QFR values was determined by calculating the intraclass correlation coefficient (ICC). The predictive accuracy of QFR for identifying FFR values ≤ 0.80 was evaluated using ROC curve analysis. Additionally, ROC curve analysis was employed to examine the predictive utility of AVA and %DS for identifying discrepancies between FFR and QFR results. The analyses provided unadjusted area under the curve (AUC) values accompanied by 95% confidence intervals (CIs). The optimal cutoff points for prediction were identified by maximizing the Youden index. Multivariable logistic regression analysis was utilized to identify predictors of discordance between FFR and QFR measurements, with results presented as odds ratios (ORs) and 95% CIs. All statistical tests were two-tailed, and a *p*-value < 0.05 was considered indicative of statistical significance. Data analysis was performed using IBM SPSS Statistics version 29.0.0 (IBM Corp, Armonk, NY, USA).

Results

Out of 221 patients with severe AS, 47 (21.2%) presented with AVA < 0.5 cm^2. Patients with lower AVA were older and had lower left ventricular ejection fraction. Moreover, they exhibited more pronounced symptoms of angina, although dyspnea symptoms were similar between the two groups (Table I). In the group with AVA < 0.5 cm^2, 89 (21.4%) lesions were evaluated, whereas 327 lesions were assessed in the group with AVA ≥ 0.5 cm^2. Distribution of the affected coronary vessels was similar in both groups, predominantly involving the left anterior descending artery (LAD). The severity of lesions was comparable between the groups; however, lesions with irregular contours were more common in the AVA < 0.5 cm^2 group (Table II).

Table I. Baseline characteristics of patients stratified by aortic valve area

Variable	Aortic valve area		*P*-value
	< 0.5 cm² (*n* = 47)	≥ 0.5 cm² (*n* = 174)	
Age [years] median (IQR)	85.0 (84.0, 89.0)	81.0 (71.0, 87.0)	< 0.001
Age ≥ 80 years, *n* (%)	39 (83.0)	90 (51.7)	< 0.001
Female, *n* (%)	29 (61.7)	101 (58.0)	0.65
Body mass index [kg/m²] mean (SD)	27.4 (4.4)	27.0 (4.5)	0.55
Arterial hypertension, *n* (%)	41 (87.2)	156 (89.7)	0.11
Diabetes mellitus, *n* (%)	22 (30.1)	40 (29.4)	0.91
Hyperlipidemia, *n* (%)	47 (100.0)	174 (100.0)	-
Smoking, *n* (%)	14 (29.8)	57 (32.8)	0.70
Previous MI, *n* (%)	14 (29.8)	59 (33.9)	0.59
Previous PCI, *n* (%)	11 (23.4)	59 (33.9)	0.17
Chronic kidney disease, *n* (%)	29 (65.9)	107 (64.8)	0.90
eGFR [ml/min/1.73 m²] median (IQR)	51.0 (39.0, 63.0)	50.0 (39.0, 66.0)	0.87
Atrial fibrillation, *n* (%)	11 (23.4)	52 (29.9)	0.38
Previous stroke, *n* (%)	8 (17.0)	21 (12.1)	0.38
Peripheral artery disease, *n* (%)	8 (17.0)	33 (19.0)	0.76
Chronic obstructive pulmonary disease, *n* (%)	7 (14.9)	19 (10.9)	0.45
Canadian Cardiovascular Society class, *n* (%)			
I + II	9 (19.1)	88 (50.6)	< 0.001
III	35 (74.5)	81 (46.6)	
IV	3 (6.4)	5 (2.8)	
New York Heart Association class, *n* (%)			
II	6 (12.8)	39 (22.4)	0.30
III	36 (76.6)	121 (69.5)	
IV	5 (10.6)	14 (8.0)	
Aortic valve parameters:			
TG max [mm Hg] median (IQR)	87.0 (73.0, 95.0)	96.0 (80.0, 106.0)	0.005
TG mean [mm Hg] median (IQR)	46.0 (42.0, 51.0)	50.0 (44.0, 62.0)	0.028
LVEF, %, median (IQR)	39.0 (32.0, 50.0)	50.0 (35.0, 60.0)	0.008

eGFR – estimated glomerular filtration rate, IQR – interquartile range, LVEF – left ventricle ejection fraction, MI – myocardial infarction, PCI – percutaneous coronary intervention, SD – standard deviation, TG – transaortic gradient.

Table II. Lesion characteristics in vessels stratified by aortic valve area

Variable	Aortic valve area		*P*-value
	< 0.5 cm² (*n* = 89)	≥ 0.5 cm² (*n* = 327)	
Vessel distribution, *n* (%)			
LAD	47 (52.8)	175 (53.5)	0.96
Dg	4 (4.5)	15 (4.6)	
Cx	14 (15.7)	50 (15.3)	
Mg	6 (6.3)	17 (5.2)	
RCA	18 (20.2)	70 (21.4)	
Quantitative coronary angiography results			
Lesion length [mm] median (IQR)	15.7 (10.5, 22.9)	16.5 (10.5, 23.4)	0.81
RVD [mm] median (IQR)	3.5 (3.0, 3.6)	3.4 (3.0, 3.7)	0.94
MLDm [mm] median (IQR)	1.3 (1.1, 1.7)	1.5 (1.1, 1.7)	0.12
DS, %, median (IQR)	57.0 (49.0, 73.0)	55.0 (48.0, 68.0)	0.33
Eccentric lesion, *n* (%)	42 (48.8)	149 (47.3)	0.80
Moderate/severe tortuosity, *n* (%)	32 (37.2)	107 (34.0)	0.58
Irregular contours, *n* (%)	13 (15.1)	24 (7.6)	0.033
Moderate/severe calcifications, *n* (%)	43 (50.6)	165 (52.9)	0.71
Ostial lesion, *n* (%)	6 (7.2)	22 (7.2)	0.99

Cx – circumflex artery, Dg – diagonal branch, DS – diameter stenosis, LAD – left anterior descending artery, LMCA – left main coronary artery, Mg – marginal branch, MLD – minimal lumen diameter, SD – standard deviation, RCA – right coronary artery, RVD – reference vessel diameter.

Table III. Results of fractional flow reserve (FFR) and quantitative flow ratio (QFR) assessment stratified by aortic valve area (per vessel)

Variable	Aortic valve area		*P*-value
	< 0.5 cm²	≥ 0.5 cm²	
All vessels	*n* = 89	*n* = 327	
FFR ≤ 0.80, *n* (%)	20 (22.5)	88 (26.9)	0.40
FFR, median (IQR)	0.87 (0.81, 0.89)	0.87 (0.80, 0.89)	0.68
QFR ≤ 0.80, *n* (%)	32 (36.0)	100 (30.6)	0.33
QFR, median (IQR)	0.86 (0.79, 0.89)	0.86 (0.79, 0.90)	0.50
LAD	*n* = 47	*n* = 175	
FFR ≤ 0.80, *n* (%)	14 (29.8)	61 (34.9)	0.51
FFR, median (IQR)	0.85 (0.80, 0.89)	0.85 (0.78, 0.88)	0.34
QFR ≤ 0.80, *n* (%)	18 (38.3)	71 (40.6)	0.78
QFR, median (IQR)	0.85 (0.78, 0.88)	0.84 (0.77, 0.88)	0.42
Non-LAD	*n* = 42	*n* = 152	
FFR ≤ 0.80, *n* (%)	6 (14.3)	27 (17.8)	0.60
FFR, median (IQR)	0.88 (0.81, 0.89)	0.89 (0.86, 0.90)	0.08
QFR ≤ 0.80, *n* (%)	14 (33.3)	29 (19.1)	0.049
QFR, median (IQR)	0.87 (0.79, 0.90)	0.89 (0.85, 0.90)	0.05
Concordance – general	*n* = 89	*n* = 327	
Concordant	77 (86.5)	315 (96.3)	< 0.001
Discordant	12 (13.5)	12 (3.7)	
FFR-|QFR-	57 (64.0)	227 (69.4)	0.002
FFR-|QFR+	12 (13.5)	12 (3.7)	
FFR+|QFR-	0 (0.0)	0 (0.0)	
FFR+|QFR+	20 (22.5)	88 (26.9)	

IQR – interquartile range, LAD – left anterior descending artery.

The median (IQR) FFR was 0.87 (0.80 to 0.89), and FFR ≤ 0.80 was observed in 26.0% of the vessels examined. The median (IQR) QFR was 0.86 (0.79 to 0.89), and QFR ≤ 0.80 occurred in 31.7% of the vessels evaluated. As shown in Table III, the distribution of FFR and QFR values was similar across the patient groups. The incidence of significant ischemia, defined as FFR ≤ 0.80 and QFR ≤ 0.80, was almost identical between the groups. A notable difference was observed in the frequency of positive QFR results only within the non-LAD subgroup ($p = 0.049$). The agreement between FFR and QFR was strong, indicated by ICC of 0.96 (95% CI: 0.95 to 0.96). This high level of agreement persisted across different AVAs. Specifically, for vessels in patients with AVA < 0.5 cm², the ICC was 0.96 (95% CI: 0.94 to 0.97), and for patients with AVA ≥ 0.5 cm², the ICC was 0.97 (95% CI: 0.97 to 0.98), as shown in Figure 1. The accuracy of QFR in detecting FFR ≤ 0.80 was high, with an AUC from the ROC analysis of 0.988 (95% CI: 0.981 to 0.995; $p < 0.001$). The diagnostic precision of QFR for detecting FFR ≤ 0.80 in patients with AVA < 0.5 cm² was similarly high, with an AUC of 0.969 (95% CI: 0.939 to 0.999; $p < 0.001$). The optimal QFR cutoff of 0.80 to identify FFR ≤ 0.80 provided a sensitivity of 82.6% and a specificity of 100.0%. Likewise, for patients with AVA ≥ 0.5 cm², the AUC for QFR in detecting FFR ≤ 0.80 was 0.993 (95% CI: 0.987 to 0.999; $p < 0.001$), with a sensitivity of 95.0% and a specificity of 100.0% at the optimal QFR cutoff of 0.80.

The concordance between FFR and QFR was high in patients with AVA ≥ 0.5 cm², showing agreement in

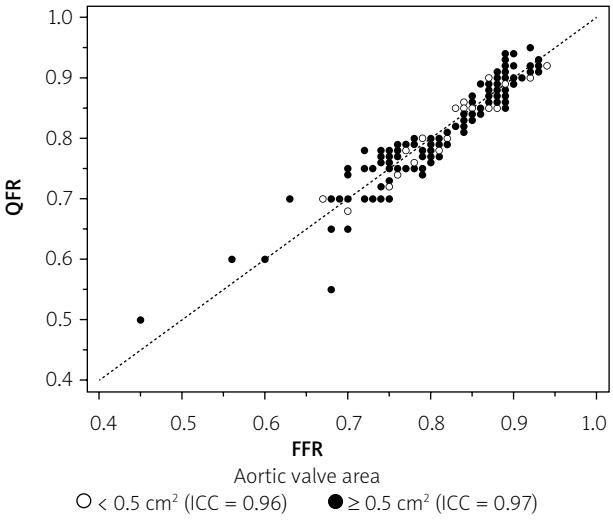

Figure 1. The relationship between fractional flow reserve (FFR) and quantitative flow ratio (QFR) in patients categorized by aortic valve area

ICC – intraclass correlation coefficient.

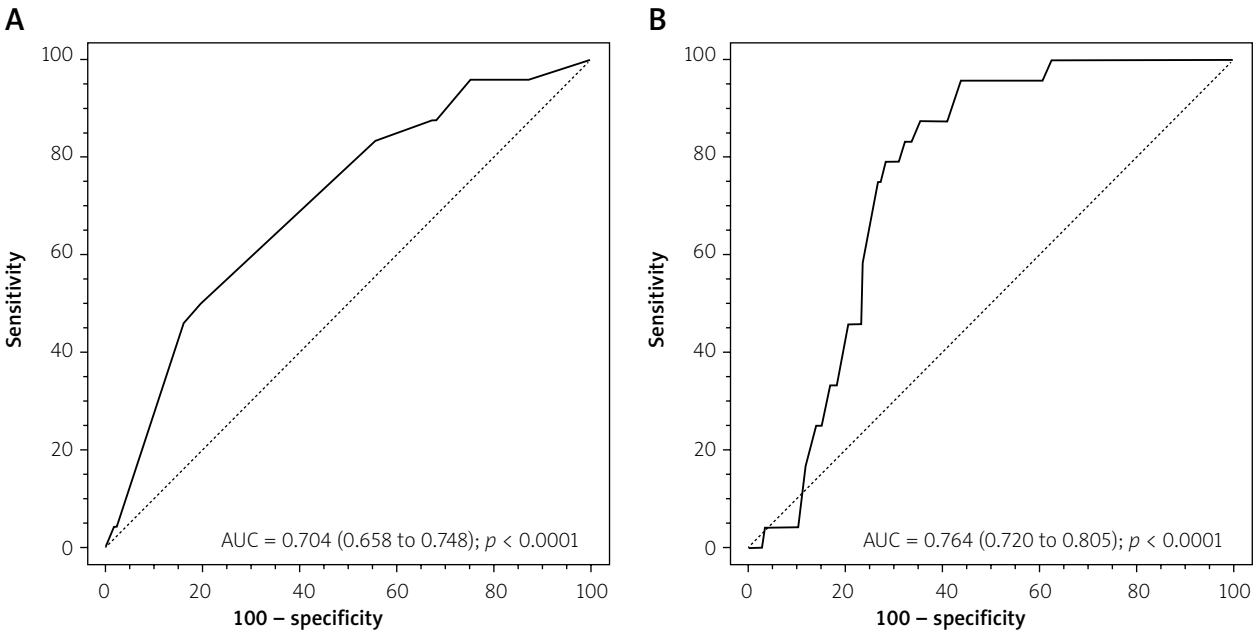

Figure 2. Receiver operating characteristic (ROC) curves for prediction of the discordance between fractional flow reserve and quantitative flow ratio based on aortic valve area (**A**) and percentage of diameter stenosis (DS) in the evaluated vessel at baseline (**B**)

AUC – area under the curve, %DS – % diameter stenosis.

96.3% of cases (Table III). However, for patients with AVA < 0.5 cm², agreement was lower, at 86.5% ($p < 0.001$). Discordance was exclusively noted in cases where FFR results were negative while QFR results were positive. The AUC from the ROC analysis for AVA in identifying discordant cases was 0.704 (95% CI: 0.658 to 0.748; $p < 0.001$) – Figure 2. The most effective AVA cutoff for detecting discordant cases was < 0.5 cm², which had a sensitivity of 50.0% and a specificity of 80.4%. For %DS, the AUC from the ROC analysis was 0.764 (95% CI: 0.720 to 0.805; $p < 0.001$), with the optimal %DS threshold for identifying discordant cases being > 56%, which provided a sensitivity of 95.8% and a specificity of 56.2%. Furthermore, in the multivariable models, AVA and %DS in QCA were independently associated with discordance. When analyzed as a continuous variable, the OR for AVA was 0.007 (95% CI: 0.000 to 0.258) for each 1 cm² increase ($p = 0.007$), and for %DS, the OR was 1.064 (95% CI: 1.030 to 1.100) for each 1% increase ($p < 0.001$). When AVA was categorized, the OR for AVA ≥ 0.5 cm² (vs. AVA < 0.5 cm²) was 0.229 (95% CI: 0.095 to 0.548; $p < 0.001$), and for %DS, the OR was 1.070 (95% CI: 1.034 to 1.107) per 1% increase ($p < 0.001$).

Discussion

This study supports our previous findings [13] that QFR is generally effective for evaluating borderline coronary lesions in patients with severe AS. However, our current analysis indicates that the reliability of QFR may be compromised in patients with an AVA < 0.5 cm². Consequently, clinicians should interpret borderline QFR results with caution in this subset of patients to avoid false-positive diagnoses of ischemia.

Importantly, our results are consistent with the QASTA study [15], which found, in a smaller sample of 138 coronary arteries from 115 patients, that the accuracy of QFR diminished as AVA decreased, particularly in patients with AVA < 0.60 cm². The lower cutoff point in our analysis may be attributed to inclusion of patients with more severe AS, characterized by smaller AVAs and higher transaortic gradients. Interestingly, in contrast to the QASTA study [15], the classification agreement with FFR in our study was high and seemingly unaffected by the severity of AS. However, notable angiographic differences between the cohorts warrant attention. The median reference vessel diameter in the QASTA study was 2.8 mm, with a quarter of the vessels being < 2.5 mm in diameter. This suggests that their study involved more lesions in distal segments, affecting a smaller myocardial area, compared to our findings of a median diameter of 3.4 mm, indicative of lesions in more proximal locations. Additionally, the mean %DS was 58.6% in our study vs. 48% in the QASTA study. The incidence of lesions with an FFR ≤ 0.80 and QFR ≤ 0.80 was 26.0% and 31.7% in our study, respectively, compared to 40% and 46% in the QASTA study [15]. The discrepancy in QFR performance may also stem from the use of different software versions: our study used the commercially available version 2.1.12.2, while the QASTA study used the research edition 1.1 of Medis Suite. Consequently, we cannot rule out

the possibility of improvements in the QFR calculation algorithms influencing our results [15]. Subsequent analysis from those authors confirmed good diagnostic performance of QFR in patients with severe AS [12].

Previous studies have established QFR as superior to angiography in detecting functionally significant stenoses, outperforming both conventional visual assessment and %DS derived from two-dimensional and three-dimensional QCA models [9, 10, 12, 15]. However, discrepancies between FFR and QFR measurements may occur in specific clinical situations [5, 9, 15]. In our investigation, a higher likelihood of discrepancy was associated with more severe lesions; a %DS threshold of 56% was identified as optimal for detecting such cases. Importantly, in another study, %DS was identified as an independent predictor of discordant results between FFR and iFR/RFR in patients undergoing routine physiological assessment of borderline coronary lesions [19]. We observed no influence from other angiographic or baseline characteristics on the potential for QFR-FFR discrepancies. Conversely, the study by Zaleska *et al.* reported a marked difference between FFR and QFR values in patients with insulin-treated diabetes and patients with chronic kidney disease (CKD), with a notably lower classification agreement in CKD patients [20]. This discrepancy could be due to a more severe and diffuse atherosclerotic pattern, common coronary microcirculatory dysfunction (CMD), and a diminished vasodilatory response to hyperemia-inducing agents in these groups, potentially affecting FFR measurements [5, 21]. Another study found that the diagnostic accuracy of QFR for predicting FFR ≤ 0.80 was numerically lower in arteries associated with a prior myocardial infarction compared to those without myocardial infarction [22]. This could suggest that CMD influences FFR measurements within infarcted regions, as confirmed by Mejía-Rentería *et al.* [23], who noted that CMD reduces the diagnostic efficacy of QFR. Furthermore, Legutko *et al.* [24] proposed that CMD significantly contributes to discrepancies between hyperemic (FFR) and non-hyperemic (RFR) physiological assessment methods. The absence of clinical factors affecting QFR-FFR agreement in our study may be due to the specific patient cohort examined – individuals with severe AS, a condition that might profoundly alter functional measurements [5]. Consistent with our results, the diagnostic effectiveness of QFR remained robust across various clinical groups, such as women and patients with atrial fibrillation, and among diverse anatomical presentations, including both focal and non-focal lesions [12].

The belief that concurrent CAD worsens outcomes of patients with severe AS undergoing TAVI has been longstanding [2, 3, 25]. Recent findings, however, challenge this assumption, suggesting that revascularization with PCI before TAVI may not improve, or might even impair, outcomes compared to PCI performed after TAVI [25–29]. Nevertheless, the non-randomized nature of these studies leaves room for potential selection bias [25]. Moreover, the accuracy of invasive assessments for borderline coronary lesions in severe AS patients has been debated, highlighting the potential benefits of reassessing lesions after TAVI [5, 30]. In this context, QFR emerges as a particularly valuable tool, enabling lesion evaluation using routine coronary angiograms, thereby reducing the need for additional invasive procedures [13, 15]. This wire-free method may lessen the risk of complications and reduce contrast load, benefits that are especially significant in elderly and often frail patients. Moreover, QFR could assist Heart Teams in identifying patients at high risk for cardiovascular mortality and major adverse cardiovascular events following TAVI [10, 14]. Crucially, studies have demonstrated a strong correlation between pre-TAVI QFR measurements and post-TAVI FFR and iFR values [14].

Current research primarily concentrates on the potential application of FFR obtained from computed tomography angiography (CT-FFR). CT scans, routinely utilized for periprocedural planning, may extend their utility to non-invasive hemodynamic and anatomical evaluation of coronary lesions [31–33]. This approach could identify patients who may not require invasive assessment before TAVI. In contrast to coronary angiograms, CT scans offer the capability to examine plaque morphology and peri-coronary adipose tissue [31–33]. However, the added predictive value of these parameters for risk assessment in patients with severe AS remains to be determined [32, 34].

Our study is subject to several limitations. The relatively small sample size might compromise the robustness and generalizability of the results. Noninvasive evaluations of myocardial ischemia were not performed, which limits the availability of comparative reference methods. Additionally, there was no follow-up assessment of coronary physiology after the treatment for severe AS. The applicability of the study findings may be limited to measurements obtained using the Medis Suite software, as alternative methods, such as FFRangio (Cathworks Ltd., Kfar Saba, Israel), were not evaluated [35]. Data regarding CMD, coronary flow reserve, and central venous pressure were not collected. Lastly, coronary pressure pullbacks, necessary for calculating pressure gradients to identify diffuse coronary disease, were not performed.

Conclusions

In severe AS, QFR closely correlates with FFR. However, patients with AVA < 0.5 cm² might exhibit a higher incidence of false-positive ischemia detections by QFR.

Funding

This work was supported by the National Science Center (grant number 2018/02/X/NZ5/02648 to PK).

Ethical approval

No. 1072.6120.1.2019, issued on 31st January 2018 from the Jagiellonian University.

Conflict of interest

The authors declare no conflict of interest.

References

1. van Bakel PAJ, Ahmed Y, Hou H, et al. Geographic variation in aortic stenosis treatment and outcomes among Medicare beneficiaries in the United States. Catheter Cardiovasc Interv 2024; 103: 490-8.
2. D'Ascenzo F, Verardi R, Visconti M, et al. Independent impact of extent of coronary artery disease and percutaneous revascularisation on 30-day and one-year mortality after TAVI: a meta-analysis of adjusted observational results. EuroIntervention 2018; 14: e1169-77.
3. Kleczynski P, Dziewierz A, Bagienski M, et al. Impact of coronary artery disease burden on 12-month mortality of patients after transcatheter aortic valve implantation. J Interv Cardiol 2016; 29: 375-81.
4. Knuuti J, Wijns W, Saraste A, et al. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes. Eur Heart J 2020; 41: 407-77.
5. Benenati S, De Maria GL, Scarsini R, et al. Invasive "in the cath-lab" assessment of myocardial ischemia in patients with coronary artery disease: When does the gold standard not apply? Cardiovasc Revasc Med 2018; 19: 362-72.
6. Zasada W, Mikołajczyk F, Jędrychowska M, et al. Comparison of FFR, iFR, and QFR assessment in patients with severe aortic stenosis and coronary heart disease. Adv Interv Cardiol 2022; 18: 118-21.
7. Kogame N, Ono M, Kawashima H, et al. The impact of coronary physiology on contemporary clinical decision making. JACC Cardiovasc Interv 2020; 13: 1617-38.
8. Kiyohara Y, Kishino Y, Ueyama HA, et al. Comparison among various physiology and angiography-guided strategies for deferring percutaneous coronary intervention: a network meta-analysis. Cardiovasc Revasc Med 2024; 61: 35-41.
9. Dobrić M, Furtula M, Tešić M, et al. Current status and future perspectives of fractional flow reserve derived from invasive coronary angiography. Front Cardiovasc Med 2023; 10: 1181803.
10. Demola P, Colaiori I, Bosi D, et al. Quantitative flow ratio-based outcomes in patients undergoing transcatheter aortic valve implantation quaestio study. Front Cardiovasc Med 2023; 10: 1188644.
11. Dowling C, Michail M, Zhang JM, et al. Diagnostic performance of quantitative flow ratio, non-hyperaemic pressure indices and fractional flow reserve for the assessment of coronary lesions in severe aortic stenosis. Cardiovasc Diagn Ther 2022; 12: 314-24.
12. Wienemann H, Ameskamp C, Mejía-Rentería H, et al. Diagnostic performance of quantitative flow ratio versus fractional flow reserve and resting full-cycle ratio in intermediate coronary lesions. Int J Cardiol 2022; 362: 59-67.
13. Kleczynski P, Dziewierz A, Rzeszutko L, et al. Quantitative flow ratio for evaluation of borderline coronary lesions in patients with severe aortic stenosis. Rev Esp Cardiol 2022; 75: 472-8.
14. Sejr-Hansen M, Christiansen EH, Ahmad Y, et al. Performance of quantitative flow ratio in patients with aortic stenosis undergoing transcatheter aortic valve implantation. Catheter Cardiovasc Interv 2022; 99: 68-73.
15. Mejía-Rentería H, Nombela-Franco L, Paradis JM, et al. Angiography-based quantitative flow ratio versus fractional flow reserve in patients with coronary artery disease and severe aortic stenosis. EuroIntervention 2020; 16: e285-92.
16. Dziewierz A, Rzeszutko Ł, Dudek D, et al. Impact of chronic kidney disease on fractional flow reserve accuracy in severe aortic stenosis. Pol Arch Intern Med 2024; 134: 16649.
17. Dziewierz A, Rzeszutko Ł, Dudek D, et al. Impact of diabetes mellitus on the diagnostic performance of fractional flow reserve in patients with severe aortic stenosis. Kardiol Pol 2022; 80: 1217-23.
18. Kleczynski P, Dziewierz A, Rzeszutko L, et al. Hyperemic versus non-hyperemic indexes for coronary physiology assessment in patients with severe aortic stenosis. Adv Med Sci 2021; 66: 366-71.
19. Lee JM, Shin ES, Nam CW, et al. Discrepancy between fractional flow reserve and instantaneous wave-free ratio: clinical and angiographic characteristics. Int J Cardiol 2017; 245: 63-8.
20. Zaleska M, Koltowski L, Maksym J, et al. Quantitative flow ratio and fractional flow reserve mismatch – clinical and biochemical predictors of measurement discrepancy. Adv Cardiol Interv 2019; 15: 301-7.
21. Zdzierak B, Zasada W, Rakowski T, et al. Influence of diabetes mellitus on the invasive assessment of myocardial ischemia in patients with coronary artery disease. Pol Arch Intern Med 2023; 133: 16502.
22. Emori H, Kubo T, Kameyama T, et al. Diagnostic accuracy of quantitative flow ratio for assessing myocardial ischemia in prior myocardial infarction. Circ J 2018; 82: 807-14.
23. Mejia-Renteria H, Lee JM, Choi KH, et al. Coronary microcirculation assessment using functional angiography: development of a wire-free method applicable to conventional coronary angiograms. Catheter Cardiovasc Interv 2021; 98: 1027-37.
24. Legutko J, Niewiara L, Guzik B, et al. The impact of coronary microvascular dysfunction on the discordance between fractional flow reserve and resting full-cycle ratio in patients with chronic coronary syndromes. Front Cardiovasc Med 2022; 9: 1003067.
25. Dziewierz A. The time is always right to do what is right: TAVI and timing of PCI. Int J Cardiol 2023; 371: 128-9.
26. Lunardi M, Venturi G, Del Sole PA, et al. Optimal timing for percutaneous coronary intervention in patients undergoing transcatheter aortic valve implantation. Int J Cardiol 2022; 365: 114-22.
27. Aarts HM, van Hemert ND, Meijs TA, et al. Percutaneous coronary intervention in patients undergoing transcatheter aortic valve implantation: a systematic review and meta-analysis. Neth Heart J 2023; 31: 489-99.
28. Wilimski R, Huczek Z, Krauz K, et al. Impact of previous coronary artery revascularization on outcomes in patients undergoing transcatheter aortic valve implantation. Adv Interv Cardiol 2023; 19: 243-50.
29. Rheude T, Costa G, Ribichini FL, et al. Comparison of different percutaneous revascularisation timing strategies in patients undergoing transcatheter aortic valve implantation. EuroIntervention 2023; 19: 589-99.
30. Zelis JM, Tonino PAL, Johnson NP. Why can fractional flow reserve decrease after transcatheter aortic valve implantation? J Am Heart Assoc 2020; 9: e04905.

31. Dai N, Tang X, Ling R, et al. Prognostic implications of pre-transcatheter aortic valve replacement computed tomography-derived coronary plaque characteristics and stenosis severity. Eur Radiol 2024; 34: 5923-33.
32. Langenbach MC, Langenbach IL, Foldyna B, et al. Advanced CT measures of coronary artery disease with intermediate stenosis in patients with severe aortic valve stenosis. Eur Radiol 2024; 34: 4897-908.
33. Peper J, Becker LM, van den Berg H, et al. Diagnostic performance of CCTA and CT-FFR for the detection of CAD in TAVR Work-Up. JACC Cardiovasc Interv 2022; 15: 1140-9.
34. Mesnier J, Rodés-Cabau J. CT-FFR in the TAVR work-up: optimizing the gatekeeper. JACC Cardiovasc Interv 2022; 15: 1150-2.
35. Skalidis I, Noirclerc N, Meier D, et al. Head-to-head comparison of two angiography-derived fractional flow reserve techniques in patients with high-risk acute coronary syndrome: a multicenter prospective study. Int J Cardiol 2024; 399: 131663.