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Original Research

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Diastolic Hyperemia-Free Ratio in Patients With Coronary Artery Disease: A Prospective Observational Study

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AUTHOR'S SUMMARY

Diastolic hyperemia-free ratio (DFR), an alternative to fractional flow reserve (FFR) for the assessment of intermediate coronary artery stenosis, helps reduce patients' time, cost, and inconvenience. However, the validation data for DFR and FFR are lacking. We found that DFR value showed a strong correlation with FFR value. In addition, DFR (≤0.89) value in the present study showed a favorable accuracy rate of 92.0% compared with the FFR (≤0.8) value. In real-world clinical practice, DFR and FFR values showed an excellent correlation with a high accuracy rate (DFR ≤0.89, FFR ≤0.8) for intermediate coronary artery stenosis.

ABSTRACT

Background and Objectives: Diastolic hyperemia-free ratio (DFR), an alternative to fractional flow reserve (FFR) for the assessment of intermediate coronary artery stenosis, helps reduce patients' time, and inconvenience. However, the validation data for DFR and FFR are lacking. We aimed to evaluate the diagnostic accuracy of DFR and FFR and to assess the effective decision making for revascularization using their values.
Methods: Patients subjected to an invasive physiological study for intermediate coronary artery stenosis at a single center in South Korea between August 2022 and January 2024 were prospectively recruited. We evaluated the correlation between DFR and FFR measurements and the diagnostic accuracy of DFR ≤0.89 to predict FFR ≤ 0.80. We also compared the correlation for each coronary artery.
Results: A total of 324 intermediate coronary stenotic lesions from 300 patients were evaluated using DFR and FFR values simultaneously. There was a strong linear relationship between DFR and FFR (r = 0.80; 95% confidence interval [CI], 0.76–0.84; p < 0.001). The diagnostic accuracy of the DFR was 92.0% in predicting FFR ≤0.80. When compared separately for each coronary artery, all vessels showed a strong linear relationship with no statistical differences between any of the vessels (p=0.641). There was also a strong linear relationship between DFR and distal coronary pressure/aorta pressure (r=0.93; 95% CI, 0.91–0.94; p<0.001).

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Conflict of Interest
YK received speaker fees from Boston Scientific. The remaining authors declare no potential conflict of interest.

Data Sharing Statement
The data generated in this study is available from the corresponding author(s) upon reasonable request.

Author Contributions
Conceptualization: Cho DK, Kim Y; Data curation: Roh JW, Lee OH, Heo SJ, Im E, Kim Y; Formal analysis: Heo SJ; Funding acquisition: Cho DK, Kim Y; Investigation: Roh JW, Lee OH, Kim Y; Methodology: Kim Y; Project administration: Kim Y; Resources: Cho DK, Kim Y; Supervision: Cho DK, Kim Y; Validation: Kim Y; Visualization: Kim Y; Writing - original draft: Roh JW, Lee OH; Writing - review & editing: Lee OH, Heo SJ, Im E, Cho DK, Kim Y.

Conclusions: There was a strong correlation between DFR and FFR and a high diagnostic accuracy rate of DFR compared to FFR. Good diagnostic performance of DFR was also observed in each coronary artery.

Trial Registration: ClinicalTrials.gov Identifier: NCT05421169

Keywords: Coronary stenosis; Fractional flow reserve, myocardial; Physiology; Hemodynamics; Pressure; Percutaneous coronary intervention

INTRODUCTION

Fractional flow reserve (FFR) is a reliable test that evaluates the hemodynamic status of coronary artery disease (CAD) and determines the pressure difference between lesions by hyperemia that FFR-guided percutaneous coronary intervention (PCI) has demonstrated a survival benefit for intermediate CAD.[1-3] Therefore, current guidelines strongly recommend the use of FFR to assess the hemodynamic significance of intermediate coronary artery lesions in patients with symptomatic angina and undocumented ischemia.[4][5] However, the performance rate of FFR-guided PCI for intermediate lesions is less than 10% in daily practice.[6-8] FFR is a standard assessment tool for intermediate coronary lesions, but it requires intracoronary or intravenous infusion of adenosine or nicorandil to achieve maximal hyperemia, which is time-consuming, costly, uncomfortable for the patient, and occasionally leads to hemodynamic complications, all of which contribute to its low performance rate.[9]

Recently, several non-hyperemic pressure ratios (NHPR) have been developed to assess the physiological significance of coronary stenosis without the need for hyperemia. Among these, the instantaneous wave-free ratio (iFR) is the only NHPR currently recommended as a class 1A approach for PCI in the management of intermediate coronary artery stenosis, based on its demonstrated non-inferiority to FFR in major randomized trials.[4][10][11] The iFR, the most widely studied NHPR, focuses on a specific portion of the cardiac cycle with a wave-free period, and a newer NHPR such as the resting full cycle ratio, which is the lowest ratio of distal coronary pressure (Pd)/aorta pressure (Pa) within the entire cardiac cycle,[12] and the diastolic free ratio (DFR), which evaluates the mean values of Pd/Pa specifically during diastole below the mean Pa value, the period of least resistance in coronary blood flow.[13] This approach minimizes variations due to systolic hemodynamics and noise, potentially improving diagnostic confidence and providing a practical alternative in the clinical setting. Both indices aim to replicate the ability of FFR to detect hemodynamically significant stenosis, but without the need for hyperemia, thereby improving patient comfort and procedural efficiency.[14]

However, there is a paucity of data comparing DFR and FFR in patients with intermediate CAD. Therefore, the aim of the present study was to evaluate the diagnostic value of DFR in real-world practice.

METHODS

Ethical statement

This study protocol was approved by the Institutional Review Board of Yongin Severance Hospital, Seoul, South Korea (approval number: 9-2022-0047), and all participants provided

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written informed consent before participating in the study. The study protocol was registered at ClinicalTrials.gov (NCT05421169) and adhered to the ethical guidelines of the Declaration of Helsinki (2013).

Study population

The Invasive funCtional assEssment using diastolic HypEremia-free rATio in patients with CAD: a prospective, single-center observational study (ICE-HEAT) conducted at Yongin Severance Hospital in South Korea. Patients aged >19 years with suspected ischemic heart disease (IHD) who underwent coronary angiography (CAG) between August 2022 and January 2024 were enrolled in this study if a de novo intermediate stenosis was diagnosed. We excluded patients with single lesion in acute coronary syndromes, left main CAD, stenosis in a coronary artery bypass graft, and a life expectancy of <1 year. For non-culprit lesions in patients with acute coronary syndrome, we performed DFR/FFR immediately if the patient was stable after index PCI for culprit lesion, and staged DFR/FFR measurement was done within 7 days if the patient was unstable. The funding sources did not participate in the design or conduct of the study, the analysis or interpretation of the data, or the decision to submit the manuscript for publication.

Cardiac catheterization and quantitative coronary angiography

CAG was performed by 5 interventional cardiologists with more than 10 years of experience in coronary intervention according to current guidelines and standard technique using a femoral, or radial approach.[3)4)] The percentage of diameter stenosis, minimal and reference vessel lumen diameter, and lesion length were assessed by quantitative coronary angiography (QCA) using CASS Workstation 7.4 (Pie Medical Imaging, Maastricht, The Netherlands). In our study, we enrolled only patients with de novo intermediate coronary artery stenosis who had QCA showing >50% stenotic lesion performed immediately during CAG by 2 independent technicians with >5 years of experience in the cardiac catheterization laboratory.

Coronary physiologic measurements and assessment

Physiologic assessment of intermediate coronary lesions, i.e., 50% to 90% diameter stenosis by QCA analysis, was performed using a 0.014" intracoronary pressure wire (COMET™ II Pressure Guidewire; Boston Scientific Inc., Marlborough, MA, USA) and automatically calculated using the i-Lab POLARIS Multi-Modality Guidance System (Boston Scientific Inc.). Pd/Pa is the ratio of Pd to Pa measured throughout the entire cardiac cycle without inducing hyperemia. It serves as the foundational measurement for various NHPRs and is instrumental in calibrating pressure wires during coronary physiologic assessments. DFR is defined as the average of the Pd to Pa values measured during the diastolic phase, specifically below the mean Pa threshold. This index provides a resting physiologic measurement without the need for hyperemia, focusing on the diastolic segment to minimize variability from systolic pressure changes (**Figure 1**).[13)14)] The pressure wire was equalized to the aortic pressure and the procedure was performed after the pressure wire was placed on the tip of the guiding catheter and contrast was removed with saline flush. The pressure wire was then advanced 20 to 30 mm distally to a target vessel to assess DFR. After the DFR was measured, the pressure wire was withdrawn back into the tip of the guiding catheter to verify the presence of pressure differences. A final Pd/Pa between 0.97 and 1.03 was considered acceptable.[15)] After confirming that there was no pressure drift, the pressure wire was again advanced to the same position in the distal portion of the target vessel to assess FFR. In all lesions, FFR values were measured during hyperemia, assessed as a period of 20 to 50 seconds induced by an intracoronary bolus injection of 2 mg nicorandil (Sigmart®;

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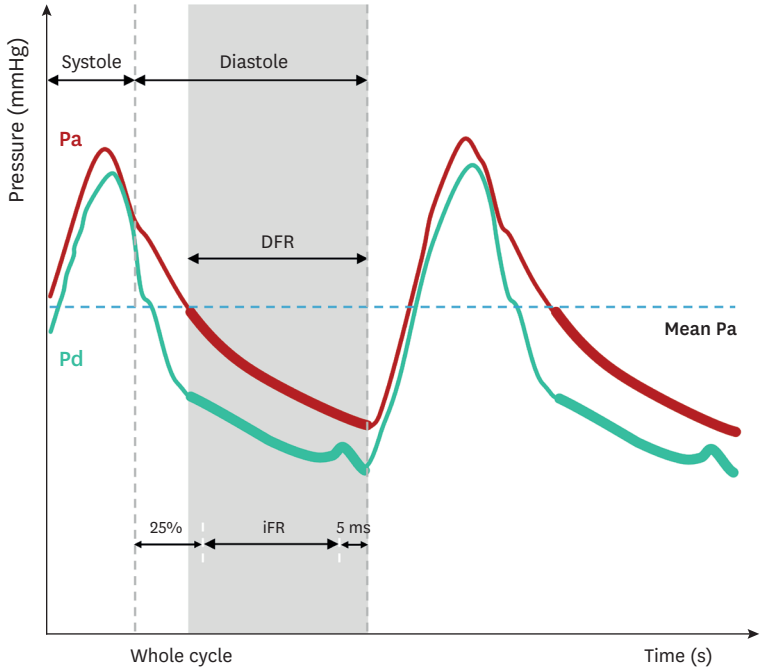

Figure 1. Measuring DFR and its relationship to Pd/Pa. Pd/Pa is the ratio of Pd to Pa measured throughout the entire cardiac cycle without inducing hyperemia. The plot shows the pressure waveform, representing the portion of the cardiac cycle used for calculating DFR. DFR resting index scans through average of the Pd/Pa values over the entire segment below the mean Pa during the diastolic segment.
DFR = diastolic hyperemia-free ratio; iFR = instantaneous wave-free ratio; Pa = aortic pressure; Pd = distal coronary pressure.

Chugai Pharmaceutical Co., Ltd., Tokyo, Japan). Pressure drift was monitored after each FFR measurement. In patients with multivessel disease, we had a sufficient time interval of at least 5 minutes between FFR measurements in each vessel.

Study endpoint

We evaluated the correlation between DFR and FFR measurements for primary endpoints as well as the diagnostic performance of DFR to identify FFR-positive coronary stenosis, where hemodynamically significant stenosis was defined as FFR ≤0.80 and DFR ≤0.89.[1)3)13)] In addition, the relationship between DFR and Pd/Pa was analyzed for secondary endpoints. The functional significance of Pd/Pa is ≤0.92.[16)] We also analyzed the correlation between DFR and FFR separately by vessel for each left anterior descending artery (LAD), left circumflex artery (LCX), and right coronary artery (RCA). We further analyzed whether the proximal segment was involved or not, using the American Heart Association (AHA) classification for segment classification or the modified AHA classification.

Statistical analysis

All data are expressed as mean ± standard deviation or number of patients (%). The 95% confidence intervals (CIs) of the means of continuous variables and percentages of categorical variables were calculated using t-tests and Clopper-Pearson (exact) approaches, respectively. Pearson's correlation coefficient (r) between DFR and FFR was calculated with 95% CIs. The receiver operating characteristic (ROC) curve was used to represent the overall diagnostic performance of DFR for FFR ≤0.80 and Pd/Pa ≤0.92 with the area under the ROC curve (AUC). Diagnostic performance measures such as accuracy, sensitivity, specificity,

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positive predictive values (PPV) and negative predictive values (NPV) were calculated. Statistical significance was set at p<0.05 (2-sided). All statistical analyses were performed using R software (version 4.3.0; R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

Study population

A total of 324 stenotic coronary intermediate lesions from 300 patients were investigated and included in this study. Participants' baseline clinical and angiographic characteristics are shown in **Tables 1** and **2**. The overall mean age was 65.8±10.2 years, and 78.0% of patients were male. The common clinical presentation was stable angina (73.0%), followed by unstable angina (12.3%), and the lesions were located most often in the left anterior descending artery (66.0%). The distribution of the DFR and FFR values is shown in **Supplementary Figure 1**.

FFR ≤0.80 was observed in 98 of 324 lesions (30.4%) and DFR ≤0.89 was observed in 90 of 324 lesions (27.8%). The study population comprised patients with angiographically intermediate stenosis (diameter stenosis [%]: 58.4±6.8 using QCA).

Relationship between diastolic free ratio and fractional flow reserve or distal coronary pressure/aorta pressure

Figure 2A shows the scatterplot of the relationship between DFR and FFR. A strong correlation was found between both indices (r=0.80; 95% CI, 0.76–0.84; p<0.001). **Figure 2B** shows the ROC analysis for predicting FFR ≤0.80 with an AUC of 0.92 (95% CI, 0.88–0.95; p<0.01). The diagnostic accuracy of the DFR was 92.0% in predicting FFR ≤0.80. The accuracy rate was 90.0% for DFR value 0.86–0.89 and 90.5% for DFR value 0.90–0.93 (**Supplementary Table 1**). In addition, DFR ≤0.89 demonstrated sensitivity, specificity, PPV and NPV of 82.7%, 96.0%, 90.0%, and 92.7%, respectively, in predicting FFR ≤0.80. The optimal cut-off value of DFR was 0.89, with a Youden index of 0.79 (**Supplementary Figure 2**). **Supplementary Figure 3** shows the scatterplot of the relationship between DFR and Pd/Pa. A strong correlation was observed between both indices (r=0.93; 95% CI, 0.91–0.94; p<0.001). ROC analyses for predicting Pd/Pa ≤0.92 showed an AUC of 0.94 (95% CI, 0.92–0.97; p<0.01). Using Pd/Pa ≤0.92 as a reference, the diagnostic accuracy, sensitivity, specificity, PPV, and NPV of DFR were 87.3%, 70.6%, 97.1%, 93.3%, and 85.0%, respectively.

Diastolic free ratio and fractional flow reserve according to each coronary vessel and segment

When the relationship between DFR and FFR was analyzed separately for LAD, LCX, and RCA, the concordance rate was 92.1% for LAD, 88.9% for LCX, and 93.8% for RCA. These 3 vessels were not statistically different with a p value of 0.641 (**Figure 3**, **Supplementary Figure 4**). Relationship between DFR and Pd/Pa for each vessel also showed strong correlation and high diagnostic accuracy, respectively (**Supplementary Figure 5**). We further analyzed the diagnostic accuracy of DFR in predicting FFR by dividing cases with and without proximal segment involvement and found that DFR had high diagnostic accuracy compared with FFR in both groups, with no statistical difference (90.0% in lesions with involved proximal segment and 93.9% in lesions without involved proximal segment, p=0.277) (**Supplementary Figures 6** and **7**).

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Table 1. Baseline clinical characteristics of the study population (n=300)

Characteristics	Values	95% CI*
Age (years)	65.8±10.2	64.6–66.9
Male sex	234 (78.0)	72.9–82.6
Height (cm)	164.2±8.6	163.2–165.2
Weight (kg)	68.1±11.4	66.8–69.4
Body mass index (kg/m^2)	25.2±3.3	24.8–25.6
Hypertension	216 (72.0)	66.6–77.0
Diabetes mellitus	143 (47.7)	41.9–53.5
Dyslipidemia	243 (81.0)	76.1–85.3
Current smoking	49 (16.3)	12.3–21.0
Prior PCI	78 (26.0)	21.1–31.4
Prior myocardial infarction	28 (9.3)	6.3–13.2
Prior cerebrovascular accident	19 (6.3)	3.9–9.7
Prior coronary bypass graft	0 (0.0)	0.0–1.2
Atrial fibrillation	11 (3.7)	1.8–6.5
Chronic kidney disease (≥stage 3)	35 (11.8)	8.3–16.0
Dialysis	13 (4.3)	2.3–7.3
LVEF (%)	57.0±9.6	55.6–58.4
Systolic blood pressure (mmHg)	148.4±25.9	145.5–151.4
Diastolic blood pressure (mmHg)	77.9±12.0	76.5–79.3
Heart rate (bpm)	70.7±12.9	69.2–72.2
Clinical presentation		
Stable angina	219 (73.0)	67.6–77.9
Unstable angina	37 (12.3)	8.8–16.6
NSTEMI	6 (2.0)	0.7–4.3
STEMI	6 (2.0)	0.7–4.3
Others	32 (10.7)	7.4–14.7
Laboratory findings		
Total cholesterol (mg/dL)	142.1±41.0	137.4–146.8
Triglyceride (mg/dL)	149.2±95.2	138.0–160.3
HDL-cholesterol (mg/dL)	48.1±11.3	46.7–49.4
LDL-cholesterol (mg/dL)	79.2±36.3	75.0–83.5
Creatinine (mg/dL)	1.1±1.1	1.0–1.2
Hemoglobin (g/dL)	13.8±2.0	13.6–14.1
Platelet count (10^3/μL)	223.6±62.3	216.5–230.8
CRP (mg/L)	3.8±12.3	2.3–5.3
Pre-procedural medication		
Aspirin	266 (88.7)	84.5–92.0
$P2Y_{12}$ inhibitor	279 (93.0)	89.5–95.6
Clopidogrel	258 (86.0)	81.6–89.7
Ticagrelor	16 (5.3)	3.1–8.5
Prasugrel	5 (1.7)	0.5–3.8
Oral anticoagulation	11 (3.7)	1.8–6.5
ACEi or ARB	157 (52.3)	46.5–58.1
Beta-blocker	114 (38.0)	32.5–43.8
Calcium channel blocker	116 (38.7)	33.1–44.4
Statin	261 (87.0)	82.7–90.6

Values are presented as mean ± standard deviation or number (%).
ACEi = angiotensin converting enzyme inhibitor; ARB = angiotensin receptor blocker; CI = confidence interval; CRP = C-reactive protein; HDL = high density lipoprotein; LDL = low density lipoprotein; LVEF = left ventricular ejection fraction; NSTEMI = non-ST-segment elevation myocardial infarction; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.
*95% CI of the mean.

DISCUSSION

This prospective, observational ICE-HEAT study evaluated the validation of a novel non-hyperemic resting physiologic index using DFR for intermediate coronary artery stenosis in patients with IHD. Herein, we reported several clinically important findings to support

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Table 2. General characteristics of epicardial stenosis (n=324)

Characteristics	Values	95% CI*
FFR value	0.84±0.08	0.83–0.85
DFR value	0.90±0.08	0.89–0.91
Vessel		
Left anterior descending artery	214 (66.0)	60.6–71.2
Left circumflex artery	45 (13.9)	10.3–18.1
Right coronary artery	65 (20.1)	15.8–24.8
Lesion location		
Proximal	107 (33.0)	27.9–38.4
Mid or distal lesion	156 (48.1)	42.6–53.7
Diffuse lesion	61 (18.8)	14.7–23.5
Stenosis characteristics		
Lesion length (mm)	13.5±7.9	12.6–14.3
Reference vessel diameter (mm)	2.9±0.6	2.8–3.0
Percentage of diameter stenosis	58.4±6.8	57.7–59.1
ACC/AHA B2/C lesion	261 (80.6)	75.8–84.7
Percutaneous coronary intervention	118 (36.4)	32.5–40.1
Drug eluting stent	101 (85.6)	80.1–91.2

Values are presented as mean ± standard deviation or number (%).
ACC = American College of Cardiology; AHA = American Heart Association; CI = confidence interval; DFR = diastolic free ratio; FFR = fractional flow reserve.
*95% CI of the mean.

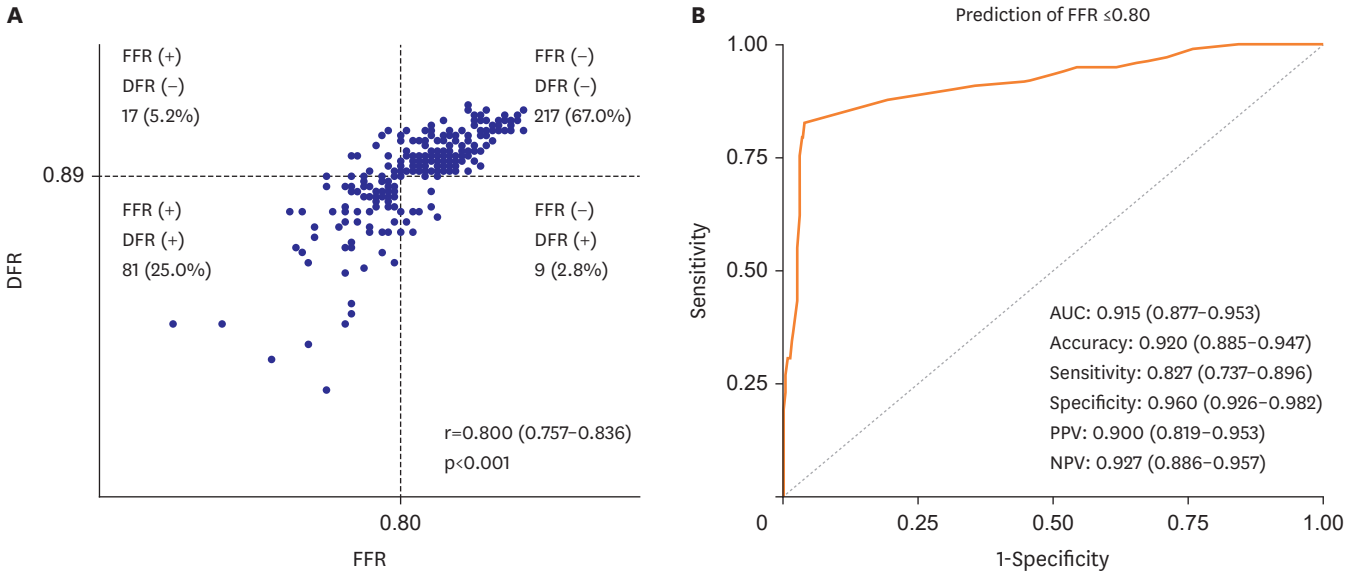

Figure 2. Concordance and discordance of FFR and DFR with ROC curves. (A) FFR and DFR showed a strong correlation (r=0.800; p<0.001). (B) ROC curves for FFR ≤0.80 versus DFR showed an AUC of 0.915 (0.877–0.953) and a diagnostic accuracy of 0.920.
AUC = area under the receiver operating characteristic curve; DFR = diastolic hyperemia-free ratio; FFR = fractional flow reserve; NPV = negative predictive value; PPV = positive predictive value; ROC = receiver operating characteristic.

the effective use of DFR with FFR in daily clinical practice. First, DFR value showed a strong correlation (r=0.80; 95% CI, 0.76–0.84; p<0.001) with FFR value in the present study, which was comparable to that in the previous study using iFR, which is the gold standard of NHPR. Second, compared with the FFR value, DFR (≤0.89) value in the present study showed a favorable accuracy rate of 92.0%, which was comparable to that of iFR or NHPR in other studies. Third, when DFR and FFR were analyzed by dividing the values into LAD, LCX, and RCA separately, there was no difference in accuracy between the 3 vessels (p=0.641).

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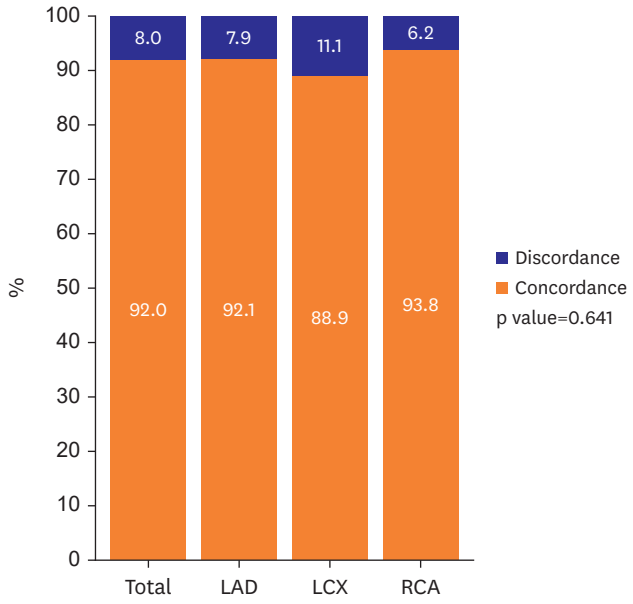

Figure 3. Prevalence of concordance of the FFR and diastolic hyperemia-free ratio. The prevalence of concordance of the FFR and resting full cycle ratio in this study were not significantly different in the LAD, LCX, and RCA (p=0.641).
FFR = indicates fractional flow reserve; LAD = left anterior descending artery; LCX = left circumflex artery; RCA = right coronary artery.

FFR-guided decision-making has shown superior long-term outcomes in randomized trials and is recommended as a class 1A approach for intermediate coronary stenosis.[2)4)5)] However, real-world adoption of FFR is limited due to the time, cost, and patient discomfort associated with adenosine-induced hyperemia.[6-8)] Recently, NHPR methods like iFR, which have demonstrated non-inferiority to FFR in randomized trials, have addressed these concerns and are also class 1A recommended.[4)5)] DFR is a newer NHPR index that measures the average Pd/Pa value in diastole over the entire segment below the mean Pa during the diastolic segment, without the need for hyperemia.[13)] The present study demonstrated a strong correlation between DFR and FFR and a high diagnostic accuracy of DFR (92.0%) as compared to FFR in real-world practice. Although there is no direct study comparing iFR and DFR, there is a study comparing DFR and FFR that was performed on 343 lesions and showed a diagnostic accuracy of 83%, and they found that when the DFR value was between 0.88 and 0.90, the accuracy rate was low at 40%.[14)] Our study demonstrated favorable diagnostic accuracy for DFR compared with previously reported values for other resting indices, including iFR and Pd/Pa. In our study, the patient selection with QCA analysis and rigorous study design likely contributed to the observed high accuracy. In addition, compared to iFR, which focuses on a shorter wave-free period, and Pd/Pa, which uses the entire cardiac cycle, DFR may offer superior reliability by exploiting the physiological stability of diastole. These features contribute to more stable and reproducible measurements. These findings highlight the potential of DFR as a practical and effective tool in coronary physiology without hyperemia, particularly for the assessment of intermediate coronary lesions. Furthermore, our study showed similar diagnostic accuracy of the DFR in predicting FFR ≤0.80 for each vessel in the LAD, LCX, and RCA. Nevertheless, it is clear that iFR is still a class I indication in the latest guidelines and the most reliable NHPR with the most accumulated data, and DFR expects a promising NHPR, although more research is needed in the future.

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Recently, a study-level meta-analysis of long-term outcome data comparing iFR and FFR raised concerns about iFR-guided revascularization.[17] The discrepancy in outcomes between iFR and FFR has been attributed to the diagnostic inaccuracy of iFR, particularly for lesions in the left main or proximal lesions in the LAD or large proximal portion of the RCA and LCX. These lesions often have normal coronary flow reserve but are misclassified by iFR, potentially leading to delayed revascularization and increased mortality. The analysis demonstrated that FFR is still more reliable tool for assessing significant lesions in these critical proximal or large coronary artery locations, supporting its use over iFR in guiding revascularization decisions.[18] In our study, considering this NHPR concern, we divided the proximal lesion into involved and uninvolved cases according to the AHA classification and measured the accuracy of FFR ≤0.80 and DFR ≤0.89. The involved cases had an accuracy of 90.0% and the uninvolved cases had an accuracy of 93.9%, although the sample size was small. However, because our study was an observational study with a small number of lesions, it should be taken as a guidance only, and FFR should be considered for large or proximal coronary lesions to prevent future events. In the future, a large-scale random validation study should be conducted using FFR and NHPR, including iFR with DFR, which can overcome this limitation of NHPR to evaluate intermediate coronary artery stenosis accurately.

This study has several limitations. First, it was a single-center, prospective, observational study. Second, because this study was conducted in East Asians, caution is needed in interpreting the results for patients around the world. Third, the sample size was small compared with other NHPR studies, the interpretation of the concordance of DFR and FFR in LAD, LCX, RCA, and cases in which the proximal segment was involved or not needs careful consideration. Fourth, in NHPR, iFR, which is the gold standard, could not be directly compared with DFR in this study.

In real-world clinical practice, DFR and FFR values showed an excellent correlation with a high accuracy rate (DFR ≤0.89, FFR ≤0.8) for coronary lesions detected by QCA 50–90% stenosis.

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SUPPLEMENTARY MATERIALS

Supplementary Table 1
Accuracy of DFR values for FFR values

Supplementary Figure 1
Frequency distribution of FFR and DFR values in 324 intermediate stenotic lesions.

Supplementary Figure 2
Optimal cut-off value of DFR by Youden index.

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Supplementary Figure 3

Concordance and discordance of DFR and Pd/Pa with ROC curves. (A) DFR and Pd/Pa showed a strong correlation (r=0.927; p<0.001). (B) ROC curves for Pd/Pa ≤0.92 versus DFR showed an AUC of 0.941 (0.918–0.965) and a diagnostic accuracy of 0.873.

Supplementary Figure 4

Concordance and discordance of FFR and DFR with receiver operating characteristic curves according to each coronary vessel. LAD: (A) FFR and DFR showed a strong correlation (r=0.759; p<0.001), (B) FFR ≤0.80 versus DFR showed an AUC of 0.931 (0.891–0.971) and a diagnostic accuracy of 0.921. LCX: (C) FFR and DFR showed a strong correlation (r=0.720; p<0.001), (D) FFR ≤ 0.80 versus DFR showed an AUC of 0.907 (0.818–0.997) and a diagnostic accuracy of 0.889. RCA: (E) FFR and DFR showed a strong correlation (r=0.833; p<0.001), (F) FFR ≤0.80 versus DFR showed an AUC of 0.863 (0.727–1.000) and a diagnostic accuracy of 0.938.

Supplementary Figure 5

Concordance and discordance of DFR and Pd/Pa with receiver operating characteristic curves according to each coronary vessel. LAD: (A) DFR and Pd/Pa showed a strong correlation (r=0.909; p<0.001), (B) Pd/Pa ≤0.92 versus DFR showed an AUC curve of 0.906 (0.868–0.945) and a diagnostic accuracy of 0.832. LCX: (C) DFR and Pd/Pa showed a strong correlation (r=0.873; p<0.001), (D) Pd/Pa ≤0.92 versus DFR showed an AUC of 0.970 (0.920–1.000) and a diagnostic accuracy of 0.933. RCA: (E) DFR and Pd/Pa showed a strong correlation (r=0.944; p<0.001), (F) Pd/Pa ≤0.92 versus DFR showed an AUC of 0.999 (0.995–1.000) and a diagnostic accuracy of 0.969.

Supplementary Figure 6

Concordance and discordance of FFR and DFR with receiver operating characteristic curves for coronary intermediate lesions involving proximal segments. (A) FFR and DFR showed a strong correlation (r=0.802; p<0.001). (B) FFR ≤0.80 versus DFR showed an AUC of 0.911 (0.862–0.961) and a diagnostic accuracy of 0.900.

Supplementary Figure 7

Concordance and discordance of FFR and DFR with receiver operating characteristic curves for intermediate coronary lesions not involving proximal segments. (A) FFR and DFR showed a strong correlation (r=0.793; p<0.001). (B) FFR ≤0.80 versus DFR showed an AUC of 0.918 (0.855–0.980) and a diagnostic accuracy of 0.939.

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