The Egyptian Journal of Hospital Medicine (April 2021) Vol. 83, Page 1195-1202

# Outcomes of Instantaneous Wave-Free Ratio versus Fractional Flow Reserve Guided Strategies for Coronary Revascularization in Patients with Acute Myocardial Infarction

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## ABSTRACT

**Background:** The instantaneous wave-free ratio (iFR) is non-hyperemic pressure-derived indices of the severity of stenosis. The index has been tested against fractional flow reserve (FFR) in small trials, and the two measures have been found to have similar diagnostic accuracy. However, studies of clinical outcomes associated with the use of iFR are lacking.

**Objectives:** To improve the outcomes of percutaneous coronary intervention (PCI) in patients presenting with ST segment elevation myocardial infarction (STEMI) and have multivessel coronary artery disease (CAD) through using a new technology of iFR in STEMI patients.

**Subjects and methods:** The present prospective cohort study was conducted by cooperation between Zagazig University Hospitals, Egypt and Chest Disease Hospital, Kuwait. During the period from April 2019 to April 2020. It included 188 patients presented with acute myocardial infarction (STEMI). Patients were divided into 2 groups each one enrolled 94 patients. Group I (iFR technique) and Group II (FFR technique), both were used to guide the decision as to whether percutaneous revascularization was appropriate.

**Results:** There was no statistically significant difference regarding lesion characteristics assessed among studied patients. 90.4% of IFR group were not suffering from chest discomfort during the procedure versus 29.8% of FFR group with a high statistically significant difference among both groups. Four patients (4.3%) out of total number of the first group had sustained non-fatal MI, however only three cases (3.2%) had non-fatal MI, the calculated p value was 0.71.

**Conclusion:** iFR-guided revascularization strategy was non-inferior to an FFR-guided revascularization strategy with respect to the rate of major adverse cardiac outcomes and was associated with less chest discomfort.

**Keywords:** FFR, iFR, STEMI, PCI.

## INTRODUCTION

Patients presenting with acute ST segment elevation myocardial infarction (STEMI) are best treated with primary percutaneous coronary intervention (PCI) of the infarction related coronary artery and the implantation of stents[(1)]. Approximately 50% of these patients have additional, severe stenotic lesions in non–infarction related coronary arteries[(2)]. In both trials, the decision to use stents for these lesions was based on angiographic appearance, irrespective of whether the lesions were causing ischemia or symptoms. The question of whether preventive stenting is always needed is debatable, because coronary angiography may both underestimate and overestimate the functional severity of a lesion and may lead to overtreatment, with additional costs and risks[(3)].

The use of fractional flow reserve (FFR) to guide decisions regarding the use of PCI in patients with stable coronary artery disease has been shown to reduce the risk of serious adverse events as compared with angiography-guided PCI or conservative treatment[(4)]. A recent randomized trial that evaluated an FFR-guided approach to justify the use of PCI for non–infarct-related coronary artery lesions among patients presenting with STEMI and multivessel disease showed that patients who had complete staged (FFR-guided) revascularization had significantly fewer repeat revascularizations than those who received treatment for the infarct-related coronary artery only[(5)]. FFR was successful largely because of its technical simplicity and because clinical trials showed that it was associated with improved clinical outcomes after percutaneous coronary intervention (PCI)[(6)]. Consequently, FFR is now included in the appropriate-use criteria for coronary angiography and in the American College of Cardiology–American Heart Association–European Society of Cardiology guidelines; despite these recommendations, its adoption remains limited[(7)].

FFR must be measured during maximal hyperemia, which is typically induced with the administration of a potent intravenous or intracoronary vasodilator, such as adenosine[(8)]. Several studies have questioned the need for the administration of a vasodilator to assess stenosis severity[(9)]. In these studies, investigators found that in determining stenosis severity, FFR was not superior to the instantaneous wave-free ratio (iFR), a pressure-derived index of stenosis severity that is not obtained with the administration of a vasodilator. We aimed to determine the efficacy and safety of an iFR-guided strategy versus an FFR-guided strategy for coronary





Received:26 /6 /2020
Accepted:24 /8 /2020

revascularization. Instantaneous wave-free ratio is performed using high fidelity pressure wires that are passed distal to the coronary stenosis. iFR isolates a specific period in diastole, called the wave-free period, and uses the ratio of distal coronary pressure (Pd) to the pressure observed in the aorta (Pa) over this period. During this wave-free period, the competing forces (waves) that affect coronary flow are quiescent meaning pressure and flow are linearly related as compared to the rest of the cardiac cycle[10].

When stenoses are flow limiting, Pd and Pa pressures over the wave-free period diverge; a normal ratio is 1.0 and iFR values of below 0.90 suggest flow limitation. iFR can be calculated using dedicated consoles available for medical use and typically uses an average over 5 heart beats but can be performed using a single heart beat. iFR is measured at rest, without the need for pharmacological vasodilators or stressors and compares well to other invasive and non-invasive markers of ischemia or flow limitation[11]. We aimed to improve the outcomes of PCI in patients presenting with STEMI and have multivessel coronary artery disease (CAD) through using a new technology of iFR in STEMI patients.

## PATIENTS AND METHODS

This prospective cohort study conducted on 188 patients, who were admitted to Cardiology Department at Chest Disease Hospital, Kuwait. Patients were divided into 2 groups; Group I: (iFR technique). In this group iFR measurements were used to guide the decision as to whether percutaneous revascularization was appropriate. In the case of non–infarct-related coronary arteries with flow-limiting lesions (iFR, ≤0.89), PCI was performed, during the same intervention. The treating physician asked the patients to assess their level of chest discomfort during the procedure on a four-point grading scale, ranging from none to severe. Group II: (FFR technique): In this group FFR measurements were used to guide the decision as to whether percutaneous revascularization was appropriate. In the case of non–infarct-related coronary arteries with flow-limiting lesions (FFR, ≤0.80), PCI was performed, during the same intervention.

**FFR measurement:** lesions with 40 to 80% stenosis on visual examination were identified. Pressure wire was used to measure the Pa/Pd ratio at rest and during maximally induced hyperemia. Hyperemia was achieved through intravenous administration of 140 μg of adenosine per kilogram of body weight per minute or through repeated, dose-increasing, intracoronary injections of adenosine boluses (40 to 100 μg for the right coronary artery and 60 to 100 μg for the left coronary artery).

**Ethical approval:**

**The study protocol was formally reviewed and approved by the ethics committee for human research at the Zagazig Faculty of Medicine** with informed consent obtained from all participants prior to commencement of the study after a thorough explanation of the study objectives. The study was carried out in accordance with recommendations of the Declaration of Helsinki.

***Inclusion Criteria:*** Patients with STEMI admitted for primary or rescue PCI and MVD detected at time of angiography.

***Exclusion Criteria:*** Contraindications for antiplatelet and anticoagulants. Inability to tolerate adenosine (known asthmatic, significant bradycardia, or hypotension). Chronic total occlusion in the non–infarct-related coronary artery. Suboptimal result or complications after treatment of an infarct-related coronary artery. Cardiogenic shock patients and who are Killip class III or IV. Patients with unsuitable anatomy for primary PCI. Severe non-ischemic valvular lesions.

All patients were subjected to detailed history taking, including coronary artery disease (CAD) risk factors, physical examination, standard ECG was done on admission at emergency room triage. STEMI was diagnosed. In patients with left bundle branch block (LBBB) or ventricular paced rhythm, infarct diagnosis based on the ECG is difficult, we used Sgarbossa criteria for enrollment the patient as acute MI. If the ECG has > 3 points it was considered as acute MI.

Cardiac biomarkers, hemoglobin level, kidney function tests, and total cholesterol were measured, Echocardiography was done. Left ventricle (LV) systolic function was assessed by calculating Ejection Fraction (EF).

LV volumes were measured from the apical four- and two-chamber views. Two-dimensional echocardiographic image acquisition aimed to maximize LV areas, while avoiding foreshortening of the left ventricle, which results in volume underestimation. Acquiring LV views at a reduced depth to focus on the LV cavity to reduce the likelihood of foreshortening and minimize errors in endocardial border tracings[12].

Both left ventricle end diastolic (LVED) and end systolic (LVES) volumes in apical four chamber (A4C) and apical two chamber (A2C) views were measured .The mean of the two readings (the biplane) ejection fraction was then taken. The EF was then calculated using the following formula for each view: **EF (%) = ((EDV - ESV) / EDV) X 100**[12].

All patients received 300 mg aspirin, 8 tablets of clopidogrel (600 mg) no loading dose for those patients already on clopidogrel or ticagrelor 150 mg as loading doses and 50-100 IU/Kg. unfractionated heparin intravenously in catheterization laboratory. Glycoprotein (GP) IIb/IIIa inhibitors infusion if indicated. Patients continued on 81 mg aspirin, 75 mg clopidogrel daily or (one ticagrelor tablet 90 mg twice

daily) for at least 1 year. Heparin infusion was adjusted by PTT or ACT to be 1.5 to double the normal.

STEMI patients underwent primary PCI if door to balloon time<120 minutes. Patient receive thrombolytic therapy underwent coronary angiography within first 24 hours (pharmaco-invasive strategy) [13]. For both groups the technique was the same except for the step of hyperemia.

In both trial groups, intracoronary nitroglycerin was administered before the lesion was assessed. Lesions with at least 80% stenosis on angiography were treated without the use of physiological indexes. For lesions with 40 to 80% stenosis on visual examination, physiologically guided assessment was performed.

The iFR and FFR measurements were obtained with the use of a coronary-pressure guidewire (Philips Volcano,. For FFR, hyperemia was induced with the administration of intracoronary or intravenous adenosine. Revascularization of the investigated vessel was mandated if the iFR was 0.89 or lower or the FFR was 0.80 or lower; these thresholds indicated the presence of hemodynamically important stenosis. When the iFR was higher than 0.89 or the FFR was higher than 0.80, revascularization of the vessel was deferred.

Revascularization was performed in accordance with standard clinical practice. Percutaneous coronary intervention (PCI). At the conclusion of the procedure, the treating physician asked the patients to assess their level of chest discomfort during the procedure on a four-point grading scale, ranging from none to severe. The type of P2Y12 inhibitor that was administered during and after PCI was left to the discretion of the physician; however, lifelong treatment with acetylsalicylic acid was recommended.

Epicardial and resistance arteries have to be vasodilated. Epicardial vessels were dilated using a bolus of 100-200 mcg of intracoronary nitroglycerine at least 30 seconds before the first measurement. Hyperemia was induced in the resistance vessels using adenosine (IC or IV).

***Statistical analysis***

Data were analyzed using IBM SPSS 23.0 for windows (SPSS Inc., Chicago, IL, USA) and NCSS 11 for windows (NCSS LCC., Kaysville, UT, USA). Quantitative data were expressed as mean ± standard deviation (SD). Independent sample t-test of significance was used when comparing between two means. Mann-Whitney test was used when comparing two means of not normally distributed data. Chi-square ($X^2$) test of significance was used in order to compare proportions between two qualitative parameters. Fisher Exact test was used in the place of chi square test in cases of small samples. P-value <0.05 was considered significant.

**RESULTS**

Regarding the demographic characteristics there was no statistically significant difference between FFR and iFR groups (Table 1).

**Table (1): Demographic characteristics among both studied groups**

| | | Group I (iFR technique) N=94 | | Group II (FFR technique) N=94 | | P |
|---|---|---|---|---|---|---|
| **Gender** | **Male** | **72** | **76.6** | **72** | **76.6** | >0.05 |
| | **female** | **22** | **23.4** | **22** | **23.4** | |
| **Age (years) Mean ±SD** | | **62.4 ± 5.5** | | **62.1 ± 5.5** | | >0.05 |
| **BMI (kg/m$^2$) Mean ±SD** | | **28.4±2.71** | | **26.3±4.51** | | <0.001 |
| **Smoking** | | **46 (48.9%)** | | **50 (53.2%)** | | >0.05 |
| **Diabetes Mellitus** | | **35 (37.2%)** | | **32 (34%)** | | >0.05 |
| **Dyslipidemia** | | **59 (62.8%)** | | **62 (66%)** | | >0.05 |
| **Positive family history** | | **29 (30.9%)** | | **26 (27.7%)** | | >0.05 |
| **Previous MI** | | **36 (38.3%)** | | **31 (33%)** | | >0.05 |
| **Previous PCI** | | **36 (38.3%)** | | **40 (42.6%)** | | >0.05 |

BMI: The body mass index

PCI: percutaneous coronary intervention MI: myocardial infarction

There was significant difference in favor of group II. In FFR group (II) there was more decrease in heart rate (HR) and diastolic blood pressure. While there was close matching between both groups in relation to hemoglobin level, total cholesterol and serum creatinine level (Table 2).

**Table (2): Clinical and laboratory data among both studied groups**

| | Group I (iFR group N=94 | Group II (FFR group) N=94 | P value |
|---|---|---|---|
| **Heart rate (bpm) Mean ±SD** | **79.8 ± 8.63** | **76.8 ± 8.63** | **0.02** |
| **Systolic blood pressure (mmHg) Mean ±SD** | **137.8 ± 16.3** | **135.8 ± 16.3** | >0.05 |
| **Diastolic blood pressure (mmHg) Mean ±SD** | **83.1 ± 10.04** | **78.1 ± 10.04** | **0.001** |
| **Hemoglobin (g/dl) Mean ±SD** | **13.04 ± 1.31** | **13.1 ± 1.26** | >0.05 |
| **Total cholesterol (mg/dL) Mean ±SD** | **164.9 ± 32.2** | **165.96 ± 32.6** | >0.05 |
| **Creatinine (mg/dL) Mean ±SD** | **1.02 ± 0.35** | **1.05 ± 0.35** | >0.05 |

Between the two groups the number of lesions treated with PCI was nearly the same. The P value for all was not significant (Table 3).

**Table (3): Comparison between patients who was treated with PCI between both groups**

| Variables | | Group I (IFR group) N=78 | | Group II (FFR group) N=77 | | P value |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| **Number of diseased vessels studied per patients** | **1** | **42** | **53.85** | **42** | **54.55** | >0.05 |
| | **2** | **22** | **28.20** | **21** | **27.27** | |
| | **3** | **14** | **17.95** | **14** | **18.18** | |
| **Distribution of diseased coronary vessel which treated by PCI.** | **RCA** | **22** | **28.2** | **22** | **28.57** | >0.05 |
| | **LAD** | **47** | **60.26** | **46** | **59.74** | >0.05 |
| | **LCX** | **41** | **52.56** | **40** | **51.94** | >0.05 |
| | **LMS** | **18** | **23.08** | **18** | **23.38** | >0.05 |

RCA: right coronary artery LAD: left anterior descending artery
LCX: left circumflex artery LMS: left main artery

There were no statistically significant differences between the two groups as regard the number of patients who deferred for medical treatment (table 4).

**Table (4): Comparison between patients who deferred for medical treatment between both groups**

| Variables | | Group I (IFR group) N=16 | | Group II (FFR group) N=17 | | P value |
|---|---|---|---|---|---|---|
| | | N | % | N | % | |
| **Number of diseased vessels studied per patients** | **1** | **10** | **62.5** | **10** | **58.82** | >0.05 |
| | **2** | **5** | **31.25** | **7** | **41.18** | |
| | **3** | **1** | **6.25** | **0** | **0** | |
| **Distribution of diseased coronary vessel which treated medically.** | **RCA** | **4** | **25.0** | **5** | **29.41** | >0.05 |
| | **LAD** | **9** | **56.25** | **9** | **52.94** | >0.05 |
| | **LCX** | **9** | **56.25** | **8** | **47.09** | >0.05 |
| | **LMS** | **1** | **6.25** | **2** | **11.76** | >0.05 |

RCA: right coronary artery LAD: left anterior descending artery
LCX: left circumflex artery LMS: left main artery

This table shows that 90.4% of IFR group did not suffer of chest discomfort during the procedure versus 29.8% of FFR group with a high statistically significant difference among both groups (Table 5).

**Table (5): Chest discomfort assessed during procedure between both studied groups**

| | Studied groups | | P- value |
|---|---|---|---|
| | iFR N=94 | FFR N=94 | |
| **No** | **85 (90.4%)** | **28 (29.8%)** | **<0.001** |
| **Mild** | **5 (5.3%)** | **26 (27.7%)** | **<0.001** |
| **Moderate** | **3 (3.2%)** | **29 (30.9%)** | **<0.001** |
| **Severe** | **1 (1.1%)** | **11 (11.7%)** | **0.003** |

Table 6, showed the follow up of our study patients through 6 months in OPD (outpatient clinic). There was no significant difference as regard the outcome between the two groups. Only relative risk of non-cardiac death was higher among IFR group by 1.54 times (95% CI; 0.67-2.88).

**Table (6): Follow up outcome between both studied groups**

| | | Studied groups | | P-value |
|---|---|---|---|---|
| | | iFR N=94 | FFR N=94 | |
| **Follow UP outcome** | **No hazard (angina heart failure symptoms and palpitation)** | **74 (78.7%)** | **79 (84%)** | >0.05 |
| | **Unplanned $ revascularization per medically deferred vessel** | **6 (37.5%)** | **5 (29.4%)** | >0.05 |
| | **non-fatal MI** | **4 (4.3%)** | **3 (3.2%)** | >0.05 |
| | **Stent thrombosis** | **1 (1.3)** | **3 (3.9)** | >0.05 |
| | **Re-stenosis** | **3 (3.2%)** | **2 (2.1%)** | >0.05 |
| | **All cause morality** | **7 (7.4%)** | **5 (5.3%)** | >0.05 |
| | **cardiac death** | **3 (3.2%)** | **2 (2.1%)** | >0.05 |
| | **Non-cardiac death** | **4 (4.3%)** | **3 (3.2%)** | >0.05 |

MI: myocardial infarction. **$**: defined as revascularization that was not the index procedure and was not identified at the time of the index procedure as a staged procedure to be performed within 60 days.

## DISCUSSION

In the present study regarding the whole study population, the mean age was 62 years with the male representing 76.6%. 35.6% and 40.4% had a past history of myocardial infarction and previous PCI respectively. 67% had hypertension, 64.3% had dyslipidemia, 35.6% had diabetes mellitus, 51% were smokers**.** This came in agreement with **Davies *et al.*** **(14)** **who** found that the mean age of the patients was 65 years and 76% were men. **Shiode *et al.*** **(15)** found that regarding the study population, the mean age was 70 years with the male representing 74.8%. 10.6% had a past history of myocardial infarction. 79.6% had hypertension, 59.2% had dyslipidemia, 38.8% had diabetes, and 27.1% were smokers.

In the current study, there was no statistically significant difference among both studied groups as regarding demographic characters, age, gender and BMI. This came in agreement with **Götberg *et al.*** **(16)** who found that the two groups were similar in terms of risk factors, indication for angiography, extent of coronary artery disease, and clinical and demographic characteristics. The mean age was 68 years, and 21.8% of the patients had diabetes mellitus, 62.0% had stable angina, and 33.0% had a previous myocardial infarction.

In the present study, systolic blood pressure (SBP) and diastolic blood pressure (DBP) decreased in FFR than iFR group with only significant difference regarding DBP. There was significant difference regarding HR. **Shiode *et al.*** **(15)** found that the patients' systolic and diastolic blood pressure values significantly decreased in FFR than iFR group, while their heart rates significantly increased.

In this study, FFR distribution in the analyzed population was typical for intermediate stenosis, with a mean FFR 0.82 (SD 0.04) while mean iFR was 0.92 (SD 0.04). This came in agreement with **Götberg *et al.*** **(16)** who found that the mean (±SD) iFR was 0.91±0.10, and the mean FFR was 0.82±0.10. And in agreement with **Davies *et al.*** **(14)** who found that the mean iFR and FFR measurements were close to their respective

thresholds (mean iFR, 0.91±0.09; mean FFR, 0.83±0.09); these findings suggest that most of the assessed vessels had stenosis of intermediate severity. Also, **Härle *et al.*** [17] found that the mean of FFR was 0.82 (SD 0.1).

In the present study, the median procedure time was significantly shorter in the iFR group than in the FFR group (39.6 minutes vs. 44.0 minutes). This came in agreement with **Davies *et al.*** [15] who found that the median procedure time was significantly shorter in the iFR group than in the FFR group (40.5 minutes vs. 45.0 minutes P=0.001).

In the current study, PCI was the primary revascularization procedure in 83% and 81.9% of the patients in iFR and FFR group who underwent revascularization with no statistically significant difference. Also, there was no statistically significant difference regarding Coronary artery bypass graft (CABG) as primary revascularization procedure. This came in agreement with **Götberg *et al.*** [16] who found the same results.

In the current study, the number of vessels evaluated did not differ significantly between the iFR group and the FFR group. This came in agreement with **Davies *et al.*** [14] who found the same result (P=0.58).

In the present study, practicability and performance of real-time iFR measurement were excellent, including patient comfort. Despite induction of hyperemia, the procedures for iFR and FFR measurement were completely identical, including the required equipment. After positioning the guide wire, automated online calculation of iFR was very fast (less than 5 s), and repeated measurements showed excellent short-term reproducibility. These findings agree with the recently published ADVISED-in-practice study **Petraco *et al.*** [9] and also with **Härle *et al.*** [17]. The ability to perform functional assessments of coronary stenoses without adenosine induced hyperemia could significantly improve the workflow in the catheterization laboratory due to reduced acquisition times. In addition, adenosine-dependent procedural costs would drop, because both the drug itself and the administration equipment would be unnecessary. Furthermore, considering adenosine contraindications and side effects, more patients could undergo functional assessment, and patient comfort would improve significantly. In the light of these advantages, iFR is a promising tool, which may increase acceptance and use of invasive functional assessment of coronary stenoses and this agreed with **Härle *et al.*** [17].

**Dilsizian *et al.*** [18] found that although evidence supporting the benefits of physiologically guided revascularization has accumulated over the past decade, adoption of this approach in clinical practice has lagged. There are many reasons for this, including equipment and drug costs, inadequate reimbursement, physician preferences, patient symptoms, and additional procedural burden. Although adenosine is a generally safe drug that is used in millions of diagnostic procedures annually, its risks are well documented and it is not suitable for every patient; therefore, avoiding the use of adenosine is preferable[19].

In addition, adenosine contributes substantially to the cost of physiological stenosis assessment, and its use is hampered in many countries because it is unavailable or not indicated for this purpose. Thus, the ability to perform physiological assessments of coronary artery stenosis without the use of adenosine may increase the use of such assessments in clinical practice. Although the patients were not informed of their group assignments, adverse procedural symptoms or signs occurred in 30.8% of the patients in the FFR group, as compared with 3.1% of the patients in the iFR group. This difference is most likely due to the side effects of adenosine. It is therefore possible that at least some patients in the FFR group became aware of their group assignment. Such unblinding could have led to bias in the rates of unplanned revascularization, especially if patients discussed these symptoms with their physicians[14].

Also, in agreement with our study **Götberg *et al.*** [16] found that chest discomfort during the procedure was reported by 3.0% of the patients in the iFR group and by 68.3% of the patients in the FFR group (P<0.001). Also, this was similar to those reported by **Davies *et al.*** [14].

**Sen *et al.*** [20] found that iFR is a resting index of stenosis severity that provides a physiological quantification of the effect of a stenosis on the coronary circulation. iFR is measured during a specific period of diastole known as the wave-free period, when flow is intrinsically at its highest compared with the whole cycle. Thus, iFR allows physiological assessment of coronary stenosis under rest conditions free of the side effects of hyperemic agent.

However, it takes much more time and cost to induce pharmacological hyperemia and some patients experience chest discomfort during hyperemia. The assessment of the severity of coronary stenosis without the induction of hyperemia is attractive because it reduces the procedural time and cost, and avoids the patient-related discomfort associated with pharmacological hyperemia[15].

In the present study, there was no statistically significant difference among both studied groups regarding the number of deaths. This came in agreement with **Götberg *et al.*** [16] who found that the number of deaths did not differ significantly between the iFR group and the FFR group (P=0.57). Also, **De Bruyne *et al.*** [4], **Davies *et al.*** [14], **Barbato *et al.*** [21] **and Tonino *et al.*** [22] found the same results.

In the current study, the rates of nonfatal myocardial infarction and unplanned revascularization also did not differ significantly between the two groups. Restenosis was observed in 3.2% of the patients in the iFR group and in 2.1% in the FFR group. This came in agreement with **Götberg *et al.* [16]** who found that the rates of nonfatal myocardial infarction, unplanned revascularization, and target lesion revascularization also did not differ significantly between the two groups. Restenosis was observed in 1.9% of the patients in the iFR group and in 1.8% in the FFR group (P=0.87).

For correct interpretation of coronary pressure measurements, it is of fundamental importance to realize that coronary circulation consists of at least three compartments: the epicardial coronary vessels (conductive vessels), the microvascular bed (resistance vessels), and the collateral vessels. Myocardial blood flow is the sum of antegrade coronary flow and collateral flow[23].

It is essential to understand that both FFR and iFR are used to evaluate myocardial blood flow, not coronary blood flow. Therefore, collateral flow is an important factor in coronary pressure measurements. Adenosine acts systemically and increases not only coronary flow, but also collateral flow[23].

Furthermore, there are individual differences in the microvascular anatomy, function, and its vasodilatory reserve. Therefore, it is very likely that response to adenosine varies greatly, and maybe not even constant within individuals. These differential effects of adenosine-induced hyperemia might explain at least a part of the divergent results between iFR and FFR measurements. Generally, FFR and iFR are distinct parameters which presumably take collateral flow into account differentially, but which method better reflects the true real impact of collateral flow is currently unknown. In fact, when compared with FFR, iFR showed a stronger correlation with coronary flow velocity reserve in a published study[9].

## LIMITATIONS

The size of our population is relatively small. This study was on STEMI patients, so we don't know clinical outcome in NSTEMI patients.

## CONCLUSION

iFR-guided revascularization strategy was noninferior to an FFR-guided revascularization strategy with respect to the rate of major adverse cardiac outcomes and was associated with less chest discomfort.

Further studies for longer follow up period are recommended to identify predictors of high-risk patients and provide a strict medical follow up for them.

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