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The efficacy and safety of quantitative flow ratio-guided complete revascularization in patients with ST-segment elevation myocardial infarction and multivessel disease: A pilot randomized controlled trial

Jing Zhang et al., QFR-guided complete revascularization

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Abstract

Background: In patients with ST-segment elevation myocardial infarction (STEMI) and multivessel disease (MVD), the treatment strategy for non-infarct-related artery (non-IRA) remains controversial. Quantitative flow ratio (QFR) is a new angiography-based physiological assessment index. However, there is little evidence on the practical clinical application of QFR.

Methods: Two hundred and twenty-nine patients with STEMI and MVD were recruited for this study. Patients were randomly assigned to either receive QFR-guided complete revascularization (QFR-G-CR) of non-IRA or receive no further invasive treatment. The primary (1º) endpoint analyzed included death due to all causes, non-fatal myocardial infarction (MI), and ischemia-induced revascularization at 12 months post-surgery. Secondary (2º) endpoints included cardiovascular death, unstable angina, stent thrombosis, New York Heart Association (NYHA) class IV heart failure (HF), and stroke at 1 year post surgery. Massive bleeding and contrast-associated acute kidney injury (CAKI) were used as safety endpoints.

Results: Around the 12 month follow up, the 1º outcome was recorded in 11/115 patients (9.6%) in the QFR-G-CR population, relative to 23/114 patients (20.1%) in the IRA-only PCI population (hazard ratio [HR]: 0.45; 95% confidence interval [CI]: 0.22–0.92; p = 0.025). Unstable angina in 6 (5.2%) and 16 (14.0%) patients (HR: 0.36; 95% CI: 0.14–0.92; p = 0.026), respectively. No marked alterations were found in the massive bleeding and CAKI categories.

Conclusions: In conclusion, STEMI and MVD patients can benefit from QFR-G-CR of non-IRA lesions in the initial stages of acute MI. This can help reduce incidences of major adverse cardiovascular events and unstable angina, relative to IRA treatment only.

Chinese Clinical Trial Registration number: ChiCTR2100044120.

Key words: ST-segment elevation myocardial infarction, multivessel disease, complete revascularization, physiological assessment, quantitative flow ratio

Introduction

Multiple studies have revealed that 30–50% of patients with ST-elevation myocardial infarction (STEMI) exhibit additional severe stenotic lesions in the non-infarct-related artery (non-IRA) [1]. The recommended treatment for these patients is primary percutaneous coronary intervention (pPCI) for infarct-related artery (IRA) [2]. The importance of revascularization during pPCI for clinically important stenoses of non-IRA is controversial.

Prior studies have demonstrated that pPCI in non-IRA can be detrimental [3, 4]. Therefore, recent approaches are more geared toward complete revascularization (CR) [5–8]. However, the most suitable timing and program of PCI for these patients is still a common dilemma [9].

Earlier studies have revealed the highly beneficial use of Fractional flow reserve (FFR) guided PCI for positive long-term outcomes [10, 11]. Therefore, expanding the application of physiological assessment of lesions, a noninvasive, economical, and reliable tool to evaluate the functionality of non-IRA may be highly beneficial. The quantitative flow ratio (QFR) is an angiography-based procedure used to assess the extent of coronary stenosis, according to the three-dimensional quantitative coronary angiography (3D-QCA) and contrast frame counting. Recently, multiple studies have reported on the feasibility and accuracy of QFR in predicting stenosis [12–15]. In addition, trials have shown that QFR can also be used for the functional assessment of non-IRA in STEMI and multivessel disease (MVD) patients [16, 17]. Our goal for this trial was to examine the efficacy of QFR-guided complete revascularization (CR) during the acute phase, relative to no invasive treatment, in STEMI and MVD patients, with previous pPCI of IRA.

Methods

Study design

This is a researcher-instigated, prospective, randomized clinical trial. Our goal was to evaluate the clinical outcomes of QFR-guided CR (QFR-G-CR) against IRA only revascularization in STEMI and MVD patients. Our hypothesis was that the QFR-G-CR procedure would reduce incidences of major adverse cardiovascular events (MACE) at 1 year, relative to the IRA only revascularization procedure, with optimal medication treatment strategy. We followed the Declaration of Helsinki and were approved by the ethics committee of the Affiliated Hospital of Hebei University (HDFY-KL-LL-2018-36). We also received informed agreement documents from all patients. Independent clinical research associates observed the trial and accumulated data.

Participants

We recruited adult STEMI patients, who showed eligibility and were set up for pPCI within 12 hours of symptom onset. According to the contemporary guidelines, patients with STEMI > 12 hours of onset are also indicated for pPCI, if evidence of ischemia persists. All participates were hemodynamically stable after the pPCI procedure, and had ≥ 1 lesion, with a percent diameter stenosis (DS%) between 50% and 90% in ≥ 1 non-IRAs, with a > 2.0 mm standard vessel diameter by visual estimation or quantitative coronary angiography.

Patients with any of the criteria listed below were excluded from the study: (1) severe heart failure (HF) or cardiogenic shock (New York Heart Association [NYHA] ≥ III); (2) strongly weakened kidney function: creatinine > 150 μmol/L or glomerular filtration rate (GFR) < 45 mL/kg/1.73 m^2; (3) left main (LM) coronary artery disease; (4) chronic total occlusion (CTO); (5) allergic to contrast media or of relevant anticoagulants (unfraction heparin, bivalirudin and fondaparinux) or antiplatelet drugs (acetylsalicylic acid, clopidogrel and ticagrelor); (6) severe stenosis (DS% > 90%) with a TIMI flow grade ≤ 2 in the non-IRA; (7) complications post IRA therapy; (8) severe valve dysregulation; (9) with prior coronary artery bypass grafting (CABG); and (10) any interrogated vessel regarded as not conducive to QFR measurement.

Randomization, treatment, and follow-up

Following a successful pPCI of IRA, we randomly assigned eligible patients to a QFR-G-CR or an IRA-only revascularization cohort. Randomization was done by using a computer-processed random list. Please refer to Figure 1 for the randomized treatment and follow up examinations of patients. Given the risk of in-stent restenosis, drug-eluting stents (DES) were employed for all lesions. Patients, randomly picked for CR, underwent QFR measurements of non-IRA lesions. In case of all non-IRA lesions with QFR ≤ 0.80, PCI was conducted during patient's hospital stays, regardless of the presence of clinical symptoms. However, patients with QFR > 0.80 in all examined vessels were not given PCI. Patients, in the IRA only revascularization patient population, received pPCI and no other invasive procedures. Optimal medical therapy, based on contemporary guidelines, was provided to both patient populations. Follow ups were performed once a month for up to 1 year post

surgery.

QFR measurement

QFR computation was done offline, with the AngioPlus system (Pulse Medical Imaging Technology, Shanghai, China), as per routine operational directions [12]. Two independent, certified operators performed the QFR computation. QFR ≤ 0.80 was used as the diagnostic cutoff value. We also performed QFR measurement after each surgery to analyze lesion correction. All angiogram files were stored in the core laboratory for further offline analysis.

Endpoints

The patients, in this study, were followed up till 1 year post surgery. The primary (1º) endpoint was the rate of MACE, which was a combination of patient death due to any reason, nonfatal MI, and ischemia-induced revascularization for the QFR-G-CR versus IRA-only patient populations. Secondary (2º) endpoints included the cardiovascular death, unstable angina, stent thrombosis, NYHA class IV HF, and stroke. Massive bleeding (BARC ≥ type 3 bleeding) [18] and contrast-associated acute kidney injury (CAKI) were used as safety endpoints. MI definition was the same as the fourth universal definition [19]. Ischemia-induced revascularization represented any repeat pPCI or CABG, owing to constant chest pain, with or without electrocardiographic or biomarker alterations. Unstable angina was described as angina, even after appropriate therapy. Stent thrombosis was described as a stent site obstruction, in combination with acute myocardial ischemic manifestation, ischemic electrocardiographic alterations, or augmented myocardial enzymes levels. The definition of clinical events referred to the 2006 Academic Research Consortium (ARC) standards [24].

Statistical analysis

All outcomes from recruited patients were analyzed on an intent-to-treat approach. The 1º outcomes were analyzed with the time-to-first-event approach. Categorical data, as clinical event rates, are presented as numbers and percentages (%). Continuous data, evaluated with unpaired t-test, are presented as means ± standard deviations (SD) for evenly distributed variables and, assessed with Mann-Whitney U test, and presented as medians ± minimum

(min) and maximum (max) values for unevenly distributed variables. The Chi-square test or the Fisher exact test was employed for the assessment of categorical data. A two-sided p value < 0.05 was considered statistically significant. When evaluating the time-to-event endpoints, the log-rank test was used and the Kaplan-Meier technique was employed to depict survival probability. Cox proportional-hazard models were fitted to predict HRs (HR) with 95% confidence intervals (CI) for treatment comparisons. All analyses were performed with SPSS, version 22.0 (SPSS).

Results

Patients and baseline characteristics

Between August, 2019, and January, 2020, 229 STEMI and MVD patients who received pPCI were recruited for this study. The patients were randomized and 115 were placed in the QFR-G-CR category, and 114 in the IRA-only PCI category. The median follow-up time was 12.5 months (interquartile range: 11.9–13.0). It was followed by all but 3 patients (2 in QFR-G-CR and 1 in IRA-only PCI patient population) (Fig. 1). The baseline features and risk factors were relatively the same between the groups (Table 1).

Procedural data and treatment

Procedural information for both patient populations is listed in Table 2. The procedural time for the QFR-G-CR cohort, during PPCI, was ~14 minutes longer (p <0.001), with 37 mL more of the contrast agent volume used (p < 0.001), relative to the IRA-only PCI cohort. The QFR-G-CR group used more stents per patient (p < 0.001) by treating more lesions. The proportion of MVD, use of radial access, and thrombus aspiration remained relatively the same in both cohorts (Table 2). The only exception was 1 participant of the IRA-only PCI cohort who received balloon dilation only. Both cohorts received the same management during discharge (Table 1).

QFR-related endpoints

In the QFR-G-CR group, QFR values were successfully measured in all lesions of non-IRA (Table 2). The mean QFR value was 0.76 ± 0.11. Of the 115 patients allocated in this

group, 68 (59.1%) had QFR values for one or more lesions in non-IRA that were less than or equal to the discrimination value of 0.80. These lesions were chosen for stent placement (Fig. 2). In 42 (61.8%) of these 68 patients, additional PCI were performed during the pPCI procedure; the rest (26 patients, 38.2%) received early delayed PCI during the index admission (≤ 7 days).

1º endpoints

The 1º endpoint (MACE) was observed in 11 (9.6%) patients in the QFR-G-CR cohort, relative to 23 (20.1%) patients in the IRA-only PCI cohort at the 1-year follow-up (hazard ratio [HR]: 0.45; 95% CI: 0.22–0.92; p = 0.024) (Table 3, Fig. 3A). The Kaplan-Meier curves diverged early, and remained separated at the 1-year follow-up (Fig. 3A). The 1º endpoint curves are presented in Figure 3B, C, D. The result was driven mainly by the higher incidence of ischemia-driven revascularization performed in the latter group (7.2% vs. 16.7%; HR: 0.40; 95% CI: 0.18–0.91; p = 0.024). Therefore, QFR-G-CR fared much better, compared to IRA-only revascularization, in that it produced a whopping 60% decrease in repeat revascularizations.

2º and safety endpoints

Unstable angina event rate was observed in 6 (5.2%) patients in the QFR-G-CR cohort, relative to 16 (14.0%) patients in the IRA only PCI cohort (HR: 0.36; 95% CI: 0.14–0.92; p = 0.026) (Table 3, Fig. 4B). Other 2º endpoints in the two cohorts were not significantly different (Fig. 4A, C, D). Moreover, no significant difference was observed in massive bleeding and CAKI risk (Table 3).

Discussion

The present study demonstrated that supplementary QFR-G-CR of non-IRA lesions during or < 7 days post pPCI in STEMI and MVD patients produced a dramatically reduced rate of primary endpoint. This was primarily due to eliminating the need for repeat revascularizations. These findings are similar to other publications [6, 7]. Furthermore, in the 2º endpoints, the incidence of unstable angina in the QFR-G-CR cohort was far less,

compared to the IRA-only cohort, suggesting that the QFR-G-CR procedure can greatly improve clinical outcomes and quality of life of patients. Although the volume of the contrast agent and the procedural time, during pPCI, in the QFR-G-CR cohort, were higher, as compared to the IRA-only cohort, no increase in other safety events, such as major bleeding or CAKI, was observed.

Previous studies demonstrated that non-IRA can be evaluated in STEMI with MVD patients during pPCI, but adenosine during the FFR process may cause slow blood flow and spasm in IRA. QFR, an angiography-based physiological assessment tool, presents an excellent option for the use of functional-based coronary stenosis examination, preventing the risk and discomfort seen with pressure wires and adenosine [20]. Based on the results of this study, the QFR-G-CR group extended the operation time by an average of 14 minutes, which we believe is acceptable for STEMI patients with stable hemodynamics. However, there still exists a lack of evidence on the practical clinical application of QFR, and this study fills that gap. In the present trial, QFR-G-CR reduced MACE, and the percentage of angiographically significant non-IRA lesions with a 40% QFR > 0.80. This suggested that nearly half of the non-IRA lesions that coronary angiography considered significant were, in fact, not physiologically significant.

There is still controversy regarding the optimal timing of early CR. Previous clinical trials, and recent meta-analyses, vary in the CR timing [21–23]. The CR with multi-vessel PCI for MI (COMPLETE) trial [8], with a larger sample size, demonstrated that CR fared much better than primary lesion only PCI, when performed within 45 days. In this trial, the QFR-G-CR for STEMI and MVD patients were performed during the acute phase of STEMI (during or within 7 days after pPCI). Based on our results, the composite outcome with good safety endpoints (no increase in major bleeding or CAKI) was only seen with the QFR-G-CR treatment strategy, but not with the IRA-only PCI

Limitations of the study

There were some limitations in this trial. This study could not meet blinding requirements, due to interventional treatment. Given the open-label design, there could be

bias that clinicians more likely performed subsequent revascularization on the IRA-only cohort. Some anatomic factors, such as ostial lesion, diffused long lesion, or severe vessel tortuosity, were not suitable for QFR assessment. Therefore, this can lead to selective bias among patients. As such, trials with larger patient populations are needed in future to discern the effects of QFR-G-CR on these endpoints. Finally, the present trial was followed-up for 1 year, and to elucidate long-term outcomes, future trials with long-term follow-ups are needed.

Conclusions

In conclusion, among STEMI and MVD patients, the strategy of QFR-G-CR of non-IRA lesions in the early stages of acute MI could reduce the incidence of MACE and unstable angina, relative to IRA treatment alone. Additionally, herein showed no increased risk of massive bleeding or CAKI within 1 year when using QFR-G-CR.

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Conflict of interest: None declared

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Table 1. Patient demographic at baseline

Characteristic	**QFR-guided CR (n = 115)**	**IRA-only PCI (n = 114)**	**P**
Age [years]	62.1 ± 7.5	62.7 ± 6.2	0.54
Male	90 (78.2%)	91 (79.8%)	0.77
Hypertension	59 (51.3%)	60 (52.6%)	0.84
Diabetes	23 (20.0%)	21 (18.4%)	0.76
Hypercholesterolemia	38 (33.0%)	36 (31.2%)	0.81
Current smoker	56 (48.6%)	51 (44.7%)	0.55
Previous MI	9 (7.8%)	8 (7.0%)	0.82
Previous PCI	7 (6.1%)	6 (5.3%)	0.79
Previous stroke	6 (5.2%)	3 (2.6%)	0.51*
Location of infarct**			

Anterior	39 (33.9%)	37 (32.5%)	0.82
Inferior	52 (45.2%)	55 (48.2%)	0.65
Posterior	18 (15.7%)	16 (14.0%)	0.73
Lateral	6 (5.2%)	6 (5.3%)	0.99
Symptom to balloon time [h]:			
< 6	53 (46.1%)	51 (44.7%)	0.84
6 to 12	49 (42.6%)	47 (46.1%)	0.83
> 12	13 (11.3%)	16 (13.9%)	0.53
LDL-C [mmol/L]	3.0 ± 0.5	2.9 ± 0.4	0.16
Peak creatinine [μmol/L]	74.3 ± 13.7	76.3 ± 12.6	0.27
Medications at discharge:			
Acetylsalicylic acid	115 (100%)	114 (100%)	
$P2Y_{12}$ inhibitors	115 (100%)	114 (100%)	
Ticagrelor	82 (71.3%)	76 (66.7%)	0.45
Clopidogrel	33 (28.7%)	38 (33.3%)	
Beta-blocker	107 (93.0%)	103 (90.4%)	0.46
ACEI or ARB	110 (95.7%)	108 (94.7%)	0.75
Statin	115 (100%)	114 (100%)	

Data are shown as mean ± standard deviation or number (%). There were no significant differences between the two groups in any of the baseline characteristics.

*P values were calculated with the use of a continuity-corrected chi-square test.

**The location of the infarct was determined on the basis of electrocardiography.

ACEI — angiotensin converting enzyme inhibitor; ARB — angiotensin-II-receptor blocker; CR — complete revascularization; IRA= infarct-related artery; MI — myocardial infarction; LDL-C — low density lipoprotein cholesterol; PCI — percutaneous coronary intervention; QFR — quantitative flow ratio

Table 2. Procedural information.

Characteristic	**QFR-guided CR (n = 115)**	**IRA-Only PCI (n = 114)**	**P**
2-vessel disease	86 (74.8%)	83 (72.8%)	0.73
3-vessel disease	29 (25.2%)	31 (27.2%)	
QFR-guided strategy:			
QFR procedure successful in non-IRA:	115 (100%)	NA	
non-IRA Lesions with QFR ≤ 0.8	68 (59.1%)	NA	
non-IRA Lesions with QFR > 0.8	47 (40.9%)	NA	
Mean QFR value	0.76±0.11	NA	
Non-IRA Lesions successfully treated	68/68 (100%)	NA	
During primary PCI procedure	42 (61.8%)	NA	
Early delayed (≤ 7d)	26 (38.2%)	NA	
Treatment method:			

Drug-eluting stent	115 (100%)	113 (99.1%)	0.50*
Balloon dilation only	0	1 (0.9%)	
No. of stents used per patient	2 (1–5)	1 (0–3)	< 0.001**
Procedure time during primary PCI [min]	63 (40–132)	49 (22–98)	< 0.001**
Volume of contrast agent used during primary PCI [mL]	195 (120–400)	158 (70–315)	< 0.001**
Radial access	109 (94.8%)	106 (93.0%)	0.57
Thrombus aspiration	38 (33.0%)	35 (30.7%)	0.70

Data are shown as mean ± standard deviation or number (%) or median (interquartile range).

*P values were calculated with the use of a Fisher's exact test.

**P values were calculated with the use of a Mann-Whitney U test.

CR — complete revascularization; IRA — infarct-related artery; non-IRA — non-infarct-related artery; PCI — percutaneous coronary intervention; QFR — quantitative flow ratio

Table 3. Clinical and safety endpoints at the 1 year follow up.

Characteristic	**QFR-guided CR (n = 115)**	**IRA-only PCI (n = 114)**	**Hazard ratio (95% CI)**	**P**
Primary endpoint				
MACE (any first event)*	11 (9.6%)	23 (20.1%)	0.45 (0.22–0.92)	0.025
All-cause mortality	3 (2.6%)	4 (3.5%)	0.74 (0.17–3.30)	0.69
Nonfatal myocardial infarction	3 (2.6%)	5 (4.4%)	0.58 (0.14–2.44)	0.47
Ischemia-driven revascularization	8 (7.0%)	19 (16.7%)	0.40 (0.18–0.91)	0.024
PCI	8 (7.0%)	18 (15.8%)	0.42 (0.18–0.97)	0.037
Coronary artery bypass graft	0	1 (0.9%)	NA	NA
Secondary endpoints				
Cardiovascular death	2 (1.7%)	2 (1.8%)	0.99 (0.14–7.01)	0.99
Unstable angina	6 (5.2%)	16 (14.0%)	0.36 (0.14–0.92)	0.026
Stent thrombosis	1 (0.9%)	1 (0.9%)	0.99 (0.06–15.78)	0.99
NYHA class IV heart failure	4 (3.5%)	5 (4.4%)	0.78 (0.21–2.91)	0.71
Stroke	0	1 (0.9%)	NA	NA
Safety endpoints				
Major bleedings	3 (2.6%)	2 (1.8%)	1.48 (0.25–8.88)	0.66
Contrast-associated acute kidney injury	2 (1.7%)	1 (0.9%)	1.99 (0.18–21.93)	0.57

Values are number (%) for occurrences of both first events and total events.

*MACE denotes the composite of all-cause mortality, non-fatal myocardial infarction, and any ischemia-driven revascularization.

CI — confidence interval; CR — complete revascularization; IRA — infarct-related artery; MACE — major adverse cardiovascular events; NYHA — New York Heart Association; PCI — percutaneous coronary

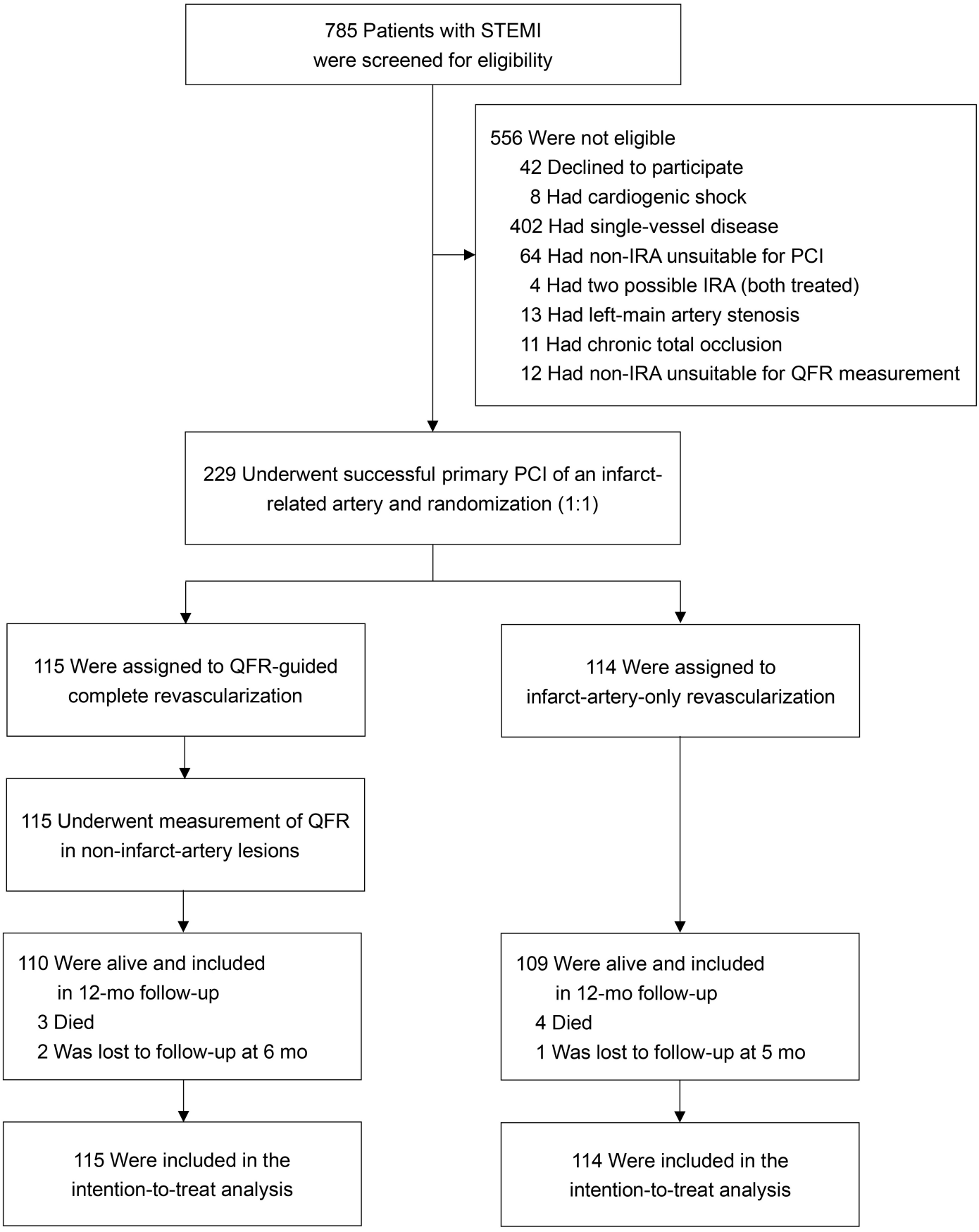
intervention; QFR — quantitative flow ratio

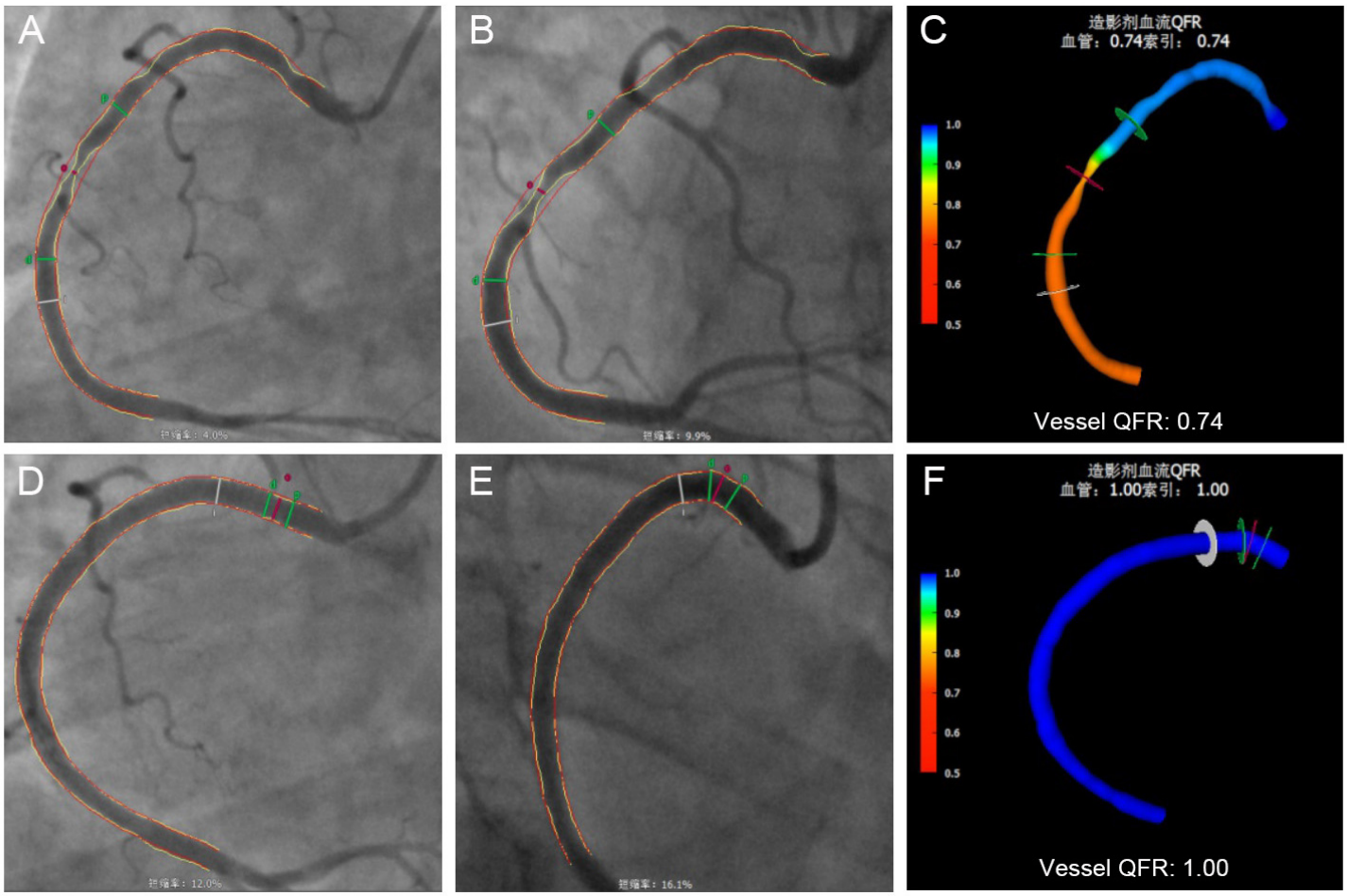
Figure 1. Enrollment, treatment, and follow-up. 229 patients with ST-segment elevation myocardial infarction (STEMI) and multivessel disease (MVD) were randomized to receive quantitative flow ratio (QFR)-guided complete revascularization (115) or infarct-related artery (IRA)-only percutaneous coronary intervention (PCI) (114). Patients were followed-up for 1 year, and analysis was by intention-to-treat.

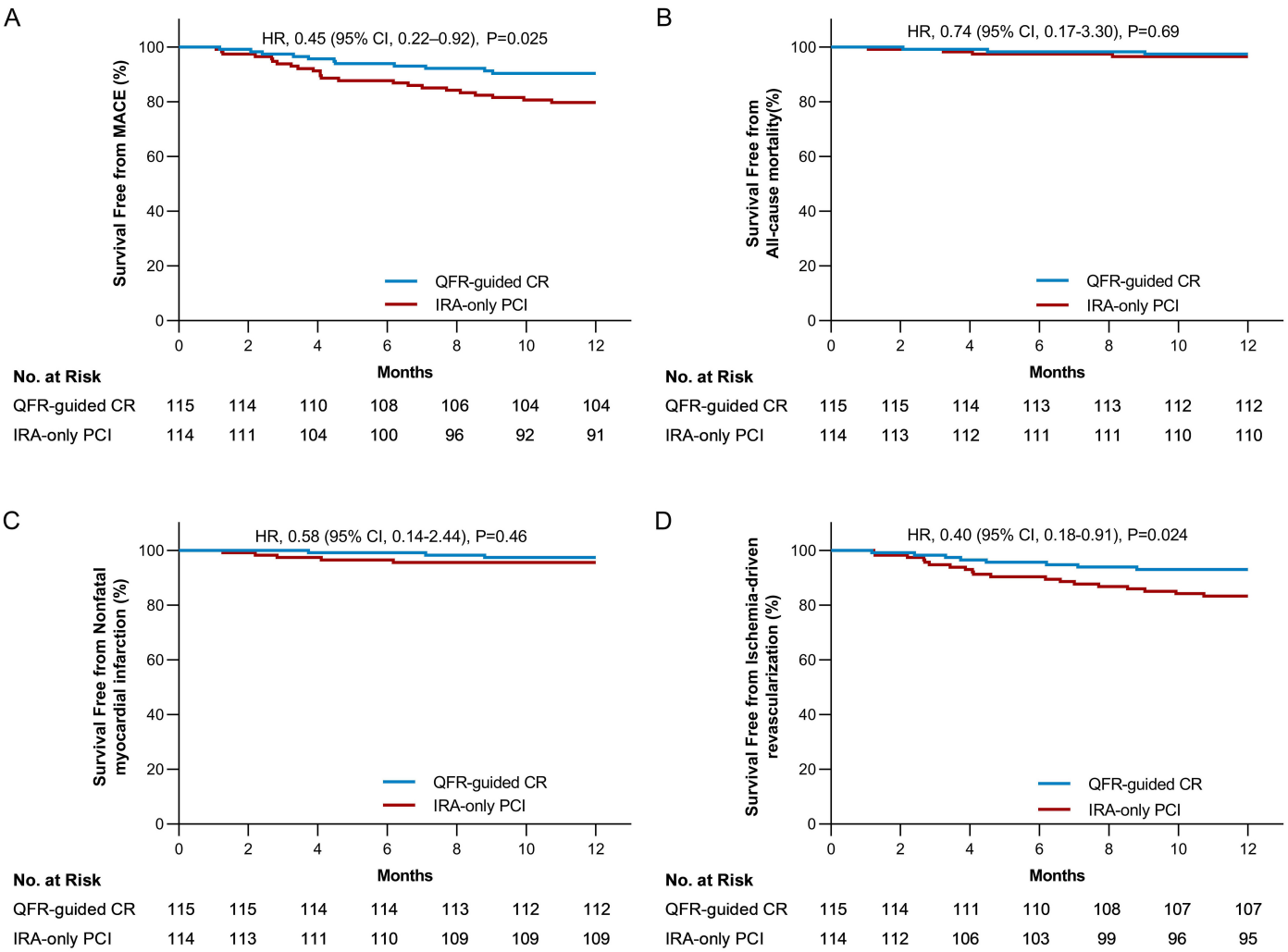
Figure 2. Example of quantitative flow ratio (QFR) computation in a right coronary artery (RCA). Example of assessment with QFR of a non-infarct-related artery (IRA) lesion; **A, B.** Non-IRA lesion in the mid-portion of RCA before percutaneous coronary intervention (PCI); **C.** Vessel QFR of RCA lesion before PCI; **D, E.** Non-IRA lesion in the mid-portion of RCA after PCI; **F.** Vessel QFR of RCA lesion after PCI.

Figure 3. Kaplan-Meier Curves for the primary (1º) endpoint and its components; **A.** Kaplan-Meier estimate of the survival rate of the 1º endpoint (major adverse cardiovascular events [MACE]); **B–D.** The components of MACE (all-cause mortality, nonfatal myocardial infarction, and ischemia-driven revascularization), respectively; CI — confidence interval; CR — complete revascularization; HR — hazard ratio; IRA — infarct-related artery; PCI — percutaneous coronary intervention; QFR — quantitative flow ratio.

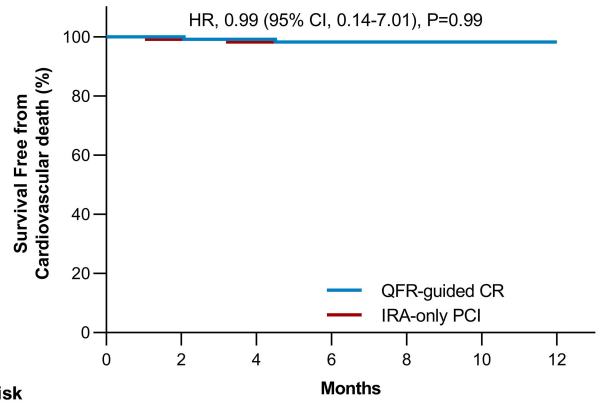
Figure 4. Kaplan-Meier curves for the secondary (2º) endpoints; **A–D.** Kaplan-Meier estimates of the survival rate of the components of 2º endpoint (cardiovascular death, unstable angina, stent thrombosis, and New York Heart Association class IV heart failure), respectively; CI — confidence interval; CR — complete revascularization; HR — hazard ratio; IRA — infarct-related artery; PCI — percutaneous coronary intervention; QFR — quantitative flow ratio.


785 Patients with STEMI
were screened for eligibility
556 Were not eligible
42 Declined to participate
8 Had cardiogenic shock
402 Had single-vessel disease
64 Had non-IRA unsuitable for PCI
4 Had two possible IRA (both treated)
13 Had left-main artery stenosis
11 Had chronic total occlusion
12 Had non-IRA unsuitable for QFR measurement
229 Underwent successful primary PCI of an infarct-related artery and randomization (1:1)
115 Were assigned to QFR-guided complete revascularization
114 Were assigned to infarct-artery-only revascularization
115 Underwent measurement of QFR in non-infarct-artery lesions
110 Were alive and included in 12-mo follow-up
3 Died
2 Was lost to follow-up at 6 mo
109 Were alive and included in 12-mo follow-up
4 Died
1 Was lost to follow-up at 5 mo
115 Were included in the intention-to-treat analysis
114 Were included in the intention-to-treat analysis


A
B
C
造影剂血流QFR
血管：0.74索引： 0.74
1.0
0.9
0.8
0.7
0.6
0.5
Vessel QFR: 0.74
D
E
F
造影剂血流QFR
血管：1.00索引： 1.00
1.0
0.9
0.8
0.7
0.6
0.5
Vessel QFR: 1.00

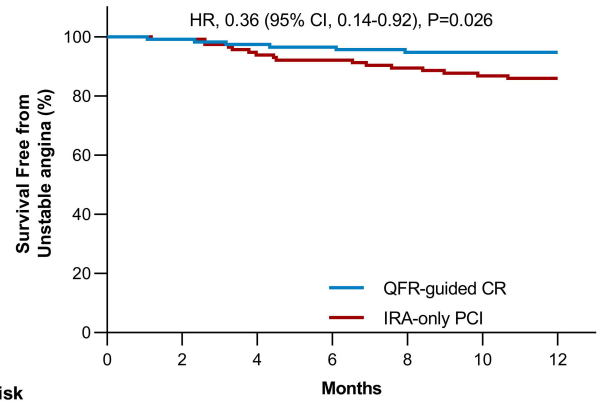

A
HR, 0.45 (95% CI, 0.22–0.92), P=0.025
Survival Free from MACE (%)
100
80
60
40
20
0
0
2
4
6
8
10
12
Months
QFR-guided CR
IRA-only PCI
No. at Risk
QFR-guided CR 115 114 110 108 106 104 104
IRA-only PCI 114 111 104 100 96 92 91
B
HR, 0.74 (95% CI, 0.17-3.30), P=0.69
Survival Free from All-cause mortality(%)
100
80
60
40
20
0
0
2
4
6
8
10
12
Months
QFR-guided CR
IRA-only PCI
No. at Risk
QFR-guided CR 115 115 114 113 113 112 112
IRA-only PCI 114 113 112 111 111 110 110
C
HR, 0.58 (95% CI, 0.14-2.44), P=0.46
Survival Free from Nonfatal myocardial infarction (%)
100
80
60
40
20
0
0
2
4
6
8
10
12
Months
QFR-guided CR
IRA-only PCI
No. at Risk
QFR-guided CR 115 115 114 114 113 112 112
IRA-only PCI 114 113 111 110 109 109 109
D
HR, 0.40 (95% CI, 0.18-0.91), P=0.024
Survival Free from Ischemia-driven revascularization (%)
100
80
60
40
20
0
0
2
4
6
8
10
12
Months
QFR-guided CR
IRA-only PCI
No. at Risk
QFR-guided CR 115 114 111 110 108 107 107
IRA-only PCI 114 112 106 103 99 96 95

A



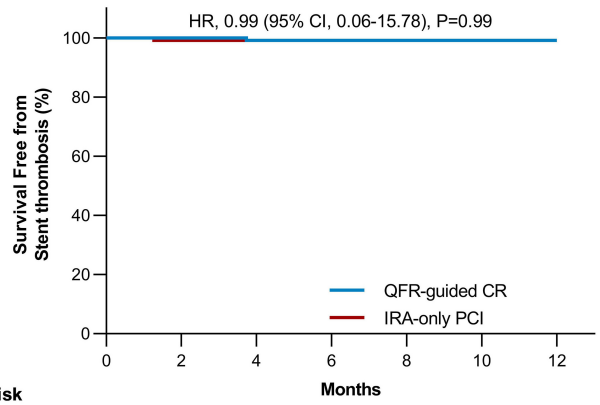
No. at Risk							
QFR-guided CR	115	115	114	113	113	113	113
IRA-only PCI	114	113	112	112	112	112	112

B



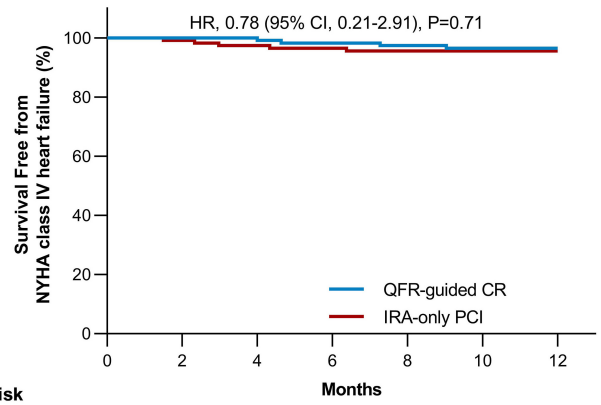
No. at Risk							
QFR-guided CR	115	114	112	111	109	109	109
IRA-only PCI	114	113	107	105	102	99	98

C



No. at Risk							
QFR-guided CR	115	115	114	114	114	114	114
IRA-only PCI	114	113	113	113	113	113	113

D



No. at Risk							
QFR-guided CR	115	115	115	113	112	111	111
IRA-only PCI	114	113	111	110	109	109	109