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Original article

Optical frequency domain imaging vs. intravascular ultrasound in percutaneous coronary intervention (OPINION trial): Study protocol for a randomized controlled trial

Takashi Kubo (MD, PhD, FJCC)[a], Toshiro Shinke (MD, PhD, FJCC)[b], Takayuki Okamura (MD, PhD)[c], Kiyoshi Hibi (MD, PhD, FJCC)[d], Gaku Nakazawa (MD, PhD)[e], Yoshihiro Morino (MD, PhD)[f], Junya Shite (MD, PhD, FJCC)[g], Tetsuya Fusazaki (MD, PhD)[f], Hiromasa Otake (MD, PhD)[b], Ken Kozuma (MD, PhD)[h], Takashi Akasaka (MD, PhD, FJCC)[a,*]

[a] Department of Cardiovascular Medicine, Wakayama Medical University, Wakayama, Japan
[b] Department of Internal Medicine, Division of Cardiovascular and Respiratory Medicine, Kobe University Graduate School of Medicine, Kobe, Japan
[c] Division of Cardiology, Department of Medicine and Clinical Science, Yamaguchi University Graduate School of Medicine, Ube, Japan
[d] Division of Cardiology, Yokohama City University Medical Center, Yokohama, Japan
[e] Division of Cardiology, Tokai University School of Medicine, Isehara, Japan
[f] Division of Cardiology, Iwate Medical University, Morioka, Japan
[g] Division of Cardiology, Osaka Saiseikai Nakatsu Hospital, Osaka, Japan
[h] Division of Cardiology, Teikyo University School of Medicine, Tokyo, Japan

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ABSTRACT

Background: Optical coherence tomography is becoming increasingly widespread as an adjunctive intravascular diagnostic technique in percutaneous coronary intervention (PCI), because of its ability to visualize coronary structures at high resolution. Several studies have reported that intravascular ultrasound (IVUS) guidance in PCI might be helpful to reduce subsequent stent thrombosis, restenosis, repeat revascularization, myocardial infarction, and cardiac death. The OPtical frequency domain imaging vs. INtravascular ultrasound in percutaneous coronary InterventiON (OPINION) trial is aimed at evaluating the impact of optical frequency domain imaging (OFDI) guidance in PCI on clinical outcomes compared with IVUS guidance.

Methods and design: The OPINION trial is a multicenter, prospective, randomized, controlled, open-label, parallel group, non-inferiority trial in Japan. The eligible patients are randomly assigned to receive either OFDI-guided PCI or IVUS-guided PCI. PCI is performed using the biolimus-eluting stent in accordance with a certain criteria of OFDI and IVUS for optimal stent deployment. All patients will undergo a follow-up angiography at 8 months. The primary endpoint is target vessel failure composed of cardiac death, myocardial infarction attributed to the target vessel, and clinically-driven target vessel revascularization at 12 months.

Conclusion: When completed, the OPINION trial will contribute to define the clinical value of the OFDI guidance in PCI.

Introduction

Percutaneous coronary intervention (PCI) is a common management strategy for patients with coronary artery disease. Since its introduction into clinical practice in 1977, angiography has been the workhorse imaging guidance for PCI [1]. However, angiography provides little information about the vessel wall or plaque lining the vessel, and has limitations in assessing lesion morphology because it depicts the coronary artery from a planar two-dimensional silhouette of the contrast-filled vessel lumen [2]. The angiographic lesion assessment is impeded in patients with eccentric lesions, diffuse disease, tortuous vessels, and multiple branches overlapping segments.

In the early 1990s, intravascular ultrasound (IVUS) was developed as an adjunctive imaging modality to overcome these

* Corresponding author at: Department of Cardiovascular Medicine, Wakayama Medical University, 811-1 Kimiidera, Wakayama 641-8509, Japan.
Tel.: +81 73 441 0621; fax: +81 73 446 0631.
E-mail address: akasat@wakayama-med.ac.jp (T. Akasaka).

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limitations of angiography. IVUS provides cross-sectional images of coronary arteries and allows assessment of arterial atherosclerotic diseases. By detecting luminal, external elastic membrane, and stent boundaries, IVUS is able to estimate vessel diameter, lumen area, plaque volume, and the results of PCI procedures such as stent underexpansion, incomplete stent apposition, and coronary artery dissection. The major role of IVUS in PCI is assessment of lesion morphology before PCI, stent optimization during PCI, and prediction of complications after PCI. Previous randomized trials, registries, and meta-analyses of IVUS-guided versus angiography-guided PCI reported that IVUS results in greater acute lumen gains with reductions in subsequent restenosis, stent thrombosis, repeat revascularization, myocardial infarction, and cardiac death [3–8].

In the mid-2000s, optical coherence tomography (OCT) emerged as a high-resolution intracoronary imaging technology that is capable of providing microscopic images of the coronary wall. OCT measures the intensity of reflected light waves and translates these optical echoes into a cross-sectional image. The spatial resolution of OCT is 10–20 μm, and it is approximately 10 times greater than that of IVUS. An excellent contrast between lumen and vessel wall in OCT allows accurate lumen measurements, which might be helpful in determining appropriate balloon or stent size [9–12]. Compared with IVUS, OCT is more sensitive in detecting suboptimal lesion morphologies after PCI, such as intra-stent tissue protrusion, incomplete stent apposition, stent edge dissection, and intra-stent thrombus [9,13,14]. In addition, tissue characterization by OCT enables us to identify lipid-rich plaques and aids to predict no-reflow phenomenon after PCI and peri-procedural myocardial infarction [15–17]. Furthermore, the most recently developed optical frequency domain imaging (OFDI: LUNAWAVE, Terumo Corporation, Tokyo, Japan) provides a high frame rate (158 frames/s), which enables imaging of long coronary segments (up to 150 mm) within a few seconds in combination with rapid spiral pullback (40 mm/s) and contrast injection through a guiding catheter. OFDI is becoming increasingly widespread as a clinical tool to guide PCI. Like IVUS, OFDI guidance is expected to improve procedural and clinical results [18]. Therefore, we designed the OPtical frequency domain imaging vs. INtravascular ultrasound in percutaneous coronary InterventiON (OPINION) trial powered to evaluate the non-inferiority of OFDI-guided PCI compared with IVUS-guided PCI in terms of clinical outcomes.

Materials and methods

Study design

The OPINION is a multicenter, prospective, randomized, controlled, open-label, parallel group, non-inferiority trial comparing OFDI-guided PCI with IVUS-guided PCI. Patients who satisfy all of the inclusion criteria (Table 1) and none of the exclusion criteria (Table 2) are enrolled in this trial. The eligible patients give written informed consent and are then randomly assigned to receive either OFDI-guided PCI or IVUS-guided PCI using a web-based randomization software conducted at the Translational Research Informatics Data Center, Kobe, Japan (Fig. 1). Minimization, a dynamic randomization method that can balance groups with respect to both the numbers in each treatment arm and the characteristics of each group, is utilized in this trial [19]. The randomization is stratified by (1) age, (2) history of diabetes, and (3) participating cardiovascular centers. In each group, either OFDI or IVUS is used before, during, and immediately after PCI. Investigators will follow up the subjects for 12 months at participating centers and will conduct medical examinations and blood testing. Coronary angiography will be performed at 8 months follow-up time point at participating cardiovascular centers. This trial is approved by the Institutional Review Board or Independent Ethics Committee of all of the participating cardiovascular centers. The planned duration is between June 2013 and December 2015. This trial has been registered at clinicaltrials.gov (NCT01873027), according to the statement of the International Committee of Medical Journal Editors.

Table 1
Inclusion criteria.

1.	Patients scheduled for PCI using drug-eluting stent to a de novo native coronary artery lesion
2.	Aged 20–85 years at the time of their consent
3.	Patients who agree to be enrolled in the trial giving signed written informed consent

PCI, percutaneous coronary intervention.

Table 2
Exclusion criteria.

1.	STEMI or NSTEMI in previous 3 months
2.	Cardiogenic shock
3.	Congestive heart failure
4.	Chronic kidney disease (eGFR <30 ml/min/1.73 m^2 or serum creatinine level >1.5 mg/dl)
5.	Hemodialysis or peritoneal dialysis
6.	Three-vessel disease
7.	Left main coronary artery disease
8.	Aorto-ostial lesion arising within 3 mm of the origin of a coronary artery
9.	Chronic total occlusion
10.	Small vessel disease (reference vessel diameter <2.5 mm)
11.	Coronary bypass graft
12.	In stent restenosis
13.	Planned surgery within 1 year

STEMI, ST-segment elevation myocardial infarction; NSTEMI, non-ST-segment elevation myocardial infarction; eGFR, estimated glomerular filtration rate.

OFDI-imaging

OFDI imaging is performed using LUNAWAVE™ imaging system and FastView™ imaging catheter (Terumo corporation). A bolus intracoronary injection of nitroglycerin or isosorbide dinitrate is administered before OFDI imaging. After manual

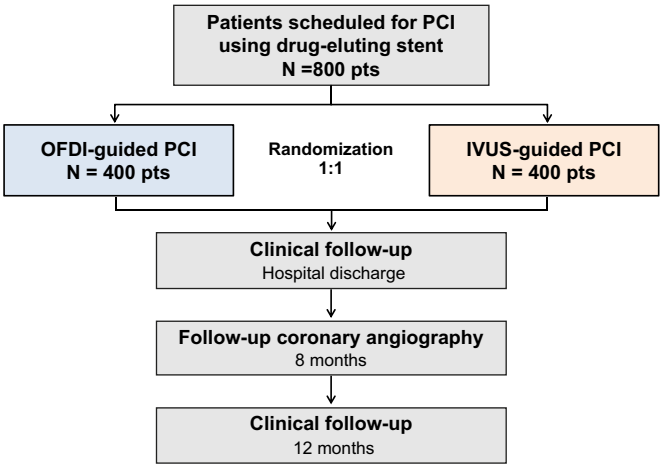

Fig. 1. Flow chart of the trial timeline. Patients are randomly assigned to receive either OFDI-guided PCI or IVUS-guided PCI. Clinical or coronary angiography follow-up is performed at the time of hospital discharge, 8 months, and 12 months after PCI. OFDI, optical frequency domain imaging; PCI, percutaneous coronary intervention; IVUS, intravascular ultrasound.

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