Optical coherence tomography tissue tissue typing - Clinical validation

Published: 31-03-2011
Last updated: 04-05-2024

We aim to validate the quantitative OC3T tissue characterization method in a clinical setting, using independent imaging as a validation standard. The development of this technique was developed based on ex vivo data, and in vivo validation is...

Ethical review	Approved WMO
Status	Recruitment stopped
Health condition type	Coronary artery disorders
Study type	Observational invasive

Summary

ID

NL-OMON36438

Source
ToetsingOnline

Brief title
OC3T

Condition

- Coronary artery disorders

Synonym
Atherosclerose

Research involving
Human

Sponsors and support

Primary sponsor: Erasmus MC, Universitair Medisch Centrum Rotterdam
Source(s) of monetary or material Support: Nederlandse Hartstichting

Intervention

Keyword: diagnostic imaging, Interventional cardiology, optical coherence tomography, tissue characterization

Outcome measures

Primary outcome

The primary endpoint of the study is a quantification of the performance of OC3T as a tissue type imaging tool. This quantification will entail calculation of sensitivity and specificity of the optical attenuation as measured by OCT for three different categories: lipid-rich/necrotic core plaque, macrophage infiltrated regions, and fibrous/calcified tissues. Matched cross-sections will be scored for tissue type in quadrants in Lipiscan/IVUS and macrophage score from OCT variance analysis. These scores will be correlated with optical attenuation measured by OCT. This endpoint will be assessed on a per vessel basis and in the entire data set overall.

Secondary outcome

OCT

Mean, maximal and minimal lumen diameter (mm);

Number of lesions, defined as a % diameter stenosis (%DS) >20%. %DS is calculated as (1-MLD/RD)x100, where MLD is minimal lumen diameter, and RD is reference diameter.

Lesion type according to published criteria;

Lesion composition derived from OC3T processing;

If a cap can be identified, minimum cap thickness.

Lipiscan/IVUS

Calcium deposits from IVUS;

Lipid-core plaques from Lipiscan;

Lumen area, vessel area, and plaque burden at 1 mm intervals from IVUS.

QCA

Mean, maximal and minimal lumen diameter (mm).

Study description

Background summary

Cardiovascular disease is responsible for 30% of all deaths, in The Netherlands and worldwide, while ischemic heart disease is the single largest cause of death in The Netherlands. In spite of a growing range of treatment options, nearly half of all cardiac deaths are due to acute coronary syndromes. Most of those are triggered by rupture of a so-called vulnerable plaque. The histopathology of a vulnerable plaque is largely known: a mildly stenotic, positively remodeled, eccentric lesion, containing a lipid-rich necrotic core under a thin fibrous cap that is weakened by inflammation. Rupture of the cap releases the thrombogenic contents into the bloodstream.
Nevertheless, our understanding is far from complete, resulting in an inability to accurately identify high-risk plaques in vivo. This lack of diagnostic capacity is aptly illustrated by the outcomes of the recent PROSPECT trial, presented at TCT2009. Only about half of the cardiac events in this trial were caused by lesions that fit the classical vulnerable plaque characteristics, as assessed by IVUS. In addition, many apparent vulnerable plaques were found that remained silent during the 3 years of the study. The significant gaps remaining in our understanding of disease processes in the coronary tree originate in the limited sensitivity and specificity of in vivo vulnerable plaque detection techniques, and in the post-mortem nature of the studies that led to the present picture of the vulnerable plaque.
Accurate data on vascular wall condition can provide valuable data for guidance of interventions. A recently published case suggests a relationship between plaque type and long-term clinical outcome of drug-eluting stent placement. In addition, the occurrence of post-procedural microemboli and post-MI cardiac enzyme levels have been linked to culprit lesion composition.
Coronary atherosclerosis will be imaged in vivo, using a novel multimodality imaging validation scheme. We will use independent imaging data as a validation standard. IVUS clearly shows the presence of calcified tissue, but has a limited specificity for different soft tissue types. Dense calcium shows up in IVUS images as a bright reflection, with a dark shadow behind it. The Lipiscan

NIRS technology has a high specificity for detection of lipid-core plaques, and was shown to produce similar spectra ex vivo and in vivo. It processes a measured reflection spectrum into a probability for the presence of lipid-core containing plaque (LCP), which is displayed as a color-coded fold-out map of the imaged artery segment, called a chemogram. Lipiscan/IVUS collects both data sets in one pullback, and indicates the probability of LCP circumferentially around the IVUS data. In addition, the probability of LCP per IVUS cross section is displayed as a color code, the block chemogram. Joint interpretation of the data sets allows the operator to identify the location of the lipid concentration in the vessel wall.
The NIRS data collected by the Lipiscan system will serve as the standard for the presence of lipids in the artery wall, while grayscale IVUS provides the standard for dense calcium. A combination catheter Lipiscan/IVUS system was recently introduced commercially. This dual modality system will be used for the study, reducing the number of catheters and complication risk, while ensuring registration between the validation data sets. OCT will be performed using the Lightlab Imaging C7XR imaging system and Dragonfly catheters (CE mark & FDA approval since 2010). Lipiscan/IVUS catheters are expected to receive CE-mark in early 2011.
Pullbacks will be acquired by OCT and by Lipiscan/IVUS. The data sets will be longitudinally and circumferentially matched landmarks such as side branches. In the OCT pullbacks, the segments of interest will be identified (2*3 per study vessel). The imaging catheter will be positioned at such a segment, with auxiliary information from x ray angiography. A stationary recording will be made during 4 to 5 heart cycles, with simultaneous ECG recording. Using the synchronous ECG data, we will select frames in the OCT recording during end-diastole, when catheter motion is minimal. The end-diastolic frames will be averaged and processed to tissue optical attenuation images. This procedure was shown to result in very reproducible attenuation data. The IVUS and NIRS cross sections, corresponding to the analyzed OCT images, will be scored for calcifications and NC respectively. Note that we do not anticipate to distinguish calcium from fibrous tissue based on the optical attenuation alone, but further development of the quantitative analysis may produce other quantifiers of the OCT signal that are specific for calcium. No independent validation exists for macrophage proliferation in vivo. We will apply variance analysis of the OCT signal, which has been proposed for this purpose.
Further development of the analysis will include the design of a procedure to eliminate the averaging step. This will allow the analysis of full pullbacks, which can be matched at regular intervals to create a much larger data set.

Study objective

We aim to validate the quantitative OC3T tissue characterization method in a clinical setting, using independent imaging as a validation standard. The development of this technique was developed based on ex vivo data, and in vivo validation is needed to demonstrate its clinical value.

Study design

This is a single-center, investigator-initiated, prospective, observational, cross-sectional study. A total of 80 patients with documented stable or unstable coronary artery disease, including non-ST segment elevation myocardial infarction (NSTEMI), unstable angina (rest pain without troponin elevation), or stable (effort) angina pectoris who are scheduled to undergo PCI and who meet all inclusion/exclusion criteria, will be included.
All patients will be enrolled in the Thoraxcenter, Erasmus MC, Rotterdam.

Study burden and risks

Introduction of a catheter in the coronary circulation can cause vasospasm, dissection, or stent damage. These complications can be managed well in the catheterization room. Although every catheterization inherently carries a risk, an enhanced risk of the techniques applied in this study have not been demonstrated. The complication rate of PCI is approximately 1%. The recent PROSPECT study, in which three coronary arteries per patient were imaged, had a complication rate of 1.6% (11 in a population of 697 pts with acute coronary syndrome). In this study, only one vessel will be investigated, hence the overall risk is probably smaller than this number.
The burden to the participants will be an extension of the PCI procedure by 15 minutes.

Contacts

Public
Erasmus MC, Universitair Medisch Centrum Rotterdam

Postbus 2040
3000CA Rotterdam
NL
Scientific
Erasmus MC, Universitair Medisch Centrum Rotterdam

Postbus 2040
3000CA Rotterdam
NL

Trial sites

Listed location countries

Netherlands

Eligibility criteria

Age
Adults (18-64 years)
Elderly (65 years and older)

Inclusion criteria

Patient eligible for percutaneous coronary intervention (PCI) of a native coronary artery
Study vessel must be accessible to the OCT and Lipiscan/IVUS catheters
Study vessel has at least 20 mm of native artery wall with analyzable OCT image quality
Informed consent

Exclusion criteria

Unable to provide informed consent
Hemodynamic instability
Cardiogenic shock
TIMI 0 flow at target lesion site
Lesion beyond acute bends or in a location within the coronary anatomy where the catheter cannot traverse
Bypass graft as target vessel
Ejection fraction less than 30%
Contra-indication to emergency coronary artery bypass surgery
No access to cardiac surgery
Contra-indication to treatment with aspirin, ticlopidine, clopidogrel, prasugrel or heparin
Renal insufficiency (creatinine clearing < 50ml/min)
Pregnancy or inadequate anticonception

Study design

Design

Study type: Observational invasive
Masking: Open (masking not used)

Control:	Uncontrolled
Primary purpose:	Diagnostic

Recruitment

NL

Recruitment status:	Recruitment stopped
Start date (anticipated):	18-06-2012
Enrollment:	80
Type:	Actual

Medical products/devices used

Generic name:	Lipiscan/IVUS combination catheter (Near-infrared spectroscopy and ultrasound)
Registration:	No

Ethics review

Approved WMO Date:	31-03-2011
Application type:	First submission
Review commission:	METC Erasmus MC, Universitair Medisch Centrum Rotterdam (Rotterdam)

Study registrations

Followed up by the following (possibly more current) registration

No registrations found.

Other (possibly less up-to-date) registrations in this register

No registrations found.

In other registers

Register	ID
CCMO	NL35189.078.10