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Visualisation of disease progression in human coronary arteries and the relationship with biomechanical forces

Submission date 24/06/2020	**Recruitment status** No longer recruiting	[_] Prospectively registered [X] Protocol
Registration date 07/07/2020	**Overall study status** Completed	[_] Statistical analysis plan [_] Results
Last Edited 07/08/2020	**Condition category** Circulatory System	[_] Individual participant data [_] Record updated in last year

Plain English summary of protocol

Background and study aims

A myocardial infarction (MI), also known as a heart attack, occurs when blood flow decreases or stops to a part of the heart, causing damage to the heart muscle. Atherosclerosis is a disease in which plaque builds up inside the arteries. Arteries are blood vessels that carry oxygen-rich blood to the heart and other parts of the body. Plaque is made up of fat, cholesterol, calcium, and other substances found in the blood. Over time, plaque hardens and narrows the arteries. Acute coronary syndrome is a term used to describe a range of conditions associated with sudden, reduced blood flow to the heart.

The aim of this study is to investigate the association between shear stress and plaque growth and plaque composition changes over time in patients with acute coronary syndrome. Furthermore, the local stress inside the plaque will be calculated to investigate possible rupture risk.

Who can participate?

Patients with acute coronary syndrome that are eligible for percutaneous coronary interventions and who contain arteries that are accessible with imaging catheters. Patients will need to give their informed consent.

What does the study involve?

The study involves additional imaging of another non-treated, less severe diseased coronary artery during the percutaneous coronary intervention initiated for treatment of the most diseased coronary artery. After 1 year, imaging of the non-treated coronary artery is repeated during another percutaneous coronary intervention. During these interventions blood will be collected. Furthermore, one month after the initial procedure a computed tomography coronary angiogram is acquired. Besides, regular clinical check-ups are performed.

What are the possible benefits and risks of participating?

Intravascular coronary imaging is often part of the clinical routine in percutaneous coronary intervention as it can help the operator to achieve an optimal stent result. The burden of this study to the patient at baseline and follow-up is the additional imaging of non-treated coronary,

which adds extra time to the total procedural time and a very small risk of coronary complications associated with introduction of a guide wire and imaging catheter in the coronary artery (less than 1 promille). The patient might potentially benefit from the invasive imaging in two ways. First, invasive imaging might help to reach optimal treatment of the most diseased region of the coronary artery and at follow up the treatment location will be investigated for restenosis, and if necessary re-treated. Secondly, thorough evaluation of the less severe diseased vessel might reveal additional, significant, but angiographically silent lesions warranting treatment. Recently the failure rate of angiography to visualize such additional lesions causing clinical events in the near future, has been

Where is the study run from?
The study will be run at the Thoraxcenter of the ErasmusMC Rotterdam, the Netherlands

When is the study starting and how long is it expected to run for?
August 2015 to April 2019

Who is funding the study?
The study is in part funded by the European Research Council

Who is the main contact?
Dr. ir. JJ Wentzel, j.wentzel@erasmusmc.nl

Contact information

Type(s)
Scientific

Contact name
Dr Jolanda Wentzel

ORCID ID
https://orcid.org/0000-0001-9893-3404

Contact details
Erasmus University Medical Center
Molewaterplein 50
Rotterdam
Netherlands
3000 CA
+31 10 7044044
j.wentzel@erasmusmc.nl

Additional identifiers

Clinical Trials Information System (CTIS)
Nil known

ClinicalTrials.gov (NCT)
Nil known

Protocol serial number
METC-2015-535

Study information

Scientific Title
Imaging and Modeling to investigate the mutual relationship of plaque growth and biomechanical parameters in human coronary arteries

Acronym
IMPACT

Study objectives
The objective of this study is to investigate the association between biomechanical parameters (e.g. shear stress) and plaque geometry and composition and plaque changes over time. This study has a large potential in finding new parameters that give novel insights in plaques that might cause a myocardial infarction. Thereby this study might contribute to the identification of patients at risk of cardiovascular events in the future.

Ethics approval required
Old ethics approval format

Ethics approval(s)
Approved 05/11/2015, Medisch Ethische Toetsings Commissie of the ErasmusMC (Molewaterplein 50, Rotterdam, the Netherlands; no telephone number provided; metc@erasmusmc.nl), ref: METC-2015-535 Positief Besluit NL54519.078.15, v02

Study design
Single-center prospective observational longitudinal- study

Primary study design
Observational

Study type(s)
Diagnostic

Health condition(s) or problem(s) studied
Acute coronary syndrome

Interventions
This study is an observational study on atherosclerotic plaque progression in human coronary arteries. The aim of this study is to investigate the influence of biomechanical factors on plaque progression over time. The intravascular imaging of the coronary arteries that is performed at baseline and after one year follow up will be used to delineate the local atherosclerotic plaque thickness. By also analyzing the local plaque thickness at one year follow up the local plaque progression will be measured. Furthermore, biomechanical parameters will be calculated using finite element modelling using 3D reconstructions of the coronary arteries based on information from intravascular imaging and computed tomography. Moreover, plaque phenotype will be identified and used in further analysis.

Methodology:
Acute coronary syndrome patients treated for coronary artery disease at the catheterization laboratory are enrolled in this study. After treatment of the most diseased coronary artery (indication for the percutaneous coronary intervention), another less severe diseased coronary artery is imaged using multiple imaging modalities and this imaging procedure is repeated at the catheterization laboratory after one year. Furthermore at one month after the first imaging moment, the patient will undergo a CT coronary angiography procedure. Blood is collected during the baseline and follow up imaging procedure.

Intervention Type
Other

Primary outcome(s)
1. Shear stress measured using computational fluid dynamics in 3D reconstructions of the coronary arteries based on the imaging at baseline and categorized as low, mid or high at baseline and 1 year
2. Plaque geometry and composition (including wall thickness, cap thickness and lipids) measured at several locations in the coronary arteries using images acquired and compared for regions exposed to low, mid and high shear stress at baseline and 1 year

Key secondary outcome(s))
Stress inside the wall will be calculated using finite element modelling based on the images acquired at baseline and 1 year follow up

Completion date
17/04/2019

Eligibility

Key inclusion criteria
1. Patient eligible for PCI of a native coronary artery
2. Written informed consent obtained
3. Study coronary artery must be accessible to the OCT /NIRS-IVUS catheters

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Adult

Sex
All

Total final enrolment
56

Key exclusion criteria

1. Unable to provide informed consent
2. Under 18 years of age
3. Hemodynamic instability
4. Cardiogenic shock
5. TIMI 0 flow at target lesion site
6. Lesion beyond acute bends or in a location within the coronary anatomy where the catheter cannot transverse
7. Bypass graft as target vessel
8. Ejection fraction less than 30%
9. Contra-indication to emergency coronary artery bypass surgery
10. No access to cardiac surgery
11. Contra-indication to treatment with aspirin, ticlopidine, clopidogrel, prasugrel, ticagrelor, or heparin
12. Renal insufficiency (creatinine clearing < 50ml/min)
13. Pregnancy or inadequate anticonception
14. History of bleeding diathesis or coagulopathy.
15. History of stroke within the past year
16. History of significant gastrointestinal bleed within the past month

Date of first enrolment
03/03/2016

Date of final enrolment
30/03/2018

Locations

Countries of recruitment
Netherlands

Study participating centre
Erasmus University Medical Center
Molewaterplein 50
Rotterdam
Netherlands
3000 CA

Sponsor information

Organisation
Erasmus University Medical Center

ROR
https://ror.org/018906e22

Funder(s)

Funder type
Research council

Funder Name
European Research Council

Alternative Name(s)
The European Research Council, ERC

Funding Body Type
Government organisation

Funding Body Subtype
National government

Location

Results and Publications

Individual participant data (IPD) sharing plan
All data generated or analysed during this study will be included in the subsequent results publication.

IPD sharing plan summary
Other

Study outputs

Output type	Details	Date created	Date added	Peer reviewed?	Patient-facing?
Protocol file	version v2.0	08/11/2016	07/08/2020	No	No