

CHALLENGES



YOUR PROJECT, OUR SUPPORT



Hospital
Braga



OPTICAL COHERENCE TOMOGRAPHY AND BIOMARKERS FOR EVALUATION OF VULNERABLE PLAQUES USING NANO- PROBES

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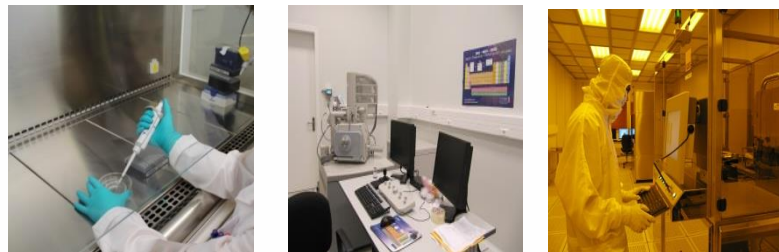
1- Hospital de Braga, Cardiology Department, Braga, Portugal;

2- International Iberian Nanotechnology Laboratory, Braga, Portugal.



1. WHO WE ARE

CHALLENGES
ACCELERATOR
YOUR PROJECT, OUR SUPPORT

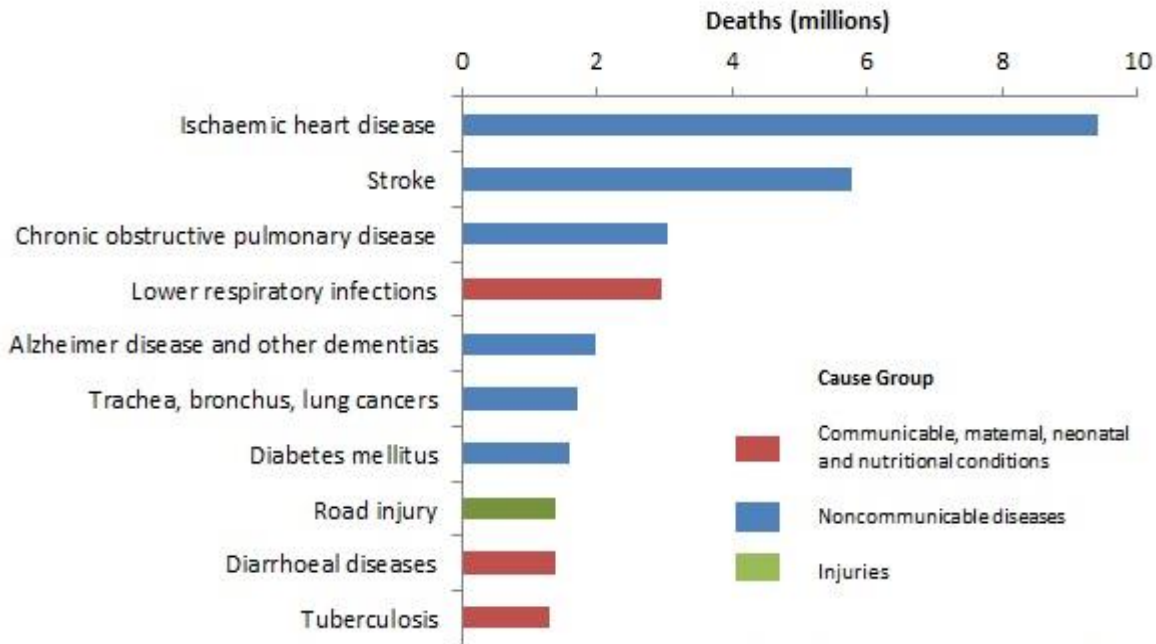


Total site area: ca. 47,000 m²
Total buildings area: ca. 26,000 m²
Main scientific bldg: ca. 22,000 m²

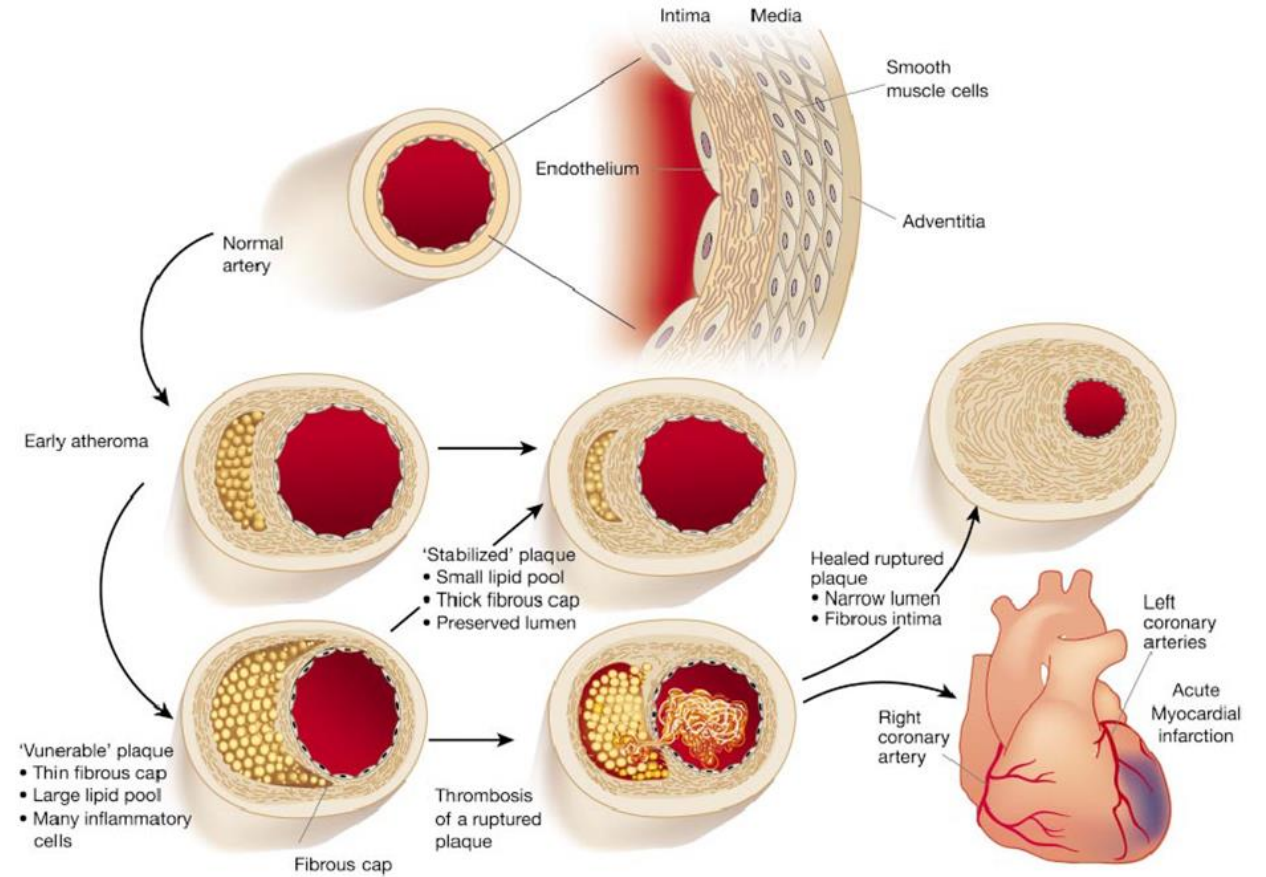


2. The cardiovascular disease

Top 10 global causes of deaths, 2016



Source: Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization; 2018.

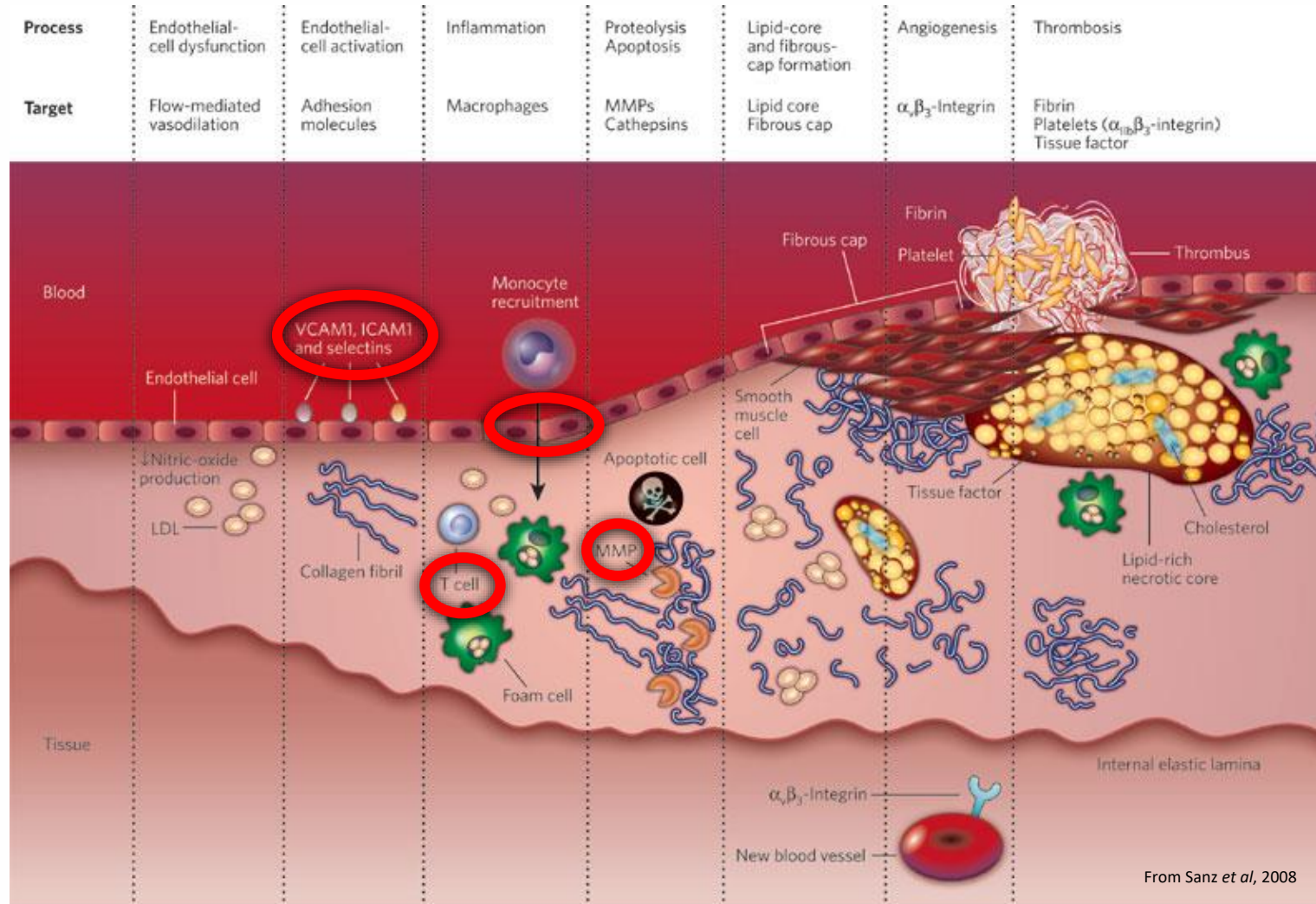


Cardiovascular diseases (CVD), including acute coronary syndromes (ACS) and stroke are the leading causes of death and disability.

Inflammatory activation, rather than the degree of stenosis, renders the plaque rupture prone and precipitates thrombosis, resulting tissue ischemia



2. The cardiovascular disease



Candidates:

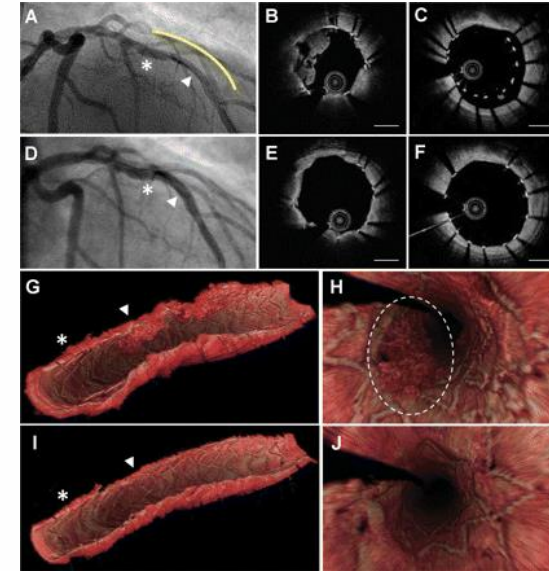
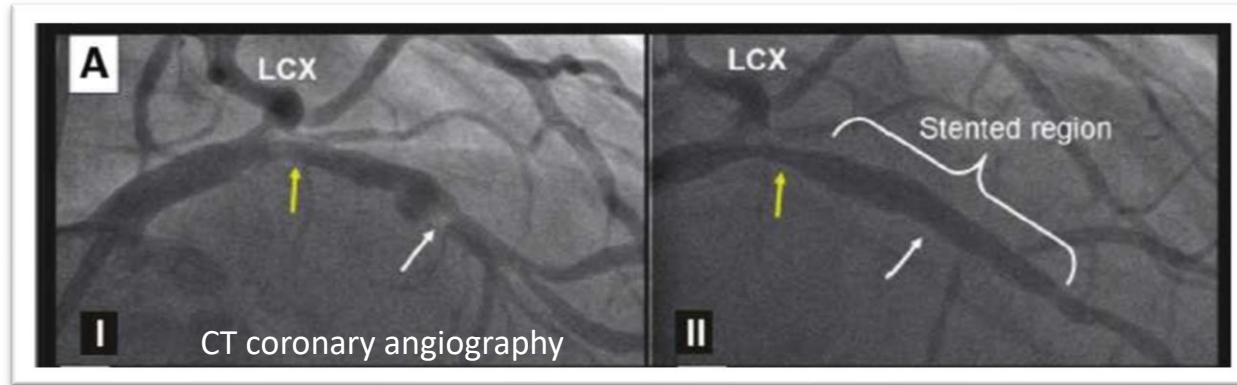
- **MMP 2**
- **MMP 9**
- **MPO**
- **MCP-1**
- **VCAMP-1**
- **ICAMP-1**



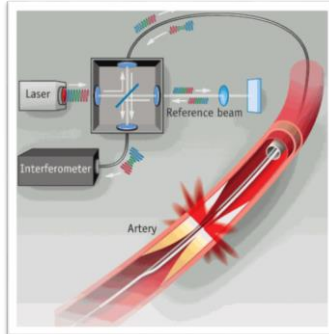
3. Project reasoning

Existent invasive imaging techniques (Coronary angiography):

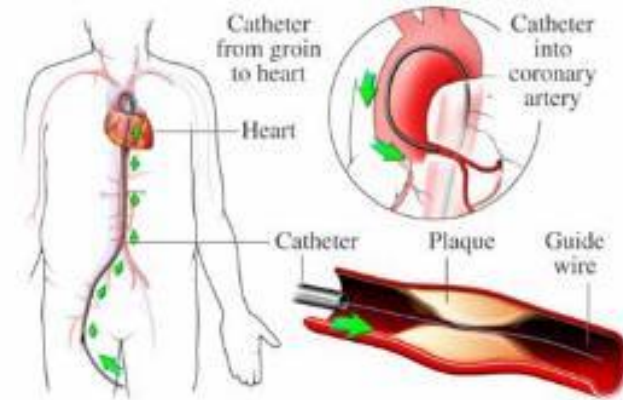
- Detect the culprit lesion
- Other atherosclerotic plaques: vulnerable or stable?



- **Existent Intravascular Imaging techniques**



- Used by Medical Doctors in cardiovascular interventions
- Gives morphologic information
 - We will add the biological information



INL's project goal is to deliver *in situ* the targeted biomarkers of vulnerable plaques and image them with an intravascular imaging device



4. Goals

To correlate the presence of vulnerable plaques detected by OCT and the development of major adverse cardiac event after 24 months of follow-up

To correlate clinical characteristics of patients presenting with an ACS with the presence of vulnerable plaques identified by OCT

To identify the baseline morphological characteristics of vulnerable plaques with subsequent rapid angiographic progression and with maintenance of vulnerable features after 1 year of medical treatment

To take advantage of the well-clinically established OCT technique, incorporating a soon available nanotechnology to deliver a robust diagnostic tool for vulnerable plaques, improving current intravascular imaging techniques as well as enabling validation of new markers of plaque instability.



Where?



On going

When?

To be started

Experimental study

What?

Clinical evaluation

✓

Budget

X



ACS without ST elevation

(Clinical questionnaire, standard physical examination, peripheral blood drawing)

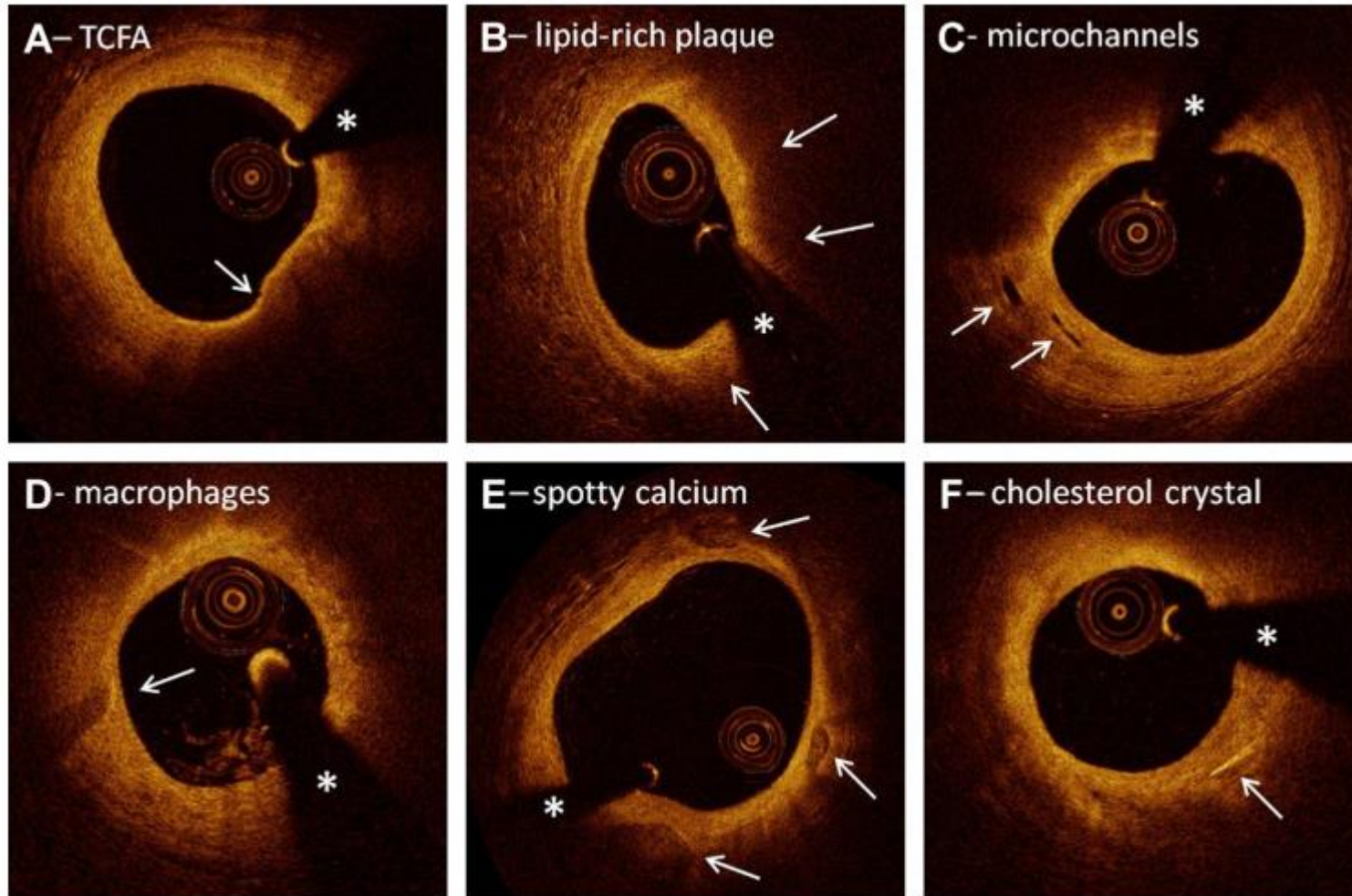


- ≥ 18 years old;
- Considered to be at **high or very high cardiovascular (CV)** risk according to the European Society of Cardiology guidelines;
- Signed informed **consent** .



OCT of intermediate lesions with vulnerable features in the proximal segments of non-culprit arteries (5 mm proximal and 5 mm distal to the site of minimal luminal area)

- **GFR < 60ml/ min** (despite the high CV risk);
- **Instability profile** (Cardiogenic shock, hypotension needing vasopressors, hypoxia needing intubation and IABP);
- Procedural **complication**;
- **Life expectancy** less than 2 years at the time of index catheterization;
- Ejection fraction $\leq 30\%$;
- **Pregnant and lactating** patients;
- History of **CABG** or planned CABG within 6 months;
- Absent informed consent .

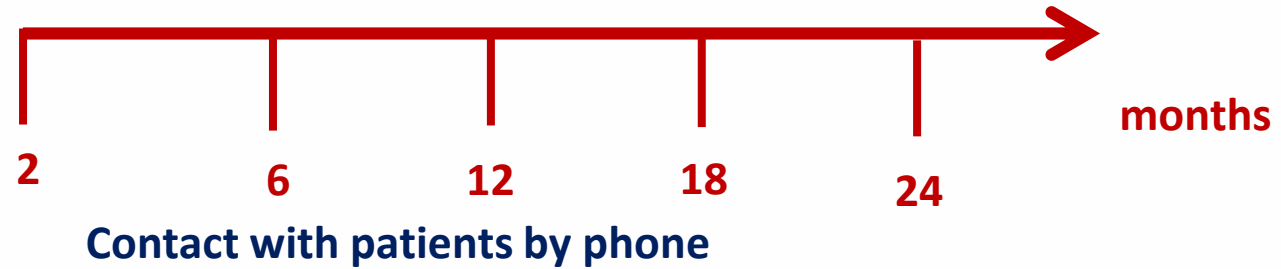


Features associated with plaque vulnerability :

- (A) Thin-cap fibroatheroma (arrow);
 - (B) Lipid-rich plaque (arrows);
 - (C) Microchannels (arrows);
 - (D) Macrophage accumulations (arrow) ;
 - (E) Spotty calcium deposits (arrows);
 - (F) Cholesterol crystals (arrow);
- (The asterisks denote guidewire shadow artifact).



**ACS without ST-
elevation**



**VP on OCT
analysis**



**New OCT analysis will be held after 1 year of medical
therapy**

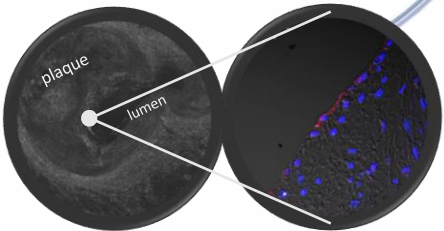


Vulnerable plaque nano-probes

Molecular targets

validation in post-mortem samples

AuNps-contrast agents



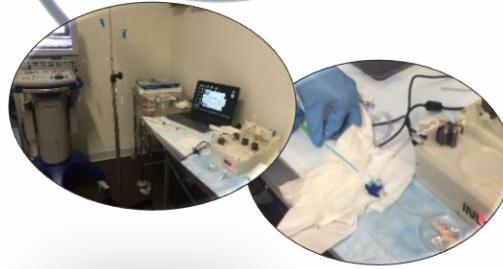
Imaging methodology (IV-OCT)

Fiber-optic based imaging



Imaging technologies validation

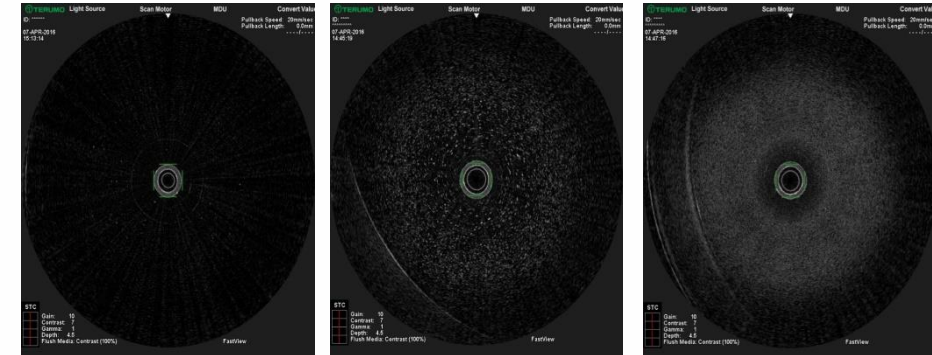
Biomimetic platform, with human samples



In situ nano-probes for vulnerable atherosclerotic plaques

Marina Brito (mbrito@inl.int) (ResearcherID: A-4203-2015)

AuNPs (100nm) – backscattered signal using Terumo Lunawave® OCT



Zero – H₂O

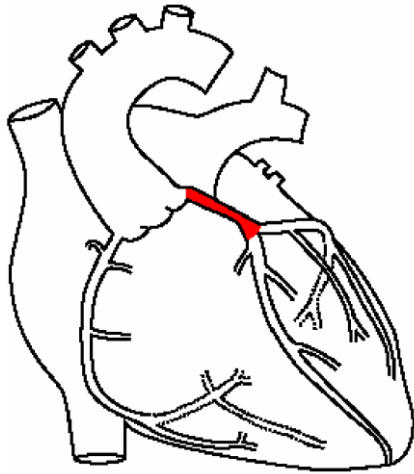
AuNPs
conc.1

AuNPs
conc.2
(higher)

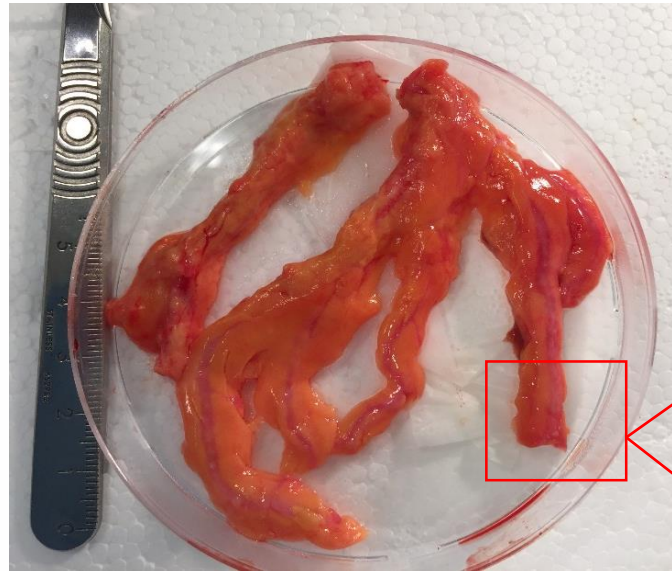


Goal: Mimic real scenario

- Real arteries – human samples
- Blood flow – dynamic tests



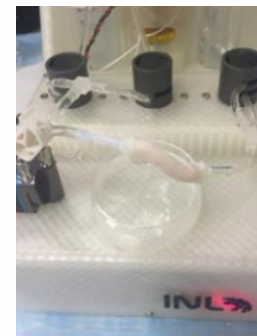
**Samples collected by MD
in the Hospital de Braga**



**Untreated human arteries to
integrate in the HFDP.**



**Samples for slicing
(controls)**

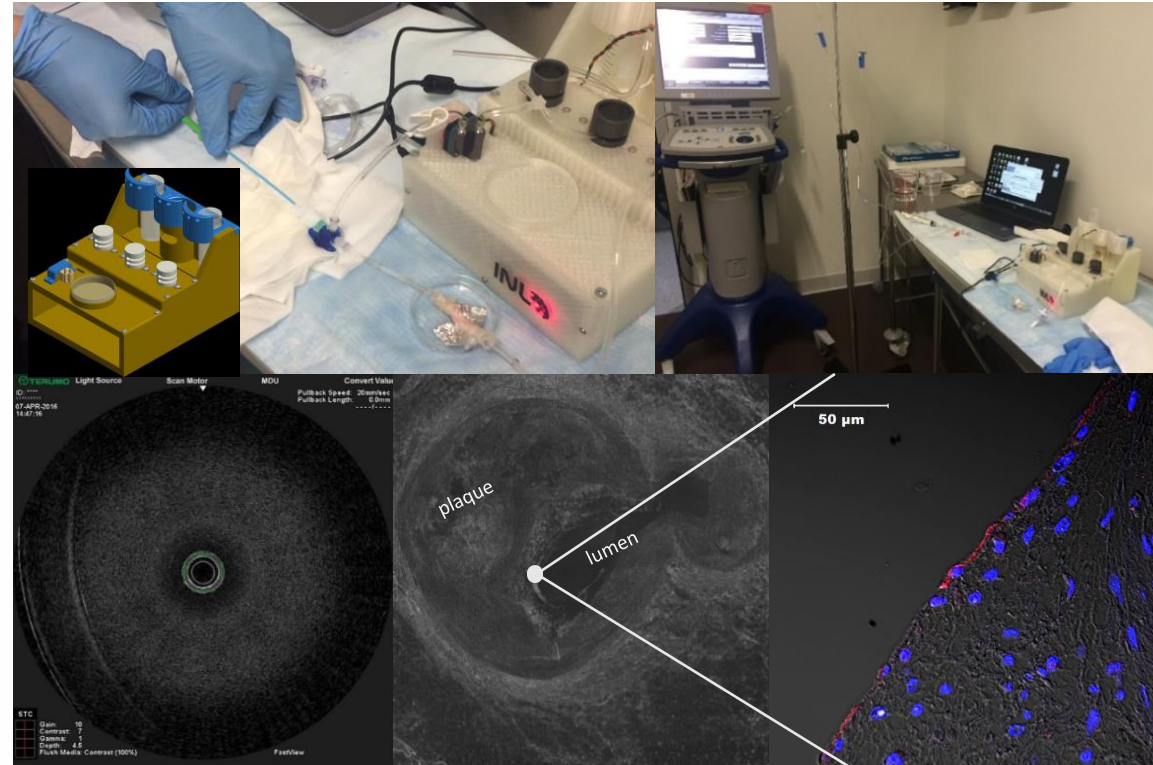


**Samples for
biomimetic system**



Goal: Mimic real scenario

- Blood flow – dynamic tests
- Real arteries – human samples



Cardiac OCT imaging using Biomimetic system



5. Conclusion

- INL and Hospital de Braga are developing a partnership with a great potential of changing the diagnosis and prognosis of ischemic heart diseases.
- The implementation of this study will improve the current diagnostic capabilities of OCT, resulting in early recognition of artery diseases with high-risk features and will be of help at identifying those patients who will likely develop acute events in the near future
- This project may add important information to a still unknown field in Cardiology influencing the strategy of revascularization patients with coronary heart disease.



6. References

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Obrigada pela atenção!
Thank you for listening!

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Our vision is to become **the worldwide hub for nanotechnology deployment** addressing society's grand challenges through **great performance** and interdisciplinary **cutting edge research**.

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