Nurse and Technician Forum

Carotid Intravascular Imaging – Technique and Indication

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Disclosure

Speaker name:

...Gianmarco de Donato..................

I have the following potential conflicts of interest to report:

- Consulting
- Employment in industry
- Stockholder of a healthcare company
- Owner of a healthcare company
- Other(s)

X I do not have any potential conflict of interest
History of carotid imaging

1960s

Donald Baker

Eugene Strandness

Robert Rushmer

An early transistorised transcutaneous CW doppler used by Strandness, later evolved into the 'Doptone'
History of carotid imaging

color flow image of the carotid artery and jugular vein created in 1975
History of carotid imaging

The ATL Mark V marketed in 1978

ATL Mk500, 1981
History of carotid imaging
Intravascular imaging
Duplex Ultrasound / OCT

high quality images
OCT vs. standard imaging

Resolution (log)

1 mm

100 μm

10 μm

1 μm

Penetration depth (log)

1 mm

1 cm

10 cm

Confocal microscopy

OCT

High frequency

HD IVUS

IVUS

Ultrasound

Standard clinical
OCT in Ophthalmology
OCT in Ophthalmology

Diagnosis of retinal diseases
- **Optical Coherence Tomography** is an *intravascular high-resolution imaging technology* that employs near-infrared light.
Analogous to sonar and radar, OCT measures **optical echoes**.

**Basic Principle of OCT**

Transducer

(Lens)

![Diagram of OCT principle]

$\Delta d$
OCT uses low-intensity infrared light instead of ultrasound (IVUS). Near-infrared light is used, because it is less absorbed and scattered than visible light, avoiding loss of image quality and making OCT superior for visualization of microscopic structures.
Optical Coherence Tomography

The typical OCT image has a **homoaxial resolution of 10 μm**, which is 10 times higher than that of any clinically available diagnostic imaging method.
Comparison of IVUS and OCT

Resolution

IVUS

(axial) 100 - 150 μm
(lateral) 150 - 300 μm

OCT

10 μm
25 - 40 μm
What is OCT?

OCT is a high-resolution imaging technology.

OCT provides in situ images of tissues at nearly histological resolution.
OCT in coronary arteries

OCT is progressively a more frequent intravascular imaging modality to assess coronary stents.

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OCT catheter

- rapid exchange 2.6-F catheter compatible with a 6-F guiding catheter.
- It acquires 100 frames per second
- pullback speeds up to 25 mm/s.
Conclusions: Intravascular OCT during a nonocclusive flush appears to be feasible and safe in carotid arteries.
Why do I use OCT in carotids?

**UTILITY - results**

1. High definition of carotid plaque
2. Interaction between plaque & stent
OCT in carotids – new frontiers

1. High definition of carotid plaque
   - Plaque type
   - Degree of stenosis
   - Area of stenosis
   - Fibrous cap integrity
   - Rupture of fibrous cap
   - Ulceration

Calcium
Lipid
Attenuation & backscattering of infrared signals
OCT in carotids – new frontiers

1. High definition of carotid plaque
   - Plaque type
   - **Degree of stenosis**
   - **Area of stenosis**
   - Fibrous cap integrity
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![OCT Image]

A Area: 4.09mm^2
B Length: 2.18mm
1. High definition of carotid plaque

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- Thrombus
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OCT in carotids – new frontiers

0.2 mm
Why do I use OCT in carotids?

UTILITY - results

1. High definition of carotid plaque

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Intraop control:
- Residual stenosis
- **Stent apposition**
- Stent malapposition
- Cell area modification
- Fibrous cap rupture
- Plaque micro-prolaps
- Branch side coverage

Follow-up control:
- neointimal thickness
- complete/incomplete stent struts coverage
2. Interaction between plaque & stent

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*OCT in carotids – new frontiers*
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- Stent malapposition
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- **Fibrous cap rupture & Plaque micro-prolaps**
- Branch side coverage

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Starting points

- Plaque prolapse $\Rightarrow$ cause of postprocedural complications following CAS

OCT can recognize further details of the plaque-stent interaction
INTRODUCTION

Design
Prospective single center study

Objectives
To evaluate the rate of:
- stent malapposition
- plaque prolapse
- fibrous cap rupture

OPTICAL COHERENCE TOMOGRAPHY AFTER CAROTID STENTING: RATE OF STENT MALAPPOSITION, PLAQUE PROLAPSE AND FIBROUS CAP RUPTURE ACCORDING TO STENT DESIGN. *Eur J Vasc Endovasc Surg* 2013;45:579-87
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according to carotid stent design

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Results:

40 consecutive CAS:

- 0% stroke/death at 30 days

- 2 TIAs (*1 in Open Cell, 1 in Hyb*)
Results:

Stent apposition

- Closed-cell
- Open-cell
- Hybrid

<table>
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<tr>
<th></th>
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<td>%</td>
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<td>9</td>
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<td>16.3</td>
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Results:
Plaque prolapse

CONCLUSIONS

- Intravascular OCT revealed that micro-defects after carotid stent deployment are frequent and are related to the design of implanted stents.

- Stent malapposition is more frequent with closed cell stents, while plaque prolapse is more common with open cell stents.

- It remains, however, unknown whether these figures now detected with OCT are of any clinical and prognostic significance.

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New carotid stent design

Terumo Road saver: Double layer micromesh nitinol design
New carotid stent design

Inspire C-Guard: nitinol stent wrapped with an expandable, MicroNet (PET mesh).
An high resolution imaging makes the difference!

Low-resolution image

High-resolution image
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