Assessment of carotid plaque morphology using photoacoustic imaging

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Disclosure

Speaker name:

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I have the following potential conflicts of interest to report:

Consulting and speakers fee
- WL Gore & Associates
- Medtronic

Unrestricted research grants
- Medtronic
- W.L Gore & Associates
- Philips Medical Systems
In 1977 Harrison and Marshall demonstrated that 66% of symptomatic patients undergoing CEA < 4 weeks of their most recent event had thrombus overlying the carotid stenosis, compared with 21% of patients waiting for a longer period.

*Brit J Surg 1977;64:511-2*

A carotid plaque becomes symptomatic by plaque ruptuur
Plaque rupture

68% of heart attacks and most strokes are caused by plaque rupture and thrombosis, not stenosis.
The composition and mechanical properties of the individual carotid plaque can be different. This influences the plaque vulnerability.

To prevent (recurrence of) cerebrovascular incidents assessment of plaque vulnerability is important.
Plaque vulnerability

Vulnerable plaque
- thin fibrous cap
- large lipid-rich necrotic core
- plaque inflammation,
- vascular remodeling,
- neovascularization,
- intra-plaque hemorrhage
Vulnerability assessment

Gray scale median

MRI plaque morphology
Photoacoustic imaging (PAI) has the advantage of detecting tissue-specific optical contrast due to the presence of certain chromophores in the tissue that is not visible in ultrasound imaging.

**A chromophore is the part of a molecule responsible for its color.**
**Visible light that hits the chromophore can thus be absorbed by exciting an electron from its ground state into an excited state.**
**The chromophore is the moiety that causes a conformational change of the molecule when hit by light.**
Photoacoustic imaging device that can detect markers for plaque vulnerability, i.e., intra-plaque hemorrhages, lipid accumulation and collagen.
Photoacoustics
Impression of a hand-held, integrated, **photoacousticking probe**. Histology samples of plaques with intra-plaque hemorrhage.

Photoacoustic images at wavelength of 808 nm (red)

*Arabul MU J Biomed Opt 2017;22:41010*
Photoacoustics

Current limitations of photoacoustic imaging

- Penetration depth (limited in vivo testing)
- Wavelength
- Ultrasound acoustic contrast (towards ultrafast US)
The Future
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