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Towards in-vivo photoacoustic imaging of atherosclerotic plaques

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Introduction
Cardiovascular disease related deaths are at the top of mortality statistics in developed countries. The large portion of deaths occurs abruptly, without expressing symptoms a priori. This urges the need for reliable and inexpensive diagnostic technologies in cardiovascular clinical practice.

Atherosclerosis is a disease that results excessive accumulation of lipids, fibers and macrophages in the arterial wall. Plaque formation in the arterial wall intrinsically causes stenosis in the vessel and disturbs the blood flow. However, vulnerable plaques that are prone to rupture are a major cause of sudden cardiovascular deaths due to blood clot formation [1].

Motivation
Retrospective autopsy studies have stated the need for a diagnostic method that is able to reveal the composition of the plaque as well as its structure for the assessment of plaque vulnerability.

Methods
Medical ultrasound provides structural and mechanical information of plaques. Although mechanical contrast between the plaque and arterial wall is low, a significant optical contrast exists. Photoacoustic imaging measures the optical absorption distribution acoustically. Combining optical contrast with acoustic resolution makes photoacoustic imaging (PAI) a promising diagnostic tool for cardiovascular applications.

Pre-clinical validation
The validation of feasibility of PAI will be done in three steps:

- Polyvinyl alcohol cryogen (PVA-C) phantom studies to quantify sensitivity and specificity
- Porcine carotid and human carotid endarterectomy samples as intermediate step for preclinical validation of in-vivo imaging
- Clinical studies with human subjects

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Reference