

INTRAVASCULAR IMAGING OF ATHEROSCLEROSIS

Prof.dr.ir. Ton van der Steen^{1,2}

¹Thoraxcenter Biomedical Engineering, Erasmus MC Rotterdam, the Netherlands;

²Interuniversity Cardiology Institute of the Netherlands, Utrecht, The Netherlands.

Corresponding e-mail: a.vandersteen@erasmusmc.nl

Intravascular ultrasound (IVUS) is a technology that uses an ultrasound element on the tip of a catheter[1, 2]. This catheter is advanced through the groin into the coronary arteries. In this way a tomographic image of the vascular wall and atherosclerotic plaques can be produced. The steering of the ultrasound beam can be done by mechanically rotating a single ultrasound transducer, or electronically, using an array of 64 elements in the tip.

Historically it has been used to assess the level of occlusion, the atherosclerotic plaque burden and the native size of the vessel. This information can be used to decide to treat or not and to determine the diameter and length of the stent to be used for treatment. It has also been used extensively to determine if the stent was well deployed.

The composition and morphology of an atherosclerotic lesion are currently considered more important determinants of acute coronary ischemic syndromes than the degree of stenosis[3]. When a lesion is unstable, it can rupture and cause an acute thrombotic reaction. An unstable plaque can be characterized by a lipid core that is covered by a thin fibrous cap, which has been locally weakened by inflammatory cells.

The last decade serious effort has been put in developing IVUS towards identifying these unstable plaques. This lecture will focus on the development of measuring the elastic properties of the plaque as a marker for plaque instability[4] and measuring the vascularization in the plaque[5], which plays an important role in the pathogenesis of unstable plaque. Furthermore the role of combined ultrasound/light catheters will be discussed[6, 7]. These will allow to image the luminal plaque at a resolution of around 10 μm , while maintaining the full overview. Furthermore photoacoustics and combination of NIR spectroscopy and imaging will be possible.

Technology development in the elements, the echomachines and the signal processing will be presented as well as their validation and the role of IVUS to provide imaging biomarkers in natural history studies and trials for the development of new cardiovascular drugs[8, 9].

Index Terms—Ultrasound, intravascular, atherosclerosis, photoacoustics.

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Prof.dr.ir. Ton van der Steen received his MSc degree in Applied Physics at the Technical University in Delft in 1989 and his PhD in Medical Sciences in 1994 at the University of Nijmegen. From 1994 to 1996 he was a senior scientist at the Laboratory for Experimental Echocardiography of the Thoraxcentre and since 1997 he is the head of this laboratory. Current research interests are in vulnerable plaque detection, intravascular ultrasound, ultrasound contrast agents and transducer design for special applications, including transesophageal, three-dimensional and harmonic imaging.

He is project leader of a national program on vulnerable plaque visualisation (ICIN32) and was appointed the 2000 NWO PIONIER Technical Sciences for Vulnerable Plaque Detection. In 2000 he was appointed Associate Professor at the

Royal Academy of Arts and Sciences and the Erasmus University Rotterdam and in 2002 Professor in Biomedical Engineering in Cardiology at the Erasmus University Rotterdam and the Interuniversity Cardiology Institute of the Netherlands.

He is the treasurer of the Dutch Foundation for Ultrasound in Medicine and Biology (DFUGB), the president of the section Ultrasound Techniques of this society and the Dutch representative at the Board of Directors of the European Federation Societies in Ultrasound in Medicine and Biology (EFSUMB). He is a member of the scientific committee and/or local organisation of the semi-annual scientific meetings of the DFUGB, the IEEE Ultrasonics symposiums, the EFSUMB, Ultrasonics International, World Conference of Ultrasonics, Acoustical Imaging and the International Conferences on Ultrasound Biomicroscanning.