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Introduction to Symposium on Intravascular Ultrasound Assessment of the Coronary Arteries

During the past 5 years a new technology has been developed which uses high-frequency soundwaves to generate cross-sectional images of vascular structures that contain microanatomic information of the geometry and tissue composition of the vascular wall. This method, called intravascular ultrasound imaging, provides for the first time in vivo a means to interrogate vascular structures and assess the development of intimal hyperplasia, atherosclerosis, or regression of disease. This technology has already had significant impact on the clinical understanding of the pathophysiology of atherosclerosis as well as on the effects of various interventional devices to treat this disease process.

The technique of intravascular ultrasonography has become a refined, reproducible, easily performed technique that provides innovation to the investigation of atherosclerosis. It is accurate in defining lumen dimensions, plaque area, and morphology both before and after interventions. As a research tool, it is ideal in quantitating lumen dimensions and the cross-sectional area of intimal hyperplasia or in evaluating the results of various interventional procedures, with information comparable to low-power histology. The clinical utility of this device, outside of research studies, will depend on data confirming the usefulness of the extraordinary information these images reveal.

Preliminary data indicate the technique is quite useful in confirming full stent expansion, may differentiate thrombus from dissection as a cause of an angiographically poor percutaneous transluminal coronary angioplasty (PTCA) result, and may potentially predict those lesions predisposed to restenosis. It also has diagnostic utility in confirming lesion severity in those cases in which the angiographic results remain equivocal, ie, in regions of overlap or very discrete "napkin ring" stenoses. It has often been useful in our laboratory in deciding whether to "size up" on balloons when a suboptimal PTCA result occurs. In addition, the ultimate utility may be in using intravascular ultrasonography as a method to guide atherectomy and stent interventions.

It is difficult to prove how a new diagnostic technology such as intravascular ultrasonography influences interventional cardiologists. The response is often subjective but dramatic. Having become accustomed to the benefits and ease of angiography, we forget how limited a view an angiogram provides. Using intravascular ultrasonography, we see directly for the first time during an invasive procedure the pathology that we are attempting to treat. The result is frequently a humbling experience because the angiogram seduces us into believing we have performed a miracle when in fact intravascular ultrasound demonstrates in detail the trauma we produce and the large residual atheroma we leave behind. These observations influence experienced angioplasters to alter their approach and to use different balloons or devices. A randomized study is now in progress to determine whether the restenosis rate can be reduced when intravascular ultrasonography is used to guide interventional procedures.

This collection of articles on the use of intravascular ultrasonography in coronary arteries provides an introduction to some of the exciting capabilities of this new technology by several of the leading researchers in this field. Peter Fitzgerald and Paul Yock describe the insights that they have observed on the mechanism of balloon angioplasty and atherectomy. These observations by intravascular ultrasonography have alerted us that the mechanism of atherectomy has both a cutting as well as a stretching component. Fitzgerald and Yock also describe the multicenter trial they are conducting called GUIDE, which will determine whether the morphologic information obtained by ultrasound imaging at the time of angioplasty and atherectomy will be useful in predicting the future clinical course and restenosis rate. Drs. Rasheed and Hodgson discuss their experience using real-time

imaging to assess the physiology of coronary arteries in response to various vasoactive stimulants, such as acetylcholine, nitroglycerin, papaverine, and adenosine. In addition, they describe their observations of arterial distensibility and elastic recoil in coronary arteries that were imaged with an ultrasound imaging system combined with a balloon dilatation catheter. Finally, Drs. Mintz, Pichard, Satler, Popma, Kent and Leon present their work in three-dimensional reconstruction of coronary artery stents inserted both in vitro and in vivo. The ability to reconstruct the stacked cross-sectional ultrasound images to provide a three-dimensional representation of the atherosclerotic plaque and lumen volume is one of the more exciting potential applications of this unique technology.

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Guest Editors