THM53 Fluorescence analysis of laser ablated arteriosclerotic human aortas

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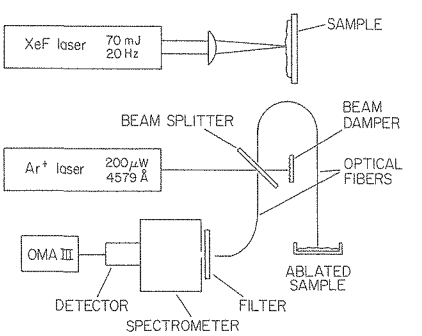
Laser angioplasty has the potential to be a treatment for coronary artery disease. Currently, one of the main problems with this approach is uncontrolled damage to the vessel wall including perforation. Therefore, real-time diagnostic techniques such as tissue autofluorescence analysis, which could indicate when laser application should be terminated, are highly desirable.

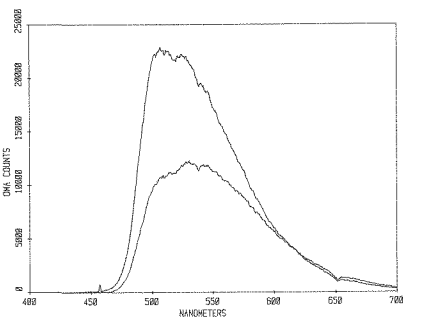
The experiment setup for the experiment to be reported is shown in Fig. 1. Argon-ion laser radiation at 457.9 nm, coupled via an optical fiber to the aorta sample, is used to obtain fluorescent spectra. These spectra can be used to distinguish normal arterial wall lipid-rich tissue (the early stage of arteriosclerosis) and calcified plaque. Spectral analysis is performed on cadaver aorta samples. These spectra are used to categorize each sample as one of the three tissue types. Excimer laser ablation is subsequently performed to remove tissue to a certain depth. New fluorescence spectra are obtained at the ablation sites. Typical results are shown in Fig. 2. The upper trace is the initial spectrum of a calcified plaque, while the lower spectrum is from the same tissue after laser ablation. A decrease in absolute intensity as well as change in profile shape is observed. Samples where the calcified tissue has been completely removed (as confirmed by histologic analysis) show spectral characteristics of lipid-rich regions. These results agree with those obtained by mechanically removing the calcified wall. Normal and fatty regions were subjected to the same procedure, and these results are summarized in Table I. Both tissue types show an increase in peak fluorescence intensity.

THM53 Table I. Peak Intensity Before and After Ablation for Each Tissue Type

	Normal	Fatty	Calcified
Before Ablation	2935 ± 188	2679 ± 303	23323 ± 463
After Ablation	5220 ± 750	3501 ± 496	6454 ± 1778



THM53 Fig. 1. Experimental setup. The depth of excimer laser ablation was varied by altering exposure time.



THM53 Fig. 2. Fluorescence spectrum of region of calcified plaque before (upper) and after (lower) excimer laser ablation.

These studies also indicate that it should be possible to utilize a single-laser system both for tissue ablation and fluorescence diagnosis. UV laser ablation has been shown to be very effective in tissue. The possibility of excimer laser-based spectral analysis is discussed.

In summary: This diagnostic technique can be useful in distinguishing healthy from diseased arterial wall and in assessing the appropriate degree of laser ablative therapy in real time.

(Poster paper)

M. Sartori, R. Sauerbrey, S. Kubodera, F. K. Tittel, R. Roberts, and P. D. Henry, IEEE J. Quantum Electron. **QE-23,** 1794 (1987).

M. Sartori *et al.*, "Laser Induced Autofluorescence of Human Arteries," submitted to Circulation.