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***In Vitro* Monitoring of the Dynamic Elasticity Changes During Radiofrequency Ablation with Acoustic Radiation Force Impulse Imaging**

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Acoustic radiation force impulse (ARFI) imaging is an ultrasound technique that generates relative tissue elasticity maps. Acoustic radiation force from the ultrasound transducer displaces the tissue and the resulting tissue response is monitored with conventional ultrasound methods. The tissue displacement magnitude is inversely proportional to tissue stiffness. The objective of this *in vitro* demonstration was to monitor *dynamic* elasticity changes during radiofrequency ablation (RFA).

A section of porcine myocardium was ARFI imaged during RFA using a VF10-5 transducer and software modified ACUSON Antares ultrasound scanner (SiemensHealthcare; Issaquah, WA). RF delivery was temperature controlled at 65°C for 120 seconds.

Figure 1 shows a pre-RFA ARFI image (A), three images taken during RFA (B-D), and two post-RFA images (E, F). In these images, the plane of the RFA catheter is into the page and the effective depth of field (15 mm ARFI energy focus) is between 10 and 22.5 mm. The color bar units are micrometers of displacement. The pre-RFA image shows high ARFI-induced displacement throughout the myocardium. During RFA a growing region of increased stiffness appeared. Figure 1(G) shows that the mean and standard deviation ($n = 960$ pixels) of the ARFI displacements measured outside the lesion (figure 1(A)-1) remained constant during RFA, while inside the lesion (figure 1(A)-2) they decreased. The tissue was sliced in the approximate imaging plane and stained with triphenyltetrazolium chloride (TTC) to confirm that a lesion was created (figure 2(H)).

This experiment demonstrated that ARFI imaging can visualize the dynamic myocardial stiffness increase caused by RFA. This experimental paradigm could be used to enhance our understanding of how RFA lesions form and to evaluate lesion growth dynamics for new thermal ablation catheter designs.

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Drs. Trahey and Wolf report the loan of equipment from an unspecified source. Dr. Trahey holds patents on the methods used in this article, and Dr. Wolf holds patents through Duke University on ARFI. Other authors: No disclosures.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.