MONITORING HIGH INTENSITY ULTRASOUND TREATMENT BY PASSIVE ELASTOGRAPHY: AN *IN VITRO FEASIBILITY* STUDY IN LIVER

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Background, Motivation and Objective

High Intensity Focused Ultrasounds (HIFU) is a non-invasive modality of treatment allowing thermal ablation in soft tissue by locally increasing temperature. This method has been developed for different organs as prostate and liver is a widely studied topic in literature. Thermal lesions in liver can be observed as a change in tissue elastic properties, and so in shear wave velocity, by elastography. In human body, a natural noise due to cardiac activity or arterial pulsatility can be used to characterize the elasticity in using noise correlation techniques; it corresponds to passive elastography. The objective is here to study the feasibility of using passive elastography technique to visualize the effects of a high intensity ultrasound (HIU) treatment.

Statement of Contribution/Methods

Experiments were performed in *in vitro* bovine livers, heated with a 3MHZ circular planar transducer up to 80°C and imaged with a high framerate ultrasound scanner Vantage 2256 (Verasonics, Kirkland, USA) coupled with a 5MHz linear transducer array ATL5 (Philips, Amsterdam, Holland). Ultrasonic acquisitions were performed using plane wave emissions at 600 images per second and with a compounding over 5 angles. Shear waves displacements were then computed with Loupas' motion estimator from beamformed IQ data and then used in the passive elastography algorithm to obtain shear waves velocity maps. This process was executed every minute during treatments as well as for heating and cooling periods.

Results/Discussion

Eight experiments were performed and led to the creation of eight thermal lesions. Shear waves velocity maps were obtained for each lesion and corresponding increases in shear wave velocity were observed during treatments. Shear wave velocity maps were then computed every minute and an average shear wave velocity (see Figure) was calculated to investigate the tissue elasticity change due to high intensity ultrasounds. Results show an increase during heating and a stable phase during cooling which is characteristic of an irreversible change. A first study of monitoring by passive elastography has been performed and the lesion formation has been successfully observed. Further experiments should be dedicated to evaluate the in vivo feasibility.

Acknowledgements

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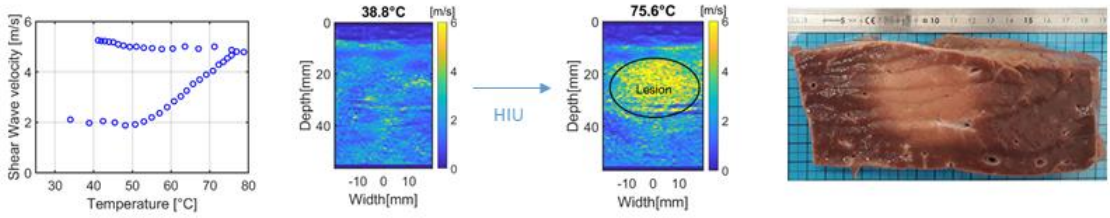

Figure: Average shear wave velocity during a treatment (left); Shear Wave velocity maps before (center left) and after (center right) heating. Photography of thermal lesion after experiment (right). A lesion is created by high intensity ultrasounds and imaged during treatment. Lesion formation appears as an irreversible change in shear wave velocity.