D 1.8 /Summary of the Deliverable:

Experimental report on multi-modality imaging setup (MRI, US, optical ultra-high frame microscopic camera etc.) for characterization of the influence of various parameters (dissolved gas, bulk temperature, average and peak acoustic pressure, average diameter of micelles, formulation of surfactant) on enhanced acoustic absorption

Provided by ESR3, Ryan Holman, M.Sc.,M.Sc. Under the supervision of Prof. Rares Salomir, Ph.D.

University of Geneva

The equipment for parametric testing of the droplets has been established. Detailed information regarding the testing apparatus is given in *Lorton et al.*[1] The two primary components of the high intensity focused ultrasound system are the phased array transducer and a beam former unit. The system is further connected to a 3T MRI scanner for near real-time thermometry. Primarily, the droplets have been tested in a custom perfused agarose phantom and also in excised pig kidneys and liver. The concentration was varied in the perfusion fluid and the heating was assessed with MR-thermometry. The temperature maps allow simultaneous parameters to be extracted. Notably, the amount of attenuation or energy absorbed by the droplets relative to the control sample. A saturating effect was observed in droplet attenuation, exhibiting asymptotic behaviour at higher concentrations. A semi-empirical model was generated to describe this saturating effect. Other conditions that have been analyzed for thermal enhancement are the HIFU duty cycle, dissolved oxygen content, droplet size, and surfactant formula. Moreover, recent experiments have been performed with a FLASH-ARFI-MRT-XNO MRI sequence for simultaneous elasticity mapping & temperature mapping with ^{19}F X-nucleus imaging capabilities. Currently, this sequence is being used to establish droplet elasticity effects in excised pig kidneys. Also, ^{19}F imaging is being used to study the droplets properties.

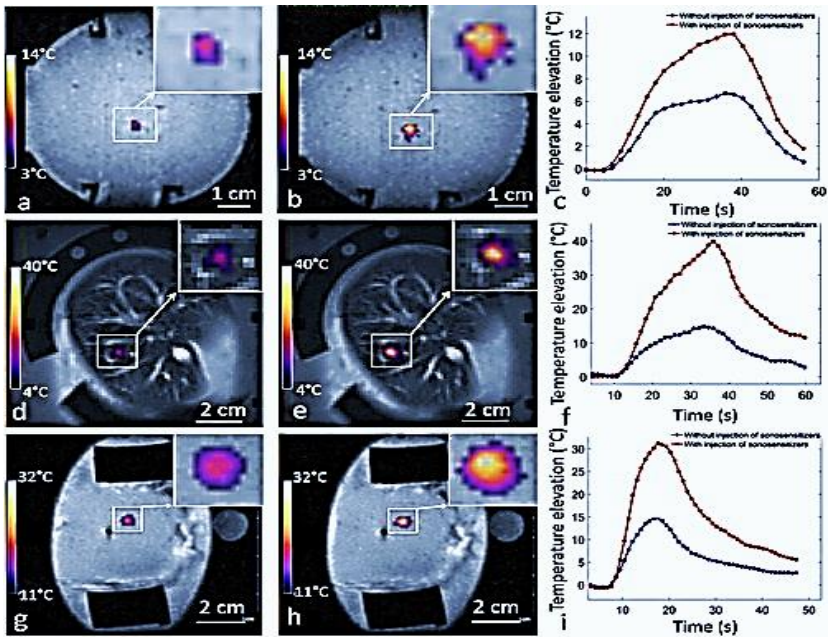

Figure 1: Temperature maps at the end-point in the perfused tissues, (a,d,g) without injection and (b,e,h) with injection of sonosensitizers. (c,f,i) temperature elevation as function of the time without injection (blue line) and after injection of one dose of sonosensitizers (red line), in the in vitro model of perfused tissue (1st row. 0 vs. 0.1%, fixed focus, 60W), in the liver (2nd row. 0 vs. 0.188%, fixed focus, 94W) and kidney (3rd row. 0. vs 0.235%, fixed focus, 135W). Reprinted from Lorton et al.[1]

1. Lorton O, Guillemin P, Holman R, Desgranges S, Gui L, Crowe LA, Terraz S, Nastasi A, Lazeyras F, and Contino-Pépin C, *Enhancement of HIFU thermal therapy in perfused tissue models using micron-sized FTAC-stabilized PFOB-core endovascular sonosensitizers.* International Journal of Hyperthermia, 2020. **37**(1): p. 1116-1130.