MI-4

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Topic: Liver
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TRANS-FUSIMO — Preliminary *in vivo* animal results of MR-guided focused ultrasound of liver under respiratory motion

Cesare Gagliardo[1], Angelo Gambino[1], Patrizia Toia[1], Jan Strehlow[2], Michael Schwenke[2], Luca Cicero[3], Giovani Cassata[3], Sabrina Haase[2], Tobias Preusser[2], Andreas Melzer[4], Massimo Midiri[1]

[1]University of Palermo, Palermo, Italy
[2]Fraunhofer Institute for Medical Image Computing MEVIS, Bremen, Germany
[3]Sicily Zooprophilactic Institute, Palermo, Italy
[4]The University of Dundee, Dundee, United Kingdom

Background: Treating liver tumors using FUS poses a great challenge due to the respiratory motion of the target and by the rib cage obscuring the anatomical location of the malignancy. In the EU FP7 project TRANS-FUSIMO (www.trans-fusimo.eu) a novel treatment software has been developed to support MR guided focused ultrasound treatment of liver lesions through electronic real-time beam steering of the ultrasound transducer. Prior to clinical use we conduct an *in vivo* animal trial using the TRANS-FUSIMO treatment system (TTS) to evaluate the safety and the technical efficacy and efficiency of generation predefined necrotic lesions in the healthy liver.

Methods: The pre-clinical animal trial includes a crossbred porcine model of thirty large white swine (all females; 55-85Kg) that will be treated using the TTS. Animals were sedated and underwent general anaesthesia with intubation. The following sampling time points have been scheduled: 1) acute, where the animal will be sacrificed immediately after therapy with completion of the post-operative MR imaging, dissected and sent for histopathological examination to assess the extent of the acute stage of the tissue destruction, 2) subacute, where after 5-7 days animals will be sacrificed after an MRI follow-up, the liver surgically dissected and sent for histopathological examination to assess the extent of the early stage of tissue necrosis and 3) late, where by day 28 animals will be scarified after an MRI follow-up, the liver surgically dissected and sent for histopathological examination to assess the extent of the late stage of tissue necrosis. All treatments haven been performed under ventilator-controlled breathing and using an improved non-clinical prototype version of INSIGHTEC's conformal bone system (iCBS) integrated with a 1,5T MRI unit (GE Signa HDxt); a set of interventional flexible coils (MRI Instruments DuoFLEX) were used. Before starting the treatment, a 3D LAVA sequence was scanned; 3D FIESTA sequences were then used for planning During each sonication, real-time multi reference thermal monitoring was achieved using a 3mm istotropic EPI-GRE slice (8Hz). At the end of the treatment session we injected 2ml/Kg of gadobenate dimeglumine (Multihance, Bracco) at 2ml/s followed by a saline flush of 20ml. A 3D LAVA sequence was than scanned to identified any necrotic lesion.

Results: The results from the first successfully treated animals will be presented (Figure 1). Liver lesioning was possible during both breath-hold and ventilator-controlled breathing due to the TTS motion compensation algorithm which allows the electronic steering to be controlled according to the MRI images. During all pre-clinical sessions, the TTS was used, including real-time multi reference thermal monitoring.

Conclusions: Although the TRANS-FUSIMO animal trial is still ongoing and subject to further optimizations, the preliminary results achieved using the TTS are promising. It was possible to confirm FUS induces lesions by both contrast enhanced MR imaging and post-operative pathological examination. The TRANS-FUSIMO treatment system is capable of compensating liver motion under ventilator controlled-respiration through real-time MR motion detection and real-time FUS beam steering.

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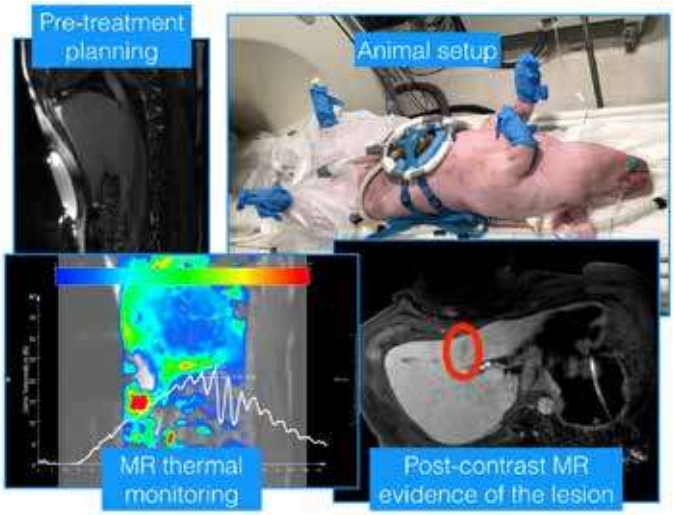

Figure 1 - Pre-treatment sag 3D FIESTA used for planning (top L); animal setup during one of the treating session (top R); screenshot from the thermal imaging monitoring sequence (bot L); ax post-Gd 3D LAVA to identify the FUS induced lesion (bot R).