MULTI-FOCI SONICATIONS FOR HYPERTHERMIA TREATMENTS USING MAGNETIC RESOURCE-GUIDED HIGH-INTENSITY FOCUSED ULTRASOUND (MR-HIFU)

SUMMARY (1024-CHARACTER LIMIT)

The National Institutes of Health Clinical Center (NIH CC) and the National Cancer Institute (NCI) are seeking parties interested in licensing a multi-foci sonication approach combined with a mild hyperthermia heating algorithm and implemented on a clinical Magnetic Resonance-Guided High-Intensity Focused Ultrasound (MR-HIFU) platform.

NIH REFERENCE NUMBER

E-013-2013

PRODUCT TYPE

- Therapeutics

KEYWORDS

- National Institutes of Health Clinical Center, NIH CC, Magnetic Resonance-Guided High Intensity Focused Ultrasound, MR-HIFU, Thermotherapy, Mild Hyperthermia, Therapeutic Technique, Multi-Foci Sonications, Dreher

COLLABORATION OPPORTUNITY

This invention is available for licensing.

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STATUS

Active

DESCRIPTION OF TECHNOLOGY

Hyperthermia has been used extensively and successfully in the treatment of solid tumors. For accessible solid tumors with impressive efficacy not amenable to surgery, ablative hyperthermia (>55°C for 20 s to 15 min) has been used as a definitive treatment. By contrast, for both radiotherapy and chemotherapy, mild hyperthermia (40-45°C for up to 1 hour) has been shown useful as an adjuvant. It induces a multitude of changes to the physiology and biology of the target tumor that improve the effectiveness of

other treatments and make mild hyperthermia synergistic with many chemotherapeutic agents and radiation therapies. Many currently available devices, including but not limited to radiofrequency (RF) applicators, microwave applicators, hot water baths, lasers, and magnetic fluids, can heat the target tissue to the mild hyperthermic range. However, these suffer from drawbacks: limited or superficial heating, hot and cold spots, inaccurate or spatially uneven heating, and a lack of spatiotemporal feedback control.

To resolve these challenges and safely heat anatomical regions with Magnetic Resource-Guided High-Intensity Focused Ultrasound (MR-HIFU), researchers at the National Institutes of Health Clinical Center (NIH CC) have developed a multi-foci sonication technology for sustained mild hyperthermia over an extended period. The multi-foci sonication approach controls temperature accuracy and uniformity, confines heated volumes, and lower peaks acoustic pressures in the heated region. The refined multi-foci sonication heating strategy is combined with a heating algorithm, and results in accurate and precise heating within the targeted region with significantly lower acoustic pressures and spatially more confined heating in the beam path direction (compared to the single focus sonication method). This multi-foci sonication hyperthermia technology may be implemented on a clinical MR-HIFU platform for oncology therapy.

The multi-foci heating strategy may also have other applications such as in MR-HIFU thermal ablations. The more even thermal profile may be utilized in drug delivery or gene therapy to obtain a more even drug release or gene expression, which can be combined with large area sonication strategies. Moreover, the multi-foci sonication approach can be combined with any control algorithm with an additional constraint on the allowed peak pressure which can be estimated based on quick Rayleigh integral evaluation or more sophisticated acoustic simulations in heterogeneous media.

This technology is currently available for licensing opportunities.

POTENTIAL COMMERCIAL APPLICATIONS

- Improved treatments for the target tumor
- Synergistic application with chemotherapeutic agents and radiation therapies
- Utilization in drug delivery or gene therapy
- Can be combined with any control algorithm

COMPETITIVE ADVANTAGES

- Compared to the single focus approach, multi-foci sonications showed significantly lower, 67% reduction, peak acoustic pressures in simulations and hydrophone measurements
- Heated regions were significantly shorter in the beam path direction, 35% reduction, for multi-foci sonications

INVENTOR(S)

Matthew R Dreher (NIH CC)

DEVELOPMENT STAGE

- Pre-clinical (in vivo)

PUBLICATIONS

Partanen A, et al. Reduction of peak acoustic pressure and shaping of heated region by use of multi-foci sonications in MR-guided high-intensity focused ultrasound mediated mild hyperthermia. [PMID 23298120]

PATENT STATUS

- **U.S. Provisional:** U.S. Provisional Patent Application Number 61/713,132 , Filed 12 Oct 2012
- **U.S. Patent Filed:** U.S. Patent Application Number PCT/IB2016/054805 , Filed 30 Sep 2013
- **U.S. Patent Filed:** U.S. Patent Application Number 14/433,468 , Filed 03 Apr 2015
- **Foreign Filed:** - Patent Application 1120150078486, Filed 08 Apr 2015
- **Foreign Filed:** - Patent Application 2015536248, Filed 09 Apr 2015
- **Foreign Filed:** - Patent Application 201380053265.1, Filed 10 Apr 2015
- **Foreign Filed:** - Patent Application 2013814610, Filed 14 Apr 2015
- **Foreign Filed:** - Patent Application 2632/CHENP/2015 , Filed 07 May 2015
- **Foreign Filed:** - Patent Application 2015117609

THERAPEUTIC AREA

- Cancer/Neoplasm