Washington University in St. Louis
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EMMI- NON-INVASIVE IMAGING METHOD FOR SAFE, ACCURATE, ROBUST MONITORING OF UTERINE CONTRACTIONS

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Technology Description

Researchers at Washington University in St. Louis have developed an electromyometrial imaging (EMMI) method to non-invasively monitor uterine contractions. During pregnancy, many women experience preterm contractions. Sometimes these contractions progress to pre-term labor and delivery, but other times they do not. The differences between preterm contractions that stop and those that do not are not known. It would be beneficial to be able to distinguish between these two types of contractions, as preterm delivery increases the baby's risk of death or long-term health complications. Several methods have been developed to monitor contractions, but these methods are not optimal as they have limitations including low resolution and invasiveness. To overcome these limitations the inventors have developed EMMI. EMMI is a noninvasive, three-dimensional imaging method that can be used to monitor uterine contractions with high spatial and temporal resolution. EMMI combines MRI with electrical activity data obtained from electrodes placed on the abdomen to reconstruct uterine electrical activity patterns during contraction. This technology can be used to non-invasively monitor the initiation and propagation of uterine contractions. Further, this technology may be used to triage and, if needed, treat patients presenting with preterm contractions.

Depiction of EMMI method. Top left- MRI scans are acquired and segmented to generate body-uterus geometry. Bottom left- electrodes are placed on the body surface and electrograms are recorded and mapped onto body surface potentials. The EMMI software combines the body-uterus geometry and body surface potentials to generate reconstructed uterine surface potentials (right). For further details and to see the comparison to maps made from direct measurements on the uterus surface, please see the associated publication listed below.

Stage of Research

Using sheep as a model, the inventors showed EMMI could be used to noninvasively map induced uterine contractions. Further, the results obtained by EMMI were similar to those obtained with invasive electrodes placed directly on the sheep's uterus. Additional development for clinical use is ongoing.

Applications

- Imaging method for:
  - Obstetrics

    - Preterm labor diagnostic- evaluate and diagnose preterm uterine contractions
    - Evaluate efficacy of labor suppressing therapeutics
    - Potential to aid in development of new therapeutics to manage preterm labor
  - Research tool
    - Understand uterine electrophysiology and pathophysiology

Key Advantages

- Potential to diagnose preterm labor- could be used to rapidly determine if contraction pattern will progress to labor
- Non-invasive- can be used on humans
- Accurate- EMMI reconstructions closely match those measured by electrodes placed directly on uterine surface
- Reconstructions are minimally affected by noise and geometrical deformation
- Can track electrical signals across entire uterine surface
- Can image electrophysiology at higher spatial resolution than invasive EMG method
- Potential to allow physicians to make more informed decisions about the labor process and more rapidly administer treatments to stop preterm labor

Publications

- Wu W, Wang H, Zhao P, Talcott M, Lai S, McKinstry RC, Woodard PK, Macones GA, Schwartz AL, Cahill AG, Cuculich PS, Wang Y. Noninvasive high-resolution electromyometrial imaging of uterine contractions in a translational sheep model. Sci Transl Med. 2019 Mar 13;11(483). pii: eaau1428. doi: 10.1126/scitranslmed.aau1428.

Patents

- Provisional patent application has been filed

Related Web Links

- Dr. Cuculich profile
- Wang lab