Researchers create first 3D mathematical model of uterine contractions

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By studying the electric activity that causes uterine contractions in pregnant women, researchers at Washington University in St. Louis and their collaborators have developed a multiscale model they believe may aid in predicting preterm birth. Credit: Washington University in St. Louis

Although researchers have been seeking the origins of preterm birth for many years, the causes are still relatively unknown. By studying the electrical activity that causes contractions, researchers at Washington University in St. Louis and their collaborators have developed a multiscale model they believe may aid in predicting preterm birth.

Arye Nehorai, the Eugene and Martha Lohman Professor of Electrical Engineering and chair of the Department of Electrical & Systems Engineering in the School of Engineering & Applied Science, and his team have developed the first 3-D multiscale mathematical model of the electrophysiology of a woman's contractions as they begin from a single cell to the myometrium, or uterine tissue, into the uterus. The results of their research were published recently in the journal *PLoS One*.

"We know that the cell starts the electrical activity, but nothing is known about the positions or numbers or how they interact in different places in the uterus," Nehorai said. "In addition, we don't yet know the directions of the fibers in the myometrium, which is important because the electricity propagates along the muscle fibers, and that direction varies among women."

Using a special instrument at the University of Arkansas, the researchers applied sensors to the abdomen of 25 pregnant women. The instrument has 151 magnetometers that measure the strength of the magnetic field in the abdomen as a result of the electrical activity from a contraction. From those measurements, the team created a mathematical model that precisely replicated the electrical activity in the uterus during a contraction.

Next, the team plans to use data associated with preterm and term labor to determine what parameters can predict between the preterm and term, Nehorai said. In addition, they will take the measurements from the machine and estimate the electrical activity and the position, number and distribution of the electrical sources in the uterus.

"Our ultimate goal is to share this with obstetricians and gynecologists so they can take measurements and make a prediction of whether a woman will have preterm or term labor," Nehorai said. "Creating a realistic, multiscale forward model of uterine contractions will allow us to better interpret the data of magnetomyography measurements and, therefore, shed light on the prediction of preterm labor."

More information: Mengxue Zhang et al, Modeling Magnetomyograms of Uterine Contractions during Pregnancy Using a Multiscale Forward Electromagnetic Approach, *PLOS ONE* (2016). DOI: 10.1371/journal.pone.0152421