Sonogenetics: A Novel, Non-invasive and Selective Method to Examine & Manipulate Cellular Activity and Function

INVENTION: Salk scientists have developed a new way to selectively activate brain, heart, muscle, and other cells using ultrasonic waves in order to better understand their function. The new technique, termed sonogenetics, has similarities to the popular field of optogenetics where light is used to activate cells in a selective manner, but this method uses low-frequency ultrasound that can travel through the body without any scattering and loss of signal.

APPLICATIONS:

- Selective activation of cells to study cellular function and examine network connections
- Therapeutic intervention by activation of a particular cell or network

ADVANTAGES:

- Non-invasive
- Greater depth of signal without loss of signal strength

STAGE OF DEVELOPMENT:
Proof of concept in invertebrates completed; currently conducting studies in mammals. Ready for collaboration or commercial evaluation.

BACKGROUND:
Scientists at Salk have identified a pore-forming subunit of a mechanotransduction channel, TRP-4, that is sensitive to low-pressure ultrasound. The nematode *C. elegans* expresses TRP-4 and normally uses these channels to sense when their bodies are stretching. When the worms stretch, the channels open and allow calcium to flow through. The investigators found that expressing TRP-4 in neurons sensitized the cells to ultrasound stimulus, resulting in specific behaviors. They used this discovery to selectively activate cells that are expressing TRP-4 with low-intensity ultrasound waves (same type of ultrasound used in medical sonograms). As these waves travel deeper into tissue, it avoids invasive surgical methods, illustrating that sonogenetics is an attractive approach and potentially adaptable for human therapeutic use.

INVENTORS:
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PATENT STATUS: US 10,806,951

PUBLICATIONS:
http://www.salk.edu/news-release/in-first-salk-scientists-use-sound-waves-to-control-brain-cells/
Ibsen S., et al. 2015. Sonogenetics is a non-invasive approach to activating neurons in Caenorhabditis elegans. Nat Commun. 2015 Sep 15;6:8264.

https://www.nature.com/articles/s41467-022-28205-y
Duque, M., et al. 2022. Sonogenetic control of mammalian cells using exogenous Transient Receptor Potential A1 channels. Nat Commun. 2022 Feb 13,600.

https://www.youtube.com/watch?v=tNnRd0JfT4o
Video: Progress for Sonogenetics a non-invasive way to treat brain disorders. Salk researchers control mammalian cells with sound. The method paves the way toward non-invasive versions of deep brain stimulation and pacemakers. 2022 Feb.

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