Sonogenetics – a novel, non-invasive and selective method to examine and manipulate cellular activity and function

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Technology description

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, dubbed sonogenetics, has similarities to the popular field of optogenetics, which uses light to activate cells in a selective manner, however unlike light, which scatters in tissue, low-frequency ultrasound can travel through the body without any scattering and loss of signal.

Salk scientists identified a pore-forming subunit of a mechanotransduction channel, TRP-4, that is sensitive to low-pressure ultrasound. C. elegans express TRP-4 and normally use channels to sense when their bodies are stretching. When the worms stretch, the channels open and allow calcium to flow through. Salk scientists found that neuron-specific misexpression of TRP-4, sensitizes neurons to ultrasound stimulus, resulting in behavioral outputs.

Sonogenetics uses ectopic expression of TRP-4 and low-intensity ultrasound waves, the same type of waves used in medical sonograms, to selectively activate cells. As these waves can travel deep into tissue, it avoids the need to used surgical technologies such as imbedding the fiber optic cables used to deliver light to these regions. Avoiding such invasive surgery makes sonogenetics a particularly attractive approach especially when it comes to adapting the technology for human therapeutic use.

Publication

Ibsen S, Tong A, Schutt C, Esener S, Chalasani SH. Sonogenetics is a non-invasive approach to activating neurons in Caenorhabditis elegans. Nat Commun. 2015 Sep 15;6:8264.

Application area

- Selective activation of cells in order to:
o Study cellular function
o 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

BBC - Sound waves used to activate brain cells in worm

Forbes - Can brain cells be controlled with sound waves?

Nautilus - Turning on cells with sound

International Business Times - Sonogenetics - sounds waves sucessfully used to control brain cells of worms

The Scientist - Stimulating neurons with sound

Examiner - Researchers report first successful use of sound to control brain cells

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