

Scientists Have Discovered a “Mini-Brain” Inside the Heart

New research reveals that the heart has its own complex nervous system, or "mini-brain," which plays a critical role in controlling its rhythm, independent of the brain.

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The heart has its own nervous system that regulates its rhythm, challenging previous assumptions. This finding could lead to new heart disease treatments.

(Artist’s concept.) Credit:

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New research reveals that the heart has its own complex nervous system, or “mini-brain,” which plays a critical role in controlling its rhythm, independent of the brain.

Researchers from [Karolinska Institutet](#) and [Columbia University](#) have discovered that the heart possesses its own “mini-brain”—an independent nervous system that regulates the heartbeat. This system is far more intricate and diverse than previously understood. Gaining deeper insights into its workings could pave the way for innovative treatments for heart diseases. The study, conducted using zebrafish as a model, is detailed in *Nature Communications*.

The heart has long been thought to be controlled solely by the autonomic nervous system, which transmits signals from the brain. The heart’s neural network, which is embedded in the superficial layers of the heart wall, has been considered a simple structure that relays the signals from the brain.

However, recent research suggests that it has a more advanced function than that.

Controlling the heartbeat

Scientists have now discovered that the heart has its own complex nervous system that is crucial to controlling its rhythm.

“This ‘little brain’ has a key role in maintaining and controlling the heartbeat, similar to how the brain regulates rhythmic functions such as locomotion and breathing,” explains Konstantinos Ampatzis, principal researcher and docent at the Department of Neuroscience, Karolinska Institutet, Sweden, who led the study.

The researchers identified several types of neurons in the heart that have different functions, including a small group of neurons with pacemaker properties. The finding challenges the current view on how the heartbeat is controlled, which may have clinical implications.

Similar to the human heart

“We were surprised to see how complex the nervous system within the heart is,” says Konstantinos Ampatzis.

“Understanding this system better could lead to new insights into heart diseases

and help develop new treatments for diseases such as arrhythmias.”

The study was conducted on zebrafish, an animal model that exhibits strong similarities to human heart rate and overall cardiac function. The researchers were able to map out the composition, organization, and function of neurons within the heart using a combination of methods such as single-cell RNA sequencing, anatomical studies, and electrophysiological techniques.

New therapeutic targets

“We will now continue to investigate how the heart’s brain interacts with the actual brain to regulate heart functions under different conditions such as exercise, stress, or disease,” says Konstantinos Ampatzis. “We aim to identify new therapeutic targets by examining how disruptions in the heart’s neuronal network contribute to different heart disorders.”

Reference: “Decoding the molecular, cellular, and functional heterogeneity of zebrafish intracardiac nervous system” by Andrea Pedroni, Elanur Yilmaz, Lisa

Del Vecchio, Prabesh Bhattarai, Inés Talaya Vidal, Yu-Wen E. Dai, Konstantinos Koutsogiannis, Caghan Kizil and Konstantinos Ampatzis, 4 December 2024, *Nature Communications*.
[DOI: 10.1038/s41467-024-54830-w](https://doi.org/10.1038/s41467-024-54830-w)

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