Molecular biomedical expert discusses the sensation of itch

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Santosh Mishra is an assistant professor in the Department of Molecular Biomedical Sciences. He studies the neurological pathways involved in itch, in order to help us understand why and how we feel this sensation. He was recently involved in an international research collaboration aimed at identifying the process by which itch sensations are transmitted to the brain. Mishra agreed to sit down with the Abstract to talk a little about the basics of itching and this latest research project.

The Abstract (TA): Why do we itch? What purpose does it serve?

Mishra: Pruritus (or itch) is defined as an irritating sensation that evokes a desire to scratch. Itch was initially speculated to serve as a defense mechanism that alerts us about microbes, insects and allergens so we can remove them from our skin by scratching. However, itch is also increasingly a symptom associated not only with skin conditions, but also with systemic and neurological diseases. So researchers are trying to find out more about this irritating sensation.

TA: How do we "feel" itching? How does our brain recognize that we itch and then tell us what's happening?

Mishra: As a sensation, we've known about itching for very long time but

it was unclear how the sensation of itching was carried to the brain. Does itch use the same neural pathways as pain, or does it have its own pathway? I've worked on several studies that try to answer that question.

We studied a subset of neurons that are located in the dorsal root ganglia (DRG), which are clusters of sensory cells located at the root of the spinal nerves. Sensations like itch first travel from your skin to the DRG, and from there to the spinal cord and brain. The neurons we looked at in the DRG express a neurotransmitter called natriuretic polypeptide precursor b (Nppb). We have evidence that Nppb "transmits" the itch signal from the DRG to the spinal cord, then the signal travels to the brain, is interpreted as itch, and the body can respond.

In our latest study, we found that those same Nppb-producing neurons also make somatostatin, a hormone that is involved in neurotransmission. When nerve cells containing somatostatin were activated in mice via optogenetics – a light-based technique that can turn on or off specific neurons – the animals vigorously scratched their cheeks, demonstrating that these neurons play a role in itch by transmitting that signal to the brain.

TA: What don't we know about itch – what are we still trying to figure out?

Mishra: Our latest discovery provides important new information about how itch is detected and processed in the nervous system. Regarding treating itch, we are still far from it because of its association with number of diseases and complexity. I think it is important to understand whether the same neural circuits and molecules are involved in chronic itch feelings. Once we identify the molecular components involved with chronic itch, then we will use those as treatment targets. We're really at the beginning of a longer research process for this complex problem.

TA: Why did you get into this field of research? What are you most excited about finding out, related to itch?

Mishra: Itching and pain sensations tell our body that something is wrong but persistent itch and pain is not fun. During my postdoc, I was interested in untangling the neural pathways for pain but discovering the itch neural circuit came to me completely as a surprise and that's how I got interested in this research area. I find itching more challenging and exciting because of its complexity and association with so many diseases – in both pets and humans – and its effect on quality of life. Currently, research in my lab is divided into two main areas and one of them is focusing on identifying molecules (especially receptors) that are involved in chronic itch sensation in cutaneous, or skin, disease.

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