Researchers uncover reason why mole rats are oblivious to acid pain

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Naked Molerat Heterocephalus glaber eating. Image: Wikipedia.

(PhysOrg.com) -- Mole rats aren't the prettiest things; living underground as they do, they more resemble Gollum from the Lord of the Rings trilogy than other rats or mice. But they're interesting to scientists nonetheless because they have some interesting traits. They live for twenty years for example, and none of them ever get cancer.

Perhaps even more interesting is the fact that because they live so close together underground, carbon dioxide builds up in their den to levels that would kill most other mammals, and because oxygen levels are low too, an environment exists that would prove painful for most animals due to acid buildup in tissues. Mole rats are impervious to pain from acid

though, a fact that has intrigued scientists for years. Most assumed they simply had different types of nociceptors than other mammals.

But that's not the case, as Gary Lewin and his colleagues from the Max Delbrück Center for Molecular Medicine in Berlin write in their paper published in *Science*. Instead, it appears the mole rats have a species specific variant of a certain sodium channel.

In order to feel things such as acid burn, animals have sensory neurons in their tissues, the tips of which have channels called nociceptors which control the flow of sensory information to the neuron, which is responsible for sending electrical signals to the brain. Channels can let things through, or slam shut blocking things off depending on the cause of the stimulation. In the case of acid, nociceptors for most mammals are stimulated and partially close, but let enough of the sensory information pass through to allow the brain to feel the pain acidic substances create. Oddly enough, the team found that to be the case with mole rats too, which meant they had to look elsewhere. In this case that meant looking at another type of sodium channel, called $Na_V1.7$, which they found became blocked when exposed to acid.

This new discovery by the team means they have discovered that an animal doesn't have to have a unique type of nociceptor in order to be free from acid pain, all that's necessary is a change in the $Na_V1.7$ channel that directs the flow of information passed on to neuron below. This is quite a find because it could lead to ways to alleviate certain kinds of pain that people experience, such as inflammation from arthritis.

More information: The Molecular Basis of Acid Insensitivity in the African Naked Mole-Rat, *Science*, 16 December 2011: Vol. 334 no. 6062 pp. 1557-1560. DOI: 10.1126/science.1213760

ABSTRACT

Acid evokes pain by exciting nociceptors; the acid sensors are proton-gated ion channels that depolarize neurons. The naked mole-rat (Heterocephalus glaber) is exceptional in its acid insensitivity, but acid sensors (acid-sensing ion channels and the transient receptor potential vanilloid-1 ion channel) in naked mole-rat nociceptors are similar to those in other vertebrates. Acid inhibition of voltage-gated sodium currents is more profound in naked mole-rat nociceptors than in mouse nociceptors, however, which effectively prevents acid-induced action potential initiation. We describe a species-specific variant of the nociceptor sodium channel NaV1.7, which is potently blocked by protons and can account for acid insensitivity in this species. Thus, evolutionary pressure has selected for an NaV1.7 gene variant that tips the balance from proton-induced excitation to inhibition of action potential initiation to abolish acid nociception.