New research on gene mutation responsible for deafness shows it also causes heightened skin sensitivity

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(Medical Xpress) -- Researchers have known since 1997 that mutations in the KCQN4 channel (a pathway that leads from the external environment to neurons) lead to progressive deafness and that the KCQN4 channel is only found in the hair cells in the inner ear, a part of the brain involved in hearing and oddly enough in skin cells. Now new research on the KCQN4 channel by a diverse group of scientists finds that the same gene mutation that causes people to go slowly blind also causes them to have increased sensitivity in their skin. They have published the results of their findings in *Nature Neuroscience*.

What the group has found is that the KCQN4 channel appears to work as a buffer or brake, preventing neurons from becoming over stimulated. When the gene mutation occurs in the channel, it is no longer able to buffer as it would normally, resulting in all of the stimuli passing through to the neurons resulting in heightened sensitivity in the skin. Unfortunately, the team also suggests that when the loss of buffering occurs in the inner ear, it's too much for the hyper-sensitive hairs to stand, which is why they slowly die, leading to deafness.

After electrically testing skin sensitivity in mice with the gene mutation, the researchers found that the KCQN4 channel only appeared in those neurons in the skin that were sensitive to low level vibrations, causing a damping of such sensations. They then extended their study to groups of Dutch and Spanish families known to carry the mutation and found that

virtually all of them had increased sensitivity to low frequency vibrations as well, i.e. the kind that comes about when movement across the skin occurs, such as with rough material. People that have the gene mutation are better able to discern the subtle differences in a variety of soft materials, for example.

The team says that the evidence appears to show that the sensitivity to touch in such people was in existence before they went blind, and thus is not an adaptation that occurred subsequently. They also note that the gene mutation in the KCQN4 channel is just one of many different kinds of gene mutations that cause deafness, thus, not all people who progressively lose their hearing will develop this particular type of heightened skin sensitivity.

More information: KCNQ4 K+ channels tune mechanoreceptors for normal touch sensation in mouse and man, *Nature Neuroscience* (2011) doi:10.1038/nn.2985

Abstract
Mutations inactivating the potassium channel KCNQ4 (Kv7.4) lead to deafness in humans and mice. In addition to its expression in mechanosensitive hair cells of the inner ear, KCNQ4 is found in the auditory pathway and in trigeminal nuclei that convey somatosensory information. We have now detected KCNQ4 in the peripheral nerve endings of cutaneous rapidly adapting hair follicle and Meissner corpuscle mechanoreceptors from mice and humans. Electrophysiological recordings from single afferents from Kcnq4−/− mice and mice carrying a KCNQ4 mutation found in DFNA2-type monogenic dominant human hearing loss showed elevated mechanosensitivity and altered frequency response of rapidly adapting, but not of slowly adapting nor of D-hair, mechanoreceptor neurons. Human subjects from independent DFNA2 pedigrees outperformed age-matched control subjects when tested for vibrotactile acuity at low

frequencies. This work describes a gene mutation that modulates touch sensitivity in mice and humans and establishes KCNQ4 as a specific molecular marker for rapidly adapting Meissner and a subset of hair follicle afferents.