KCNQ4 Gene

Subjects: Genetics & Heredity
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Potassium voltage-gated channel subfamily Q member 4

genes

1. Introduction

The *KCNQ4* gene provides instructions for making a protein that is part of a family of potassium channels. These channels transport positively charged potassium atoms (potassium ions) between neighboring cells. The channels play a key role in the ability of cells to generate and transmit electrical signals. The specific function of a potassium channel depends on its protein components and its location in the body. Potassium channels made with the KCNQ4 protein are found in certain cells of the inner ear and along part of the nerve pathway from the ear to the brain (the auditory pathway). To a lesser extent, KCNQ4 potassium channels are also found in the heart and some other muscles.

Because KCNQ4 potassium channels are present in the inner ear and auditory pathway, researchers have focused on their role in hearing. Hearing requires the conversion of sound waves to electrical nerve signals, which are then transmitted to the brain. This conversion involves many processes, including maintenance of the proper levels of potassium ions in the inner ear. KCNQ4 channels help to maintain these levels, playing a critical role in the efficient transmission of electrical nerve signals from the inner ear to the brain.

2. Health Conditions Related to Genetic Changes

2.1. Nonsyndromic Hearing loss

Several *KCNQ4* gene mutations have been reported in individuals with nonsyndromic hearing loss, which is loss of hearing that is not associated with other signs and symptoms. Mutations in this gene cause a form of nonsyndromic hearing loss called DFNA2. This form of hearing loss generally begins after a child learns to speak (postlingual) and particularly affects the ability to hear high-frequency sounds. DFNA2 is described as progressive, which means it becomes more severe over time.

Most *KCNQ4* gene mutations change one of the building blocks (amino acids) used to make the KCNQ4 protein. Some mutations prevent the channel from reaching the cell membrane, where it is needed to transport potassium ions. Other mutations lead to the formation of abnormal channels that cannot transport these ions effectively. The

loss of functional KCNQ4 channels appears to cause a buildup of potassium ions in certain cells of the inner ear, which damages those cells and leads to progressive hearing loss in people with DFNA2.

3. Other Names for This Gene

- DFNA2
- KCNQ4_HUMAN
- KQT-like 4
- KV7.4
- potassium channel, voltage gated KQT-like subfamily Q, member 4
- potassium voltage-gated channel, KQT-like subfamily, member 4

References

1. Coucke PJ, Van Hauwe P, Kelley PM, Kunst H, Schatteman I, Van Velzen D, MeyersJ, Ensink RJ, Verstreken M, Declau F, Marres H, Kastury K, Bhasin S, McGuirt WT, Smith RJ, Cremers CW, Van de Heyning P, Willems PJ, Smith SD, Van Camp G.Mutations in the KCNQ4 gene are responsible for autosomal dominant deafness infour DFNA2 families. Hum Mol Genet. 1999 Jul;8(7):1321-8.
2. Gao Y, Yechikov S, Vázquez AE, Chen D, Nie L. Impaired surface expression and conductance of the KCNQ4 channel lead to sensorineural hearing loss. J Cell MolMed. 2013 Jul;17(7):889-900. doi: 10.1111/jcmm.12080.
3. Kim HJ, Lv P, Sihn CR, Yamoah EN. Cellular and molecular mechanisms ofautosomal dominant form of progressive hearing loss, DFNA2. J Biol Chem. 2011 Jan14;286(2):1517-27. doi: 10.1074/jbc.M110.179010.
4. Kubisch C, Schroeder BC, Friedrich T, Lütjohann B, El-Amraoui A, Marlin S,Petit C, Jentsch TJ. KCNQ4, a novel potassium channel expressed in sensory outer hair cells, is mutated in dominant deafness. Cell. 1999 Feb 5;96(3):437-46.
5. Naito T, Nishio SY, Iwasa Y, Yano T, Kumakawa K, Abe S, Ishikawa K, Kojima H, Namba A, Oshikawa C, Usami S. Comprehensive genetic screening of KCNQ4 in a largeautosomal dominant nonsyndromic hearing loss cohort: genotype-phenotypecorrelations and a founder mutation. PLoS One. 2013 May 23;8(5):e63231. doi:10.1371/journal.pone.0063231. Print 2013.

6. Smith RJH, Hildebrand M. DFNA2 Nonsyndromic Hearing Loss. 2008 Apr 4 [updated 2018 May 10]. In: Adam MP, Ardinger HH, Pagon RA, Wallace SE, Bean LJH, Stephens K, Amemiya A, editors. GeneReviews® [Internet]. Seattle (WA): University ofWashington, Seattle; 1993-2020. Available fromhttp://www.ncbi.nlm.nih.gov/books/NBK1209/