KCNQ2 gene

potassium voltage-gated channel subfamily Q member 2

Normal Function

The *KCNQ2* gene belongs to a large family of genes that provide instructions for making potassium channels. These channels, which transport positively charged atoms (ions) of potassium into and out of cells, play a key role in a cell's ability to generate and transmit electrical signals.

The specific function of a potassium channel depends on its protein components and its location in the body. Channels made with the KCNQ2 protein are active in nerve cells (neurons) in the brain, where they transport potassium ions out of cells. These channels transmit a particular type of electrical signal called the M-current, which prevents the neuron from continuing to send signals to other neurons. The M-current ensures that the neuron is not constantly active, or excitable.

Potassium channels are made up of several protein components (subunits). Each channel contains four alpha subunits that form the hole (pore) through which potassium ions move. Four alpha subunits from the *KCNQ2* gene can form a channel. However, the KCNQ2 alpha subunits can also interact with alpha subunits produced from the *KCNQ3* gene to form a functional potassium channel, and these channels transmit a much stronger M-current.

Health Conditions Related to Genetic Changes

Benign familial neonatal seizures

A mutation in the *KCNQ2* gene has been identified in most people with benign familial neonatal seizures (BFNS), a condition characterized by recurrent seizures (epilepsy) in newborn babies. The seizures begin around day 3 of life and usually go away within 1 to 4 months. More than 60 mutations in the *KCNQ2* gene have been identified in families with this condition. Sometimes, the mutated protein never gets to the cell surface to form a channel, or the channel may be located in the wrong part of the neuron. Alternatively, the channel formed from the mutated protein may not function properly. As a result of these mutations, the M-current is reduced or altered, which leads to excessive excitability of neurons. Researchers believe that a reduction of the M-current by 25 percent is enough to cause BFNS. Seizures develop when neurons in the brain are abnormally excited. It is unclear why the seizures stop around the age of 4 months.

It has been suggested that potassium channels formed from the KCNQ2 and KCNQ3 proteins play a major role in preventing excessive excitability of neurons in newborns, but other mechanisms that prevent constant neuron activity develop during infancy.

Other disorders

Mutations in the *KCNQ2* gene are also involved in early-onset epileptic encephalopathy, a more severe condition than BFNS (described above) characterized by epilepsy and profound intellectual disability. The seizures begin in the first weeks of life and typically show little response to treatment. They usually go away in a few months to a few years but can return later in childhood. Most affected individuals are unable to talk, and they have low muscle tone (hypotonia) or very stiff muscles, causing difficulty with movement.

It has been suggested that *KCNQ2* gene mutations that cause early-onset epileptic encephalopathy lead to production of an abnormal KCNQ2 protein that can still bind to normal subunits to form potassium channels. However, the presence of the abnormal KCNQ2 subunit keeps the channels from functioning, which likely leads to a severe reduction of the M-current. The resulting over-excitability of neurons can lead to seizures and brain dysfunction (encephalopathy).

Early-onset epileptic encephalopathy caused by *KCNQ2* gene mutations resembles a condition called Ohtahara syndrome; however, seizures do not usually subside in people with Ohtahara syndrome. It is unclear whether the epileptic encephalopathy caused by *KCNQ2* gene mutations is a form of Ohtahara syndrome or a separate disorder.

Other Names for This Gene

- BFNC
- BFNS1
- EBN
- EBN1
- EIEE7
- ENB1
- HNSPC
- KCNA11
- KCNQ2_HUMAN
- KQT-like 2
- KV7.2
- KVEBN1
- potassium channel, voltage gated KQT-like subfamily Q, member 2
- potassium voltage-gated channel subfamily KQT member 2
- potassium voltage-gated channel, KQT-like subfamily, member 2

- voltage-gated potassium channel subunit Kv7.2

Additional Information & Resources

Tests Listed in the Genetic Testing Registry

- Tests of KCNQ2 (https://www.ncbi.nlm.nih.gov/gtr/all/tests/?term=3785[geneid])

Scientific Articles on PubMed

- PubMed (https://pubmed.ncbi.nlm.nih.gov/?term=%28KCNQ2%5BTIAB%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+1440+days%22%5Bdp%5D)

Catalog of Genes and Diseases from OMIM

- POTASSIUM CHANNEL, VOLTAGE-GATED, KQT-LIKE SUBFAMILY, MEMBER 2; KCNQ2 (https://omim.org/entry/602235)

Gene and Variant Databases

- NCBI Gene (https://www.ncbi.nlm.nih.gov/gene/3785)
- ClinVar (https://www.ncbi.nlm.nih.gov/clinvar?term=KCNQ2[gene])

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Genomic Location

The *KCNQ2* gene is found on chromosome 20 (https://medlineplus.gov/genetics/chromosome/20/).

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