NOTCH3 gene
notch 3

Normal Function

The NOTCH3 gene provides instructions for making a protein with one end (the intracellular end) that remains inside the cell, a middle (transmembrane) section that spans the cell membrane, and another end (the extracellular end) that projects from the outer surface of the cell. The NOTCH3 protein is called a receptor protein because certain other proteins, called ligands, attach (bind) to the extracellular end of NOTCH3, fitting like a key into a lock. This binding causes detachment of the intracellular end of the NOTCH3 protein, called the NOTCH3 intracellular domain, or NICD. The NICD enters the cell nucleus and helps control the activity (transcription) of other genes.

The NOTCH3 protein plays a key role in the function and survival of vascular smooth muscle cells, which are muscle cells that surround blood vessels. This protein is thought to be essential for the maintenance of blood vessels, including those that supply blood to the brain.

Health Conditions Related to Genetic Changes

Cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy

More than 270 mutations in the NOTCH3 gene have been found to cause cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy, commonly known as CADASIL. Almost all of these mutations change a single protein building block (amino acid) in the NOTCH3 protein. The amino acid involved in most mutations is cysteine. The addition or deletion of a cysteine molecule in a certain area of the NOTCH3 protein, known as the EGF-like domain, presumably affects NOTCH3 function in vascular smooth muscle cells. Disruption of NOTCH3 functioning can lead to the self-destruction (apoptosis) of these cells. Damage to vascular smooth muscle cells is thought to cause recurrent strokes and other signs and symptoms of CADASIL.

Lateral meningocele syndrome

At least six NOTCH3 gene mutations have been identified in people with lateral meningocele syndrome. This disorder affects the nervous system, the bones and muscles, and other body systems. The condition is characterized by abnormalities known as lateral meningoceles. Lateral meningoceles are protrusions of the membranes surrounding the spinal cord (known as the meninges) through gaps in the bones of the spine (vertebrae). The protrusions are most common and typically
larger in the lower spine. The meningoceles associated with this disorder may damage the nerves that spread from the spine to the rest of the body.

The mutations that cause lateral meningocele syndrome occur at the end of the gene in a region known as exon 33. These gene mutations result in a NOTCH3 protein with an abnormally short (truncated) NICD. The shortened protein is missing the portion that normally causes the breakdown of the NICD after it has performed its function in the cell nucleus and is no longer needed. As a result, the presence of the NICD in the cell is prolonged, and the protein continues to affect the activity of other genes. However, the result of this prolonged NICD activity and its connection to the specific features of lateral meningocele syndrome are not well understood.

**Chromosomal Location**

Cytogenetic Location: 19p13.12, which is the short (p) arm of chromosome 19 at position 13.12

Molecular Location: base pairs 15,159,038 to 15,200,995 on chromosome 19 (Homo sapiens Updated Annotation Release 109.20191205, GRCh38.p13) (NCBI)

Credit: Genome Decoration Page/NCBI

**Other Names for This Gene**

- CADASIL
- CASIL
- Neurogenic locus notch homolog protein 3
- NOTC3_HUMAN
- Notch homolog 3
- Notch homolog 3 (Drosophila)
Additional Information & Resources

Clinical Information from GeneReviews

- CADASIL
  https://www.ncbi.nlm.nih.gov/books/NBK1500
- Lateral Meningocele Syndrome
  https://www.ncbi.nlm.nih.gov/books/NBK368476

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28NOTCH3%5BTIAB%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29+AND+english%5BLa%5D+AND+human%5Bmh%5D+AND+%22last+720+days%22+AND+%5Bdp%5D

Catalog of Genes and Diseases from OMIM

- NOTCH RECEPTOR 3
  http://omim.org/entry/600276

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/NOTCH3ID41557ch19p13.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=NOTCH3%5Bgene%5D
- HGNC Gene Symbol Report
- Monarch Initiative
  https://monarchinitiative.org/gene/NCBIGene:4854
- NCBI Gene
- UniProt
  https://www.uniprot.org/uniprot/Q9UM47
Sources for This Summary

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/18347334 
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2290794/

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/12417361

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/27336130

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/25394726

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/11909813 
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3690627/

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15537516

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/16508299

- OMIM: NOTCH RECEPTOR 3 
  http://omim.org/entry/600276

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15265274

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/24844136


Reviewed: August 2016
Published: March 3, 2020