PTCH1 gene

patched 1

Normal Function

The *PTCH1* gene provides instructions for producing the patched-1 protein, which functions as a receptor. Receptor proteins have specific sites into which certain other proteins, called ligands, fit like keys into locks. A protein called Sonic Hedgehog is the ligand for the patched-1 receptor. Together, ligands and their receptors trigger signals that affect cell development and function.

Patched-1 and Sonic Hedgehog function in a pathway that is essential for early development. This pathway plays a role in cell growth, cell specialization, and determining the shape (patterning) of many different parts of the developing body. When Sonic Hedgehog is not present, patched-1 prevents cells from growing and dividing (proliferating). When Sonic Hedgehog is attached, patched-1 stops suppressing cell proliferation. Based on its role in preventing cells from proliferating in an uncontrolled way, *PTCH1* is called a tumor suppressor gene.

Health Conditions Related to Genetic Changes

Gorlin syndrome

More than 225 mutations in the *PTCH1* gene have been found to cause Gorlin syndrome (also known as nevoid basal cell carcinoma syndrome), a condition that affects many areas of the body and increases the risk of developing various cancerous and noncancerous tumors. Mutations in this gene prevent the production of patched-1 or lead to the production of an abnormal version of the receptor. An altered or missing patched-1 receptor cannot effectively suppress cell growth and division. As a result, cells proliferate uncontrollably to form the tumors that are characteristic of Gorlin syndrome. It is less clear how *PTCH1* gene mutations cause the other signs and symptoms related to this condition, including small depressions (pits) in the skin of the palms of the hands and soles of the feet, an unusually large head size (macrocephaly), and skeletal abnormalities.

Nonsyndromic holoprosencephaly

9q22.3 microdeletion

The *PTCH1* gene is located in a region of chromosome 9 that is deleted in people with a 9q22.3 microdeletion. As a result of this deletion, affected individuals are missing one copy of the *PTCH1* gene in each cell. Researchers believe that many of the features associated with 9q22.3 microdeletions, particularly the signs and

symptoms of Gorlin syndrome (described above), result from a loss of the *PTCH1* gene. When this gene is missing, patched-1 is not available to suppress cell proliferation. As a result, cells divide uncontrollably to form the tumors that are characteristic of Gorlin syndrome. Other signs and symptoms related to 9q22.3 microdeletions (such as delayed development, intellectual disability, overgrowth of the body, and other physical abnormalities) may result from the loss of additional genes in the deleted region of chromosome 9.

Coloboma

Cancers

Some mutations are acquired during a person's lifetime and are present only in certain cells. These genetic changes, called somatic mutations, are not inherited. Somatic mutations in both copies of the *PTCH1* gene are associated with a non-hereditary (sporadic) type of skin cancer called basal cell carcinoma. Other sporadic types of cancer may be associated with somatic mutations in the *PTCH1* gene, including some forms of skin cancer, a childhood brain tumor called medulloblastoma, breast cancer, and colon cancer. A noncancerous (benign) jaw tumor called a keratocystic odontogenic tumor can also be associated with somatic *PTCH1* gene mutations.

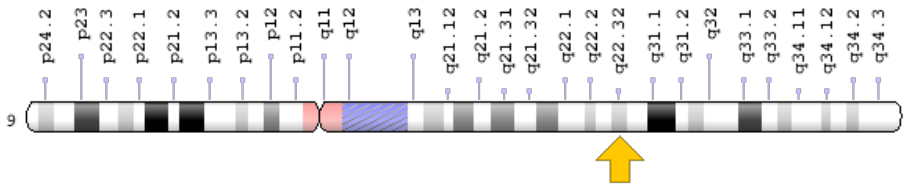
Other disorders

At least seven mutations in the *PTCH1* gene have been found to cause nonsyndromic holoprosencephaly. This condition occurs when the brain fails to divide into two halves during early development. *PTCH1* gene mutations are a rare cause of nonsyndromic holoprosencephaly. These mutations prevent the signaling that is necessary for normal brain cell patterning. The signs and symptoms of nonsyndromic holoprosencephaly are caused by abnormal development of the brain and face.

Chromosomal Location

Cytogenetic Location: 9q22.32, which is the long (q) arm of chromosome 9 at position 22.32

Molecular Location: base pairs 95,442,980 to 95,517,057 on chromosome 9 (Homo sapiens Updated Annotation Release 109.20190905, GRCh38.p13) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- BCNS
- FLJ26746
- FLJ42602
- HPE7
- NBCCS
- patched
- patched homolog 1 (Drosophila)
- PTC
- PTC1
- PTC1_HUMAN
- PTCH

Additional Information & Resources

Educational Resources

- Developmental Biology (sixth edition, 2000): The Hedgehog Signal Transduction Pathway
  https://www.ncbi.nlm.nih.gov/books/NBK10043/?rendertype=figure&id=A1064
- Eurekah Bioscience Collection: The Patched Receptor: Switching On/Off the Hedgehog Signaling Pathway
  https://www.ncbi.nlm.nih.gov/books/NBK6164/

Clinical Information from GeneReviews

- Holoprosencephaly Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1530
- Nevoid Basal Cell Carcinoma Syndrome
  https://www.ncbi.nlm.nih.gov/books/NBK1151

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28PTCH1%5BTIAB%5D%29+OR+%28patched1%5BTIAB%5D%29%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+720+days%22%5Bdp%5D

Catalog of Genes and Diseases from OMIM

- PATCHED 1
  http://omim.org/entry/601309

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/PTCHID100.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=PTCH1%5Bgene%5D
- HGNC Gene Symbol Report
  https://www.genenames.org/data/gene-symbol-report/#!/hgnc_id/HGNC:9585
- Monarch Initiative
  https://monarchinitiative.org/gene/NCBIGene:5727
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/5727
- UniProt
  https://www.uniprot.org/uniprot/Q13635

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