EDA Gene

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Ectodysplasin A: The EDA gene provides instructions for making a protein called ectodysplasin A.

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1. Normal Function

This protein is part of a signaling pathway that plays an important role in development before birth. Specifically, it is critical for interactions between two embryonic cell layers called the ectoderm and the mesoderm. In the early embryo, these cell layers form the basis for many of the body's organs and tissues. Ectoderm-mesoderm interactions are essential for the formation of several structures that arise from the ectoderm, including the skin, hair, nails, teeth, and sweat glands.

One version of the ectodysplasin A protein, known as ectodysplasin A1, interacts with a protein called the ectodysplasin A receptor (produced from the *EDAR* gene). On the cell surface, ectodysplasin A1 attaches to this receptor like a key in a lock. When these two proteins are connected, they trigger a series of chemical signals that affect cell activities such as division, growth, and maturation. Starting before birth, this signaling pathway controls the formation of ectodermal structures such as hair follicles, sweat glands, and teeth.

2. Health Conditions Related to Genetic Changes

2.1 Hypohidrotic Ectodermal Dysplasia

More than 300 mutations in the *EDA* gene have been found to cause hypohidrotic ectodermal dysplasia, the most common form of ectodermal dysplasia. Starting before birth, ectodermal dysplasias result in the abnormal development of the skin, hair, nails, teeth, and sweat glands. Hypohidrotic ectodermal dysplasia is characterized by a reduced ability to sweat (hypohidrosis), sparse scalp and body hair (hypotrichosis), and several missing teeth (hypodontia) or teeth that are malformed. *EDA* gene mutations are the most frequent cause of hypohidrotic ectodermal dysplasia, accounting for more than half of all cases.

Some mutations in the *EDA* gene change single DNA building blocks (base pairs), whereas other mutations insert or delete a larger section of DNA. These changes lead to the production of a nonfunctional version of the ectodysplasin A1 protein. A shortage of functional ectodysplasin A1 prevents the protein from interacting effectively with its receptor, which impairs chemical signaling needed for interactions between the ectoderm and the mesoderm in early development. Without these signals, hair follicles, teeth, sweat glands, and other ectodermal structures do not form properly, which leads to the characteristic features of hypohidrotic ectodermal dysplasia.

2.2 Other Disorders

EDA gene mutations have also been reported in some people with a condition called nonsyndromic tooth agenesis. This condition causes one or more teeth not to form. Although missing teeth is a common feature of ectodermal dysplasias, "nonsyndromic" suggests that in these cases tooth agenesis occurs without the other signs and symptoms of those conditions. It is unclear why the effects of some mutations in this gene appear to be limited to tooth development, while other mutations affect the formation of multiple ectodermal tissues.

3. Other Names for This Gene

- Ectodermal dysplasia protein
- ectodysplasin
- ectodysplasin-A

- ED1
- ED1-A1
- EDA-A1
- EDA-A2
- EDA1
- EDA_HUMAN
- HED
- XHED
- XLHED

References

1. Cluzeau C, Hadj-Rabia S, Jambou M, Mansour S, Guigue P, Masmoudi S, Bal E,Chassaing N, Vincent MC, Viot G, Clauss F, Manière MC, Toupenay S, Le Merrer M,Lyonnet S, Cormier-Daire V, Amiel J, Faivre L, de Prost Y, Munnich A, BonnefontJP, Bodemer C, Smahi A. Only four genes (EDA1, EDAR, EDARADD, and WNT10A) accountfor 90% of hypohidrotic/anhidrotic ectodermal dysplasia cases. Hum Mutat. 2011Jan;32(1):70-2. doi: 10.1002/humu.21384.
2. Han D, Gong Y, Wu H, Zhang X, Yan M, Wang X, Qu H, Feng H, Song S. Novel EDAmutation resulting in X-linked non-syndromic hypodontia and the pattern ofEDA-associated isolated tooth agenesis. Eur J Med Genet. 2008Nov-Dec;51(6):536-46. doi: 10.1016/j.ejmg.2008.06.002.
3. Kowalczyk-Quintas C, Schneider P. Ectodysplasin A (EDA) - EDA receptorsignalling and its pharmacological modulation. Cytokine Growth Factor Rev. 2014Apr;25(2):195-203. doi: 10.1016/j.cytogfr.2014.01.004.
4. Song S, Han D, Qu H, Gong Y, Wu H, Zhang X, Zhong N, Feng H. EDA genemutations underlie non-syndromic oligodontia. J Dent Res. 2009 Feb;88(2):126-31. doi: 10.1177/0022034508328627.
5. Tarpey P, Pemberton TJ, Stockton DW, Das P, Ninis V, Edkins S, Andrew Futreal P, Wooster R, Kamath S, Nayak R, Stratton MR, Patel PI. A novel Gln358Glumutation in ectodysplasin A associated with X-linked dominant incisor hypodontia.Am J Med Genet A. 2007 Feb 15;143(4):390-4.
6. Vincent MC, Biancalana V, Ginisty D, Mandel JL, Calvas P. Mutational spectrum of the ED1 gene in X-linked hypohidrotic ectodermal dysplasia. Eur J Hum Genet.2001 May;9(5):355-63.
7. Wiśniewski SA, Kobielak A, Trzeciak WH, Kobielak K. Recent advances inunderstanding of the molecular basis of anhidrotic ectodermal dysplasia:discovery of a ligand, ectodysplasin A and its two receptors. J Appl Genet.2002;43(1):97-107. Review.
8. Wohlfart S, Hammersen J, Schneider H. Mutational spectrum in 101 patients withhypohidrotic ectodermal dysplasia and breakpoint mapping in independent cases of rare genomic rearrangements. J Hum Genet. 2016 Oct;61(10):891-897. doi:10.1038/jhg.2016.75.
9. Wright JT, Grange DK, Fete M. Hypohidrotic Ectodermal Dysplasia. 2003 Apr 28[updated 2017 Jun 1]. In: Adam MP, Ardinger HH, Pagon RA, Wallace SE, Bean LJH,Stephens K, Amemiya A, editors. GeneReviews® [Internet]. Seattle (WA): Universityof Washington, Seattle; 1993-2020. Available fromhttp://www.ncbi.nlm.nih.gov/books/NBK1112/