CHAT gene

choline O-acetyltransferase

Normal Function

The *CHAT* gene provides instructions for making a protein called choline acetyltransferase. This protein is located at the ends of nerve cells in specialized areas called presynaptic terminals. Choline acetyltransferase facilitates the production of a molecule called acetylcholine. Acetylcholine is essential for normal muscle movement. When acetylcholine is released from the presynaptic terminal, it attaches (binds) to a receptor protein located in the membrane of muscle cells. When acetylcholine binds to its receptor protein, specialized channels in the receptor then open, allowing certain charged atoms (ions) to flow into and out of muscle cells. The flow of these ions allows for muscle contraction and relaxation, resulting in muscle movement.

Health Conditions Related to Genetic Changes

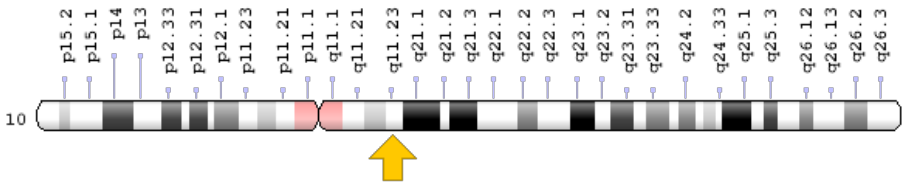
Congenital myasthenic syndrome

More than 30 mutations in the *CHAT* gene have been found to cause congenital myasthenic syndrome. Most of these mutations replace single DNA building blocks (nucleotides) in the *CHAT* gene. The mutations lead to decreased production of choline acetyltransferase or the production of a protein with decreased ability to aid in the production of acetylcholine. The resulting lack of acetylcholine decreases the availability of open receptors, impairing ion flow through muscle cells. A reduction in muscle cell ion flow decreases muscle movement leading to muscle weakness characteristic of congenital myasthenic syndrome. In addition, people with congenital myasthenic syndrome who have mutations in the *CHAT* gene are more likely than affected individuals with mutations in other genes to have short pauses in breathing (apnea), but the cause for this association is unclear.

Chromosomal Location

Cytogenetic Location: 10q11.23, which is the long (q) arm of chromosome 10 at position 11.23

Molecular Location: base pairs 49,609,095 to 49,665,104 on chromosome 10 (Homo sapiens Annotation Release 109, GRCh38.p12) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- acetyl CoA:choline O-acetyltransferase
- CHOACTASE
- choline acetylase
- CLAT_HUMAN
- CMS1A

Additional Information & Resources

Educational Resources

- Molecular Cell Biology (fourth edition, 2002): Opening of Acetylcholine-Gated Cation Channels Leads to Muscle Contraction
  https://www.ncbi.nlm.nih.gov/books/NBK21586/#A6231
- Neuroscience (second edition, 2001): Acetylcholine
  https://www.ncbi.nlm.nih.gov/books/NBK11143/
- Washington University, St. Louis: Neuromuscular Disease Center
  https://neuromuscular.wustl.edu/synmg.html#familialmg

Clinical Information from GeneReviews

- Congenital Myasthenic Syndromes
  https://www.ncbi.nlm.nih.gov/books/NBK1168

Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28CHAT%5BTIAB%5D%29+OR+%28choline+acetyltransferase%5BTIAB%5D%29+NOT+%28Cri+du+chat%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+1440+days%22%5Bdp%5D

Catalog of Genes and Diseases from OMIM

- CHOLINE ACETYLTRANSFERASE
  http://omim.org/entry/118490

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
  http://atlasgeneticsoncology.org/Genes/GC_CHAT.html
- ClinVar
  https://www.ncbi.nlm.nih.gov/clinvar?term=CHAT%5Bgene%5D
- HGNC Gene Symbol Report
  https://www.genenames.org/data/gene-symbol-report/#!/hgnc_id/HGNC:1912
- Monarch Initiative
  https://monarchinitiative.org/gene/NCBIGene:1103
- NCBI Gene
  https://www.ncbi.nlm.nih.gov/gene/1103
- UniProt
  https://www.uniprot.org/uniprot/P28329

Sources for This Summary

- Barisic N, Chaouch A, Müller JS, Lochmüller H. Genetic heterogeneity and pathophysiological mechanisms in congenital myasthenic syndromes. Eur J Paediatr Neurol. 2011 May;15(3):189-96. doi: 10.1016/j.ejpn.2011.03.006. Epub 2011 Apr 17. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/21498094
- OMIM: CHOLINE ACETYLTRANSFERASE
  http://omim.org/entry/118490

- Engel AG, Shen XM, Selcen D, Sine SM. What have we learned from the congenital myasthenic syndromes. J Mol Neurosci. 2010 Jan;40(1-2):143-53. doi: 10.1007/s12031-009-9229-0. Epub 2009 Aug 18. Review.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19688192
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3050586/
- Schara U, Christen HJ, Durmus H, Hietala M, Krabetz K, Rodolico C, Schreiber G, Topaloglu H, Talim B, Voss W, Pihko H, Abicht A, Müller JS, Lochmüller H. Long-term follow-up in patients with congenital myasthenic syndrome due to CHAT mutations. Eur J Paediatr Neurol. 2010 Jul;14(4): 326-33. doi: 10.1016/j.ejpn.2009.09.009. Epub 2009 Nov 8.
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/19900826

Reprinted from Genetics Home Reference:
https://ghr.nlm.nih.gov/gene/CHAT

Reviewed: November 2011
Published: May 14, 2019

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services