MT-TV gene
mitochondrially encoded tRNA valine

Normal Function

The *MT-TV* gene provides instructions for making a particular type of RNA, a molecule that is a chemical cousin of DNA. This type of RNA, called transfer RNA (tRNA), helps assemble protein building blocks known as amino acids into full-length, functioning proteins. The *MT-TV* gene provides instructions for a specific form of transfer RNA that is designated as tRNA$^{\text{Val}}$. This molecule attaches to a particular amino acid, valine (Val), and inserts it into the appropriate locations in many different proteins.

The tRNA$^{\text{Val}}$ molecule is present only in cellular structures called mitochondria. These structures convert energy from food into a form that cells can use. Through a process called oxidative phosphorylation, mitochondria use oxygen and simple sugars to create adenosine triphosphate (ATP), the cell's main energy source. The tRNA$^{\text{Val}}$ molecule is involved in the assembly of proteins that carry out oxidative phosphorylation.

Health Conditions Related to Genetic Changes

Mitochondrial encephalomyopathy, lactic acidosis, and stroke-like episodes

Mutations in the *MT-TV* gene are a very rare cause of mitochondrial encephalomyopathy, lactic acidosis, and stroke-like episodes (MELAS). Most cases of MELAS are caused by mutations in other mitochondrial genes, but a small number of cases resulting from mutations in the *MT-TV* gene have been reported. At least two mutations have been identified, each of which alters a single DNA building block (nucleotide) in the gene. One of these mutations replaces the nucleotide guanine with the nucleotide adenine at gene position 1642 (written as G1642A). Another mutation changes the nucleotide guanine to the nucleotide adenine at position 1644 (G1644A). Changes in the *MT-TV* gene may reduce the amount of tRNA$^{\text{Val}}$ available to assemble proteins within mitochondria. Because these proteins are needed for oxidative phosphorylation, *MT-TV* mutations may impair the ability of mitochondria to produce energy. Researchers have not determined how changes in mitochondrial energy production can lead to the specific features of MELAS.

Leigh syndrome

Other disorders

A few other mutations in the *MT-TV* gene have been have been reported, most of which change single nucleotides in the gene. These mutations are responsible
for a variety of signs and symptoms chiefly affecting the muscles and nervous system. Medical problems associated with \textit{MT-TV} mutations have included recurrent migraine headaches, muscle weakness and problems with movement, poor coordination, seizures, hearing loss, learning disabilities, and loss of intellectual function (dementia). A heart condition called cardiomyopathy, which weakens and enlarges the heart muscle, also has been reported in a small number of affected individuals.

Changes in the \textit{MT-TV} gene have been identified as a rare cause of Leigh syndrome, a progressive brain disorder that typically appears in infancy or early childhood. In a few cases, \textit{MT-TV} mutations were found in people with signs and symptoms that did not appear until adulthood. Affected individuals may experience vomiting, seizures, delayed development, muscle weakness, and problems with movement. Heart disease, kidney problems, and difficulty breathing can also occur in people with this disorder.

It is unclear why changes in the \textit{MT-TV} gene can cause such a large variety of signs and symptoms. Even within a single family, affected individuals may have different health problems caused by the same genetic change.
Chromosomal Location
Molecular Location: base pairs 1,602 to 1,670 on mitochondrial DNA (Homo sapiens Annotation Release 109, GRCh38.p12) (NCBI)

Other Names for This Gene
• MTTTV
• tRNA-Val, mitochondrial
• tRNA valine
Additional Information & Resources

Educational Resources

• Basic Neurochemistry (sixth edition, 1999): Diseases of Mitochondrial Metabolism  
  https://www.ncbi.nlm.nih.gov/books/NBK27914/

• Eurekah Bioscience Collection: Mitochondrial Translation System  
  https://www.ncbi.nlm.nih.gov/books/NBK6292/#A27945

• Mayo Clinic Mitochondrial Disease Biobank  
  https://www.mayo.edu/research/centers-programs/mitochondrial-disease-biobank/overview

• Neuromuscular Disease Center, Washington University: Leigh syndrome  
  https://neuromuscular.wustl.edu/mitosyn.html#leigh

• Neuromuscular Disease Center, Washington University: MELAS  
  https://neuromuscular.wustl.edu/mitosyn.html#melas


Clinical Information from GeneReviews

• MELAS  
  https://www.ncbi.nlm.nih.gov/books/NBK1233

• Mitochondrial Disorders Overview  
  https://www.ncbi.nlm.nih.gov/books/NBK1224

• Mitochondrial DNA-Associated Leigh Syndrome and NARP  
  https://www.ncbi.nlm.nih.gov/books/NBK1173

Scientific Articles on PubMed

• PubMed  
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28MT-TV%5BTIAB%5D%29+OR+%28mitochondrially+encoded+tRNA+valine%5BTIAB%5D%29+OR+%28%28MTTV%5BTIAB%5D%29+OR+%28tRNA+valine%5BTIAB%5D%29+OR+%28G1642A%5BTIAB%5D%29+OR+%28tRNA%28Val%5BTIAB%5D%29+OR+%28tRNA+%28Val%5BTIAB%5D%29+OR+%28tRNA%5BTIAB%5D%29+AND+%28valine%5BTIAB%5D%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D
Catalog of Genes and Diseases from OMIM

- LEIGH SYNDROME
  http://omim.org/entry/256000
- TRANSFER RNA, MITOCHONDRIAL, VALINE
  http://omim.org/entry/590105

Research Resources

- ClinVar
- HGNC Gene Family: Mitochondrially encoded tRNAs
  https://www.genenames.org/cgi-bin/genefamilies/set/843
- HGNC Gene Symbol Report
  https://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=7500
- Mitomap: rRNA/tRNA mutations
  https://www.mitomap.org/MITOMAP/MutationsRNA
- Monarch Initiative
  https://monarchinitiative.org/gene/NCBIGene:4577
- NCBI Gene

Sources for This Summary

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15465092
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/9270602
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/15320572
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/8797538
  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/9450773

  Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/9443499

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