Familial dilated cardiomyopathy

Familial dilated cardiomyopathy is a genetic form of heart disease. It occurs when heart (cardiac) muscle becomes thin and weakened in at least one chamber of the heart, causing the open area of the chamber to become enlarged (dilated). As a result, the heart is unable to pump blood as efficiently as usual. To compensate, the heart attempts to increase the amount of blood being pumped through the heart, leading to further thinning and weakening of the cardiac muscle. Over time, this condition results in heart failure.

It usually takes many years for symptoms of familial dilated cardiomyopathy to cause health problems. They typically begin in mid-adulthood, but can occur at any time from infancy to late adulthood. Signs and symptoms of familial dilated cardiomyopathy can include an irregular heartbeat (arrhythmia), shortness of breath (dyspnea), extreme tiredness (fatigue), fainting episodes (syncope), and swelling of the legs and feet. In some cases, the first sign of the disorder is sudden cardiac death. The severity of the condition varies among affected individuals, even in members of the same family.

Frequency

It is estimated that 750,000 people in the United States have dilated cardiomyopathy; roughly half of these cases are familial.

Genetic Changes

Mutations in more than 30 genes have been found to cause familial dilated cardiomyopathy. These genes provide instructions for making proteins that are found in cardiac muscle cells called cardiomyocytes.

Many of these proteins play important roles in the contraction of the cardiac muscle through their association with cell structures called sarcomeres. Sarcomeres are the basic units of muscle contraction; they are made of proteins that generate the mechanical force needed for muscles to contract. Many other proteins associated with familial dilated cardiomyopathy make up the structural framework (the cytoskeleton) of cardiomyocytes. The remaining proteins play various roles within cardiomyocytes to ensure their proper functioning.

Mutations in one gene, \textit{TTN}, account for approximately 20 percent of cases of familial dilated cardiomyopathy. The \textit{TTN} gene provides instructions for making a protein called titin, which is found in the sarcomeres of many types of muscle cells, including cardiomyocytes. Titin provides structure, flexibility, and stability to sarcomeres. Titin also plays a role in chemical signaling and in assembling new sarcomeres. The \textit{TTN} gene mutations that cause familial dilated cardiomyopathy result in the production of an abnormally short titin protein. It is unclear how the altered protein causes familial dilated
cardiomyopathy, but it is likely that it impairs sarcomere function and disrupts chemical signaling.

It is unclear how mutations in the other genes cause familial dilated cardiomyopathy. It is likely that the changes impair cardiomyocyte function and reduce the ability of these cells to contract, weakening and thinning cardiac muscle.

People with familial dilated cardiomyopathy often do not have an identified mutation in any of the known associated genes. The cause of the condition in these individuals is unknown.

Familial dilated cardiomyopathy is described as nonsyndromic or isolated because it typically affects only the heart. However, dilated cardiomyopathy can also occur as part of syndromes that affect other organs and tissues in the body. These forms of the condition are described as syndromic and are caused by mutations in other genes. Additionally, there are many nongenetic causes of dilated cardiomyopathy, including viral infection and chronic alcohol abuse.

Inheritance Pattern

Familial dilated cardiomyopathy has different inheritance patterns depending on the gene involved.

In 80 to 90 percent of cases, familial dilated cardiomyopathy is inherited in an autosomal dominant pattern, which means one copy of the altered gene in each cell is sufficient to cause the disorder. In most cases, an affected person inherits the mutation from one affected parent. However, some people who inherit the altered gene never develop features of familial dilated cardiomyopathy. (This situation is known as reduced penetrance.) Other cases result from new mutations in the gene and occur in people with no history of the disorder in their family.

In rare instances, this condition is inherited in an autosomal recessive pattern, which means both copies of the gene in each cell have mutations. The parents of an individual with an autosomal recessive condition each carry one copy of the mutated gene, but they typically do not show signs and symptoms of the condition.

In other rare cases, this condition is inherited in an X-linked pattern. In these cases, the gene associated with this condition is located on the X chromosome, which is one of the two sex chromosomes. In females (who have two X chromosomes), a mutation in one of the two copies of the gene in each cell increases the risk of developing heart disease, but females with such a mutation may not develop familial dilated cardiomyopathy. In males (who have only one X chromosome), a mutation in the only copy of the gene in each cell causes familial dilated cardiomyopathy. A characteristic of X-linked inheritance is that fathers cannot pass X-linked traits to their sons.

Other Names for This Condition

- congestive cardiomyopathy
- familial idiopathic cardiomyopathy
• FDC
• primary familial dilated cardiomyopathy

**Diagnosis & Management**

**Genetic Testing**

- Genetic Testing Registry: Primary dilated cardiomyopathy

**Other Diagnosis and Management Resources**

- Cincinnati Children’s Hospital
  https://www.cincinnatichildrens.org/service/c/cardiomyopathy/types/dilated-cardiomyopathy
- GeneReview: Dilated Cardiomyopathy Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1309
- GeneReview: Dystrophinopathies
  https://www.ncbi.nlm.nih.gov/books/NBK1119
- GeneReview: LMNA-Related Dilated Cardiomyopathy
  https://www.ncbi.nlm.nih.gov/books/NBK1674
- MedlinePlus Encyclopedia: Dilated Cardiomyopathy
  https://medlineplus.gov/ency/article/000168.htm
- National Heart, Lung, and Blood Institute: Cardiomyopathy Treatment
  https://www.nhlbi.nih.gov/health-topics/cardiomyopathy#Treatment
- Seattle Children's Hospital: Cardiomyopathy
  http://www.seattlechildrens.org/medical-conditions/heart-blood-conditions/cardiomyopathy/
- The Sarcomeric Human Cardiomyopathies Registry (ShaRe)
  https://theshareregistry.org/

**General Information from MedlinePlus**

- Diagnostic Tests
  https://medlineplus.gov/diagnostictests.html
- Drug Therapy
  https://medlineplus.gov/drugtherapy.html
- Genetic Counseling
  https://medlineplus.gov/geneticcounseling.html
• Palliative Care  
  https://medlineplus.gov/palliativecare.html

• Surgery and Rehabilitation  
  https://medlineplus.gov/surgeryandrehabilitation.html

Additional Information & Resources

MedlinePlus
• Encyclopedia: Dilated Cardiomyopathy  
  https://medlineplus.gov/ency/article/000168.htm
• Health Topic: Cardiomyopathy  
  https://medlineplus.gov/cardiomyopathy.html

Genetic and Rare Diseases Information Center
• Familial dilated cardiomyopathy  
  https://rarediseases.info.nih.gov/diseases/2905/familial-dilated-cardiomyopathy

Additional NIH Resources
• National Heart, Lung, and Blood Institute: Cardiomyopathy  
  https://www.nhlbi.nih.gov/health-topics/cardiomyopathy

Educational Resources
• Ann & Robert H. Lurie Children’s Hospital of Chicago: Cardiomyopathy  
  https://www.luriechildrens.org/en-us/care-services/conditions-treatments/cardio/ 
  myopathy/Pages/index.aspx
• Boston Children’s Hospital: Cardiomyopathy  
  http://www.childrenshospital.org/conditions-and-treatments/conditions/c/ 
  cardiomyopathy
• Centre for Genetics Education (Australia): Cardiomyopathies  
  http://www.genetics.edu.au/publications-and-resources/facts-sheets/fact-sheet-57- 
  cardiomyopathies
• Cincinnati Children’s Hospital  
  https://www.cincinnatichildrens.org/service/c/cardiomyopathy/types/dilated- 
  cardiomyopathy
• Cleveland Clinic  
  https://my.clevelandclinic.org/health/diseases/16932-dilated-cardiomyopathy
• Disease InfoSearch: Dilated Cardiomyopathy  
  http://www.diseaseinfosearch.org/Dilated+Cardiomyopathy/2284
• KidsHealth from Nemours: Heart and Circulatory System  
• Merck Manual for Patients and Caregivers

• Orphanet: Familial isolated dilated cardiomyopathy
  http://www.orpha.net/consor/cgi-bin/OC_Exp.php?Lng=EN&Expert=154

Patient Support and Advocacy Resources
• American Heart Association
  http://www.heart.org/HEARTORG/Conditions/More/Cardiomyopathy/Dilated-Cardiomyopathy_UCM_444187_Article.jsp

• Cardiomyopathy UK
  http://www.cardiomyopathy.org/dilated-cardiomyopathy/intro

• Championship Hearts Foundation
  http://www.champhears.org/

• Children's Cardiomyopathy Foundation
  http://www.childrenscardiomyopathy.org/

• Contact a Family
  https://contact.org.uk/medical-information/conditions/c/cardiomyopathies-in-children/

• National Organization for Rare Disorders (NORD): Pediatric Cardiomyopathy
  https://rarediseases.org/rare-diseases/pediatric-cardiomyopathy/

• The Sarcomeric Human Cardiomyopathies Registry (ShaRe)
  https://theshareregistry.org/

GeneReviews
• Dilated Cardiomyopathy Overview
  https://www.ncbi.nlm.nih.gov/books/NBK1309

• Dystrophinopathies
  https://www.ncbi.nlm.nih.gov/books/NBK1119

• LMNA-Related Dilated Cardiomyopathy
  https://www.ncbi.nlm.nih.gov/books/NBK1674

ClinicalTrials.gov
• ClinicalTrials.gov
  https://clinicaltrials.gov/ct2/results?cond=%22familial+dilated+cardiomyopathy%22+OR+%22congestive+cardiomyopathy%22+OR+%22familial+idiopathic+cardiomyopathy%22+OR+%22primary+familial+dilated+cardiomyopathy%22+OR+%22Cardiomyopathy%2C+dilated%22
Scientific Articles on PubMed

- PubMed
  https://www.ncbi.nlm.nih.gov/pubmed?term=%28Cardiomyopathy,+Dilated%5BMAJR%5D%29+AND+%28familial+dilated+cardiomyopathy%5BTIAB%5D%29+OR+%28familial%5BTIAB%5D+AND+dilated+cardiomyopathy%5BTIAB%5D%29+AND+english%5Bmh%5D+AND+%22last+1800+days%22%5Bdp%5D

OMIM

- CARDIOMYOPATHY, DILATED, 1A
  http://omim.org/entry/115200

- CARDIOMYOPATHY, DILATED, 1AA, WITH OR WITHOUT LEFT VENTRICULAR NONCOMPACATION
  http://omim.org/entry/612158

- CARDIOMYOPATHY, DILATED, 1B
  http://omim.org/entry/600884

- CARDIOMYOPATHY, DILATED, 1BB
  http://omim.org/entry/612877

- CARDIOMYOPATHY, DILATED, 1C, WITH OR WITHOUT LEFT VENTRICULAR NONCOMPACATION
  http://omim.org/entry/601493

- CARDIOMYOPATHY, DILATED, 1D
  http://omim.org/entry/601494

- CARDIOMYOPATHY, DILATED, 1DD
  http://omim.org/entry/613172

- CARDIOMYOPATHY, DILATED, 1E
  http://omim.org/entry/601154

- CARDIOMYOPATHY, DILATED, 1EE
  http://omim.org/entry/613252

- CARDIOMYOPATHY, DILATED, 1G
  http://omim.org/entry/604145

- CARDIOMYOPATHY, DILATED, 1H
  http://omim.org/entry/604288

- CARDIOMYOPATHY, DILATED, 1HH
  http://omim.org/entry/613881

- CARDIOMYOPATHY, DILATED, 1I
  http://omim.org/entry/604765
• CARDIOMYOPATHY, DILATED, 1II
  http://omim.org/entry/615184
• CARDIOMYOPATHY, DILATED, 1J
  http://omim.org/entry/605362
• CARDIOMYOPATHY, DILATED, 1JJ
  http://omim.org/entry/615235
• CARDIOMYOPATHY, DILATED, 1K
  http://omim.org/entry/605582
• CARDIOMYOPATHY, DILATED, 1KK
  http://omim.org/entry/615248
• CARDIOMYOPATHY, DILATED, 1L
  http://omim.org/entry/606685
• CARDIOMYOPATHY, DILATED, 1M
  http://omim.org/entry/607482
• CARDIOMYOPATHY, DILATED, 1O
  http://omim.org/entry/608569
• CARDIOMYOPATHY, DILATED, 1P
  http://omim.org/entry/609909
• CARDIOMYOPATHY, DILATED, 1Q
  http://omim.org/entry/609915
• CARDIOMYOPATHY, DILATED, 1R
  http://omim.org/entry/613424
• CARDIOMYOPATHY, DILATED, 1S
  http://omim.org/entry/613426
• CARDIOMYOPATHY, DILATED, 1U
  http://omim.org/entry/613694
• CARDIOMYOPATHY, DILATED, 1V
  http://omim.org/entry/613697
• CARDIOMYOPATHY, DILATED, 1W
  http://omim.org/entry/611407
• CARDIOMYOPATHY, DILATED, 1Y
  http://omim.org/entry/611878
• CARDIOMYOPATHY, DILATED, 1Z
  http://omim.org/entry/611879
• CARDIOMYOPATHY, DILATED, 2A
  http://omim.org/entry/611880
• CARDIOMYOPATHY, DILATED, 2B
  http://omim.org/entry/614672
• CARDIOMYOPATHY, DILATED, 2B
  http://omim.org/entry/614672
• CARDIOMYOPATHY, DILATED, 3B
  http://omim.org/entry/302045
• CARDIOMYOPATHY, FAMILIAL HYPERTROPHIC, 25
  http://omim.org/entry/607487
• LEFT VENTRICULAR NONCOMPACtion 10
  http://omim.org/entry/615396

Sources for This Summary

• Ackerman MJ, Priori SG, Willems S, Berul C, Brugada R, Calkins H, Camm AJ, Ellinor PT,
  Gollob M, Hamilton R, Hershberger RE, Judge DP, Le Marc H, McKenna WJ, Schulze-Bahr E,
  statement on the state of genetic testing for the channelopathies and cardiomyopathies this
  document was developed as a partnership between the Heart Rhythm Society (HRS) and the
  j.hrthm.2011.05.020. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/21787999

• Dellefave L, McNally EM. The genetics of dilated cardiomyopathy. Curr Opin Cardiol. 2010 May;
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2939233/

• Herman DS, Lam L, Taylor MR, Wang L, Teekakirikul P, Christodoulou D, Conner L, DePalma SR,
  McDonough B, Sparks E, Teodorescu DL, Cirino AL, Banner NR, Pennell DJ, Graw S, Merlo M,
  Di Lenarda A, Sinagra G, Bos JM, Ackerman MJ, Mitchell RN, Murry CE, Lakdawala NK, Ho CY,
  Barton PJ, Cook SA, Mestroni L, Seidman JG, Seidman CE. Truncations of titin causing dilated
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3660031/

• Hershberger RE, Hedges DJ, Morales A. Dilated cardiomyopathy: the complexity of a diverse

• Hershberger RE, Morales A, Siegfried JD. Clinical and genetic issues in dilated cardiomyopathy:
  GIM.0b013e3181f2481f. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/20864896
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3118426/

• Hershberger RE, Siegfried JD. Update 2011: clinical and genetic issues in familial dilated
  Review. Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/21492761
  Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3088091/
Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23686784

Citation on PubMed: https://www.ncbi.nlm.nih.gov/pubmed/23249954 
Free article on PubMed Central: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3778334/

Reprinted from Genetics Home Reference: 

Reviewed: April 2017
Published: March 20, 2018

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