LMNB1 Gene

Subjects: Genetics & Heredity
Contributor: Dean Liu

Lamin B1

Keywords: genes

1. Introduction

The *LMNB1* gene provides instructions for making the lamin B1 protein. Lamin B1 is a structural protein called an intermediate filament protein. Intermediate filaments provide stability and strength to cells. Lamin B1 is a scaffolding (supporting) component of the nuclear envelope, which is the structure that surrounds the nucleus in cells. Specifically, this protein is located in the nuclear lamina, a mesh-like layer of intermediate filaments and other proteins that is attached to the inner membrane of the nuclear envelope. As part of the nuclear envelope, lamin B1 helps regulate the movement of molecules into and out of the nucleus. The protein also plays a role in the copying (replication) of DNA in preparation for cell division and the activity (expression) of many genes by being involved in the organization of chromosomes within the nucleus.

2. Health Conditions Related to Genetic Changes

2.1. Autosomal Dominant Leukodystrophy with Autonomic Disease

At least 30 mutations in the *LMNB1* gene have been found to cause autosomal dominant leukodystrophy with autonomic disease (ADLD). This condition is characterized by nervous system abnormalities due to the loss of myelin, which is a fatty substance that insulates nerve fibers and promotes the rapid transmission of nerve impulses. People with ADLD begin to have autonomic nervous system problems, such as difficulty with bowel and bladder function, in their thirties or forties. The autonomic nervous system controls involuntary body processes such as the regulation of blood pressure and body temperature. Affected individuals then develop movement problems that slowly worsen over time.

Nearly all cases of ADLD result from an abnormal extra copy (duplication) of the *LMNB1* gene. As a result of this duplication, more lamin B1 is produced than normal. In rare cases, a deletion of genetic material near the beginning of the *LMNB1* gene leading to increased production of lamin B1 causes ADLD. While lamin B1 is found in cells throughout the body, it appears that cells in the brain are especially sensitive to changes in lamin B1. Cells called oligodendrocytes, which help coat nerve cells with myelin, seem to be particularly affected. Increased lamin B1 activity leads to decreased expression of genes that are important for myelin function. Additionally, an increase in the amount of lamin B1 in cells leads to a hardening of the nuclear envelope, which can cause problems with cell function. These changes lead to reduced myelin production and maintenance over time.

In at least one family with ADLD, the condition is instead caused by a loss (deletion) of genetic material near the beginning of the gene. It is thought that this deletion removes a regulatory region of DNA that helps control the expression of the *LMNB1* gene. As a result of the loss of this region, *LMNB1* is overexpressed and production of the lamin B1 protein is increased, similar to the cases that are caused by *LMNB1* duplication.

In people with ADLD, the loss of myelin (demyelination) occurs in the brain and spinal cord (central nervous system), often years before movement problems develop. Demyelination of the spinal cord likely contributes to the autonomic nervous system problems by impairing transmission of nerve signals from the brain to the body. The movement problems are probably due to demyelination in the region of the brain involved in coordinating movements (the cerebellum) and of the nerve cells that extend down the spinal cord (corticospinal tracts) and control voluntary muscle movement.

3. Other Names for This Gene

- LMN

- LMN2
- LMNB

References

1. Bartoletti-Stella A, Gasparini L, Giacomini C, Corrado P, Terlizzi R, Giorgio E, Magini P, Seri M, Baruzzi A, Parchi P, Brusco A, Cortelli P, Capellari S.Messenger RNA processing is altered in autosomal dominant leukodystrophy. Hum MolGenet. 2015 May 15;24(10):2746-56. doi: 10.1093/hmg/ddv034.Erratum in: Hum Mol Genet. 2017 Oct 1;26(19):3868.
2. Ferrera D, Canale C, Marotta R, Mazzaro N, Gritti M, Mazzanti M, Capellari S, Cortelli P, Gasparini L. Lamin B1 overexpression increases nuclear rigidity inautosomal dominant leukodystrophy fibroblasts. FASEB J. 2014 Sep;28(9):3906-18.doi: 10.1096/fj.13-247635.
3. Giorgio E, Robyr D, Spielmann M, Ferrero E, Di Gregorio E, Imperiale D, Vaula G, Stamoulis G, Santoni F, Atzori C, Gasparini L, Ferrera D, Canale C, GuipponiM, Pennacchio LA, Antonarakis SE, Brussino A, Brusco A. A large genomic deletion leads to enhancer adoption by the lamin B1 gene: a second path to autosomaldominant adult-onset demyelinating leukodystrophy (ADLD). Hum Mol Genet. 2015 Jun1;24(11):3143-54. doi: 10.1093/hmg/ddv065.
4. Giorgio E, Rolyan H, Kropp L, Chakka AB, Yatsenko S, Di Gregorio E, Lacerenza D, Vaula G, Talarico F, Mandich P, Toro C, Pierre EE, Labauge P, Capellari S,Cortelli P, Vairo FP, Miguel D, Stubbolo D, Marques LC, Gahl W, Boespflug-Tanguy O, Melberg A, Hassin-Baer S, Cohen OS, Pjontek R, Grau A, Klopstock T, Fogel B,Meijer I, Rouleau G, Bouchard JP, Ganapathiraju M, Vanderver A, Dahl N, Hobson G,Brusco A, Brussino A, Padiath QS. Analysis of LMNB1 duplications in autosomaldominant leukodystrophy provides insights into duplication mechanisms andallele-specific expression. Hum Mutat. 2013 Aug;34(8):1160-71. doi:10.1002/humu.22348.
5. Heng MY, Lin ST, Verret L, Huang Y, Kamiya S, Padiath QS, Tong Y, Palop JJ,Huang EJ, Ptáček LJ, Fu YH. Lamin B1 mediates cell-autonomous neuropathology in aleukodystrophy mouse model. J Clin Invest. 2013 Jun;123(6):2719-29. doi:10.1172/JCI66737.
6. Padiath QS, Saigoh K, Schiffmann R, Asahara H, Yamada T, Koeppen A, Hogan K,Ptácek LJ, Fu YH. Lamin B1 duplications cause autosomal dominant leukodystrophy. Nat Genet. 2006 Oct;38(10):1114-23.Feb;39(2):276.
7. Rolyan H, Tyurina YY, Hernandez M, Amoscato AA, Sparvero LJ, Nmezi BC, Lu Y,Estécio MR, Lin K, Chen J, He RR, Gong P, Rigatti LH, Dupree J, Bayır H, KaganVE, Casaccia P, Padiath QS. Defects of Lipid Synthesis Are Linked to theAge-Dependent Demyelination Caused by Lamin B1 Overexpression. J Neurosci. 2015Aug 26;35(34):12002-17. doi: 10.1523/JNEUROSCI.1668-15.2015.

Retrieved from https://encyclopedia.pub/entry/history/show/12612