FFEVF

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Familial focal epilepsy with variable foci (FFEVF) is an uncommon form of recurrent seizures (epilepsy) that runs in families.

Keywords: genetic conditions

1. Introduction

Seizures associated with FFEVF can begin at any time from infancy to adulthood. The seizures are described as focal or partial, which means they begin in one region of the brain and do not cause a loss of consciousness. In more than 70 percent of affected individuals, these seizures begin in one of two areas of the brain, either the temporal lobe or the frontal lobe. The region of the brain where the seizures start tends to stay the same over time. In rare instances, seizure activity that starts in one area spreads to affect the entire brain and causes a loss of consciousness, muscle stiffening, and rhythmic jerking. Episodes that begin as partial seizures and spread throughout the brain are known as secondarily generalized seizures.

Among family members with FFEVF, individuals may not have the same brain region affected (variable foci), meaning that one person's seizures may not begin in the same part of the brain as their affected relative.

Some individuals with FFEVF also have a brain malformation called focal cortical dysplasia. Seizures in these individuals are typically not well-controlled with medication.

Most people with FFEVF are intellectually normal, and there are no problems with their brain function between seizures. However, some people with FFEVF have developed psychiatric disorders (such as schizophrenia), behavioral problems, or intellectual disability. It is unclear whether these additional features are directly related to epilepsy in these individuals.

2. Frequency

The prevalence of FFEVF is unknown.

3. Causes

Most cases of FFEVF are caused by mutations in the *DEPDC5* gene with fewer cases caused by mutations in the *NPRL2* or *NPRL3* gene. These three genes provide instructions for making proteins that attach (bind) to each other to form a protein complex called GATOR1. This complex is found in cells throughout the body, where it regulates a signaling pathway involved in cell growth and division (proliferation), the survival of cells, and the creation (synthesis) of new proteins. The role of the GATOR1 complex is to block (inhibit) this pathway when it is not needed.

A mutation in any one of the three genes associated with FFEVF reduces GATOR1 complex formation, leading to an abnormally active signaling pathway. It is unclear how overactivity in this pathway leads to the focal seizures of FFEVF. Research suggests that increased signaling in the brain leads to changes in the development of the junctions between nerve cells (synapses) and increased activation (excitation) of nerve cells, which can cause seizures. Increased excitation of nerve cells can also cause enlargement of these cells, which is characteristic of focal cortical dysplasia.

It is unknown why some individuals with the same mutation have seizures that start in different regions of the brain. Researchers believe that other, unknown genes may influence the features of FFEVF.

Some individuals with FFEVF do not have an identified mutation in any of these three genes. The cause of the condition in these individuals is unknown.

3.1. The genes associated with Familial focal epilepsy with variable foci

- DEPDC5
- NPRL2
- NPRL3

4. Inheritance

FFEVF is inherited in an autosomal dominant pattern, which means one copy of an altered gene in each cell is sufficient to cause the disorder. In most cases, an affected person inherits the mutation from one parent.

For unknown reasons, some people with FFEVF caused by a *DEPDC5* gene mutation never develop the condition, a situation known as reduced penetrance. Approximately 60 percent of individuals with *DEPDC5* gene mutations go on to develop FFEVF.

5. Other Names for This Condition

- familial partial epilepsy with variable foci
- FFEVF
- partial epilepsy with variable foci

References

1. Baldassari S, Licchetta L, Tinuper P, Bisulli F, Pippucci T. GATOR1 complex:the common genetic actor in focal epilepsies. J Med Genet. 2016 Aug;53(8):503-10.doi: 10.1136/jmedgenet-2016-103883.
2. Baulac S, Ishida S, Marsan E, Miquel C, Biraben A, Nguyen DK, Nordli D,Cossette P, Nguyen S, Lambrecq V, Vlaicu M, Daniau M, Bielle F, Andermann E,Andermann F, Leguern E, Chassoux F, Picard F. Familial focal epilepsy with focal cortical dysplasia due to DEPDC5 mutations. Ann Neurol. 2015 Apr;77(4):675-83.doi: 10.1002/ana.24368.
3. Baulac S. Genetics advances in autosomal dominant focal epilepsies: focus onDEPDC5. Prog Brain Res. 2014;213:123-39. doi: 10.1016/B978-0-444-63326-2.00007-7.Review.
4. Baulac S. mTOR signaling pathway genes in focal epilepsies. Prog Brain Res.2016;226:61-79. doi: 10.1016/bs.pbr.2016.04.013.
5. Dibbens LM, de Vries B, Donatello S, Heron SE, Hodgson BL, Chintawar S,Crompton DE, Hughes JN, Bellows ST, Klein KM, Callenbach PM, Corbett MA, Gardner AE, Kivity S, Iona X, Regan BM, Weller CM, Crimmins D, O'Brien TJ, Guerrero-LópezR, Mulley JC, Dubeau F, Licchetta L, Bisulli F, Cossette P, Thomas PQ, Gecz J,Serratosa J, Brouwer OF, Andermann F, Andermann E, van den Maagdenberg AM,Pandolfo M, Berkovic SF, Scheffer IE. Mutations in DEPDC5 cause familial focalepilepsy with variable foci. Nat Genet. 2013 May;45(5):546-51. doi:10.1038/ng.2599.
6. Ishida S, Picard F, Rudolf G, Noé E, Achaz G, Thomas P, Genton P, MundwillerE, Wolff M, Marescaux C, Miles R, Baulac M, Hirsch E, Leguern E, Baulac S.Mutations of DEPDC5 cause autosomal dominant focal epilepsies. Nat Genet. 2013May;45(5):552-5. doi: 10.1038/ng.2601.
7. Scheffer IE, Heron SE, Regan BM, Mandelstam S, Crompton DE, Hodgson BL,Licchetta L, Provini F, Bisulli F, Vadlamudi L, Gecz J, Connelly A, Tinuper P,Ricos MG, Berkovic SF, Dibbens LM. Mutations in mammalian target of rapamycinregulator DEPDC5 cause focal epilepsy with brain malformations. Ann Neurol. 2014 May;75(5):782-7. doi: 10.1002/ana.24126.
8. Sim JC, Scerri T, Fanjul-Fernández M, Riseley JR, Gillies G, Pope K, vanRoozendaal H, Heng JI, Mandelstam SA, McGillivray G, MacGregor D, Kannan L,Maixner W, Harvey AS, Amor DJ, Delatycki MB, Crino PB, Bahlo M, Lockhart PJ,Leventer RJ. Familial cortical dysplasia caused by mutation in the mammaliantarget of rapamycin regulator NPRL3. Ann Neurol. 2016 Jan;79(1):132-7. doi:10.1002/ana.24502.
9. van Kranenburg M, Hoogeveen-Westerveld M, Nellist M. Preliminary functionalassessment and classification of DEPDC5 variants associated with focal epilepsy. Hum Mutat. 2015 Feb;36(2):200-9. doi: 10.1002/humu.22723.
10. Weckhuysen S, Marsan E, Lambrecq V, Marchal C, Morin-Brureau M, An-Gourfinkel I, Baulac M, Fohlen M, Kallay Zetchi C, Seeck M, de la Grange P, Dermaut B, MeursA, Thomas P, Chassoux F, Leguern E, Picard F, Baulac S. Involvement of GATORcomplex genes in familial focal epilepsies and focal cortical dysplasia.Epilepsia. 2016 Jun;57(6):994-1003. doi: 10.1111/epi.13391.
