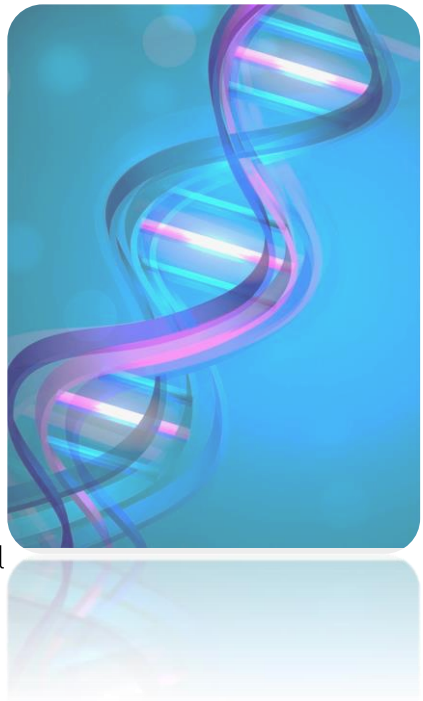
Epilepsy Action Australia

FACT SHEET:

Genetics in Epilepsy

What are genetics?



Genetics is the study of how traits such as hair and eye colour and risk for disease are passed on or "inherited" from parents to their children. Genetics influences how these traits can be different from person to person.

Your genetic information is called your genetic code or "genome" which is anything that pertains to your gene sequence (DNA) stored in almost every cell in your body.

Many human diseases have a genetic component. A genetic disorder is a disease caused in whole or in part by a change in the DNA sequence away from the normal sequence. Genetic disorders can be caused by a mutation in one gene or in multiple genes, by a combination of gene mutations and environmental factors, or by damage to chromosomes.

While the term genetic is often used interchangeably with the word hereditary, these words don't necessarily mean the same thing.

Hereditary means passed down from your mother or father. The most crucial difference between the two terms is that a hereditary disease can be passed on from one generation to another. A genetic disease, on the other hand, may or may not be hereditary, but it is always a result of a change in an organism's genome.

While many people with epilepsy have no family relatives with epilepsy, there are many types of epilepsy that do run in families.

What role do genetics play in epilepsy?

Genetics plays a notable role in epilepsy, particularly in medication resistant epilepsy. It is now known that many different types of epilepsy have a genetic basis. Future research will uncover more information, but we currently know:

- Some epilepsy syndromes are completely determined by genetics
- Genes are a major factor in other syndromes
- Not all epilepsies that are due to genetic causes are inherited
- Some inherited metabolic conditions also increase the risk of having seizures, as do some chromosomal disorders.

This means that genetic disorders can cause epilepsy as a single condition, or can result in a syndrome or disorder, where epilepsy is one of many symptoms. When epilepsy does arise from genetics, it can be:

- related to a specific gene
- a combination of genetics and environmental factors
- mutations in the DNA in mitochondria (part of the cell responsible for energy production),
- missing or mutated chromosomes or
- changes in the activity of genes.

Genetic testing

Genetic research in epilepsy has led to the start of a range of available genetic tests. Usually, genetic testing requires a blood or saliva sample to be taken and then sent to a laboratory for testing to assess the DNA of these samples. The sample is analysed for mutations or changes in a subset of genes that have a known association with different types of epilepsy.

By examining the changes in a person's genes, researchers have been able to identify altered genes that lead to some peoples' epilepsy.

Why have genetic testing?

Genetic testing may provide a more accurate diagnosis which can enable better management and prognosis. By using genetics to diagnose and treat each person individually, treatments can be tailored for different types of epilepsy. Specific precision therapies are emerging, and medications can be selected that are known to be effective for specific genetic epilepsies.

A specific genetic diagnosis avoids unnecessary testing with repeated blood tests, MRIs, invasive biopsies, pre-surgical workup, and even intracranial electrodes in the process of diagnosis. It also enables specific genetic counselling and the option for other family members to be tested.

A genetic diagnosis can be a relief for many families who have been searching for a cause of the epilepsy.

When genetic testing might be helpful

For people with epilepsy and families genetic testing:

- Allows doctors to estimate the risk to others in the family
- Is useful for reproductive planning
- Ends the search for a specific diagnosis or cause
- May reduce parental guilt or shame
- Allows for improved knowledge about their condition and sourcing support

For treating medical practitioners, genetic testing:

- Can sometimes enable changes in medical management
- Allows for prediction of epilepsy progression
- Enables genetic counselling
- Enables enrolment in clinical trials and research
- Can decrease the time and cost of diagnostic and treatment journey

- Many people expect genetic testing will provide a specific diagnosis. This is not always be the case.
- The testing might find positive results in genes that are not expected to be responsible for the person's epilepsy symptoms, as well as secondary positive findings in genes of relevance to other disorders.
- Positive test results may be distressing for other family members who are possibly carrying the same gene. However, carrying a gene variation does not necessarily mean it will lead to developing the condition or disease.
- Genetic testing may not always be affordable for everyone.

Who should have genetic testing?

It is best to do genetic testing on a person who already has a definite diagnosis of epilepsy but has a suspected genetic cause of their epilepsy.

The chance of finding a genetic cause for epilepsy is higher when there are other family members who have similar symptoms. However, people with no previous family history of epilepsy may also have a genetic form of epilepsy.

A neurologist can recommend when genetic testing would be useful, choose the appropriate testing, explain the findings and refer to genetic counselling when appropriate.

What are the costs

The cost of genetic testing procedures varies from less than $100, to over $1000, depending on several factors and health insurance rebates. It is best to speak with your neurologist about your specific situation.

Future outlook

The field of epilepsy genetics is expanding rapidly, and new genes linked with epilepsy are being identified.

Identifying genes for epilepsy provides researchers with important information towards new treatments for the condition. Including, the development of personalised and precision therapies for people with difficult and complex epilepsy. Finding medication that directly target the genetic basis of epilepsy will ultimately lead to better seizure control and improved quality of life for people with epilepsy and their families.

Genetic research may also lead to a better understanding of why people with epilepsy experience other conditions such as depression and memory or learning difficulties, at a much higher rate than the general population.

Identifying the genes that cause epilepsy is particularly important, when it is considered that a third of the 65 million people with epilepsy worldwide will not become seizure free using current treatment options.

For more detailed information on specific syndromes, please consult your doctor or a genetic counsellor.

For more information:

Introduction to Genetics

Epilepsy and Genes

Genetics and Epilepsy

National Health and Medical Research Council's advice on genetic testing

NSW Health Centre for Genetics Education also has a list of support groups for genetic conditions

Whilst care has been taken to ensure that information contained in this factsheet is reliable and accurate at time of publication, advances in research may impact on the accuracy of this information.

References:

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NIH: National Human Genome Research Institute (NHGRI) (May 2018) Accessed June 2020 https://www.genome.gov/For-Patients-and-Families/Genetic-Disorders

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