

Hypertrophic cardiomyopathy

What is hypertrophic cardiomyopathy?

Cardiomyopathy is simply a term used to describe a heart muscle disease. There are many types and causes of cardiomyopathy such as dilated, restrictive, viral, and ischaemic. This information paper deals only with *hypertrophic* cardiomyopathy.

The name means: **HYPER** – *greater than normal*, **TROPHIC** – *growth*, **CARDIO** – *heart*, **MYO** – *muscle*, **PATHY** – *disease*

It is a condition in which a part of the heart muscle (usually the main pumping chamber of the heart, called the left ventricle) is thicker than normal. The degree and distribution of thickening (called hypertrophy) varies. Hypertrophy mainly occurs in the muscle between the right and left ventricles, known as the ventricular septum. The septum is usually the thickest portion of the left ventricle in this condition, and the term asymmetric hypertrophy (ASH) is often used.

Various names have been used for this condition over the years: IHSS for **I**diopathic **H**ypertrophic **S**ubaortic **S**tenosis (rarely used now), HCM for **H**ypertrophic **C**ardio**M**yopathy or HOCM for **H**ypertrophic **O**bstuctive **C**ardio**M**yopathy. This information paper uses the abbreviation 'FHC' for **F**amilial **H**ypertrophic **C**ardiomyopathy. The features of FHC were first described in 1958. A year later, a report of three members in one family sharing the same features of heart muscle thickening suggested that it was a hereditary disease.

FHC may affect around 1 in 500 of the population. That means that approximately 36,000 Australians may have this condition.

What causes it?

In most cases, hypertrophic cardiomyopathy is a genetic condition. This means that there is a mutation (a change) in one of the genes. This gene mutation affects the heart muscle cells, which in turn affects the structure, size and function of the heart muscle. Just as there are genes responsible for determining eye and hair colour, there are some genes responsible for heart muscle development and function.

Genes come in pairs. We each have about 38,000 pairs of genes. Each parent passes on one copy of his or her genes from each pair, through the sperm or egg, to give the child a complete set. If the parent has a gene mutation that causes FHC, one of the pair of genes will carry the mutation and the other gene in the pair will be normal. There is, therefore, a 50% chance of passing down the normal, or the abnormal, gene to each child. FHC can therefore be inherited and can be passed down from generation to generation, hence the term *familial* hypertrophic cardiomyopathy.

Through genetic research over the last 10 years, at least 10 genes that contain mutations, which cause hypertrophic cardiomyopathy, have been identified. A single gene is quite a large structure in itself and may have hundreds of

different places where a mutation can occur. To date, over 150 different gene mutations have been identified and there could well be many more. The majority of these mutations seem to be unique to particular families.

How is it diagnosed?

Several steps are performed to diagnose FHC:

- a thorough medical history, symptom history and family history;
- a complete physical examination;
- an electrocardiogram (ECG, a tracing of the electrical activity of the heart);
- an echocardiogram (an ultrasound scan of the heart, like the scan that a woman has during pregnancy). The echocardiogram can reveal 'pictures' of the heart in such a way that the muscle wall thickness can be measured.

Sometimes, these clinical tests are not helpful in making a definite diagnosis of FHC. The diagnosis relies on finding evidence of left ventricular hypertrophy in the absence of other known causes such as high blood pressure, heart valve disease, advanced athletic training and some metabolic disorders.

The age at which hypertrophy develops in FHC varies considerably. A person who has inherited the genetic mutation for FHC will not usually show any signs of the condition at birth or during infancy. The teenage years seem to be the most common time for the echocardiographic signs of FHC to develop. Some adults may develop the heart muscle hypertrophy much later in life, or even not at all, despite inheriting the genetic mutation. These individuals may still be at risk of the same complications experienced by those with typical FHC. The microscopic changes of FHC may be present even though hypertrophy has not developed. Carrying the gene mutation for FHC, without obvious signs of the condition, still means that children will have the same 50% risk of inheriting FHC.

These confounding factors sometimes make it hard to diagnose FHC by clinical methods. A genetic diagnosis is the best method, but the gene mutation responsible for FHC in each family cannot always be determined. Therefore, at the present time, the clinical tests described above remain the most important method for determining who has FHC.

What symptoms or problems can FHC cause?

The symptoms that people with FHC experience vary enormously from no lifetime symptoms through to chronic disability or premature, sudden death. The risk of sudden death in FHC is very small and the majority of people with FHC have very few or no problems. This section gives an explanation of just some of the problems that can occur in FHC.

Symptoms include chest pains, unexpected shortness of breath, palpitations, unexpected lethargy, dizzy spells and blackouts. Some of these symptoms appear after meals and during or just after exercise, and can start at any age. However, these symptoms can be due to other causes and are not specific to FHC.

The hypertrophy of the heart muscle can lead to various problems such as partial obstruction to the normal blood flow as it is pumped out of the heart (hence the name **Hypertrophic *Obstructive* CardioMyopathy**). This is called 'outflow tract obstruction' and happens in about 1 in 4 patients with FHC. This may produce no symptoms, or may cause shortness of breath, chest pains, and dizzy spells on exertion or blackouts.

The hypertrophied heart muscle contains a mix of normal and abnormal muscle cells, arranged in a patchy, haphazard manner. There may also be patches of scar tissue in between the muscle cells. This may cause disturbance of normal electrical activity in the heart and may in turn cause abnormal heart rhythms called arrhythmias. There are many

different types of arrhythmia; not all of which are dangerous or require treatment. At times, palpitations relate only to an increased awareness of a normal rhythm, or acceleration of the usual rhythm. An important arrhythmia is ventricular tachycardia (VT), which is an abnormal rapid heart rhythm. Some people may have only brief bursts of VT not causing any symptoms, but sometimes VT is continuous. If the rate is very fast, this may produce chest pain, shortness of breath, dizziness or blackouts. In severe cases, VT can deteriorate into an arrhythmia called ventricular fibrillation (VF), which causes collapse and must be treated immediately.

The muscle of the normal left ventricle relaxes as it fills with blood returning to the heart from the lungs. In FHC, the heart muscle is stiff and does not relax properly. This can lead to increased pressures within the heart. Over time, the top chambers of the heart, the atria, may enlarge. This can result in an arrhythmia called atrial fibrillation (AF). This arrhythmia may go unnoticed by the patient, or it may cause palpitations, chest pain, shortness of breath, dizziness, or cause build up of blood clot in the atrium.

Increased muscle thickening in FHC can lead to a higher demand for blood supply to the heart. Sometimes the blood vessels that supply the heart with oxygen and nutrients are narrowed or not big enough to supply the extra heart muscle. This can lead to chest pains and is a possible cause of some arrhythmias.

It is important to note that many people with FHC have no symptoms at all.

What treatments are used?

There is no cure for FHC but there are many measures that can be taken to improve symptoms, and reduce the risk of some of the more serious problems associated with FHC.

There are a number of drug types that can be used in FHC. Beta blockers and calcium antagonists, used to improve problems of 'stiffness' in the left ventricle, may decrease the degree of obstruction and improve chest pains and shortness of breath. Anti-arrhythmic drugs treat or prevent heart rhythm abnormalities. Some patients may need to take drugs to prevent clots forming in the heart (anti-coagulants) and sometimes diuretics (water tablets) may be used if the heart function causes an overload of fluid in the body.

If the symptoms of outflow tract obstruction are not helped with drug therapy, some patients may benefit from a type of pacemaker called a 'dual chamber' pacemaker. Pacing may reduce the amount of obstruction and improve symptoms but it is not clearly understood how this benefit is produced. Some patients may require a surgical operation called a myectomy, which reduces the obstruction by cutting out a small segment of the hypertrophied muscle. Another treatment to reduce outflow tract obstruction involves localised injections of alcohol into parts of the heart muscle via the heart arteries. This thins the heart muscle and may relieve outflow tract obstruction.

Rarely, the hypertrophied heart muscle can thin over time and the left ventricular chamber may enlarge. The pumping action of the heart may become sufficiently impaired to result in chronic heart failure. This is usually treated by drug therapy. In severe cases of chronic heart failure, which do not respond to drug therapy, it may be necessary to consider a heart transplant. This is usually the only circumstance that such treatment is considered in FHC.

Some atrial arrhythmias may not respond to drugs and may be treated with a small electrical shock called an electrical cardioversion. This is done under a short-acting general anaesthetic and can help to restore the normal rhythm. For the more serious ventricular arrhythmias, an implantable defibrillator may be considered. This device is reserved for cases where drug therapy is not effective in preventing recurrent, serious arrhythmias such as VT, or if a patient suffers a cardiac arrest and is successfully revived. The implantable defibrillator is about the size of a pacemaker and is programmed to

deliver a small shock *inside* the heart, to restore the normal heart rhythm. Occasionally a defibrillator may be inserted in people considered very high risk for sudden death.

Many patients require no, or minimal, treatment but should visit their cardiologist for regular examination including an echocardiogram. Early changes may be noted at these visits and action taken to prevent further change.

What about my lifestyle?

People with FHC are advised to make some lifestyle changes, which may reduce the risk of serious symptoms:

- Avoid intense, strenuous exercise because, for some people, this may lead to blackouts and, in rare cases, sudden death. This includes competitive sports such as squash and football, endurance sports such as marathon running and isometric exercise such as weight lifting. Not everyone will have problems but you should be aware of the potential risks and discuss this in more detail with your cardiologist. Regular, gentle exercise is encouraged provided there is no other medical contraindication.
- Avoid taking very hot baths or showers, standing for long periods in hot weather, and becoming dehydrated from vomiting or diarrhoea. These situations can lead to a drop in blood pressure, which leads to severe light-headedness or blackouts in some people.
- Tell your doctor or dentist that you have FHC, especially when undergoing any surgical or dental procedures. You may also be given antibiotics to prevent generalised infections that may be associated with such procedures.
- Eat a balanced, nutritious diet and keep within a normal weight range for your height.
- Do not smoke.

What other tests may be performed?

Further tests can be done to determine the cause of symptoms, or to assess whether an individual is at greater risk of blackouts or serious heart rhythm abnormalities. Currently, there is no precise single method of detecting which patients will experience severe problems. However, information from *all* the tests and examinations described in this information paper may help to classify those at higher or lower risk. The further tests are:

- Holter monitoring is a continuous period of ECG recording over 24 to 72 hours. The heart rhythm and rate are measured during normal daily activities and abnormalities, not seen on the standard ECG, may be detected. These abnormalities may cause the palpitations, dizziness or blackouts that some patients have. Event monitoring may be used to record the ECG over a longer period of time, up to weeks, to record the heart rhythm during an intermittent symptom.
- Exercise testing (monitoring the heart while walking on a treadmill or, in some cases, pedalling a bicycle) helps detect heart rhythm problems that may occur during exercise. The test may also pick up abnormal blood pressure responses to exercise that some patients experience, which may be a cause of dizzy spells and blackouts. It is also used to assess the effectiveness of drug therapy in relieving symptoms.
- An ultrasound test of the heart takes 'echocardiographic' measurements to assess the degree of outflow tract obstruction and the pumping function of the left ventricle. In some patients, obstruction may increase during exercise or after patients are given a drug.

- Cardiac catheterisation and coronary angiography check for narrowing of the blood vessels (the coronary arteries) that supply the heart muscle with blood. This may help ascertain the cause of chest pain (known as angina) which can also be due to a condition other than FHC called coronary artery disease. A dye is injected into the coronary arteries through a fine tube that is inserted from the groin. This allows the arteries and heart chambers to be seen on special Xray equipment. Dye is also injected into the left ventricle to test pump function and pressures inside the heart.
- A 'pacing study' assesses the value of inserting a dual chamber pacemaker to relieve the symptoms of outflow tract obstruction. A temporary pacemaker wire is inserted into the heart using similar procedures and equipment to cardiac catheterisation. The heart is artificially paced at different intervals and measurements are made to assess the degree of obstruction that remains.
- Other tests that are less often performed include electrophysiology studies that check the heart's electrical activity in greater detail, and radionuclide studies, which test the pumping action of the heart and the distribution of blood flow to the heart muscle.

What about my family?

FHC is inherited in a manner called autosomal dominant inheritance. This means that each child of a parent with FHC has a 50% chance of inheriting the gene mutation that causes the condition. If the gene is inherited, the child may manifest FHC at any age, and with any or none of the listed symptoms and problems.

Inheriting the same gene mutation for FHC does not always mean having exactly the same problems as the parent or anyone else in the family that has FHC. This may be due to the influence of any of the other 35,000 or so genes that we inherit from both parents, or it may be due to different environmental factors that are not shared with the parent.

It is advised that all first-degree relatives (parents, brothers, sisters and children) of the person with FHC should be tested to see if they also have inherited this condition. Even family members, who do not have any symptoms, but have a family history of FHC, should be tested. It is quite possible to have FHC and yet lead an active, physically demanding life, with no symptoms and never a day's illness. It is a condition that does not always cause problems. However, because there may be no warning when problems do arise with FHC, it may be beneficial to be forewarned of the diagnosis by having the clinical screening tests mentioned earlier. FHC cannot be cured but measures can be taken to avoid serious problems. Some relatives choose not to be tested for a variety of reasons. This decision is always respected. Before deciding on screening for FHC, it is important to talk to an experienced health professional, with knowledge of FHC, about the implications of a negative or positive result so that the decision to be tested or not is a well-informed one.

Clinical screening for FHC can start from as early as birth but it is unusual to be able to detect the echocardiographic signs of FHC at such a young age. We cannot predict the age at which the echocardiographic features may develop. Therefore, it is advisable to repeat the screening at regular intervals up to the age of approximately 30 years (every three to five years in the first decade and then every two to three years in the second and third decades). If there are still no signs at all of FHC by the age of 30 years, it is considered less likely that FHC has been inherited, but screening at five-yearly intervals up to the age of about 60 years is currently advised.

Genetic testing from a simple blood sample will become the gold standard for FHC. However, genetic testing is still in the research stages. Funding for such research is limited, and turning research knowledge into routine testing for FHC families will also require large amounts of funding and expertise.

What kind of research is being conducted?

Research work is being conducted by many groups around the world, including Australia and New Zealand, to answer questions such as:

- Why does FHC affect people differently, even in the same family?
- How can we accurately predict who is at risk of serious problems and sudden death, and who can expect to lead a normal, long life with FHC?
- Which treatments are more effective at preventing symptoms?
- How many people have FHC in Australia and in the world?
- How many gene mutations are involved and how do they cause the different patterns of FHC?
- What other genes and environmental factors influence the picture of FHC?
- Can gene therapy be used in the treatment of FHC?

These questions can only be answered with the much-appreciated participation of families with FHC and by lengthy and expensive studies. Our knowledge of FHC is improving all the time. This is a good reason for keeping in touch with your cardiologist so that you and your family may benefit from the improved treatments and information that result from medical and genetic research.

What else should I be aware of?

Medical and Life Insurance – Insurance companies request that you tell them of any medical conditions that you have, and some will ask if there is a family history of any heart disease. Some companies will provide insurance for people with FHC, but will load the premium. Some companies may refuse to offer cover. It is worth shopping around if you need to take out any form of insurance. The insurance industry has voluntarily agreed *not* to demand any form of genetic testing prior to offering insurance cover. However, if you have had results from genetic testing for FHC *before* insurance cover is taken out, you may be asked to disclose these on the proposal form, just as you would any medical information.

Employment – Some types of employment may not be possible if you have FHC. These include jobs such as commercial airline pilot and some occupations in the defence forces and similar services. Some occupations may also be too strenuous or risky for some people with FHC. These issues require discussion with your doctor, who can offer more specific advice. Some employers may ask you to undergo a medical examination and to disclose your medical history before being accepted for employment.

Resuscitation training – *Everyone* should learn the skills of cardiopulmonary resuscitation (CPR). These skills are more likely to be required away from a hospital rather than inside. Anyone with a heart condition is at a higher risk of suffering a cardiac arrest than someone with a normal heart.

Antibiotic cover – Patients with FHC should take prophylactic antibiotic cover before undergoing surgical and dental procedures. This helps prevent bacteria from entering the bloodstream and causing an infection within the heart called endocarditis. Check with your doctor if this applies to you.

Pregnancy – Many women with FHC have no problems during pregnancy and labour, but every case is different and should be assessed individually. Epidural anaesthetics can sometimes cause a sudden drop in blood pressure and it may be necessary to consider alternatives. Some of the drug treatments for FHC may cause problems to the foetus and you should discuss this *before* becoming pregnant.

Medicalert – In the event of a collapse, away from home and on your own, it may be helpful to provide information about your condition, your treatment and the name of your doctor. In case you are not able to provide all this information, the well-recognised 'Medicalert' bracelet or pendant carries a contact number through which all the necessary information can be obtained.

Where can I get more information?

This information sheet only gives a very general outline of FHC. The condition affects people in so many different ways and families have many different experiences. You are strongly advised to see a cardiologist for specific advice, treatment and diagnosis. You may wish to discuss the genetic aspects of FHC (i.e. genetic testing, risk of inheritance to family members and family planning options) with a clinical geneticist or genetic counsellor as well. These health professionals are trained in genetics and can be contacted through the various Clinical Genetics departments that are usually located in major adult or children's hospitals.

A voluntary organisation exists in Australia, which aims to offer support to people with all forms of cardiomyopathy and their families, and can be contacted through:

The Secretary
Cardiomyopathy Association of Australia Inc.
PO Box 48
KEW VIC 3101
Ph/fax: 03 94391133

Feedback/Further Information

If you would like to provide feedback or comment on this document please contact the Heartline, the Heart Foundation's national telephone information service. For the cost of a local call, Heartline can also provide you with information on a variety of heart health topics.

Heartline **1300 36 27 87**

Heartline
National Heart Foundation of Australia
P.O. Box 7174 Hutt Street
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The information provided on this information sheet is for educational purposes only. The information should not be used for diagnosing or treating a health problem or a disease, and should not be substituted for professional care. Please consult your health care provider if you have, or suspect you have, a health problem.

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