MAYO CLINIC

PATIENT EDUCATION

Assessing Your Risk for Hereditary Breast and Ovarian Cancers

BARBARA WOODWARD LIPS
PATIENT EDUCATION CENTER

A Change in a Gene

Hereditary cancers are caused by gene mutations that are passed down through a family. A mutation is an alteration, or change, in a gene that causes the gene not to work correctly.

A genetic test can show whether you carry a gene mutation that puts you at a higher risk for certain cancers including breast cancer or ovarian cancer.

Read this information to learn more about hereditary breast and ovarian cancers. It explains things to think about before having genetic testing and what test results may mean for you and your family. Use this information to help you decide whether you may benefit from a genetic test.

If you have questions about this information, talk with your health care provider.

Causes of Breast or Ovarian Cancer

Researchers do not know exactly what causes most cases of breast or ovarian cancer. It happens when cells collect genetic changes and begin to divide and grow faster than healthy cells do. The cells then build up and form a tumor.

In the general population, around 12 out of 100 women (12 percent) get breast cancer and about 1 to 2 out of 100 women (1 to 2 percent) get ovarian cancer. These cancers usually develop after age 50. Although it is rare, men can get breast cancer too.

Most breast and ovarian cancers are sporadic. This means they happen by chance. Sporadic cancers are due mostly to aging, the environment and lifestyle choices. See Figures 1 and 2.

Of those who get breast cancer, only about 5 to 10 percent are hereditary, or inherited. Of those who get ovarian cancer, only about 15 to 20 percent are hereditary, or inherited. Gene mutations that are passed from parents to children can cause hereditary cancers. If you have a gene mutation, your risk for certain cancers may be higher. However, having a mutation does not guarantee that you will get cancer.

Even when several family members have the same kind of cancer, a mutation is not always the cause. More often, the cancer is familial. Familial means something that happens more often in a family than would be due to chance alone. However, it is not caused by a mutation in a single gene.

Genetic factors may play a role in familial cancers. However, families share many things besides their genes, including environmental factors. For example, family members may eat the same kinds of foods. They may live in the same kind of environment. They may have similar jobs. These things, in combination with multiple genetic factors rather than a single gene mutation, might cause cancer in a family.

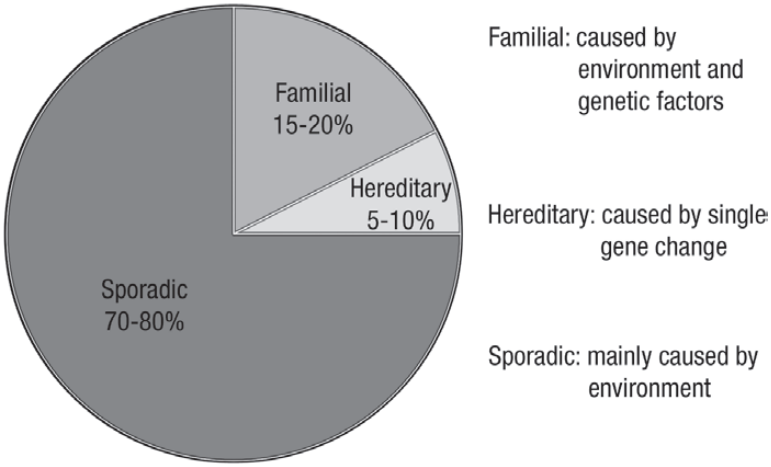

Figure 1. Causes of breast cancer

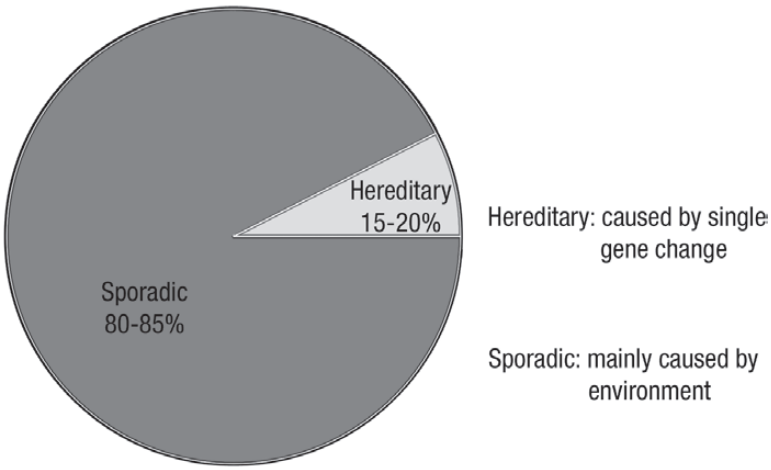

Figure 2. Causes of ovarian cancer

Hereditary Breast and Ovarian Cancers

What are genes?

Some background information about genes can help explain how you may inherit a higher risk for breast or ovarian cancers.

You have 46 chromosomes in all of your cells. Each chromosome is made of a long chain of a chemical called deoxyribonucleic acid, or DNA. A gene is a section of one of these DNA chains. See Figure 3.

Genes are like an instruction book that tells your cells how to work. For example, genes control your eye color and blood type. Mistakes or alterations in genes are called mutations. They are like words in a sentence that are spelled wrong or are in the wrong order. The sentence cannot be read correctly. In the same way, mutations can keep cells from doing their work correctly. This can lead to genetic diseases or other problems.

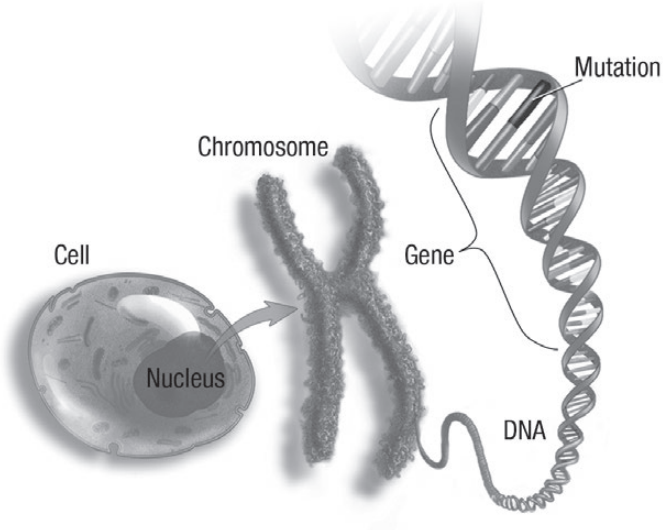

Figure 3. Each cell has chromosomes in its nucleus. Chromosomes are long chains of DNA that contain genes.

What causes hereditary breast and ovarian cancers?

Most hereditary breast and ovarian cancers come from mutations in either breast cancer gene 1 (BRCA1) or breast cancer gene 2 (BRCA2). When these genes have no mutation and work normally, they stop tumor growth. But mutations in either one of these genes increase the risk of breast and ovarian cancers. BRCA gene mutations also are linked to cancers of the pancreas, prostate, fallopian tubes and peritoneum. The peritoneum is the tissue that lines the inside of the abdomen.

There are other genes that may cause hereditary breast or ovarian cancers. Mutations in some of the genes cause rare hereditary cancer syndromes with a high risk to develop cancer. Other genes may slightly or moderately increase the risk of developing certain types of cancer. Having a gene mutation increases a person's risk for cancer, however, not everyone who has a gene mutation develops cancer.

How are gene mutations inherited?

Inherited mutations can pass from a parent to a child. They are present at birth in every cell of the child's body.

You can inherit a gene mutation from either your mother or your father. Gene mutations cannot skip generations. If your parent has a gene mutation that you do not inherit, you cannot pass the mutation on to your children.

Inherited breast and ovarian cancers are **autosomal dominant** genetic conditions. This means that every child of a parent who has a genetic mutation has a one in two chance, or a 50-50 chance, to inherit the same mutation. See Figure 4.

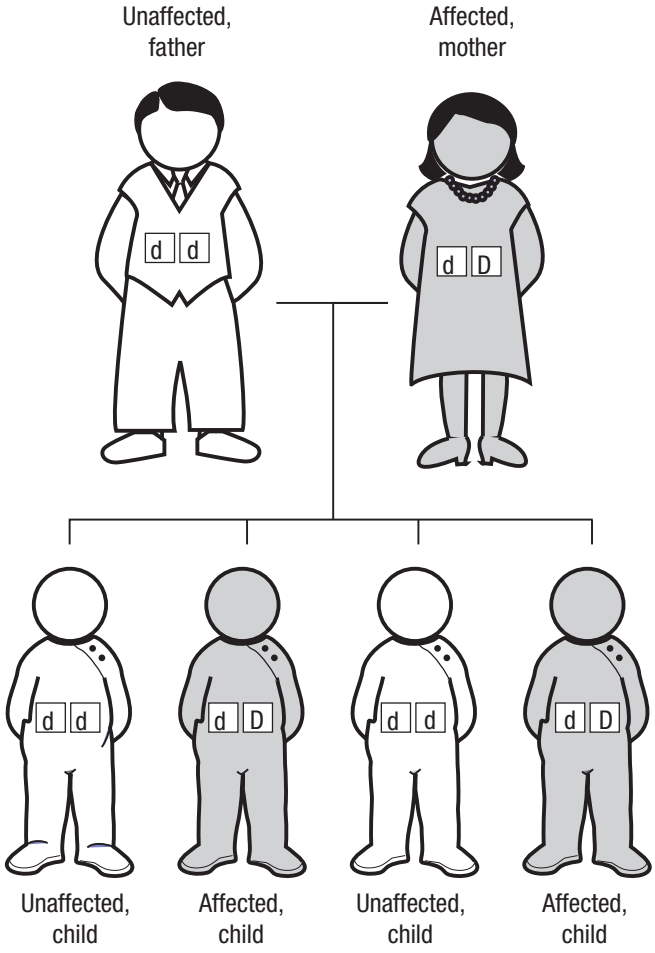

Figure 4. Autosomal dominant inheritance of gene mutations

Risk Factors for Hereditary Breast and Ovarian Cancers

Your health

The chance that you may have a gene mutation is higher if you have a history of:

- Certain cancers before age 50.
- More than one type of cancer. For example, both breast and ovarian cancer.
- Ovarian, fallopian tube or primary peritoneal cancer.

Your family's health

The chance that you may have a gene mutation is higher if you have:

- Two or more close relatives with breast or ovarian cancer at a young age. **Close relatives include your parents, siblings and children.**
- A close male relative with breast cancer.
- A close relative with cancer in both breasts.
- A close relative with multiple types of cancer such as both breast and ovarian cancers.
- A relative with a known BRCA1, BRCA2, or other cancer gene mutation.
- Ashkenazi Jewish ancestry.

Genetic Testing for Hereditary Breast and Ovarian Cancers

If you have any risk factors for hereditary breast and ovarian cancers, a genetic test may help you learn more about your cancer risk. The test may show whether mutations in a gene associated with breast or ovarian cancers are being passed through your family.

Think about whether you want to ask your health care provider to refer you to a genetic specialist such as a genetic counselor or a geneticist. These are people who have special training and experience in genetics.

A genetic specialist will review your personal and family health history. He or she also will talk with you about the benefits, risks and limitations of genetic testing.

After you have a genetic test, the genetic specialist will explain your test results with you. He or she may give you information about your risk for breast, ovarian and other cancers.

Getting ready for your appointment

Before you first meet with the genetic specialist:

- Write down your personal health history. Include the results of any past genetic tests you have had.
- Gather records from specialists you have seen for cancer treatment, screening or prevention.
- Learn about your family's health history.
  - If any family members have had cancer, find out specifically what kind, the person's age when the cancer was found, and how the cancer was treated.
  - Ask about the results of genetic tests that anyone in your family has had. Bring a copy of your results with you to your appointment.
  - Find out whether any family members had surgery to help prevent cancer. Examples are surgery to take out ovaries and fallopian tubes, called a risk-reducing or prophylactic bilateral salpingo-oophorectomy, or to remove healthy breasts, called a prophylactic mastectomy.

Bring a list of questions you have to your appointment. You may want to ask a friend or family member to come with you to help ask questions or take notes.

Meeting with a genetic specialist does not mean you will have a genetic test. Genetic testing is not useful for everyone. Usually you have a test only when your personal or family history shows you are likely to have an inherited mutation, for example if you have a personal history of breast or ovarian cancer.

The testing process

Based on your personal and family health history, a genetic specialist may recommend genetic testing.

A genetic test is usually a blood test. A member of your health care team takes a sample of your blood, usually from a vein in your arm. The sample is sent to a lab to check for mutations within a gene or number of genes linked to hereditary breast or ovarian cancers. Gene panel testing looks for mutations in multiple genes at the same time.

Test results

Your genetic specialist receives the test results after several weeks. Then your genetic specialist explains your test results and what they mean for you and your family. He or she also explains your medical management options. Talk about your test results with your health care provider.

The following is general information about the different possible test results.

Positive test result

A positive test result means that a mutation was found in one of your genes. This puts you at a higher risk to develop certain cancers. However, the exact cancer risks for some of the genes linked to hereditary cancer are not known at this time.

A positive result **does not** mean that you will get cancer. Your health care provider can talk with you about options for managing your cancer risks. See "Follow-up care" for more information.

A positive test result also means that you could pass the mutation to your children. Your siblings and parents also may carry the mutation. If your test result is positive, your siblings and parents may want to think about genetic testing.

Negative test result

A negative test result means that the test did not find a gene mutation. The effect of this on your cancer risk is not always clear.

If you were tested for a specific gene mutation found in one of your relatives and your test result is negative, you most likely do not have an increased risk for inherited cancer.

However, a negative test result **does not** mean that you will not get cancer. Your genetic specialist looks at the test result in light of your family history. You may still be at increased risk of cancer if you have close family members with cancer.

Genetic testing can find most mutations in hereditary cancer genes. However, you could have a gene mutation that the test was not able to find. In addition, there still are genes not yet identified that may put a person at increased risk to develop cancer.

Uncertain test result (variant of uncertain significance)

In some cases, a genetic test may not give helpful information about your genes. Everyone has variations in their genes. Often, these variations do not affect your health. But sometimes it can be hard to tell the difference between a harmless gene variation and a gene mutation that can cause cancer.

An uncertain test result generally is not used to make medical decisions. Family members are not recommended to be tested for an uncertain result.

If you have an uncertain test result, follow-up tests may be needed. Stay in contact with your genetic specialist over time to see if the uncertain test result is resolved.

Follow-up care

If you have a positive test result, you may choose to take steps to lower your cancer risk. What you choose to do may depend on your age and health history. It also may depend on treatments or surgeries you have had. Your personal preferences also will affect your choices.

Talk with your health care providers about your choices for follow-up care. Your providers may suggest that you have screening exams more often. Certain medicines may help decrease your risk for breast and ovarian cancers. To help prevent cancer, some women have surgery to remove healthy breasts or to remove their ovaries and fallopian tubes. Ask your health care provider to help you plan what is right for you.

Deciding Whether to Have a Genetic Test

Genetic testing is a personal choice. There are many factors that affect your decision about whether to have a genetic test. Take time to think about what is important to you.

If you wish, talk with your family and close friends about your concerns. Your health care provider and genetic specialist can give you more information to help you decide whether genetic testing is right for you.

Benefits of genetic tests

A genetic test may:

- Help show whether you are at higher risk for breast, ovarian or other cancers.
- Help you make medical and lifestyle choices.
- Explain the reason for cancer in you or your family.
- Let other family members learn about their risks so they can decide whether to have testing too.
- Make it possible for you to take part in genetic research studies.

Limitations of genetic tests

Talk with your health care provider or genetic specialist about what genetic testing can and cannot do. Genetic test results may not give you a clear answer about your cancer risk. The tests may help to find people or families with a high risk of cancer. But the tests cannot tell for sure who will or will not get cancer. Also, the exact cancer risks for some of the genes linked to hereditary cancer are not known at this time.

Reactions to your test results

If your test result is positive

Knowing your risk for cancer may make you feel in control and able to take charge of your health. Being able to inform and educate your family members about their possible cancer risks may give you a positive feeling.

However, knowing that you carry a gene mutation can be hard. You may feel anxious, sad, afraid or angry. You may think that you surely will get cancer. You may feel guilty about the chance that you may pass a gene mutation on to your children.

You may need to make some hard choices about the best cancer prevention or early detection method for you. Talking about your choices with a genetic specialist, breast or gynecologic specialist or cancer specialist can help guide you.

If your test result is negative

You may have a sense of relief to know that you do not have a gene mutation. If you do not have an increased cancer risk, you may not need to have screenings more often or make decisions about measures to prevent cancer.

However, do not let this relief lull you into a false sense of security. Even if your test result is negative, you can still get breast or ovarian cancer. Women with other risk factors such as a family history of breast and ovarian cancers or certain lifestyle choices may have an increased risk of cancer. Talk with your health care provider or genetic specialist about your risk.

You may feel "survivor guilt" if other family members do carry a mutation and face a greater risk of cancer. In addition, because test results do not always give a clear answer, your health care provider may not be able to give you a definite answer about the meaning of your results. This can leave you feeling unsure about your cancer risk. Also, a negative test result may not help explain why you or your family member gets cancer.

Other things to think about

Ask your health care provider or genetic specialist to help you think about:

- **Financial issues.** Genetic tests and related appointments can be costly. Contact your insurance company to see what costs they will pay. Some policies cover some or all costs of genetic testing. Other policies do not cover any of the costs.
- **Talking with your family.** Each person's situation is different. Some of your relatives may not want to share their medical information with you. Some may not want to know if a gene mutation is found within the family.

  It is strongly recommended that you share test results with your family members. Think about how you will share your results. Your health care provider or genetic specialist can help you find ways to share or ask for medical information within your family. For example, he or she may write a letter about your test results that you can give to family members.
- **Concerns over health insurance discrimination.** There are federal and state laws to help keep your genetic information private. The federal Genetic Information Nondiscrimination Act, or GINA, helps protect most people against discrimination in health insurance and employment. Laws to help protect you from discrimination in life insurance, long term care insurance and disability insurance vary from state to state.

Notes

BARBARA WOODWARD LIPS PATIENT EDUCATION CENTER

Mrs. Lips, a resident of San Antonio, Texas, was a loyal Mayo Clinic patient of more than 40 years and a self-made business leader who significantly expanded her family's activities in oil, gas and ranching. Upon her death in 1995, Mrs. Lips paid the ultimate compliment by leaving her entire estate to Mayo Clinic. By naming the Barbara Woodward Lips Patient Education Center, Mayo honors her generosity, her love of learning, her belief in patient empowerment and her dedication to high-quality care.

MAYO CLINIC | 200 First Street SW | Rochester, MN 55905 | mayoclinic.org

MC7073rev0817