



# Cancer Predisposition Clinic

## Nevoid basal cell carcinoma syndrome

*Also called: basal cell nevus syndrome (BCNS), Gorlin syndrome, Gorlin-Goltz syndrome, NBCCS*

### What is nevoid basal cell carcinoma syndrome?

Nevoid basal cell carcinoma syndrome is a condition that affects many areas of the body. People with this syndrome have a higher risk of developing certain kinds of tumors. These tumors can be either cancerous (malignant) or non-cancerous (benign). Tumors may develop in these areas:

- Skin
- Jaw
- Heart
- Ovaries
- Brain

People with nevoid basal cell carcinoma syndrome may also have some or all of the following:

- Small pits in the palms of the hands or soles of the feet
- Large head size (macrocephaly), sometimes caused by too much fluid in the brain (hydrocephalus)
- Distinct facial features, such as wide-set eyes, a jaw that juts out and a prominent forehead
- Tiny white cysts (bumps), called milia, around the cheeks, eyes and lips
- Defects in the ribs and spine
- Extra fingers and toes
- Eye conditions, such as cataracts, “lazy” eye, a very small eyeball or missing structures in the eye
- Cleft lip
- Cleft palate

Most people with nevoid basal cell carcinoma syndrome have only some of these features. It is important for patients with nevoid basal cell carcinoma syndrome to be evaluated by their pediatrician or family physician for the above non-tumor findings and to be referred for additional imaging studies (MRI, x-rays, or ultrasounds) or evaluation by other specialists as needed.

### What is the tumor risk for children with nevoid basal cell carcinoma syndrome?

People with nevoid basal cell carcinoma syndrome are at higher risk for the following cancerous tumors:

- Medulloblastoma, a brain tumor that occurs in children
- Basal cell carcinoma, the most common form of skin cancer

People with nevoid basal cell carcinoma syndrome are at higher risk for the following non-cancerous tumors:

- Painless cysts in the jaw, called jaw keratocysts
- Tumors in the connective tissue of the ovaries and heart, called fibromas

Although people with nevoid basal cell carcinoma syndrome are at higher risk for tumors, some people never develop them. Others might develop many tumors. About 5% of children with nevoid basal cell carcinoma syndrome develop medulloblastoma. This happens most often around 2 years of age. Basal cell carcinomas appear in about 90% of people with the syndrome, usually starting in the teenage years. Jaw cysts occur in about 90% of people with this condition. Most appear in the teenage years, but some can occur in younger children. Fibromas of the heart occur in about 2% of people with nevoid basal cell carcinoma syndrome and are often present at birth. Fibromas of the ovary occur in about 20% of females with the condition.

### **What causes nevoid basal cell carcinoma syndrome?**

Nevoid basal cell carcinoma syndrome is caused by changes in one of three genes known as *PTCH1*, *PTCH2*, or *SUFU*. Genes carry information telling cells within the body how to function. The *PTCH1*, *PTCH2*, and *SUFU* genes help to control how cells grow and divide. They also help ensure that a pregnancy develops normally, especially the growth of the jaw, skin and brain.

Most people without nevoid basal cell carcinoma syndrome carry two working copies of the *PTCH1*, *PTCH2*, and *SUFU* genes in their cells. One copy of each of these genes is inherited from the mother and one from the father. Cells from people with nevoid basal cell carcinoma syndrome carry one working copy of *PTCH1*, *PTCH2*, or *SUFU* and one copy that is changed. This change causes the gene to not work properly. It is called a mutation.

Most children with nevoid basal cell carcinoma syndrome inherit their mutation from a parent who also has the syndrome. About 20% to 30% of children have a new mutation that did not come from a parent. These children have no history of the syndrome in their family. In these cases, the change either happened in an egg or sperm cell when the child was formed or in one of the child's cells during pregnancy. These children are the first in their families to have nevoid basal cell carcinoma syndrome. No matter how they acquired the *PTCH1*, *PTCH2*, or *SUFU* mutation, people with nevoid basal cell carcinoma syndrome have a 50% or 1 in 2 chance of passing it on to their children.

Most people born with one *PTCH1*, *PTCH2*, or *SUFU* mutation will have some signs and symptoms of the condition in childhood. These can include a large head, distinct facial features or defects in the ribs and spine. During a person's life, the second copy of the *PTCH1*, *PTCH2*, or *SUFU* gene might also become changed in one or more cells of the body, such as the skin or brain. When this happens, those cells can develop into a tumor. This is why people with nevoid basal cell carcinoma syndrome have a greater risk of developing tumors such as basal cell carcinomas or medulloblastoma.

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## How are children with nevoid basal cell carcinoma syndrome screened for tumors?

People with nevoid basal cell carcinoma syndrome should be managed by a health care provider who knows this condition well. We recommend screening for anyone with nevoid basal cell carcinoma syndrome, even though not everyone with the syndrome will develop tumors. The goal of screening is finding and treating tumors early to allow the best outcome for patients. It can also prevent the growth of disfiguring tumors that could alter a person's appearance.

Tumor screenings recommended:

- **An echocardiogram** at the time of diagnosis to check for fibromas in the heart. An echocardiogram uses sound waves to make images of the heart.
- **Magnetic resonance imaging (MRI) of the brain** to look for brain tumors in patients with a *SUFU* mutation. This should be done every 4 months until the person turns 3 years old and then every 6 months until the person turns 5 years old. If there are any symptoms, the imaging may be repeated more often.
- **Digital panoramic X-rays** of the jaw to look for cysts in patients with a *PTCH1* or *PTCH2* mutation. These should begin at 8 years of age and be repeated every 12-18 months. Digital panoramic x-rays may be considered in patients with *SUFU* mutations, although jaw keratocysts have not been described with *SUFU* mutations.
- **Yearly skin exams** beginning at age 10 years to look for basal cell carcinoma. Skin exams may begin before age 10 years if abnormal skin findings are noticed.

In females, an **ultrasound of the ovaries** should be done beginning at age 18 years and repeated at the time of pregnancy or if symptoms are present.

These recommendations are the most current. It is possible that what is recommended may change over time as health care providers learn more about nevoid basal cell carcinoma syndrome. Because this syndrome is rare and complex, it is important that parents seek out and discuss all screening options for their child with a health care provider who works regularly with this syndrome.

## How is genetic testing for nevoid basal cell carcinoma done?

The health care provider may suspect nevoid basal cell carcinoma syndrome after looking at a person's medical or family history. In most cases, a health care provider or genetic counselor will ask questions about the person's health and the health of other family members.

The genetic counselor or health care provider will record which family members have developed tumors, what types of tumors and at what ages these tumors occurred. From this information they

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will create a family tree. Health care providers and genetic counselors will look at the family tree to find out:

- If there are more cancers than normal,
- If cancers occurred at younger-than-expected ages and
- If the types of tumors match up with what might be seen in those with nevoid basal cell carcinoma syndrome.

If nevoid basal cell carcinoma syndrome is suspected in a child or other family members, the health care provider or genetic counselor will likely recommend genetic testing of the *PTCH1*, *PTCH2* and *SUFU* genes.

### **Diagnostic genetic testing**

If the health care provider or genetic counselor suspects that a person has nevoid basal cell carcinoma syndrome, diagnostic testing may take place as follows:

- A blood sample is collected.
- DNA is isolated from the cells in the sample. A person's genes are made of DNA.
- Both copies of the person's *PTCH1*, *PTCH2* and *SUFU* genes are checked for possible changes. A genetic specialist compares the two copies of the person's genes to normal *PTCH1*, *PTCH2* and *SUFU* genes. If there are differences, the specialist decides if they might cause a certain condition such as nevoid basal cell carcinoma syndrome.
- If a *PTCH1*, *PTCH2* or *SUFU* mutation is found, the genetic counselor will work with the family in the following ways:
  - To help the family understand the cancer and tumor risks of nevoid basal cell carcinoma syndrome
  - To find out if other family members should consider testing
  - To help with decisions about prenatal genetic testing

### **Prenatal genetic testing**

Parents may undergo prenatal testing to find out if the pregnancy is affected with a known *PTCH1*, *PTCH2* or *SUFU* mutation in the family. Testing may take place either before pregnancy occurs or during pregnancy (after the embryo is formed).

Those considering prenatal testing should work with a genetic counselor to review the pros and cons of the tests. The genetic counselor can also help parents consider how they wish to handle the results of the testing.

**Testing that occurs before pregnancy**—Testing that happens before pregnancy is called preimplantation genetic testing (PGT). This special type of genetic testing is done along with in vitro fertilization (IVF). PGT offers a way to test embryos for a known *PTCH1*, *PTCH2* or *SUFU* mutation before placing them into the uterus.

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**Testing that occurs during pregnancy**—Testing can be used to see if a pregnancy is affected with a known *PTCH1*, *PTCH2*, or *SUFU* mutation. A doctor gathers cells from the pregnancy in one of two ways:

- **Chorionic villus sampling (CVS)**—during the first trimester (first three months)
- **Amniocentesis**—during the second trimester or later (last 6 months)

Collected tissue can be checked for the presence of the *PTCH1*, *PTCH2* or *SUFU* mutation identified in the family.

Both of these tests carry minor risks and should be discussed with an experienced doctor or genetic counselor.

### **Special concerns**

Genetic testing for nevoid basal cell carcinoma syndrome is a complex process. Those thinking about testing should take time to consider the benefits and risks. They should discuss the process with a genetic counselor before testing is done. If they choose testing, they should review the test results with the health care provider or genetic counselor to be sure they understand the meaning of the results.

Sometimes children or adults with nevoid basal cell carcinoma syndrome can feel sad, anxious or angry. Parents who pass on a *PTCH1*, *PTCH2* or *SUFU* mutation to one or more of their children can feel guilty. Some people with a *PTCH1*, *PTCH2* or *SUFU* mutations could have trouble getting disability coverage, life insurance or long-term care insurance in some states. More information about genetic discrimination can be found at [www.ginahelp.org](http://www.ginahelp.org).

### **Are there other special health care needs for children with nevoid basal cell carcinoma syndrome?**

People of any age with nevoid basal cell carcinoma syndrome have a higher risk of cancer. They should monitor their health and adopt healthy habits throughout life. It is important to continue to have regular physical checkups and screenings. That way, any cancer can be found early at the most treatable stage.

It is *critical* that people with nevoid basal cell carcinoma syndrome avoid exposure to radiation. When X-rays are needed, people should find a center that can do digital X-rays.

People with nevoid basal cell carcinoma syndrome should be careful about sun exposure:

- Avoid sun exposure during the hours of 10 a.m. and 4 p.m.
- Wear protective clothing and a hat

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- Use sunscreen with an SPF of at least 30 when going outside

Other ideas for reducing the risk of cancer include the following:

- Eat a healthy diet with lots of fruits and vegetables
- Get regular exercise
- Avoid smoking or using tobacco products
- Avoid secondhand smoke

People with nevoid basal cell carcinoma syndrome should watch closely for general signs or symptoms that could signal tumors:

- Unexplained weight loss
- Loss of appetite
- Aches, pains, lumps or swelling that cannot be explained
- Headaches or changes in vision or nerve function that do not go away
- New moles or changes in moles that are already present

It is important to seek medical help if anything unusual appears.

### **What other information and resources are there for children with nevoid basal cell carcinoma syndrome and their families?**

Resources about nevoid basal cell carcinoma syndrome:

- Basal Cell Carcinoma Nevus Syndrome Life Support Network ([www.gorlinsyndrome.org](http://www.gorlinsyndrome.org))
- Genetics Home Reference: Gorlin syndrome ([ghr.nlm.nih.gov/condition/gorlin-syndrome](http://ghr.nlm.nih.gov/condition/gorlin-syndrome))
- Skin Cancer Foundation ([www.skincancer.org/](http://www.skincancer.org/))
- Making Sense of Your Genes: A Guide to Genetic Counseling ([www.ncbi.nlm.nih.gov/books/NBK115508/](http://www.ncbi.nlm.nih.gov/books/NBK115508/))
- Young People with Cancer: A Parent's Guide ([www.cancer.gov/publications/patient-education/young-people](http://www.cancer.gov/publications/patient-education/young-people))

#### **Sources:**

1. Genetics Home Reference - Gorlin Syndrome  
[ghr.nlm.nih.gov/condition/gorlin-syndrome](http://ghr.nlm.nih.gov/condition/gorlin-syndrome)
2. Gene Reviews - Nevoid Basal Cell Carcinoma Syndrome  
[www.ncbi.nlm.nih.gov/books/NBK1151/](http://www.ncbi.nlm.nih.gov/books/NBK1151/)

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