The Leo Fung Center for CAH and Disorders of Sex Development

Living with Congenital Adrenal Hyperplasia (CAH)

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UNIVERSITY OF MINNESOTA
CHILDREN'S HOSPITAL
FAIRVIEW

Contents

Introduction

This handbook will provide you information about congenital adrenal hyperplasia. While this guide will not answer all of your questions, it offers basic medical facts that will help you to talk to your doctors. This handbook is the second part of a series of handbooks on CAH. (The first part is called *CAH in the Newborn.*)

It is important to know that CAH cannot be cured, but it can be treated. You will need to take medicine for the rest of your life. If you take this medicine, you should have a completely normal life in every way.

Successful treatment requires teamwork between you and your doctor. The doctor will monitor you in order to know what dose of medicine is needed. At the same time, you will make sure that you take the medicine on schedule.

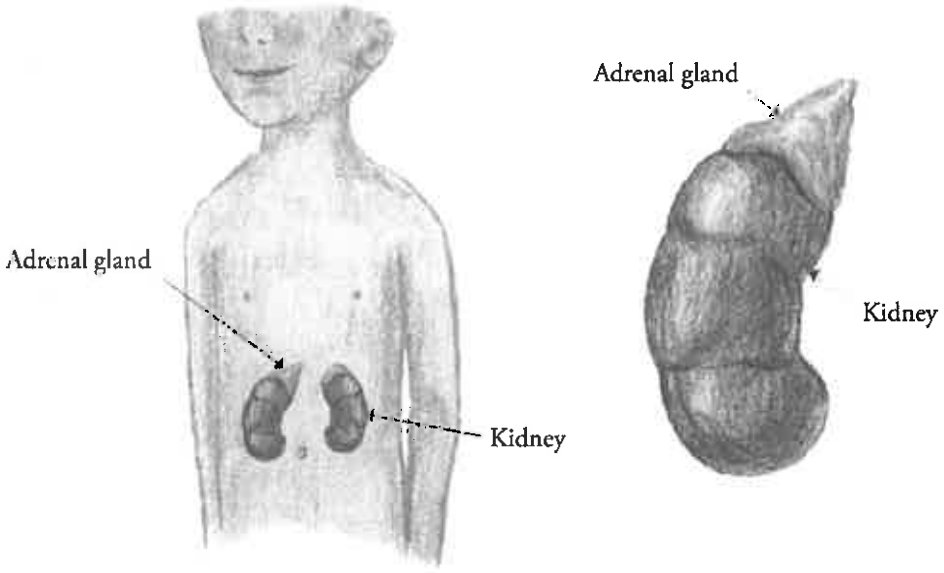
You are not alone. The Leo Fung Center for CAH and Disorders of Sex Development (DSD) at University of Minnesota Children's Hospital, Fairview, provides a large network of support, including medical specialists, therapists and counselors who all have expertise in caring for patients with CAH.

What is congenital adrenal hyperplasia?

Let's begin by examining each word.

- **Congenital** means existing at birth (inherited).
- **Adrenal** means that the adrenal glands are involved. These glands are located above the kidneys. The adrenal glands produce three important hormones—cortisol, aldosterone and androgen. Each of these hormones has an important job in the body.
- **Hyperplasia** means an abnormal increase in the number of cells that make up an organ or tissue. This causes the organ or tissue to enlarge.

Congenital adrenal hyperplasia, then, is an inherited disorder that affects the production of certain hormones and causes the adrenal glands to become too big (hyperplastic).



Hormones involved in CAH

Cortisol (stress hormone): Helps control blood pressure, blood sugar and heart function. The body uses more cortisol during times of stress, injury and infection. Not having enough cortisol can be life threatening because it can lead to shock (dangerously low blood pressure), which is also known as an "adrenal crisis."

Aldosterone (salt-saving hormone): Helps balance water, sodium and potassium in the body. Without enough aldosterone, the body can't hold on to sodium and water.

Androgens (male hormones, such as testosterone): Both males and females have androgens. A male fetus needs androgens for normal genital development. However, a female fetus should not have androgens or her genitals may not form normally (they may become more male in appearance).

Types of CAH

CAH may be "classical" or "non-classical." Your doctor will tell you which form of CAH you have.

Classical CAH

In classical CAH, the body produces more androgens (male hormones) than it needs. At the same time, there is too little cortisol (stress hormone) and sometimes too little aldosterone (salt-saving hormone). This type of CAH occurs in about 1 out of every 15,000 births.

There are two forms of classical CAH: salt-wasting and simple-virilizing.

- **Salt-wasting** CAH is the more common—and severe—form. With salt-wasting CAH, too much sodium and water are lost through urine, and the amount of potassium in the body increases, causing dehydration (loss of fluids) and very low blood pressure.
- **Simple-virilizing** CAH does not cause the body to lose sodium and water. Therefore, it is less severe than salt-wasting CAH. Like salt wasters, simple virilizers produce too many androgens.

Both salt-wasting and simple-virilizing CAH patients may develop an "adrenal crisis" during periods of physical stress (illness, surgery or trauma). This is a life-threatening situation—urgent medical care is needed.

Diagnosis in girls:

In girls, both kinds of classical CAH tend to be detected at birth because the genitals may not look normal. (Often they look more like boys' genitals.) This is because the adrenal glands produced too many androgens (male hormones) in the womb.

Diagnosis in boys:

In the male fetus, the testes already produce androgens. So if a few more androgens come from the adrenal glands, the genitals may look only slightly different at birth. (The scrotum may be more brownish in color and the penis may be a little larger).

Because the genitals tend to look normal, CAH in boys is often missed at first. If this happens, boys who have **salt-wasting** CAH may have an adrenal crisis during the second or third week of life (or sooner if triggered by stress, fever or illness).

Boys who have **simple-virilizing** CAH tend to be diagnosed later, often in early childhood. This is when signs of too much androgen show up, such as:

- early pubic hair
- an enlarged penis
- rapid growth
- advanced bone age (measured by a doctor using X-rays).

Non-classical CAH

Non-classical CAH (NC-CAH) is milder than classical CAH. It is often referred to as "late-onset" CAH, because symptoms do not appear until later in life.

Patients with NC-CAH do not have genital changes. Instead, the disease is diagnosed when the effects of too much androgen appear in childhood (rapid growth, early puberty) or during the teenage or adult years (too much face and body hair, severe acne, irregular periods). Both males and females may have fertility problems.

Treating CAH

If you have non-classical CAH, you may not need treatment (unless you have rapid growth, early puberty, excess hair, acne, fertility problems or other symptoms related to too much androgen).

If you have classical CAH, treatment involves replacing the hormones that the body cannot produce itself and keeping the body from making too much of other hormones. This means you need to take medicine regularly for the rest of your life.

While this appears simple, long-term success requires teamwork between you and your doctors. You will need to:

- Take your medicine faithfully.
- Keep all appointments with your doctors.
- See an endocrinologist (a doctor who specializes in hormones) to make sure the medicine is working.

Because each person is different, treatment is tailored to the patient. You will need to take medicine two to three times a day. This will ensure that you maintain normal energy levels and the right balance of sodium and water.

Medicines

There are two kinds of medicine used to treat classical CAH. These medicines are steroids. They replace the hormones that the adrenal glands are not making. Your doctor will tell you which kind of steroid is right for you.

- If you have either form of classical CAH, you will take a steroid to replace cortisol (stress hormone).
- If you have salt-wasting CAH, you will take both a steroid to replace cortisol and a steroid to replace aldosterone (salt-saving hormone).

People with classical CAH need extra steroids when they have increased physical stress. (Emotional stress does not require extra medicine.) The extra dose of steroids is called a **stress dose.** It can range from two to three times the normal daily dose depending on the severity of the stress.

Ask your doctor how much medicine to take in a stress dose. You may request a letter from your doctor with specific instructions. You may also request an "emergency letter" to give to doctors when you go to the emergency room.

Do not be afraid to increase your medicine if you think you need a stress dose. A single increased dose will never cause harm, even if it isn't needed. Call your endocrinologist each time you give a stress dose. You should also feel free to call for advice at any time.

Times that a stress dose is needed

During illness: Take a stress dose and then call the endocrinologist for any of the following:

- A fever of 100.5°F (38.3°C), when taken under the tongue.
- Repeat vomiting (throwing up more than once). **If this happens after taking your medicine, please call the endocrinologist and go the hospital right away.** This is an emergency and needs to be taken very seriously.
- Diarrhea (loose, watery stools when you have a bowel movement).

Let your endocrinologist know right away if you are sick with fever, vomiting or diarrhea.

Major injury: If you suffer a serious fall or broken bone, take a stress dose. Then call your endocrinologist.

Surgery: If you are going to have general anesthesia (medicine to make you sleep during surgery), extra medicine is needed before, during and after the procedure. Make sure that the surgical staff knows this and consults with your endocrinologist.

Competitive sports: Sports that result in a lot of physical stress may require a stress dose during the competition. Again, ask your doctor what the right dose should be.

Regular doctor visits

You should see your endocrinologist every three to four months as a child or teen, and every six months as an adult (or as recommended by the doctor). The doctor will:

- Test your blood to see how well your medicines are working.
- Check for signs of puberty or rapid growth during childhood.
- Take an X-ray of your bone each year during childhood.
- Check your testes, if you are male.
- Look for symptoms of excess androgen, if you are female.

Emergency hydrocortisone kit

Make sure that you always have a hydrocortisone kit at home for emergency use. This kit includes medicine that is taken with a syringe (a shot). It can be life saving. Your doctor will write a prescription and show you how to use it.

You should also wear a medical ID bracelet or necklace that reads "Adrenal Insufficiency—on hydrocortisone." You may wish to include your endocrinologist's phone number as well.

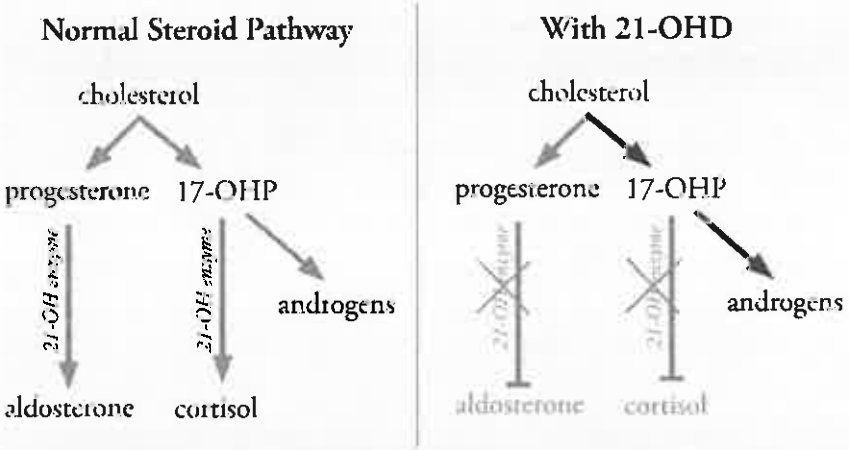
What does the blood test measure at the doctor's office?

The blood test measures the levels of certain hormones in your blood. The most important of these hormones is 17-hydroxyprogesterone (17-OHP).

In the adrenal glands, cholesterol is converted to many different steroid hormones before it becomes cortisol, aldosterone and androgen. This conversion happens with the help of several enzymes, including the 21-hydroxylase enzyme.

People with CAH due to 21-OHD (21-hydroxylase deficiency) do not have enough of this enzyme. Their bodies are therefore blocked from making cortisol and, in some cases, aldosterone. This causes 17-OHP levels to rise. When 17-OHP levels are high, it means that your doctor needs to adjust your medicine.

The graphs below show how the steroid pathway works. Think of the pathway as a river that flows into smaller streams. When one stream is blocked (17-OHP), the water flows to the stream of least resistance (away from cortisol and toward androgens).



Psychological counseling and support

With any lifelong condition, counseling is helpful. Counseling should begin as soon as the diagnosis is made. It will also help to meet with other people who have CAH. You may feel a range of emotions about having CAH, from shock and confusion to shame, anxiety, anger and sadness. Addressing these feelings will help you accept the diagnosis so you can take better care of your health.

At times, people with CAH may struggle with shame and low self-esteem as a result of "being different." Contact with others who have CAH is very helpful in turning shame into acceptance.

Other challenges may include body image concerns, insecurity with dating and sexuality and concerns about fertility. All of this requires the support of parents, friends and health professionals. Specialized counseling may be useful throughout your life.

Surgery

If CAH has affected the look of your genitals, you may think about having—or your doctor may recommend—surgery to change the way they look. You should make this decision with the help of a psychologist and surgeon. Your doctor should offer you detailed medical information and all available options.

Genetic counseling

Because you have CAH, your parents, siblings and children may wish to have a DNA test to find out if they also have CAH or if they are carriers of the CAH gene. If possible, your extended family should also be tested (grandparents, aunts, uncles and first cousins).

Genes come in pairs (one from each parent). People who have CAH have two altered genes—one from their mother and one from their father. People who are carriers of CAH have one normal gene and one altered gene.

Because carriers have one normal gene, they do not have CAH. But they could pass the altered gene onto their children. And if a carrier has a child with another carrier, their child could have CAH.

If you are planning a pregnancy, whether you have CAH or you are a carrier, your partner should be tested. This will tell you if your child could be affected by CAH. If doctors know your child is at risk, they can provide treatment at birth. This could prevent a life-threatening adrenal crisis.

Untreated CAH

If you do not take your medicine, it may lead to the following:

- Adrenal crisis (if you have classical CAH).
- Unwanted body changes in females (excess body and facial hair, hair loss from the scalp, acne, enlarged clitoris, irregular periods).
- Starting puberty too early.
- Rapid growth in childhood, resulting in a reduced adult height.
- Problems having children (for both men and women).
- Pituitary tumors in both males and females.
- Tumors in the testicles or ovaries.
- Ovarian cysts in females.

Growth and Development

The years before puberty are an important time in the growth and development of every child, but even more so for children with CAH. How well a child grows and physically matures during these years can affect how tall a child will be (final adult height) and when the child enters puberty (having an advanced, delayed or normal puberty).

Sometimes children with CAH enter puberty too early and do not grow as tall as expected. A young child who does not take the medicine regularly will grow faster than children of the same age. He or she will appear taller and more mature at first, but the child will stop growing much sooner than other children. Because of this shorter growth period, the child will have a reduced adult height.

Steroid medicine, if taken regularly and in the right amount, will give these children the best chance to reach their expected height. But taking the wrong amount of medicine could affect their growth. This is why it is so important to work with an endocrinologist.

CAH and Fertility

Females and menstruation

Most girls who have CAH will get their periods. However, their bleeding may be irregular. For girls who take their medicine, the average age for a first period is 13. This is just a little later than the average age for girls who don't have CAH.

The delayed period and irregular cycles result from high androgen levels. If not treated, high androgen can lead to polycystic ovarian syndrome (PCOS).

PCOS is a common cause of infertility and lack of menstruation. PCOS means that both the adrenal glands and the ovaries are producing too much androgen. Symptoms of PCOS include irregular bleeding, cycles without ovulation, excess body hair and enlarged ovaries with many small cysts.

If you are taking steroid medicine to suppress androgen production and it does not correct the symptoms of PCOS, your doctor may give you another medicine (such as birth control pills or anti-androgen medicine).

Fertility in women

CAH may make it harder for women to have children, especially if they do not take their medicines as prescribed. But with good medical care and the support of their medical team, most women with CAH are able to conceive and bear children.

Fertility in men

CAH increases the risk of tumors in the testicles. It can also decrease the quality and amount of sperm. It is important to have the testes checked carefully at each doctor's visit. An ultrasound should be done if there is any change in the size of the testes.

Frequently asked questions

Can a woman get pregnant if she has CAH?

It is possible for a woman with any form of CAH to get pregnant. She will need to work with her doctor to control her androgens and maintain regular menstrual cycles.

If you are thinking about having a baby, please remember:

- You and your partner should see a genetic counselor to discuss the possible risks. Your partner should be tested for CAH to see if he is a carrier.
- You will need to work with your ob-gyn doctor and endocrinologist to plan and monitor the pregnancy. You should have prenatal care at Fairview Maternal-Fetal Medicine Centers or another clinic that knows how to care for pregnant women who have CAH.
- During pregnancy, you will need to change your steroid therapy. Your doctor should switch you to glucorticoids (such as hydrocortisone or prednisone), which will not cross the placenta and therefore not affect your baby. Avoid dexamethasone unless it is needed for prenatal treatment.
- During delivery, you should get stress doses of your medicine, especially if you are to have a C-section. Have your doctor consult your endocrinologist about the correct dosing.

If a pregnant woman has CAH, can you give her medicine to stop this disease from occurring in her child?

No. However, medicine can be used to prevent a female fetus from being exposed to too much androgen. This reduces the risk that her genitals will look like a boy's.

If testing shows that the fetus has CAH, the mother can receive medicine early in the pregnancy (before 8 weeks gestation). If the baby is going to be a boy, the treatment is stopped.

There are different views on the benefits and long-term effects of prenatal treatment. It is important to discuss these with your doctor.

If I have a child with CAH, what are the chances that my next child will also have CAH?

Genes come in pairs: one from the mother and one from the father. People who have CAH have altered genes from both parents. People who are carriers received one altered gene and one normal gene. Carriers do not have CAH, but they can pass the disease onto their children if their partner has CAH or is also a carrier.

- **If both parents have CAH:** There is a 100% chance that each child will have CAH.
- **If one parent has CAH and the other is a carrier:** Each child has a 50% chance of having CAH and a 50% chance of being a carrier.
- **If both parents are carriers:** Each child has a 25% chance of having CAH and a 50% chance of being a carrier.
- **If one parent is a carrier and the other is not (and does not have CAH):** None of their children will have CAH. Each child has a 50% chance of being a carrier.

- **If one parent has CAH and the other does not (and is not a carrier)**: None of their children will have CAH. All will be carriers.

Even if your partner does not have CAH, he or she could be a carrier of the altered gene that causes CAH. When planning a pregnancy, it is very important that your partner be tested for the CAH gene. This is true whether you have CAH or you are a carrier. Genetic testing will tell you your risk of having an affected child.

Am I at risk for osteoporosis because of CAH or my medicines?

Osteoporosis, or brittle bone disease, is the loss of bone density. Those who have it are more likely to break bones when they fall. CAH will not increase your risk for this disease. In fact, the high level of androgens in your body will help to slow any bone loss. Your medicine, however, may increase your risk.

People who take high doses of steroids have a higher risk for osteoporosis. Your risk is lower, because you are taking a low dose of steroids—only enough to replace the hormones that your body should make naturally. Even so, it is best to take steps to protect your bones.

- See your endocrinologist often to make sure you are getting the right amount of steroids.
- Take 500 mg of calcium three times a day and 400 to 800 IUs (international units) of vitamin D once a day.
  - You will get enough calcium and vitamin D if you drink four 8-ounce glasses of milk per day.
  - If you do not drink this much milk, you should take calcium pills that contain vitamin D
- Avoid smoking and alcohol.

I have non-classical CAH. How soon after starting treatment will my symptoms improve?

In non-classical CAH, too many androgens in the body lead to excess body and facial hair, increased acne, greasy skin and irregular periods in females. It could take six months to one year before you see a change in your symptoms

What can I do about excess body hair and loss of scalp hair?

Men and women tend to have the same number of hair follicles. In men, high androgen levels cause the hair to grow coarse and dark. In women, androgen levels are often lower, so the hair is less visible.

Women with CAH have high androgen levels. This causes body hair that would normally be pale and fine to become dark and coarse. It has the opposite effect on the scalp: women with untreated CAH often have male pattern baldness along the sides of the forehead.

To treat this, your doctor will prescribe steroids to lower your androgen level. This will improve scalp hair in most women. To reduce body hair, your doctor may also give you an anti-androgen medicine called spironolactone. It may take some time for this drug to have a significant effect. If you stop taking the medicine, the dark, coarse hair will return.

In the meantime, bleaching, shaving, plucking, depilatory creams, waxing, electrolysis and laser treatment are all good methods for removing body hair.

Glossary

17-hydroxyprogesterone (17-OHP): Steroid hormone precursor that is measured in blood tests to see how well medicine is controlling a patient's CAH.

21-hydroxylase enzyme. One of the enzymes required to convert cholesterol into cortisol.

Adrenal glands: Small glands located above each kidney that produce three important hormones: aldosterone, cortisol and androgen (DHEA, androstenedione, testosterone).

Aldosterone: Salt-saving hormone, made by the adrenal cortex. It acts on the kidneys to help move salt from the urine back into the blood and to get rid of potassium.

Androgens: Male sex hormones that are made in the testes in males, ovaries in females and the adrenal glands in both males and females.

Carrier: A person who has one out of two genes for an inheritable condition without being affected by the condition.

Clitoris: A small, sensitive organ located above the vaginal opening. Androgens make it grow larger.

Congenital adrenal hyperplasia (CAH): An inherited disorder of the adrenal glands resulting in insufficient cortisol production.

Cortisol: A steroid hormone made by the adrenal cortex. It maintains the body's energy supply and helps the body react to stress.

Gene: A unit of heredity located on a chromosome. It transmits a characteristic from parent to offspring.

Gland. Any organ or layer of cells that produces and secretes hormones.

Hormone. A chemical messenger made in a gland. Hormones are sent through the blood to target body organs and tissues, stimulating certain life processes and stopping others as needed by the body.

Ovaries: Female reproductive organs containing the eggs.

Salt wasters: Classical CAH patients who lack the salt-saving hormone aldosterone. These patients have insufficient cortisol and high androgens. This disorder is life threatening if left untreated.

Simple virilizers: Classical CAH patients who have low cortisol and high androgens, but who are not salt wasters. This is not a life-threatening condition.

Testes: Two egg-shaped male reproductive organs located in the scrotum. They produce sperm and the male hormone testosterone.

Resources

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