Parents' Guide to Congenital Adrenal Hyperplasia (CAH)

Due to 21-hydroxylase Deficiency

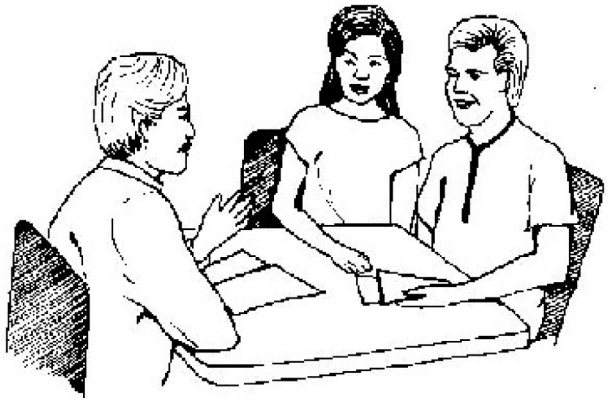
California Department of Public Health
Genetic Disease Screening Program
www.cdph.ca.gov/nbs

To Parents:

California State Law requires that all babies have the newborn screening test before leaving the hospital. A few drops of blood were taken from your baby's heel for testing. One of the tests was for classical congenital adrenal hyperplasia, or CAH.

This booklet was written to help parents learn more about CAH. People with CAH have varying symptoms. **CAH can be treated. It is managed by daily medication and ongoing checkups by a doctor.**

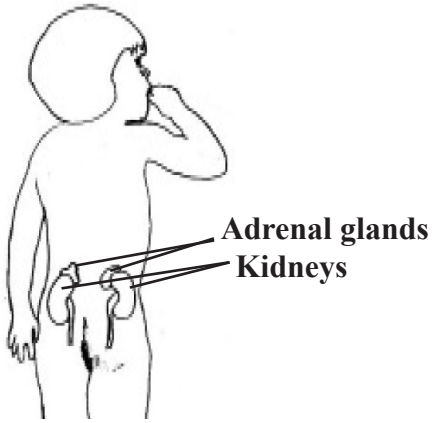
As you read this booklet, write down any questions you have on page 15. Use this booklet to discuss this disease with the specialists at an endocrine center or your pediatric endocrinologist and to help you learn more about how to care for your child. A list of CCS approved endocrine centers is included at the back of this booklet.



Discuss this booklet with your doctor.

What Is CAH?

Congenital Adrenal Hyperplasia is a disease your baby was born with (i.e. congenital) where the adrenal glands* are enlarged (i.e. hyperplasia) and do not produce the key stress-fighting hormone cortisol.



What Do the Adrenal Glands Do?

The adrenal glands are small organs that lay on top of the kidneys. These glands make several kinds of hormones. Hormones are chemical messengers. They are produced in one part of the body and act somewhere else in the body. Hormones are important for normal function and growth. Hormones affected by CAH include:

- **Cortisol** is the key stress-fighting hormone. It helps protect the body from infection, injury, and disease and provides energy.
- **Aldosterone** is the salt-retaining hormone. It helps the kidneys take salt from the urine and keep salt in the blood. Without this hormone, a person can easily become dehydrated and go into shock.
- **Androgens** are male sex hormones. They are produced in both girls and boys and are important for growth and development of the sexual organs.

* Underlined words are defined in glossary.

What Types of CAH Are There?

How severe the enzyme shortage is will determine the type of CAH. There are 2 types of classical CAH and a non-classical form.

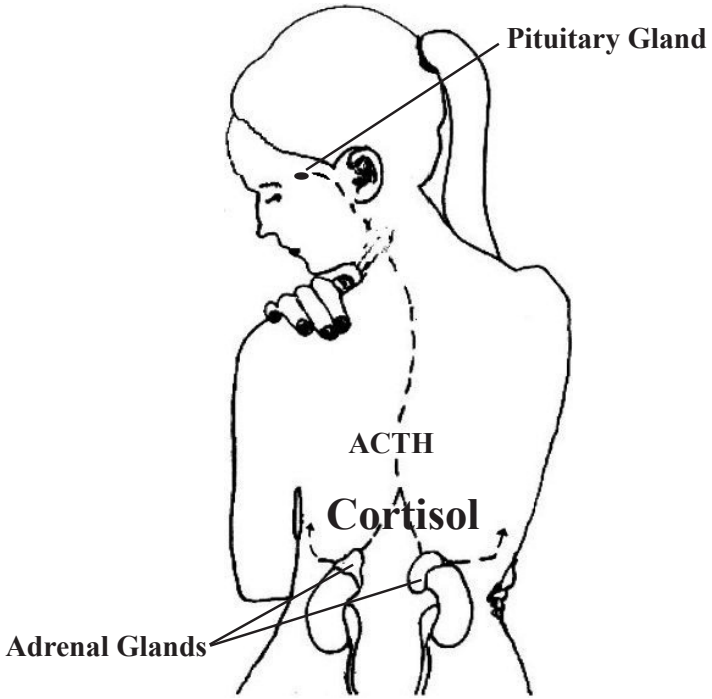
- **Salt-wasting** CAH: The adrenal glands make almost no cortisol or aldosterone (the body's salt-retaining hormone) and too much androgen (male hormone).
- **Simple-virilizing** CAH: The adrenal glands make enough aldosterone but not enough cortisol and too much androgen.
- **Non-Classical or** NCAH is a milder form that often presents in childhood or later in which the body makes some cortisol, normal amounts of aldosterone, and too much androgen.

This booklet will give information on classical CAH only.

How Do the Adrenal Glands Make Hormones?

Hormones are made in a series of steps. The body uses special proteins called enzymes for each step. The adrenal glands take cholesterol and make it into cortisol, aldosterone, and androgen by using these enzymes. The adrenal glands are controlled by the pituitary gland located in the brain. The pituitary acts like a thermostat that turns the adrenal glands on and off to control the supply of hormones in the body.

When the adrenal glands are not producing enough cortisol, the pituitary sends a chemical messenger, adrenocorticotropic hormone (ACTH), telling them to produce more cortisol. When too much cortisol reaches the pituitary, it is switched off and the adrenal glands are allowed to rest until the hormone levels are normal again. Usually the pituitary gland and the adrenal glands are in balance.



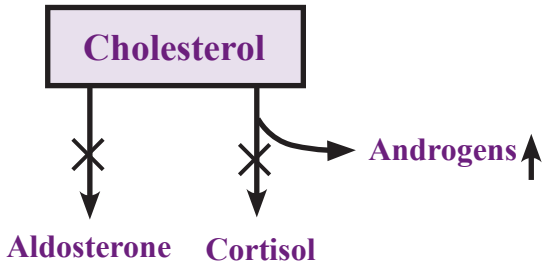
Why Can't My Baby Make Adrenal Hormones?

A child with classical CAH is missing an enzyme that makes cortisol and, in 2/3 of cases, this deficiency also prevents aldosterone from being made from cholesterol. Since the cortisol amount is always low, the pituitary never gets turned off. It tells the adrenal glands to try to make more cortisol. The adrenal glands keep trying to do this by growing more cells and becoming enlarged (hyperplasia).

When the enzyme is completely missing, both cortisol and aldosterone are blocked from being made and their amounts stay low. When a small amount of the enzyme is present, cortisol is not made, but aldosterone is made. In either case, the cholesterol is, therefore, diverted to making more androgen. As a result, affected newborn girls have male-looking genitals whereas affected newborn boys have normal looking genitals.

Children of both sexes with the more complete enzyme deficiency are at risk for losing salt and becoming severely dehydrated in the first 10-20 days of life if their condition goes unrecognized and untreated.

The type of CAH a baby has depends on how much cortisol and aldosterone its body can make. Five main enzymes are needed to make cortisol from cholesterol. CAH results when any of these enzymes are missing or not working right. **21-hydroxylase** is the most common enzyme missing for CAH. This is the most likely form your baby has. Defects with other enzymes are rare and will not be discussed in this booklet. An endocrinologist will be able to give you more information on these rarer forms of CAH.



What Causes the 21-Hydroxylase Enzyme to be Missing or Not Working Correctly?

Genes signal the body to make various enzymes. Everyone has a pair of genes for producing the enzymes that make cortisol. People with CAH have a pair of genes that do not work correctly. Because of the changes in this pair of genes, the 21-hydroxylase enzyme either does not work properly or is not made at all.

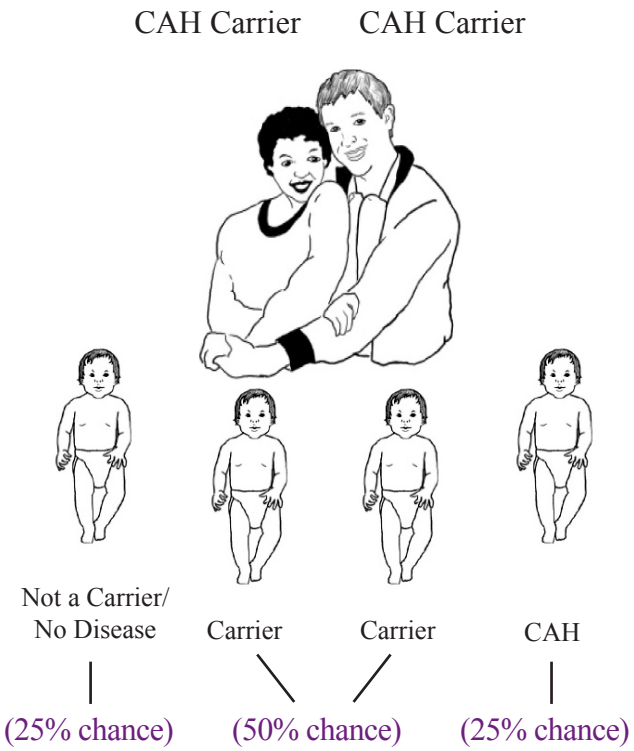
CAH is an inherited disease. This means it is passed on from parents to children through genes. People with CAH inherited one gene for this disease from each parent, just as he or she inherited hair, skin or eye color. CAH is not something your child will outgrow. Your child will always have it. CAH is not contagious. This means you cannot "catch" it like a cold or flu. Your child cannot "give" it to another child.

Your child cannot give CAH to another child.

What Are the Chances of Having Another Baby with CAH?

Parents of children with CAH rarely have the disease. They usually are carriers which means they have one working gene and one that is not working or only partially working. The working gene makes enough of the enzyme needed to make cortisol.

People who have one working and one nonworking or only partially working gene are called carriers. Parents who are carriers each pass on either their working or nonworking gene each time they get pregnant. **With each pregnancy**, the chance of a baby having CAH is the same no matter how many children the carrier couple have.



Chances apply to each pregnancy

What Happens if CAH Is Not Treated?

Classical CAH can be life threatening due to salt level imbalance which can cause dehydration, low blood pressure, vomiting, shock and even death. CAH can also cause problems with growth and development if untreated. Early identification and treatment with one or more oral medicines can help prevent these problems.

What Is the Treatment for CAH?

CAH is treated by giving the baby the missing hormones its body can't make. These hormones are given as medicine in the form of pills. They include hydrocortisone and cortisone. There are several brands. For children with salt-losing CAH, fludrocortisone (Florinef) must also be given to retain the correct salt balance. Also, salt is often given to these babies in the form of sodium pills, table salt or a saline solution.

These pills need to be taken daily for life. The amount needed differs from child to child. Body size and the rate the body absorbs the medicine will affect the dose needed. As the child grows, the dose will be adjusted as needed. The dose your baby needs will be worked out by your baby's doctors.

It is important that newborns with CAH receive care at an endocrine center or by a pediatric endocrinologist. An endocrine center is a specialized center with a team of experts trained in the treatment of hormone disorders. They can provide your child with the special care needed to treat CAH. Endocrine centers are available in California where specialists can treat children and adults.

People with CAH can have normal healthy lives. For most, there are very few problems if the disease is managed well. People with CAH will need lifelong follow up to maintain the right amount of medicine to ensure normal sexual function and fertility.

How To Give Hormone Replacement

Be sure to give your baby hormone medicine every day.
Give the tablets at the same time every day and make it a part of your routine so you do not forget. With newborns, the tablets need to be crushed and given very carefully. When your infant is older, it will be easier to give. There are several ways you can give the medicine.

FOR THE INFANT:

- Crush tablet(s) between two spoons and mix with a small amount of water or formula. Give this mixture through a dropper or an oral syringe on the side of the mouth between the cheek and gum. To be sure that all of the medicine is taken, draw up some water into the dropper or oral syringe after you have given the crushed tablet(s) and give this water to your baby. **Use room temperature water. DO NOT mix with hot water.**

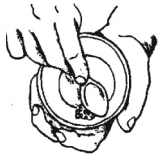
– Or –

- Wash hands well. Finely crush the tablet(s) between two spoons. Moisten your fingertips with water and dip into crushed tablet(s). Let your baby suck the crushed tablet(s) off your finger and continue to dip your finger in the crushed tablet(s) until no powder is left. Offer the baby a small amount of water after giving the tablet(s).

FOR THE OLDER INFANT AND TODDLER:

When your baby is on solid foods, you may want to try one of these methods.

- Place tablet(s) on a spoon and add a few drops of water to soften. After a few minutes, add a few drops of water on the spoon and feed this mixture to your baby.

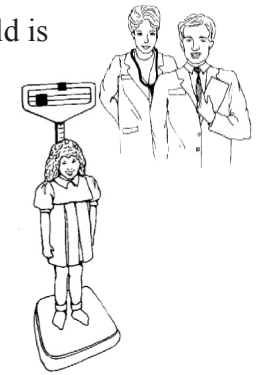


- Mix the crushed tablet(s) in a small amount of baby cereal, applesauce, breast milk or formula. Always keep this separate from the rest of your baby's food. For example, if your baby is taking two tablespoons of cereal in the morning, mix the crushed tablet(s) with a $^1/_2$ teaspoon of cereal in a separate dish. Give this portion to your baby. Some doctors recommend waiting at least one half hour after giving the tablet(s) before feeding your baby the rest of the meal. That way, you will know that your baby has received all the tablet(s).

- When your child is older, he or she may take the whole tablet(s) by mouth. Since the tablets are small, they will either melt or be swallowed whole. It is all right for the child to chew the tablet(s).

DO NOT put the tablet(s) into a whole serving of the baby's food. DO NOT put the tablet(s) in the baby's bottle. The baby may not eat or drink the whole amount.

How Do I Know My Child Is Getting the Right Amount of Medicine?



Your doctor will order blood tests to see if your child is getting the right amount of medicine. Doctors will also monitor his or her growth, development and blood pressure to decide if the dose is correct. Increases in medicine may be given when your child is sick or seriously injured. Your child will not need extra medicine for minor cuts and scrapes or minor illness. The doctor will give you directions for "stress dosing" for illness or injury.

What Should I Do If My Child Gets Sick?

When we are sick or injured our body normally makes larger amount of cortisol. This extra amount helps our body cope with the extra stress. The child with CAH can't make extra cortisol so he or she needs special care to avoid going into an adrenal crisis. This is called "stress dosing."

Make a plan with your child's doctor about what to do when she or he is sick, so you understand when and how to give a stress dose. Also, make sure you have been given a prescription for injectable hydrocortisone (Acto-Vial Solu-Cortef®) and you have been instructed on how to give a shot to your child.

Usually a larger dose of the daily medicine is needed until the body recovers from an illness with fever, diarrhea or vomiting. Vomiting may make it hard for the stomach to absorb the medicines needed. Diarrhea may cause a child to dehydrate more quickly. A hydrocortisone shot may be needed if the child cannot keep down the medicine. If a child needs surgery for any reason, he or she will need to be monitored by an endocrinologist and given extra hydrocortisone through an IV or a shot.

What Is an Adrenal Crisis?

An adrenal crisis is a sudden, life-threatening state caused by not enough cortisol when the body is stressed due to illness or injury.

What Are the Symptoms of an Adrenal Crisis?

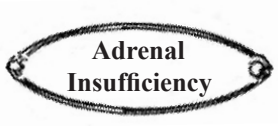
The following symptoms may mean your child is having an adrenal crisis:

- **Unusual tiredness and weakness**
- **Dizziness when standing up**
- **Nausea, vomiting, diarrhea, loss of appetite, stomach ache**

If your child has these symptoms, contact your doctor, give an injection and go to a hospital **right away.**

How Do I Care for My Child with CAH?

Children and teens should wear a medical ID or Medic Alert™ bracelet or necklace stating "adrenal insufficiency, takes hydrocortisone." If emergency care is needed, this will help doctors give the right medicine (hydrocortisone or glucocorticoids).



A person with CAH should wear a medical ID bracelet or necklace.

If you plan to take a trip, ask the doctor for a letter stating your child has CAH and outlining what needs to be done in case of an emergency.

Children with CAH need special care and medical follow up, but they can develop and enjoy life as other children do. Children with CAH are not more prone to being sick and their school performance won't be affected. Remember that with the right treatment and care, your child can grow and lead a healthy life.

Are There Issues to be Concerned About with CAH?

Both boys and girls with CAH make too much androgen. They take hydrocortisone to suppress their androgen levels. Too much androgen causes early puberty, development of pubic hair, acne, and rapid growth rate.

Children have growth plates at the end of their long bones. These plates allow for growth. As the child grows these plates close and growth stops. Too much androgen causes the plates to close up prematurely. This can result in a child being tall when young, but permanently quite short as an adult.

Treatment with hydrocortisone will prevent these problems. But, too much cortisol can cause side effects like slow growth rate, puffy cheeks and weight gain. The endocrinologist will work to balance the child's level for optimum growth and development with a minimum of side effects.

Are There Any Special Issues to be Concerned About with Boys?

Boys with CAH are not identified without screening because they do not have the ambiguous genitalia. These boys are still in danger of an adrenal crisis if they have the salt-wasting form of CAH. If untreated, boys may have problems with fertility as adults.

Are There Any Special Issues to be Concerned About with Girls?

For baby girls with CAH, it is sometimes hard to be sure about the sex at the time of birth. Tests may be needed to find out what internal organs are present. With CAH, their internal sex organs (uterus, ovaries) will be completely normal.

It is only the external genitals that are affected by the disorder while being formed in the uterus causing them to look different from typical female genitals. In baby girls with CAH, there is a large clitoris and some closing of the labia (lips around the opening of the vagina). Keep in mind that this can be treated.

In baby girls with CAH, surgery can be done to correct the masculine looking genitals including enlarging the vaginal opening and reducing the size of the clitoris. However this reconstructive surgery and its timing can be controversial. Given the rarity of this disease and the sensitivity of the procedure, this surgery requires a large degree of expertise on the part of the surgeon performing this surgery.

Virilization in a baby girl with CAH.

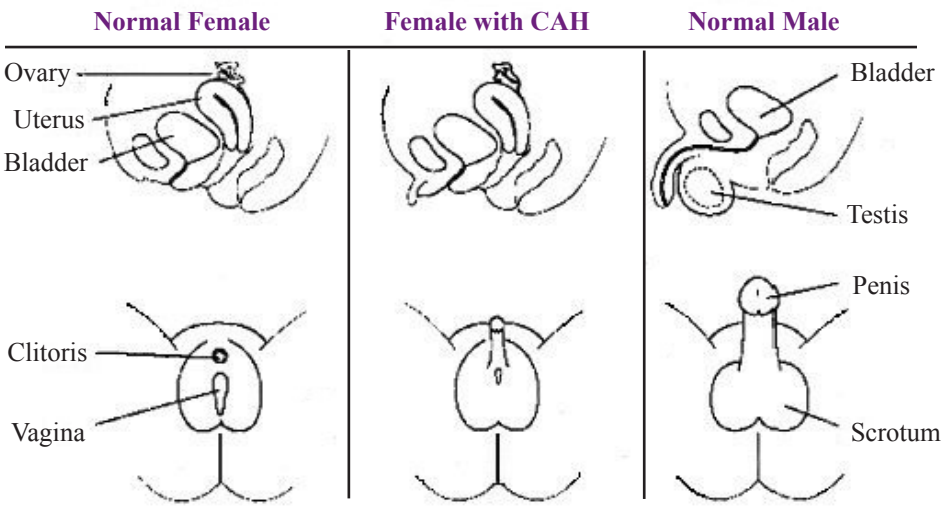


Diagram reprinted with permission from Claude J. Migeon, MD of Johns Hopkins Hospital.

Prenatal Diagnosis of CAH

Please talk to a genetic counselor or endocrinologist about future pregnancies and whether CAH can be detected during pregnancy. Research studies are testing medicines you can take in the early part of your pregnancy to reduce genital anomalies in affected female babies.

Talk with a genetic counselor

Will My Child Grow Like Other Children?

With treatment, children with CAH can have normal physical growth. There is no mental deficiency. The life expectancy is normal. Women on treatment can expect normal pregnancies and delivery like any other females. Men on treatment can have normal fertility.

Help and Support

This may be a very hard time for you. You may have many different feelings going on inside of you. You may be feeling very confused about this diagnosis especially if you have a baby girl with genital abnormalities. You may not know what to tell your family and friends. The endocrinology team can help you with some of these feelings and concerns. There are also support groups and organizations that can connect you with other parents of children with CAH.

Remember that this is a condition that can be treated. There is support available for you. Even though your baby needs regular medications and doctor visits, he or she still needs to be fed, cuddled and cared for like any other baby.

Resources for Parents

CARES (Congenital Adrenal Hyperplasia Research, Education and Support Foundation, Inc.), www.caresfoundation.org, or toll free help line at 1-866-227-3737.

CAH Education and Support Network, www.congenitaladrenalhyperplasia.org

Magic Foundation, www.magicfoundation.org or toll free line at 1-800 3 MAGIC 3 (1-800-362-4423).

Notes And Questions

Glossary

ACTH – A hormone released by the pituitary gland into the blood. It causes the adrenal glands to produce cortisol and androgens.

Adrenal crisis – A serious health problem caused by not enough cortisol when the body is stressed from an illness or injury. This can lead to low blood pressure and low blood sugar. Symptoms can include vomiting, weakness, and drowsiness. Immediate medical attention is needed.

Adrenal glands – These are 2 small organs that lie on top of each kidney which make hormones for normal body function and growth.

Aldosterone – A hormone made by the adrenal glands. It is important for salt and water balance in the body.

Androgen – A type of hormone involved in male and female sexual development.

Cortisol – A key stress-fighting hormone made by the adrenal glands. It helps protect the body from infection, injury, and disease and provides energy for the body.

Fludrocortisone – Medicine to help maintain the right salt balance in the body.

Endocrine Specialist – A doctor that treats diseases involving unusual hormone levels. Infants and children with CAH are usually seen by a pediatric endocrinologist.

Enzymes – Special proteins used to help make hormones in the body.

Hormone – A chemical with a specific effect on other organs. A hormone is produced by a gland in the body.

Hydrocortisone – A medicine used to replace the missing hormone, cortisol, when the body can not make it.

Pituitary gland – A small gland in the brain that makes hormones which control other glands such as the adrenal glands.

CCS Endocrine Centers in California

NORTHERN CALIFORNIA

Children's Hospital & Research Center – Oakland
Oakland
(510) 428-3654

Lucille Salter Packard Childrens Hospital
Palo Alto
(650) 498-4224

Sutter Memorial Hospital Sutter Children's Center
Sacramento
(916) 733-7070

UC Davis Medical Center Specialty Clinic
Sacramento
(916) 734-3112

UC San Francisco Medical Center
San Francisco
(415) 476-1017

Santa Clara Valley Medical Center
San Jose
(408) 885-5405

SOUTHERN CALIFORNIA

Cedars-Sinai Medical Center
Los Angeles
(310) 423-7940

Children's Hospital & Health Center Of San Diego
San Diego
(619) 576-4019

Children's Hospital Central California
Madera
(559) 353-8700

Childrens Hospital Los Angeles
Los Angeles
(323) 669-8700

Children's Hospital of Orange County
Orange
(714) 532-8634

Loma Linda University Medical Center
Loma Linda
(909) 558-2061

Miller Children's at Long Beach Memorial Medical Center
Long Beach
(562) 933-8561

UCLA Medical Center
Los Angeles
(310) 825-6244

Harbor-UCLA Medical Center
Torrance
(310) 222-2393

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