CONDITION

Congenital adrenal hyperplasia

Congenital adrenal hyperplasia is an inherited condition that affects how the adrenal glands make essential hormones.

WHAT IT IS
Inherited adrenal hormone-production condition

BODY SYSTEM
Hormone system and adrenal glands

MAIN SYMPTOMS
Vomiting, dehydration, genital differences, early androgen effects

WHAT CAUSES IT
Inherited gene changes affecting adrenal hormone production

HOW IT IS DIAGNOSED
Blood hormone tests, electrolytes, sometimes genetic testing

MAIN TREATMENT
Hormone replacement, stress dosing, and regular monitoring

CAN IT BE CURED?
No - inherited enzyme changes remain lifelong

IS IT AN EMERGENCY?
Sometimes - repeated vomiting, severe weakness, dehydration, or collapse

LONG-TERM OUTLOOK
Usually manageable with lifelong treatment and monitoring

Overview

Congenital adrenal hyperplasia, often shortened to CAH, is a group of inherited conditions affecting the adrenal glands. These small glands sit above the kidneys and make several important hormones.

In CAH, a gene change affects an enzyme needed to make adrenal hormones. Enzymes are proteins that help chemical reactions happen in the body. The hormone effects differ according to which enzyme is affected.

More than 90% of cases are caused by 21-hydroxylase deficiency. Most information in this article relates to that form. Rarer types can cause different hormone patterns and may need different treatment.

With 21-hydroxylase deficiency, the adrenal glands may not make enough cortisol. Cortisol helps regulate blood pressure, blood sugar and the body's response to illness or injury. Some people also lack aldosterone, which helps control salt, fluid and potassium levels.

At the same time, the adrenal glands may produce too many androgens. These are hormones involved in body hair, puberty and sexual development.

CAH may be described as:

Classic salt-wasting CAH can cause an adrenal crisis if it is not recognised and treated. An adrenal crisis is a severe shortage of cortisol, often combined with salt and fluid loss. Once diagnosed, treatment and an emergency plan greatly reduce this risk.

- Classic CAH , including salt-wasting and simple virilising forms, which usually becomes apparent in infancy or childhood
- Nonclassic CAH , a milder form that may cause symptoms later or no noticeable symptoms

Symptoms

Symptoms depend on the type of CAH, the hormones affected and the person's age.

In classic salt-wasting CAH, symptoms often begin during the first weeks after birth. They may include poor feeding, repeated vomiting, weight loss, unusual sleepiness and dehydration. A baby may have fewer wet nappies and seem weak or difficult to wake.

High androgen levels can affect genital development before birth. A baby with XX chromosomes may have external genitals that look different from typical female anatomy. The uterus and ovaries are usually present. Babies with XY chromosomes often have no obvious genital difference, so salt-wasting CAH may be harder to recognise without newborn screening.

Classic CAH that does not cause severe salt loss may become noticeable through early androgen effects, such as:

Children may initially be taller than others their age. However, their bones can mature too quickly, causing growth to stop early and reducing adult height.

Nonclassic CAH may not cause symptoms until later childhood or adulthood. Possible effects include excess facial or body hair, persistent acne, irregular periods and difficulty becoming pregnant. Some children develop pubic hair or body odour early. Symptoms can resemble polycystic ovary syndrome, but these are separate conditions.

Some people with nonclassic CAH have no symptoms and learn about it only after testing for

another reason.

Rarer forms of CAH do not always cause androgen excess. Depending on the affected enzyme, they may cause high blood pressure, low sex-hormone levels or differences in puberty and sexual development.

- Pubic or underarm hair at an unusually young age
- Rapid growth during early childhood
- Stronger body odour, oily skin or acne
- Enlargement of the penis or clitoris without other expected signs of puberty
- A deeper voice

Causes and risk factors

CAH is caused by gene changes passed through families. The usual pattern is autosomal recessive inheritance . This means a person generally inherits one altered copy of the same gene from each biological parent.

Someone with one altered copy is called a carrier. Carriers usually do not have CAH. When both biological parents carry a change in the same CAH-related gene, each pregnancy has a one-in-four chance of resulting in a child with the condition. The outcome can be different in each pregnancy.

The gene involved in 21-hydroxylase deficiency is called CYP21A2 . Different changes in this gene can leave different amounts of enzyme activity. This helps explain why some people have severe salt-wasting CAH while others have a milder form. However, genetic results do not always predict the exact symptoms.

CAH affects people of all sexes and ethnic backgrounds. Having a sibling or other close relative with CAH increases the chance of being affected or being a carrier.

CAH is not caused by anything someone did during pregnancy. It is not contagious.

Diagnosis

Many newborn screening programmes test for 21-hydroxylase deficiency using a heel-prick blood sample. The test measures 17-hydroxyprogesterone, often called 17-OHP. This substance builds up when the 21-hydroxylase enzyme is not working properly.

Screening does not confirm CAH by itself. Levels can be raised for other reasons, especially in

babies born early or babies who are unwell. Screening may also miss some milder cases.

If CAH is suspected, blood tests are used to measure 17-OHP and other adrenal hormones. Electrolyte tests check sodium and potassium levels. Renin, a hormone involved in salt and blood-pressure control, can help show whether aldosterone is low.

An ACTH stimulation test may be needed when initial results are uncertain. ACTH is the hormone that tells the adrenal glands to make cortisol. The test measures how the glands respond to a manufactured form of ACTH.

Genetic testing can identify changes in a CAH-related gene. It may confirm the type, help with family testing or support reproductive planning. A specialist interprets genetic results alongside symptoms and hormone tests.

When genital development differs from what is expected, testing may also include chromosome analysis and imaging of internal reproductive organs. This is usually coordinated by a specialist team experienced in hormone and sex-development conditions.

Treatment and management

Treatment aims to replace missing hormones, prevent adrenal crisis and limit the effects of excess androgen production.

People with classic CAH need lifelong glucocorticoid replacement. Glucocorticoids are medicines that replace cortisol. In children, treatment is carefully balanced because both excess and insufficient glucocorticoid can affect growth.

People who cannot make enough aldosterone also need a mineralocorticoid medicine, usually fludrocortisone. Babies with salt-wasting CAH may need additional salt for a period because their needs are higher than those of older children and adults.

The body normally releases more cortisol during fever, serious illness, surgery or major injury. People who cannot make this response need a temporary increase in glucocorticoid treatment, called stress dosing . The exact plan should be provided in writing by the specialist team.

If vomiting prevents medicine from staying down, an emergency hydrocortisone injection may be needed. Families and other caregivers can be trained to give it. Wearing medical identification and keeping emergency supplies available helps others respond correctly.

A newer add-on medicine, crinecerfont, can reduce the hormone signal that drives excess adrenal androgen production in some adults and children with classic CAH. It does not replace glucocorticoid treatment. Availability and eligibility differ by country.

Not everyone with nonclassic CAH needs medicine. Treatment may be considered when symptoms such as early puberty changes, troublesome excess hair, irregular periods or reduced fertility are affecting health or quality of life.

Regular monitoring may include growth, blood pressure, weight, puberty, menstrual patterns and hormone levels. Children may have bone-age X-rays to check how quickly their skeleton is maturing. Treatment often needs adjustment as the body grows, during pregnancy and with changes in health.

Some people with genital differences consider surgery, while others do not. Decisions are individual and should include balanced information about timing, possible benefits, sensation, fertility, urinary function and the possibility of further procedures. Except when there is an urgent medical problem, there is usually time for careful discussion with an experienced multidisciplinary team.

Complications

Adrenal crisis is the most serious short-term complication of classic CAH. It can cause low blood pressure, low blood sugar, abnormal sodium or potassium levels, confusion and collapse. Infection, vomiting, injury or missed glucocorticoid treatment may trigger it.

Long-term complications can come from the condition or from treatment that is not well balanced. Too little treatment may allow continued androgen excess, leading to rapid bone maturation, early puberty changes, acne, excess hair or menstrual problems.

Too much glucocorticoid can contribute to slower growth, weight gain, high blood pressure, reduced bone strength and features similar to Cushing syndrome, such as easy bruising or a rounder face. These risks are why regular monitoring matters.

Fertility can be reduced in some people, but many people with CAH have biological children. Possible causes include hormone imbalance, irregular ovulation and testicular adrenal rest tumours. These are noncancerous areas of adrenal-like tissue within the testes that can enlarge when hormone control is poor.

CAH and genital differences can also affect body image, sexual wellbeing and mental health. Support from professionals familiar with CAH may be helpful at different life stages.

Prevention

CAH cannot be prevented because the gene changes are inherited.

Genetic counselling can help people understand carrier status and the chance of CAH in a future pregnancy. Options may include carrier testing for a partner, testing during pregnancy or embryo testing with in vitro fertilisation. These are personal choices rather than required steps.

Taking the prescribed hormone replacement and following a stress-dose plan cannot prevent CAH itself, but these measures can prevent many adrenal crises and reduce other complications.

Prenatal dexamethasone has been studied as a way to alter genital development in a fetus who may have CAH. It exposes pregnancies that may be unaffected to treatment before diagnosis is possible and has unresolved safety and ethical concerns. It is not routine care and should only be considered in an approved research setting.

Living with it and what to expect

CAH is lifelong, but hormone needs and day-to-day effects change over time. Infancy and early childhood often involve close attention to growth, salt balance and illness management. During later childhood and adolescence, monitoring also focuses on puberty, bone maturation and emotional wellbeing.

Most daily activities, including school, work, exercise and travel, remain possible. Planning is important because replacement medicine must be taken consistently. Emergency medication, medical identification and a copy of the stress-dose plan should travel with you.

Hormone control is not always steady. Growth, pregnancy, other medicines and changes in health can alter what the body needs. An abnormal blood result does not always mean an immediate danger, but it may lead to a treatment review.

Transition from paediatric to adult care should include learning how to manage prescriptions, stress dosing and emergency injections independently. Adult follow-up may also cover fertility, sexual health, bone health and cardiovascular risk.

Pregnancy is possible for many people with CAH, although conception may take longer. Specialist care is needed because hormone treatment and monitoring may change during pregnancy. Glucocorticoid replacement should not be stopped without medical guidance.

Long-term outlook is generally good when classic CAH is recognised, hormone replacement is reliable and adrenal crises are prevented. Individual experiences differ, especially with rarer forms or after severe crises. CAH does not usually worsen through progressive damage, but it continues to require monitoring throughout life.

When to get medical help

Seek emergency help for a baby or person with possible CAH who has repeated vomiting, marked weakness, severe dehydration, unusual drowsiness, confusion, a seizure or collapse. These may be signs of adrenal crisis.

For someone with known CAH, inability to keep glucocorticoid medicine down is urgent. Follow the personal emergency plan, give emergency hydrocortisone if trained and instructed to do so, and contact emergency services. Do not wait for severe symptoms to develop.

A fever, significant injury or planned operation may require stress dosing. Follow the written plan and seek same-day advice if the plan is unclear or symptoms are not improving.

Arrange routine follow-up if there are changes in growth, weight, blood pressure, puberty, periods, acne or body hair. Also discuss ongoing tiredness, dizziness, fertility concerns or signs of excess steroid exposure. These changes may mean that monitoring or treatment needs review, but they are not usually emergencies by themselves.

Common questions

Is congenital adrenal hyperplasia curable?

No. The underlying gene and enzyme changes remain throughout life. Hormone replacement does not remove the condition, but it can replace missing hormones and control many of its effects.

Is congenital adrenal hyperplasia life-threatening?

Classic salt-wasting CAH can be life-threatening during an adrenal crisis. The risk is much lower when CAH is diagnosed, replacement treatment is taken consistently and an illness or emergency plan is followed. Nonclassic CAH does not usually cause salt-wasting crisis.

Can someone with CAH have children?

Yes, many people with CAH can have biological children. Hormone imbalance can reduce fertility in some people, and fertility treatment is sometimes needed. CAH can be passed on genetically, so carrier testing and genetic counselling may be useful.

Does CAH affect life expectancy?

Many people receiving effective treatment live into adulthood and lead active lives. Severe adrenal crises can affect long-term health and remain a preventable risk. Reliable access to medication, emergency treatment and specialist follow-up is important.

What is the difference between classic and nonclassic CAH?

Classic CAH begins before birth and usually causes a significant cortisol shortage. It may also cause dangerous salt loss. Nonclassic CAH leaves more enzyme activity, tends to appear later and usually causes milder androgen-related symptoms without salt-wasting crisis.

Can I exercise or travel with CAH?

Usually, yes. Routine exercise does not normally require extra glucocorticoid, although individual plans may differ for intense or prolonged activity. When travelling, carry enough medicine, emergency hydrocortisone, medical identification and written instructions for illness or injury.

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