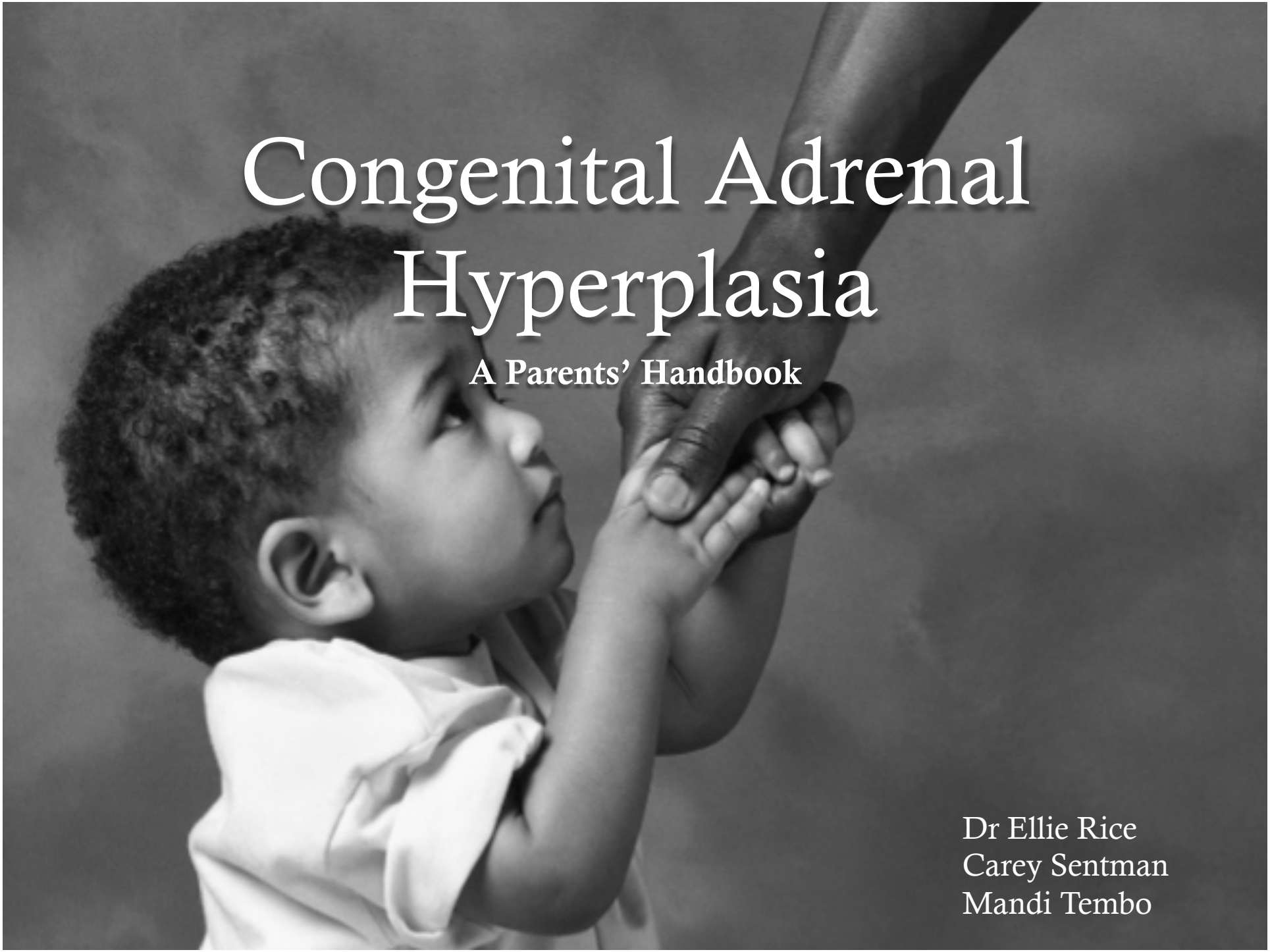
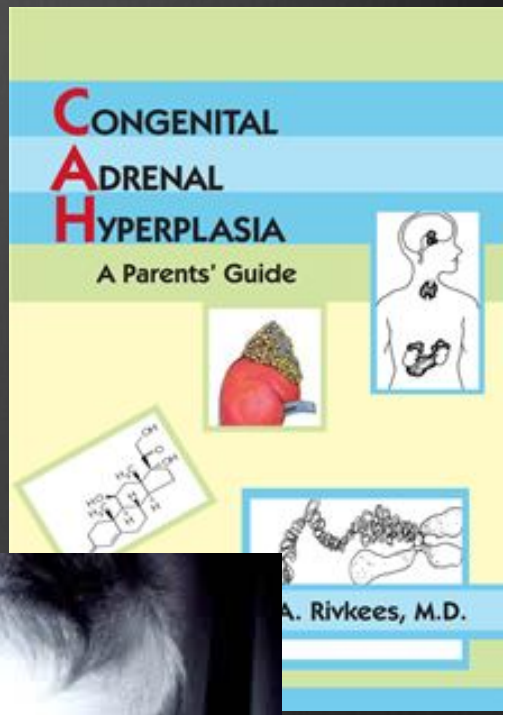


Congenital Adrenal Hyperplasia

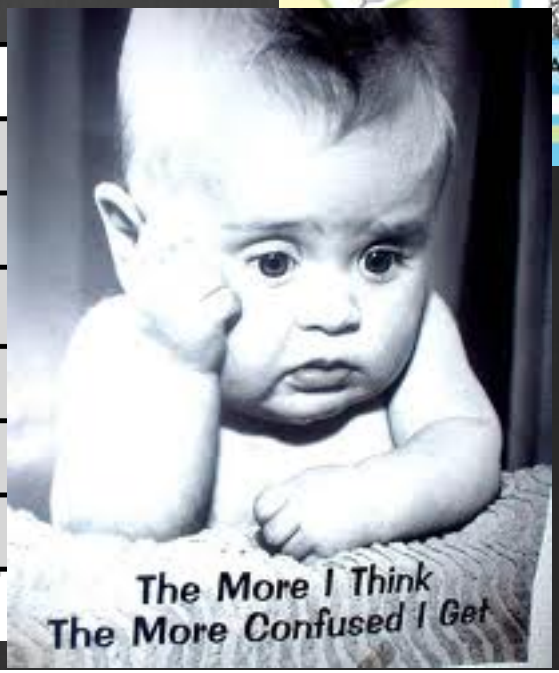
A Parents' Handbook

Dr Ellie Rice
Carey Sentman
Mandi Tembo

Why a Parent's Handbook?



What Matters Most to Patients?	
DEATH	If untimely
DISEASE	Symptoms, Signs, Derangements
DISCOMFORT	Pain, Nausea, Fatigue, Itching, etc.
DISABILITY	Impaired Daily Function
DISSATISFACTION	Sadness, Anger, Depression
DESTITUTION	Financial Burden of Illness

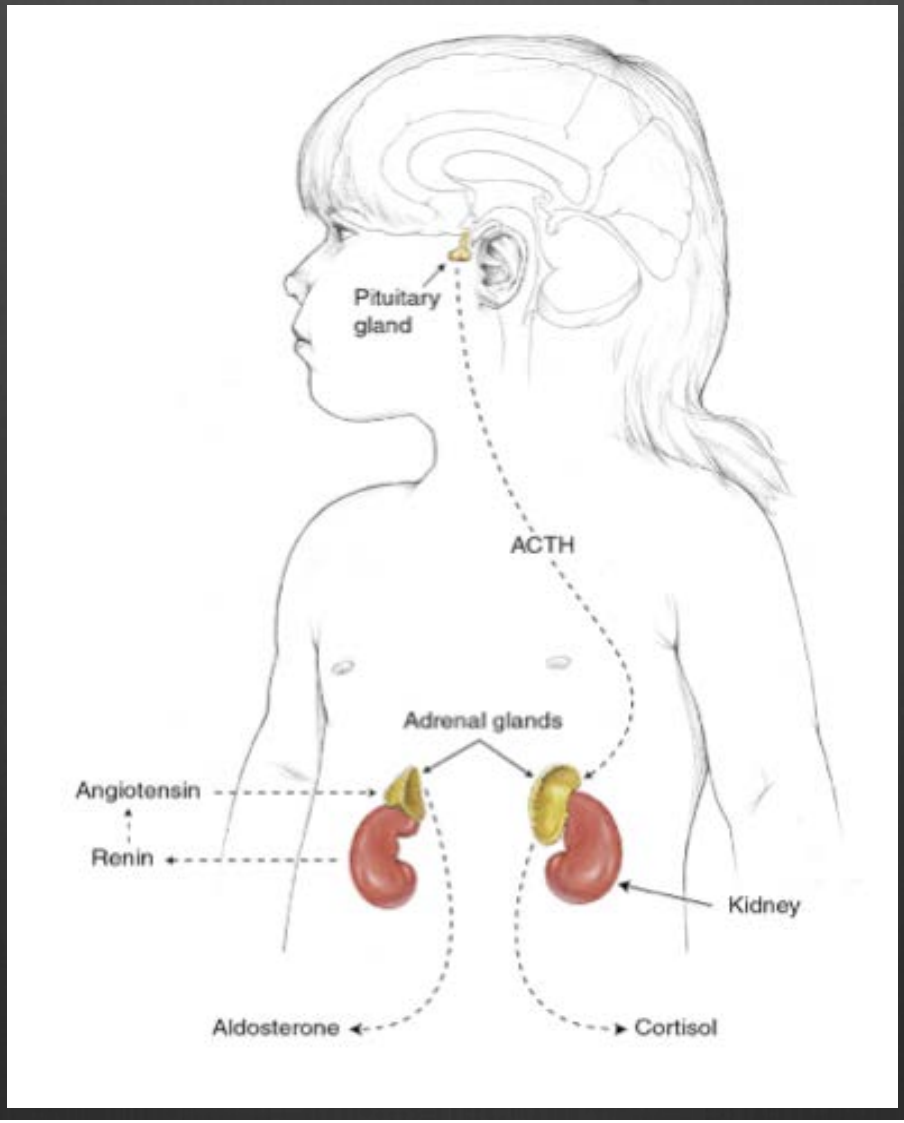


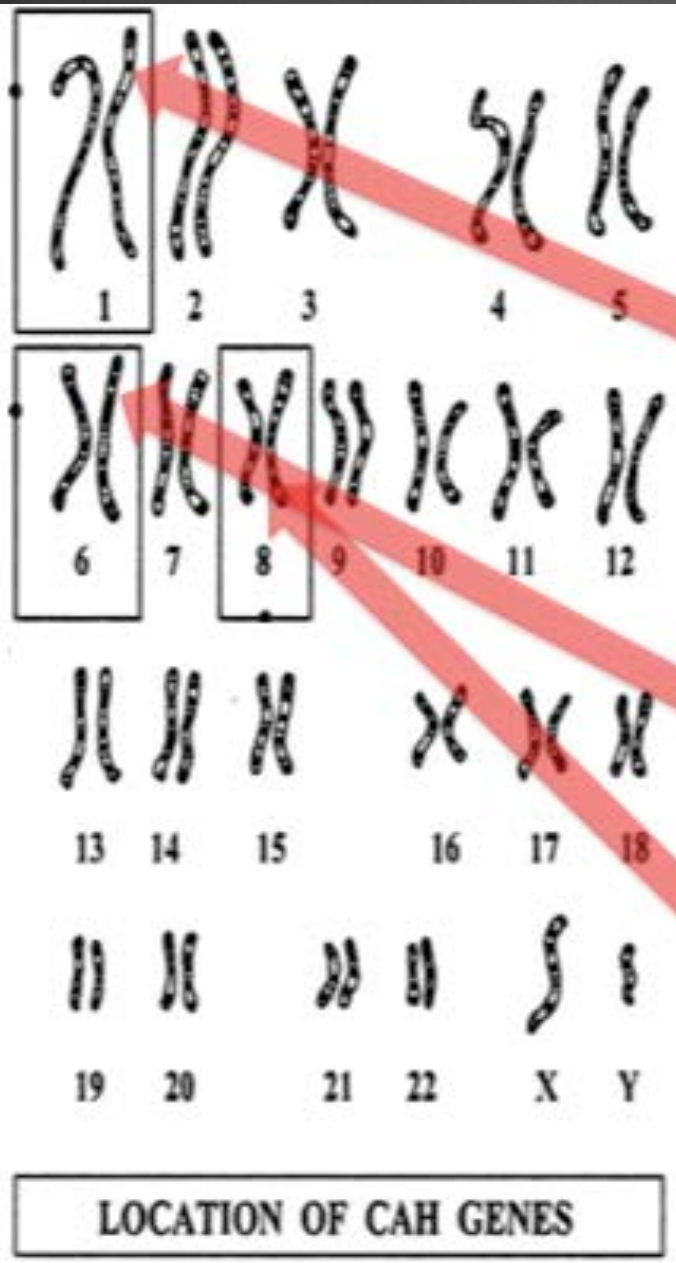
What is Congenital Adrenal Hyperplasia (CAH)?

Congenital – present at birth

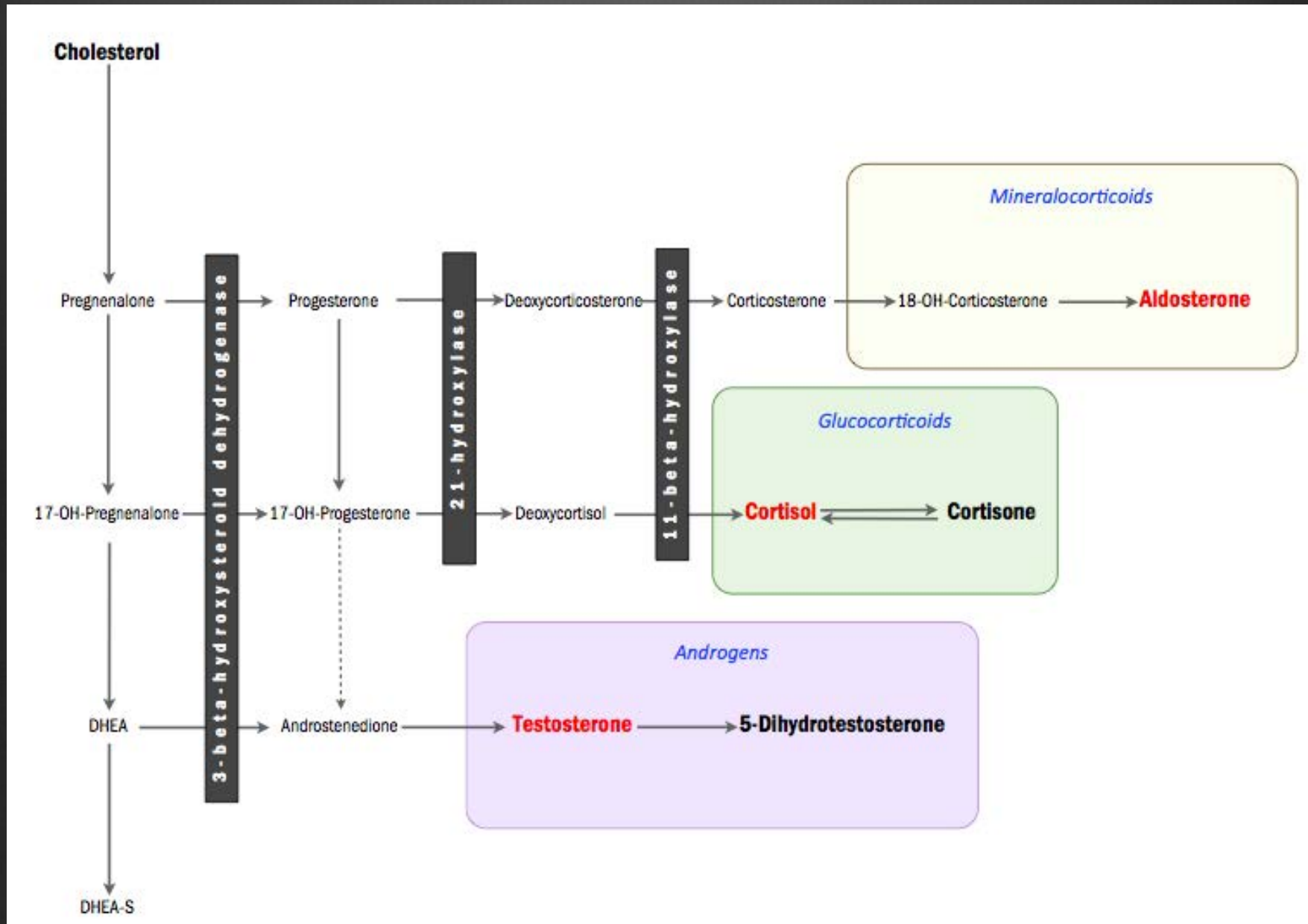
Adrenal – involving the adrenal glands

Hyperplasia – results in overgrown glands

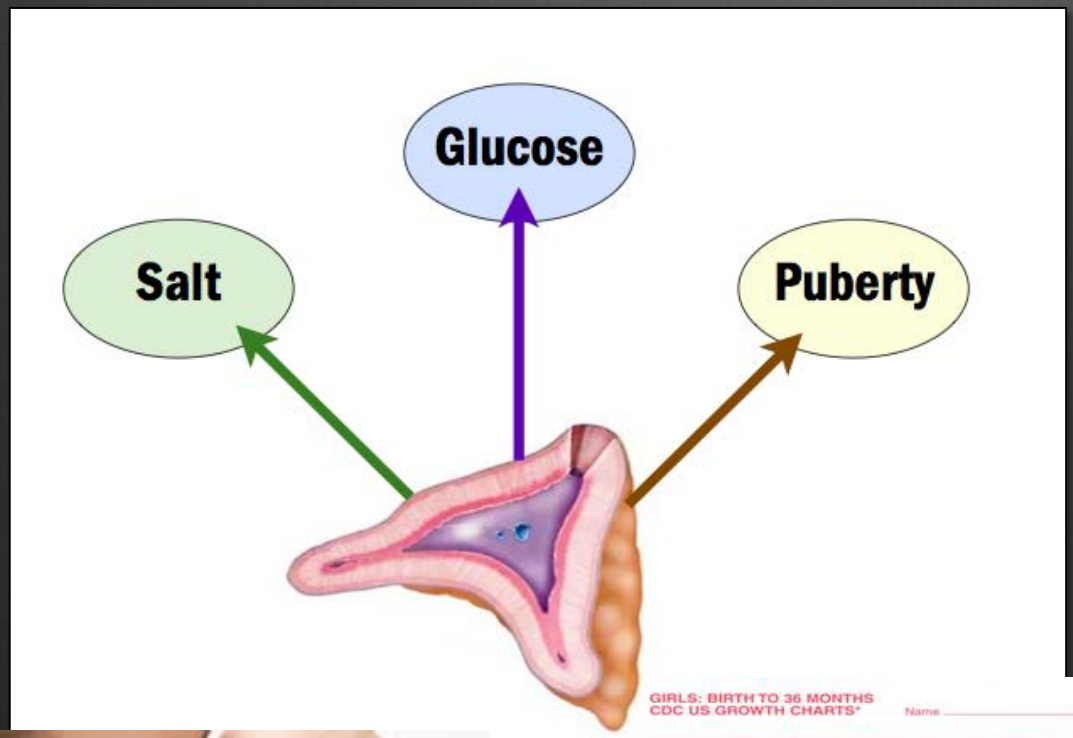


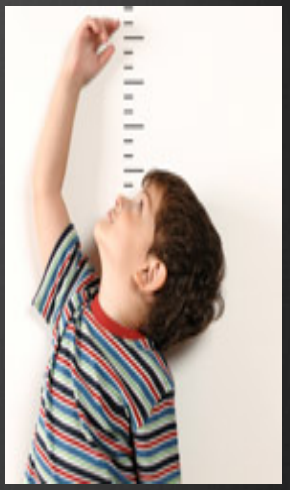


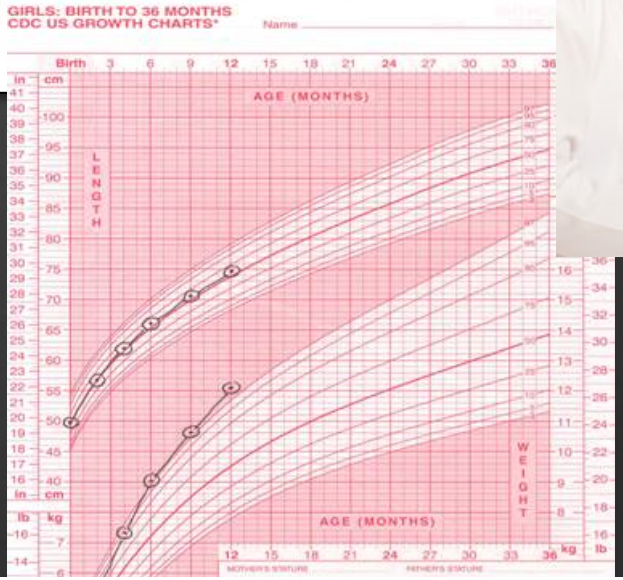
Chromosome	Gene Name	Enzyme Affected
1	HSD3B3	3-Beta Hydroxysteriod Dehydrogenase
6	CYP21	21-Hydroxlase
8	CYP11B1	11-Beta Hydroxylase


Cholesterol
Pregnenalone
Progesterone
Deoxycorticosterone
Corticosterone
18-OH-Corticosterone
Aldosterone
Mineralocorticoids
17-OH-Pregnenalone
17-OH-Progesterone
Deoxycortisol
Cortisol
Cortisone
Glucocorticoids
DHEA
Androstenedione
Testosterone
5-Dihydrotestosterone
Androgens
DHEA-S
3-beta-hydroxysterold dehydrogenase
21-hydroxylase
11-beta-hydroxylase

SYMPTOMS OF CAH



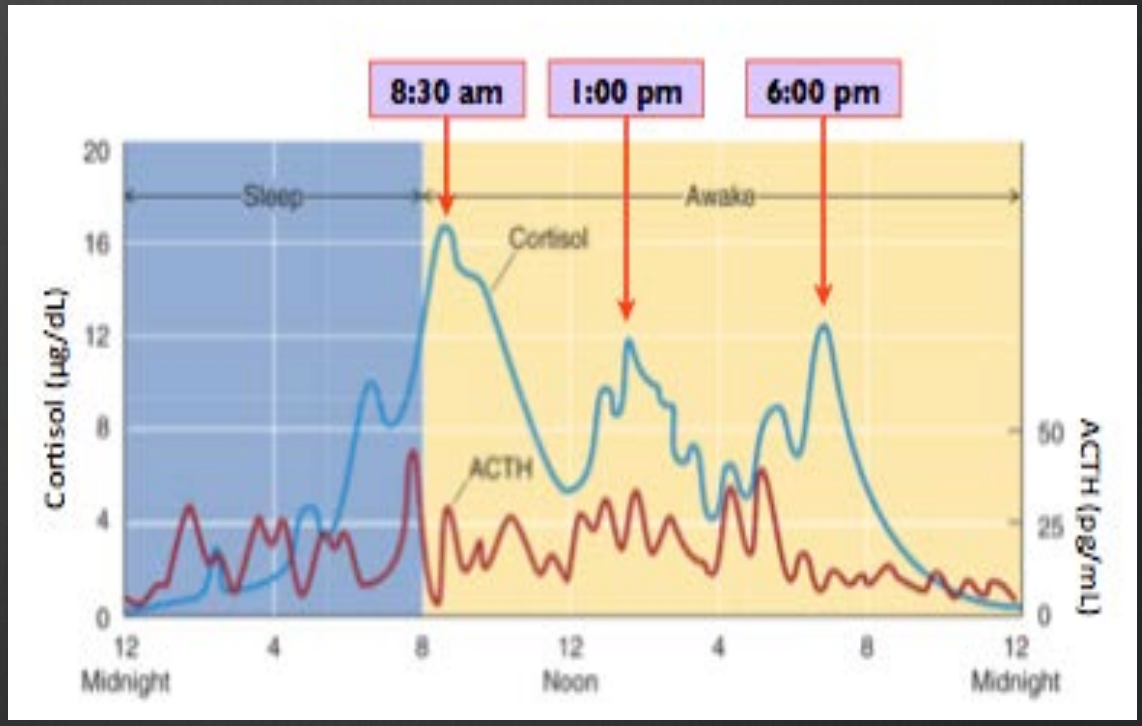




TREATMENT

Treatment is based on the individual and the type of CAH they have. Treatment includes…

- Glucocorticoid Treatment
- Mineralocorticoid Treatment
- Stress Dosing



The Beginning….

- The Clinic for Special Children
- PBH course
- Family Day

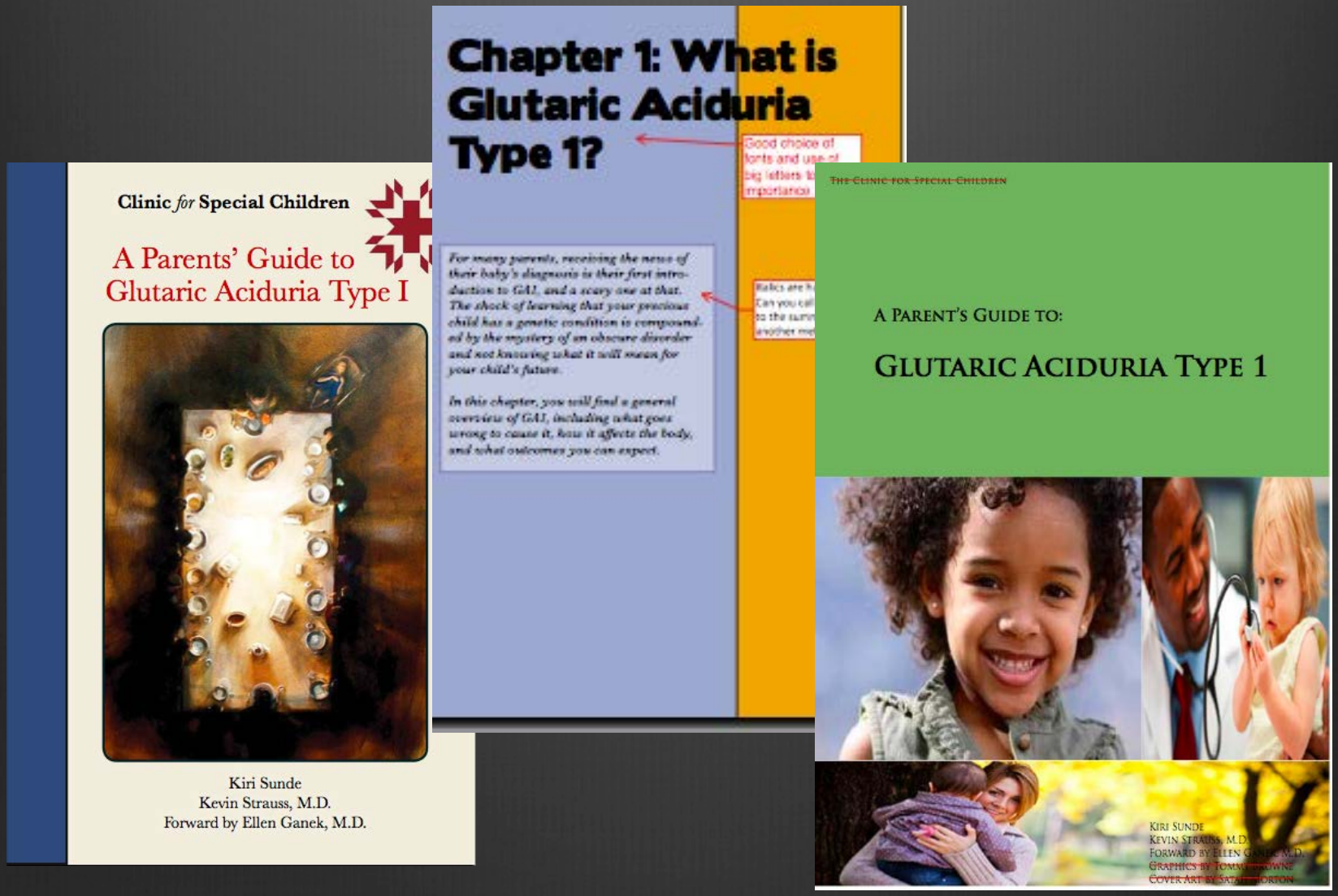
Table of Contents

Ambiguous genitalia: External genitals that do not appear to be clearly male or female, have not fully formed, or appear to be of the opposite sex of the internal sexual organs.

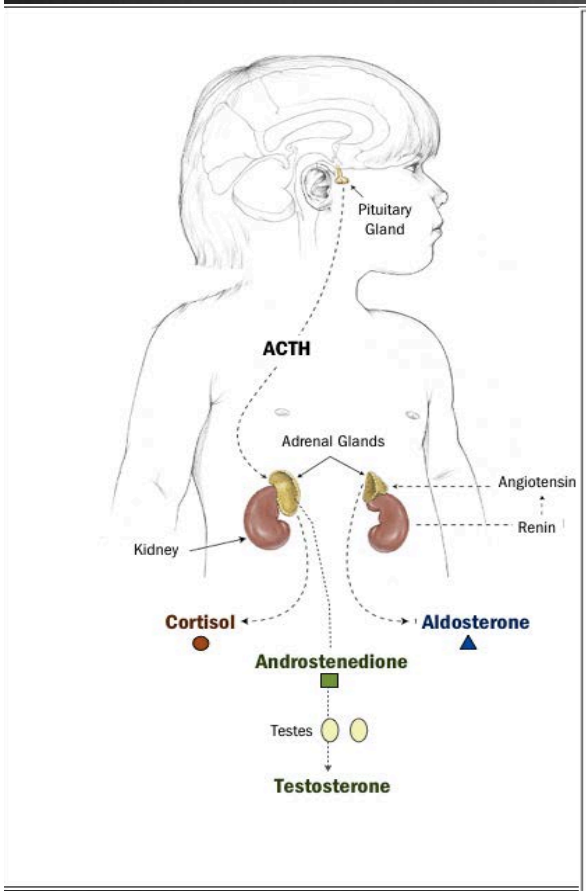
Parent-to-Parent

"When our son was a newborn, he was rushed to the hospital. When we got there the doctor asked if our child was a boy or girl. We didn't understand why he couldn't tell. Why didn't our son look normal? We questioned if we were normal because we had this child."

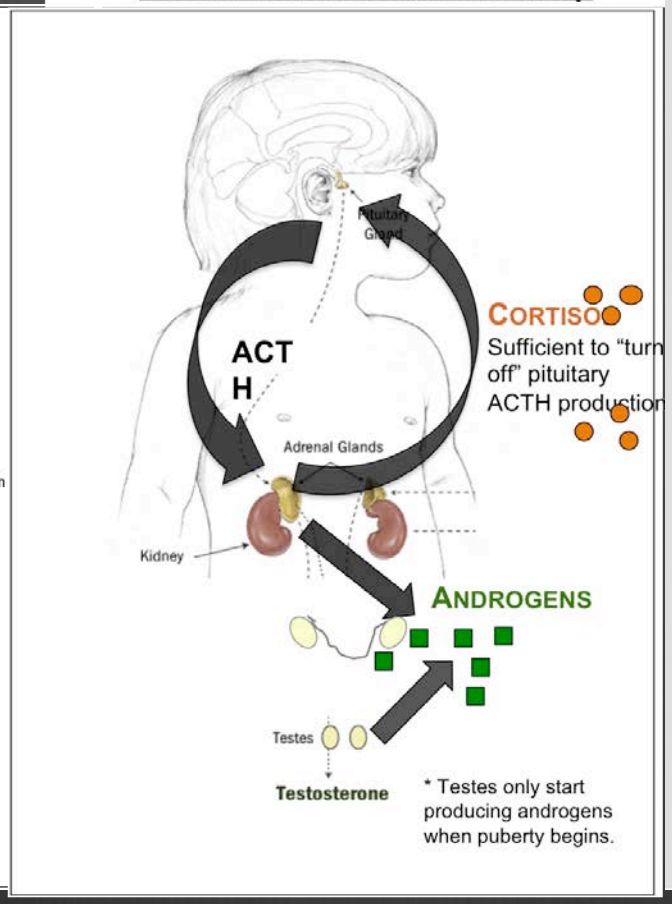
For the Summer….

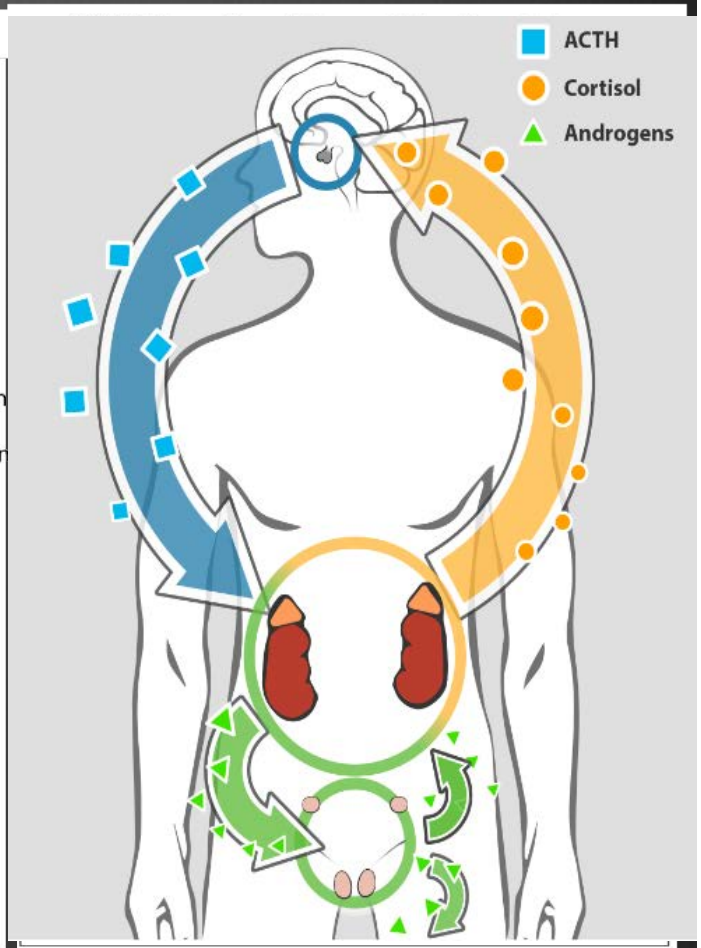


- 6 very different drafts to edit
- Review
- Amish Home Visits
- Design Elements
- Medical Reviews
- Editorial Review



Normal Adrenal Feedback Loop





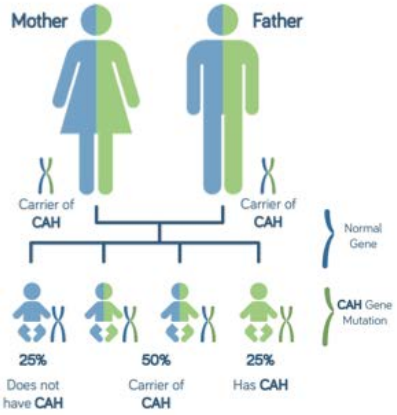


Figure 2.3: Risk chart for having a child with CAH, having a child that is a carrier for CAH, or having a child without CAH. There is 25, or 1 in 4 chance of having a child with CAH with every new pregnancy.

Parent to Parent

"We have 9 kids, and 4 of them have CAH, so it doesn't always turn out 1 in 4"

Frequently Asked Questions

Is newborn screening available for CAH?

Yes, newborn screening is available to help detect CAH, although it may miss some of the more rare variants. Keep in mind, this test only indicates that there may be a problem. A second diagnostic test is needed to confirm if the child has CAH. For more information on newborn screening, refer to Chapter 9.

Is genetic testing available for CAH?

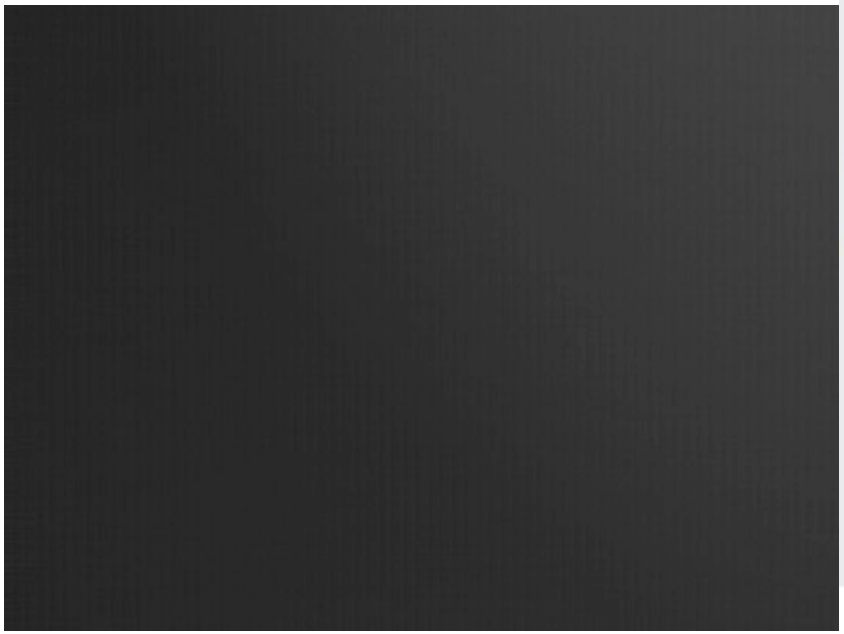
Yes, genetic testing is available to determine the specific gene error in those with CAH. Genetic testing can also determine an individual's carrier status, which can be useful for family planning. Prenatal testing is also available. Please refer to Chapter 8 for more detail.

How common is CAH?

CAH affects about 1 in 15,000 babies born in the United States. However, the condition is more common in certain areas or populations. For instance, in the Amish communities in the United States, more children are born with CAH.

Are boys or girls more likely to have CAH?

Both males and females have an equal chance of developing CAH. The odds of having a child with CAH are based on whether or not the parents are carriers. It has nothing to do with the sex of the child.



What is the Endocrine System?

The **endocrine system** is a group of **glands** and **tissues** that regulate diverse processes such as growth, development, and response to environmental stress. In individuals with CAH, the endocrine system does not work properly, resulting in the hormonal imbalances that cause the symptoms of CAH.

Glands are groups of cells that produce and secrete chemical messengers known as **hormones**. Hormones travel to target **cells**, which then respond to the hormone signal with specific changes in activity. Although different hormones circulate throughout the bloodstream, each one affects only the cells that are able to receive and respond to its message. The same hormone may impact various cells in different ways.

Hormones are the chemical messengers of the body produced and secreted by glands and received by target organs.

The major glands that make up the human endocrine system are the **pituitary, thyroid, parathyroid, pancreas, adrenal** and **reproductive glands**, which include the ovaries in females and the testes in males.

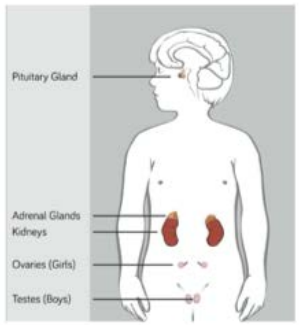


Figure 1.1: The most important glands to consider in CAH are the adrenal glands the pituitary gland, testes in boys and ovaries in girls.

What is the Adrenal Cortex?

Located atop the kidneys, the body has two cone-shaped adrenal glands (Figure 1.1). Each gland has two parts. The outer part, called the **adrenal cortex**, produces steroid hormones, hormones made from the conversion of cholesterol. **Corticosteroids** such as **mineralocorticoids**, **glucocorticoids**, and **androgens** are all termed **steroid hormones** The principle mineralocorticoid is **aldosterone**, which regulates the mineral or salt levels in the body. Glucocorticoids, such as **cortisol**, control the availability of glucose as fuel for the body and regulate the body's overall response to physical stresses such as starvation, dehydration, infection and trauma. Androgens, such as **testosterone**, play an important part in the sexual development of boys and girls.

The adrenal cortex is the outer layer of the adrenal gland that secretes hormones such as cortisol, aldosterone, and androgens.

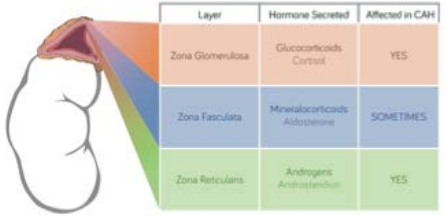
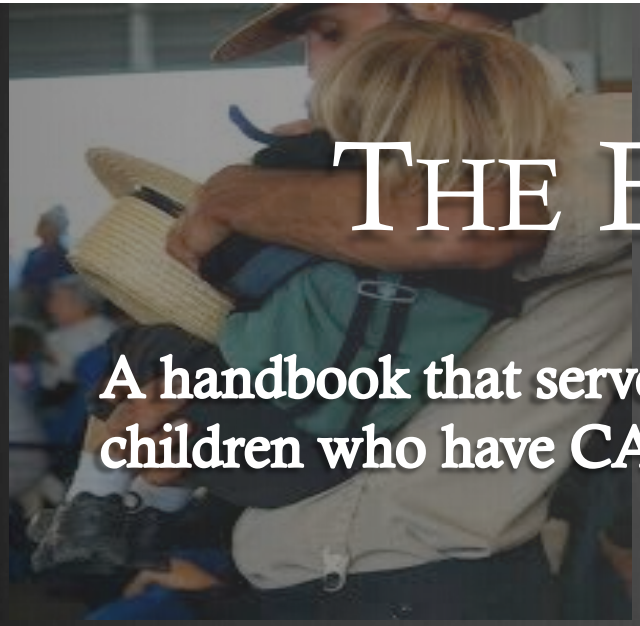


Figure 1.2: The adrenal glands are positioned atop the kidneys. Each adrenal gland is composed of a central medulla and an outer cortex. The adrenal cortex is divided into three layers: zona glomerulosa, zona fascicuta and zona reticularis, which produces and secrete glucocorticoids, mineralocorticoids and androgens respectively. All three classes of hormones are affected in CAH.



The End-Product?

A handbook that serve as a simplified guide for parents with children who have CAH

Symptoms of CAH in Infants

Recognizing the symptoms of CAH during infancy helps diagnose the condition early in life and avoid the life threatening consequences of adrenal crisis. Often newborn screening can identify CAH even before the symptoms of the condition appear (Chapter 8).

Adrenal Crisis

Adrenal crisis is a life-threatening symptom of CAH. It occurs when the body is unable to produce typical amounts of the critical hormones **cortisol** and **aldosterone**, causing low blood pressure. Untreated, low blood pressure can lead to adrenal shock, which involves reduced blood flow to essential organs and dangerously low blood salt and sugar levels (Chapter 6). Adrenal crisis more commonly occurs in individuals with salt-wasting CAH because of the decreased blood flow associated with aldosterone deficiency (Chapter 5).

Signs of Adrenal Crisis:
- Excessive tiredness
- Dizziness
- Pale and sweaty skin
- Rapid heart rate
- Unresponsiveness
- Dry lips
- Infrequent urination

Vomiting, irritability, and lethargy are also common symptoms of adrenal crisis. Often pediatricians misdiagnose vomiting and weight loss as a rejection of the infant's baby formula, leaving CAH unidentified.

Salt-Wasting

In salt-wasting CAH, excessive amounts of sodium and water are lost through urine, causing **dehydration** and low blood pressure. Before infants go into adrenal shock, they often experience less frequent urination, a loss of skin color, and a decline in body temperature. When body temperatures drop below 95°F, children are at risk of **hypothermia**.

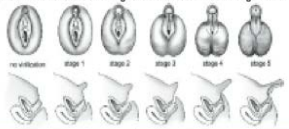
Ambiguous Genitalia

Ambiguous genitalia is a condition in which external sex organs do not appear clearly male or female. It is a common symptom in girls with most forms of CAH and boys with the 3-beta dehydrogenase form of CAH.

In girls with CAH, genitalia can appear male-like, which is known as masculinization. It can range from mild to severe. Doctors use a Prader scale to assess the level of masculinization. Prader level 1 indicates only mild masculinization of the genitalia, whereas a Prader level 5 indicates genitalia that looks male (Figure 3.1).

Ambiguous genitalia: External genitals that do not appear to be clearly male or female, have not fully formed, or appear to be of the opposite sex of the internal sexual organs.

Figure 3.1 Prader Scale showing levels of masculinzation of genitalia.



Girls	Boys	Prader Level
An enlarged clitoris or what appears to be a small penis.	Abnormally small penis, no scrotum.	1
Labia is partly fused. The vagina and urethra open into a single funnel-shaped area.	Abnormally small penis, small scrotum that is separated and looks like a labia.	2
Labia completely fused. Vagina and urethra share a single opening.	Urethral opening nearer to the scrotum.	3
Enlarged labia that resemble scrotum.	Absence of both testicles in what appears to be the scrotum.	4
Concealed vagina, unrecognizable female genitalia.	Somewhat recognizable male genitalia.	5

3 How Will I Recognize the Symptoms of the Condition?

The symptoms of Congenital Adrenal Hyperplasia (CAH) vary throughout an individual's life. Recognizing the symptoms of CAH is not only important in diagnosing the condition, but in monitoring CAH and its treatment as well. This chapter helps parents distinguish between the symptoms their children may develop at various stages of life.

Hyperpigmentation

Hyperpigmentation is an unusual darkening of the skin caused by hormonal imbalances, particularly increased ACTH secretion. ACTH stimulates the production of pigment-producing cells, which give the skin color.

Hyperpigmentation can occur in both boys and girls, and usually is most severe in the genital area. Children are often born with hyperpigmentation or develop it a few days after birth. It is a common way to identify CAH in children who do not show signs of ambiguous genitalia. Hyperpigmentation can also be a sign of under-treatment of glucocorticoids (Chapter 4).

Parent-to-Parent

"When our daughter was born, I knew right away she must have CAH. She had the same darker coloring as her brother."

Hyperpigmentation

Darkening of the skin due to high ACTH levels. In cases of CAH, this usually occurs in the genitals.

Symptoms of CAH in Older Children

Most children show signs of CAH in infancy. Those who do not show signs until early childhood (3-10 years old) usually have non salt-wasting CAH. However, those with late-onset CAH (discussed in next section) may also start to show symptoms at this age. Many of the symptoms discussed in this section are similar to those experienced by patients who are over or under treated with glucocorticoids (Chapter 4).

Early-Onset Puberty

Early-Onset Puberty, puberty that begins earlier than it should, occurs due to an excess of androgens in children with CAH. Androgens control the development of masculine characteristics and trigger changes during puberty, such as the development of pubic hair, under arm hair, body odor, and acne. Puberty usually begins around ages 10-13, whereas early-onset puberty can begin as early as 3 to 4 years of age. Males may experience an enlargement of the penis while females may experience an enlargement of the clitoris (Chapter 7).


Thank You!!!