Adrenal Disorders

What Are Adrenal Disorders?

In order to help you best understand adrenal disorders, let's first find out what adrenal glands are before learning about their disorders. The adrenal glands are two small structures that sit on top of the kidneys, deep in the back, behind the abdominal cavity and well beneath the back muscles. Although they are small, usually weighing about a tenth of an ounce apiece, they are powerful factories that make many hormones that are critically important to health and well being.

The adrenals are divided into an outside layer called the cortex and an inner layer called the medulla. Cells in the adrenal cortex make steroid hormones derived from cholesterol, including glucocorticoids (cortisol), mineralocorticoids (aldosterone) and androgrens. The medulla makes catecholamines (adrenaline).

Each of these hormones have specific functions in the body.

CORTISOL

This hormone is necessary to sustain all cells and to respond to physical stress. A deficiency of cortisol leads to subtle but serious malfunction in the chronic state, and to shock and even death in the emergency state.

ALDOSTERONE

This mineralocorticoid is necessary to keep the balance of sodium and potassium in the body and to help maintain blood pressure.

ANDROGENS

These hormones promote the growth of axillary (underarm) and pubic hair in both males and females. In the male after puberty, adrenal androgens are a very small part compared to the strong androgen testosterone, which comes from the testes. In the female, adrenal androgens are the major androgens. An excess of androgens in females can cause excess facial and body hair, acne, thinning of scalp hair and in great excess can cause deepening of the voice and muscle enlargement.

CATECHOLAMINES

These hormones, adrenaline and noradrenaline are the "fight or flight" hormones. They control the caliber of blood vessels in the skin, muscles and internal organs as well as regulating the strength and speed of the heartbeat. In stressful situations, their output is increased and leads to rapid pulse, higher blood pressure, shakiness, sweating, pallor or blanching of the skin.

Disease can result from excess or deficiency of the adrenal hormones.

Signs & Symptoms

How do you know if you have an adrenal problem?
Adrenal diseases, fortunately, are quite rare and many of the symptoms of adrenal disease are also found in other medical diseases and even in healthy people. From the symptoms described above, it is likely that many of us might qualify for testing. Testing for adrenal diseases is quite complicated; and, if there is any doubt, an endocrinologist should be consulted to determine the likelihood of over or underfunction of the adrenal gland or a tumor of the adrenal.

How are diagnoses of adrenal disorders made?
The hormones produced by the adrenal gland can all be measured by blood (and sometimes urine or salivary) testing. If certain chemical abnormalities are found, it is sometimes necessary to perform imaging of the adrenal gland with a CAT scan, MRI or specialized nuclear scans. When "secondary" adrenal disease is found, further testing of the pituitary gland in the brain will be necessary (see pituitary section). It is extremely important to consult an expert endocrinologist who can order the appropriate tests and interpret them correctly.

Conditions

CUSHING'S SYNDROME

An excess of cortisol characterizes this condition, which may be caused either by a specific kind of pituitary (brain) tumor that stimulates the adrenal glands to produce excess cortisol or by a tumor of the adrenal gland itself, which overproduces the hormone. More rarely, other non-pituitary tumors overstimulate the adrenal glands.

The symptoms of Cushing's disease include lack of menses in women, an increase in fat deposition in specific locations in the body (face, upper back, above the collar bones and in the abdomen), high blood pressure,

easy bruisability, weakening of the bones with osteoporosis and fracture, muscle weakness and thin skin with acne and dark purple stretch marks (striae). Most cases of Cushing's syndrome result in an excess of cortisol alone, while rarely combined with an excess of androgen or mineralocorticoid (see below).

HYPERALDOSTERONISM

Most cases of this condition are caused by benign tumors of the adrenal, which overproduce aldosterone leading to high blood pressure and loss of the mineral potassium, which, if severe, can cause muscle weakness and kidney problems. About a third of cases are caused by overfunction (hyperplaisia) rather than a tumor of these cells.

ADRENAL HYPERPLASIA

All adrenal cortical hormones are produced by a series of biochemical steps. Each step requires an enzyme to act as a catalyst to make the process proceed. Adrenal hyperplasia refers to a number of genetic deficiency states in which one of these enzymes is either missing or significantly reduced. This leads to a reduction in the production of that enzyme and a "build-up" of the chemicals before that enzyme step. These chemicals are then "shunted" through other pathways, much like traffic detouring a roadblock. The products of these detour pathways are then produced in excess. Depending on which enzyme is decreased, there is then a pattern of an excess of certain adrenal hormones with a deficiency of others.

Although these disorders are genetic, some are apparent at birth, while others do not appear until later in development, usually around the time of puberty.

The most common of these, called 21 hydroxylase deficiency, may be present at birth with "ambiguous genitalia" in females because of an excess of adrenal androgens, whereas male genitalia are normal. In both genders, some varieties of this disorder include a reduction in mineralocorticoids, which results in low blood pressure, low body sodium and excess potassium. In older children, there can be accelerated growth rate, but a shorter growing period, leading to short stature. In girls, signs of excess androgens, including acne, facial hair, deepening of the voice, and increased muscle mass, are present. If the disorder is not apparent during childhood, signs are often present around the time of puberty, including absent or irregular menstrual periods and signs of androgen excess.

A more rare form of adrenal hyperplaisia is caused by deficiency of the enzyme11 hydroxylase enzyme, which leads to increased androgens and excess mineralocorticoid activity that causes high blood pressure and loss of potassium.

PHEOCHROMOCYTOMA

This is a tumor of the adrenal medulla, which overproduces adrenaline and noradrenaline leading to high blood pressure which may be continuous or intermittent. There may be fast heartbeat with palpitations, weight loss, sweats, blanching or flushing, headache and chest pain. Although fewer than 0.1% of all people with high blood pressure harbor this tumor, under certain circumstances, testing is important to rule out this disorder, since it can cause fatalities because of "crisis" consisting of severe hypertension and heart arrhythmia. Pheochromocytomas occur more frequently in people with rare hereditary disorders, including multiple endocrine neoplaisia type 2 (MEN 2), VonHippel Lindau disease and Neurofibromatosis. Genetic testing is available for these disorders and for family members of affected patients.

ADDISON'S DISEASE

Insufficiency of the hormones of the adrenal gland may occur as a result of disease in the adrenal gland itself (primary adrenal insufficiency) or as a result of failure of the pituitary gland to adequately stimulate the production of adrenal hormones (secondary adrenal insufficiency).

In both cases, inadequate cortisol is produced, leading to weakness, fatigue, vague abdominal pain, sometimes with nausea and vomiting, low blood pressure, dizziness and sometimes fainting. People with inadequate cortisol fail to respond well to physical stress such as injury, anaesthesia, surgery or other medical illnesses and can develop "adrenal crisis" in these situations. This is characterized by profound weakness, low blood pressure, dehydration, shock and, ultimately, death if untreated.

If the adrenal gland itself is diseased, there is also failure to produce aldosterone, which makes the low blood pressure even worse and results in loss of sodium and water and accumulation of excess potassium. In primary adrenal insufficiency, there may be excess pigmentation of the skin, particularly in areas of skin creases, as well as in the gums and inside lining of the mouth. When the disorder is due to pituitary failure, mineralocorticoid deficiency and pigmentation do not occur.

The most common cause of primary adrenal failure is an attack by the immune system on the cells of the adrenal cortex (autoimmune disease) and this disorder is seen more frequently in people with other autoimmune diseases, including chronic thyroiditis, type 1 diabetes, hypoparathyroidism, pernicious anemia, myasthenia gravis and systemic lupus erythematosis (SLE). Adrenal failure may also occur as a result of infection of the adrenal gland with tuberculosis, mycobacterium avarium intracellulare (MAI), fungi such as histoplasmosis, and viruses, including cytomegalovirus (CMV). It occurs more

commonly in patients with HIV, as a result of either the virus itself or the "opportunistic infections" listed above which occur in this population.

ADRENAL TUMORS

What if a tumor is found on my adrenal gland on a CAT scan?
Tests of the blood and sometimes urine should be performed to see if the tumor is oversecreting any of the adrenal hormones. Specialized CAT scans and MRIs often yield clues about whether a tumor is benign or malignant. Remember that fewer than 10% of adrenal tumors over-secrete hormones, and less than 1/1000 are cancerous. The rest may be safely observed.

Adrenal tumors may be either benign or malignant, functional (hormone-secreting) or non-functional (not hormone-secretory). Malignant tumors compise less than 0.1% of all adrenal tumors and may secrete cortisol, androgens, mineralocorticoids or more than one type of hormone or no hormones at all. Benign tumors secrete only one type of hormone, with cortisol being more common than catecholamines or aldosterone (least common).

Most adrenal tumors are non-functional. In fact, as many as 8-10% of us have adrenal nodules, which are seen on imaging studies done for other reasons or found at autopsy. If an adrenal nodule is found, it is very important to make sure that it is not a pheochromocytoma because of the serious, even fatal, consequences of not treating this rare type of tumor. Pheochromocytomas make up only 3% of all incidentally found tumors, while Cushing's syndrome tumors (cortisol-producing) account for 7% and aldosterone-secreting tumors about 0.5%. The rest are non-secretory. Small non-secretory tumors do not require treatment, whereas tumors should be removed to make sure they are not malignant.

Treatment

What should you do if you are found to have an adrenal disease?
Adrenal diseases are very treatable, but because the treatment may be complicated, supervision by an expert endocrinologist is crucial.

When adrenal surgery is necessary, your endocrinologist can direct you to a surgeon who specializes in surgery on this gland. Often, though not always, these operations can be performed laparascopically in select institutions.

How are adrenal disorders treated?
Once a diagnosis is made, the correct treatment can be instituted.

In cases where hormones are missing, there are pills which can replace them.

If you have adrenal insufficiency, your endocrinologist will prescribe cortisone, and usually a synthetic mineralocorticoid if you have primary adrenal insufficiency.

It is important never to miss your medicine and to wear an ID tag so that emergency personnel can give you correct medication in an acute situation if you are unable to speak for yourself.

In acute stress, it is important to receive much higher doses of cortisone than the usual daily maintenance dose (stress dose steroids). Failure to receive stress doses can result in serious disease and death.

In cases of adrenal hyperplasia, treatment with cortisone or synthetic corticosteroids will restore normal levels and reduce the output of excess abnormal hormones. This should be done under the direct supervision of an endocrinologist to avoid excess therapy and make sure the correct balance is being maintained.

Hyperaldosteronism usually requires surgery if it is caused by a tumor, but is treated with medication if no tumor is found.

Tumors of the adrenal gland or pituitary gland should be treated only by experienced surgeons. Your endocrinologist can refer you to the appropriate surgeon in your area.

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