

## Action of Steroid Hormone and it's Function

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### DESCRIPTION

Steroid hormones, a class of lipophilic molecules derived from cholesterol, play a pivotal role in regulating various physiological processes in the human body. These hormones include sex hormones like estrogen, progesterone, and testosterone, as well as corticosteroids like cortisol and aldosterone. The action of steroid hormones is highly orchestrated and involves intricate processes, including hormone synthesis, transport, receptor binding, and gene expression regulation. In this article, we will delve into the complex mechanisms of steroid hormone action.

### Steroid hormone synthesis

The synthesis of steroid hormones primarily occurs in specialized endocrine glands. For example, the adrenal cortex produces cortisol and aldosterone, while the gonads (testes in males and ovaries in females) synthesize sex hormones. The first step in steroid hormone production is the conversion of cholesterol into pregnenolone, a precursor molecule. This process, known as cholesterol side-chain cleavage, is facilitated by the enzyme CYP11A1.

After pregnenolone is produced, it serves as the starting point for the synthesis of various steroid hormones. Different enzymes, present in specific endocrine glands, catalyze subsequent reactions to convert pregnenolone into cortisol, aldosterone, estrogen, progesterone, or testosterone. The specificity of these enzymes determines the type of steroid hormone produced.

### Steroid hormone transport

Once synthesized, steroid hormones are transported in the bloodstream bound to carrier proteins, primarily globulins. This binding to carrier proteins allows steroid hormones to be soluble in the aqueous environment of blood, increasing their stability and prolonging their half-life. For example, sex hormones like estrogen and testosterone are often bound to sex hormone-binding globulin or albumin.

Only a small fraction of steroid hormones in the blood is in the free, unbound form. This free fraction is biologically active and can diffuse into target cells to exert their effects. The binding

affinity of steroid hormones to carrier proteins can impact their availability for target tissues.

### Steroid hormone receptor binding

The actions of steroid hormones are mediated by their binding to specific intracellular receptors, known as nuclear receptors. These receptors are located in the cytoplasm or nucleus of target cells. When a steroid hormone binds to its receptor, it induces a conformational change in the receptor protein, allowing it to translocate to the nucleus.

Within the nucleus, the hormone-receptor complex binds to specific regions of DNA called hormone response elements. This binding initiates a cascade of events that regulate gene expression. Steroid hormones act as transcription factors, influencing the rate at which specific genes are transcribed into messenger RNA.

### Gene expression regulation

Steroid hormone receptors regulate gene expression through a process known as transactivation. In the case of activation, hormone-receptor complexes enhance gene transcription by recruiting co-activator proteins and facilitating the assembly of the transcription machinery.

On the other hand, steroid hormone receptors can also inhibit gene transcription through a process called trans-repression. This involves the recruitment of co-repressor proteins that prevent the activation of specific genes.

The outcome of steroid hormone receptor binding depends on various factors, including the target tissue, the specific receptor isoform, and the presence of other cofactors. This complexity allows steroid hormones to exert precise and tissue-specific effects throughout the body.

### Steroid hormone action in health and disease

Steroid hormones are involved in numerous physiological processes and have profound effects on health. For instance:

**Reproductive health:** Sex hormones regulate the development

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of secondary sexual characteristics, the menstrual cycle, and fertility. Imbalances in sex hormones can lead to conditions like polycystic ovary syndrome or infertility.

**Metabolism and stress response:** Corticosteroids like cortisol influence metabolism, immune function, and the body's response to stress. Dysregulation of cortisol levels can result in conditions such as Cushing's syndrome or Addison's disease.

**Bone health:** Sex hormones, particularly estrogen, play a vital role in maintaining bone density. Reduced estrogen levels during menopause can lead to osteoporosis.

**Immune regulation:** Some steroid hormones, such as glucocorticoids, have anti-inflammatory and immunosuppressive effects. These properties are exploited in the treatment of autoimmune diseases and allergies.

In addition to their role in health, steroid hormone dysregulation is associated with various diseases. Hormone receptor mutations,

altered synthesis pathways, or imbalances in hormone levels can contribute to conditions such as breast cancer (related to estrogen), prostate cancer (related to testosterone), and adrenal disorders (related to cortisol and aldosterone).

## CONCLUSION

Steroid hormones are essential players in the orchestration of physiological processes throughout the human body. Their actions are tightly regulated, involving synthesis, transport, receptor binding, and gene expression regulation. Understanding the complex mechanisms of steroid hormone action is not only fundamental to normal physiology but also critical for diagnosing and treating a wide range of health conditions and diseases. Advances in this field continue to uncover new insights into the intricacies of steroid hormone action and its role in maintaining health and well-being.