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## Hormonal (endocrine) system

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### Summary

- Endocrine glands secrete hormones straight into the bloodstream.
  - Hormones help to control many body functions, such as growth, repair and reproduction.
  - The endocrine system involves many organ systems and hormones, many of which are still being investigated and understood.
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Endocrine glands make chemicals called hormones and pass them straight into the bloodstream. Hormones can be thought of as chemical messages.

From the blood stream, the hormones communicate with the body by heading towards their target cell to bring about a particular change or effect to that cell. The hormone can also create changes in the cells of surrounding tissues (paracrine effect). The endocrine system works with the nervous system and the immune system to help the body cope with different events and stresses.

This branch of medicine – relating to the study of the endocrine system – is called endocrinology and is practiced by endocrinologists. The field is rapidly expanding due to understanding of the cellular pathways that hormones stimulate and the discovery of new hormones and their actions.

### Exocrine glands

An exocrine gland, unlike an endocrine gland, is a gland that secretes substances (electrolytes, proteins or enzymes) straight to a target site via ducts or tube. Some examples include:

- Salivary glands
- Sweat glands
- Sebaceous glands
- The pancreas.

The pancreas is both an endocrine and exocrine organ. It releases certain enzymes to aid in digestion delivered to the gut via the pancreatic duct. The endocrine pancreas also releases hormones such as insulin and glucagon, which are hormones predominantly related to glucose metabolism, into the blood stream.

### Functions of the endocrine system

Some of the roles of the endocrine system include:

- Growth
- Repair
- Sexual reproduction
- Digestion
- Homeostasis (constant internal balance).

### How hormones work

A hormone will only act on a part of the body if it 'fits'. A hormone can be thought of as a key, and its target site

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(such as an organ) has specially shaped locks on the cell walls. If the hormone fits the cell wall, then it will work.

The hormones can set off a cascade of other signaling pathways in the cell to cause an immediate effect (for instance, insulin signaling leads to a rapid uptake of glucose into muscle cells) or a more delayed effect (glucocorticoids bind to DNA elements in a cell to switch on the production of certain proteins, which takes a while to produce).

The endocrine system is a tightly regulated system that keeps the hormones and their effects at just the right level. One way this is achieved is through 'feedback loops'. The release of hormones is regulated by other hormones, proteins or neuronal signals.

The released hormone then has its effect on other organs. This effect on the organ feeds back to the original signal to control any further hormone release. The pituitary gland is well known for its feedback loops.

## Endocrine glands and organs

The main glands and organs of the endocrine system include:

- **Pituitary gland** – is inside the brain. It oversees the other glands and keeps hormone levels in check. It can bring about a change in hormone production somewhere else in the system by releasing its own 'stimulating' hormones. The pituitary gland is also connected to the nervous system through part of the brain called the hypothalamus. The hormones released by the pituitary gland are gonadotropins (LH and FSH), growth hormone (GH), thyroid stimulating hormone (TSH), adrenocorticotrophic hormone (ACTH), prolactin, antidiuretic hormone and oxytocin.
- **Thyroid gland** – sits in the neck at the front of the windpipe. It releases thyroid hormone (T4 and T3) which is required for metabolism and body homeostasis. It is controlled by TSH which is produced by the pituitary gland through a feed-back loop.
- **Parathyroid gland** – there are usually four parathyroid glands which lie alongside the thyroid gland. The parathyroid gland is involved in calcium, phosphate and vitamin D regulation.
- **Adrenal glands** – there are two adrenal glands which sit on top of each kidney. They make a number of different hormones. The outside part of the gland (adrenal cortex) makes cortisol, aldosterone and sex hormones. The centre of the adrenal gland (adrenal medulla) makes adrenaline. Adrenaline is an example of a hormone that is under the control of the nervous system.
- **Pancreas** – an organ of digestion which is inside the abdomen. It makes insulin, which controls the amount of sugar in the bloodstream. It also makes other hormones such as glucagon and somatostatin.
- **Ovaries** – are inside the female pelvis. They make female sex hormones like oestrogen.
- **Testes** – they hang in the male scrotal sack. They make male sex hormones like testosterone.

Other lesser known endocrine organs include:

- **Adipose tissue (fat tissue)** – is recognised to be metabolically important. It releases hormones such as leptin, which affect appetite, and is also a site of oestrogen production. Insulin also acts on adipose tissue.
- **Kidneys** – produce erythropoietin (EPO) which stimulates red blood cell production, produce renin which is needed for blood pressure regulation and produce the active form of Vitamin D (1–25 dihydroxy vitamin D3)
- **Gut** – an increasing number of hormones in the gut are being researched and being understood to effect metabolism and appetite. Included are glucagon-like peptide 1 (GLP–1), ghrelin which stimulates appetite, and somatostatin.

## Problems of the endocrine system

Numerous problems can occur in the endocrine system. These can be considered as excessive or deficient hormone production. Endocrine organs are also prone to tumours (adenomas) which can over produce hormones. Some problems of the endocrine system include:

- **Diabetes** – too much sugar in the blood caused by problems with insulin production. This includes type 1 diabetes (deficiency of insulin) and type 2 diabetes (initially excessive, then deficiency, of insulin).

- **Menstruation abnormalities** – irregular menstruation or lack of menstruation. Some causes of this include polycystic ovarian syndrome (PCOS), pituitary adenoma or primary ovarian failure (POF).
- **Thyroid problems** – when the gland is overactive (hyperthyroidism) or underactive (hypothyroidism). Thyroid nodules are common but thyroid cancers are rare.
- **Parathyroid problems** – an enlargement or one of more of the parathyroid glands can lead to high calcium levels in the blood (hypercalcemia).
- **Pituitary adenomas** – these are tumours of the pituitary gland that can make too much of a certain hormone or cause deficiencies of hormones. These tumours can be small (microadenomas) or large (macroadenomas).
- **Neuro-endocrine tumours** – these are rare to tumours of certain endocrine glands (usually the adrenal gland, pancreas or small bowel). These can include too much adrenaline released by the adrenal gland (pheochromocytoma), or too much hormone 5-HIAA from a carcinoid tumour which causes diarrhoea and flushing.

### Where to get help

- Australian Pituitary Foundation Tel. 1300 331 807
- Thyroid Australia Tel. (03) 9888 2588
- Diabetes Australia Tel. 13 RISK (13 7475)
- Unicorn Foundation (for neuro-endocrine disorders) Tel. 1300 CURE NETS (2873 6387)
- **Andrology Australia** Tel. 1300 303 878
- Australian Menopause Society Tel. (07) 4642 1603
- Jean Hailes for Women's Health Tel. 1800 JEAN HAILES (532 642)

### Things to remember

- Endocrine glands secrete hormones straight into the bloodstream.
- Hormones help to control many body functions, such as growth, repair and reproduction.
- The endocrine system involves many organ systems and hormones, many of which are still being investigated and understood.

**This page has been produced in consultation with and approved by:**

Australian Pituitary Foundation and St Vincent's Hospital

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