Clinical background

Endocrinology is the study of endocrine hormones and of the organs involved in endocrine hormone release. Classically, hormones have been described as chemical messengers, released and having their actions at distant sites. It is now clear, however, that there is a close relationship between hormones and other factors such as neurotransmitters and growth factors acting in a paracrine or autocrine fashion. Hormones are essential for the maintenance of normal physiological function and hormonal disorders occur at all stages of human life. Clinical endocrinologists thus look after patients of all ages and with a very wide range of disorders (Fig. 1a).

The principal endocrine glands

The brain is the controller of the nervous system, but it is also one of the most important endocrine glands. Specialized nerve cells, notably in the hypothalamus, synthesize hormones which are transported along the axon to the nerve terminal. Here they are released into the portal blood system, which carries them to the pituitary gland. In some cases, the axon of the neuroendocrine cell projects down to the pituitary cell itself. The principal hypothalamic neurohormones are:

1 corticotrophin-releasing hormone (CRH), controls the release of ACTH;
2 dopamine inhibits prolactin release;
3 growth-hormone-releasing hormone (GHRH) causes growth hormone release;
4 somatostatin inhibits growth hormone release;
5 gonadotrophin-releasing hormone (GnRH) causes luteinizing hormone (LH) and follicle-stimulating hormone (FSH) release;
6 thyrotrophin-releasing hormone (TRH) causes thyroid-stimulating hormone (TSH) release;
7 oxytocin causes milk ejection and contraction of the uterus in labour – it is synthesized in the hypothalamus and is stored in and released from the posterior pituitary gland;
8 vasopressin (antidiuretic hormone, ADH) promotes water reabsorption from the kidney tubules – it is synthesized in the hypothalamus, and stored in and released from the posterior pituitary gland.

The pituitary gland is composed of two lobes, anterior and posterior, which arise from different embryological origins – the anterior originates from the embryonic oral cavity and the posterior from the base of the brain (i.e. a neural origin). The two lobes become closely apposed to each other to form the pituitary gland. Humans have a non-functional intermediate lobe, which is much larger in some other animals. The principal hormones of the pituitary are:
The endocrine pancreas consists of islet cells scattered in the larger exocrine pancreas, which lies posteriorly in the upper abdomen. ('Exocrine' refers to glands which have ducts, and which are not covered in this book.) The endocrine pancreas secretes:

1 insulin, which regulates glucose and lipid metabolism;
2 glucagon, a counter-regulatory hormone to insulin that elevates blood glucose;
3 somatostatin, which regulates gastrointestinal motility;
4 pancreatic polypeptide, which regulates gastrointestinal secretion.

The ovary is the major female reproductive gland, and produces:
1 estrogens, which regulate reproductive function and secondary sexual characteristics;
2 progesterone, which stimulates endometrial vascularization and maintains pregnancy;
3 relaxin, a polypeptide also found in the placenta and uterus, which may be important in parturition by softening the cervix and relaxing the pelvic ligaments;
4 inhibin, which inhibits FSH production.

The placenta is the organ of pregnancy serving the developing fetus. Hormones produced by the placenta include:
1 chorionic gonadotrophin (CG; hCG; h = human) which maintains placental progesterone synthesis;
2 placental lactogen (PL);
3 estriol, the major form of estrogen secreted by the placenta;
4 progesterone which maintains the reproductive organs in pregnancy;
5 relaxin.
The testis is the major male reproductive gland, producing:
1 testosterone which controls reproductive function and secondary sexual characteristics;
2 inhibin, which inhibits FSH secretion;
3 Müllerian inhibiting hormone (MIH), a fetal hormone which dedifferentiates the Müllerian duct.
The gastrointestinal tract (GIT) is the largest endocrine organ and produces several autocrine, paracrine and endocrine hormones including:
1 cholecystokinin (CCK);
2 gastrin;
3 glucagon;
4 neurotensin;
5 secretin;
6 substance P;
7 vasoactive intestinal peptide (VIP).

Adipocytes produce the peptide hormone leptin which is important in the control of feeding and energy expenditure.

The kidney produces hormones involved in the control of blood pressure and in erythropoiesis. Renin cleaves angiotensinogen to angiotensin I in the kidney and plasma. Erythropoietin stimulates production of red blood cells in the marrow.

The skin, liver and kidney produce vitamin D which has certain endocrine functions.

The heart produces atrial natriuretic peptide. Circulating blood elements, including macrophages, produce peptides such as the cytokines, which are involved in immune function.

The pineal gland is situated in the brain and is involved with rhythms, for example the reproductive rhythms of animals which breed seasonally. Its role in humans is not known for certain. The pineal gland produces melatonin.

Readers should be aware that putative endocrine hormones continue to be reported.