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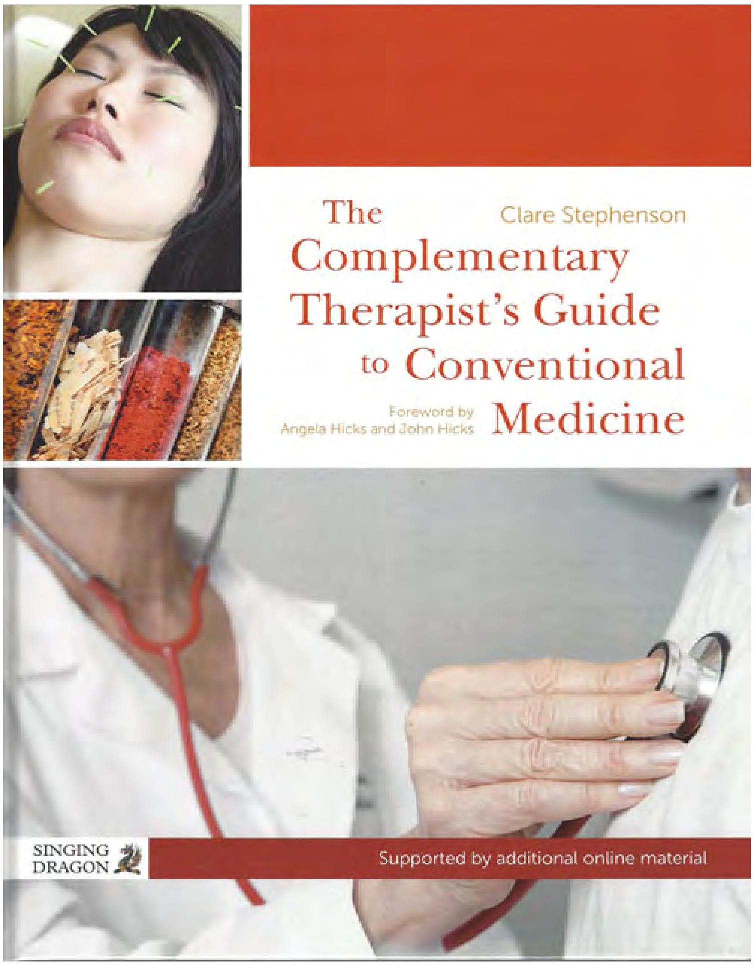
The Complementary Therapist‘s Guide to Conventional Medicine



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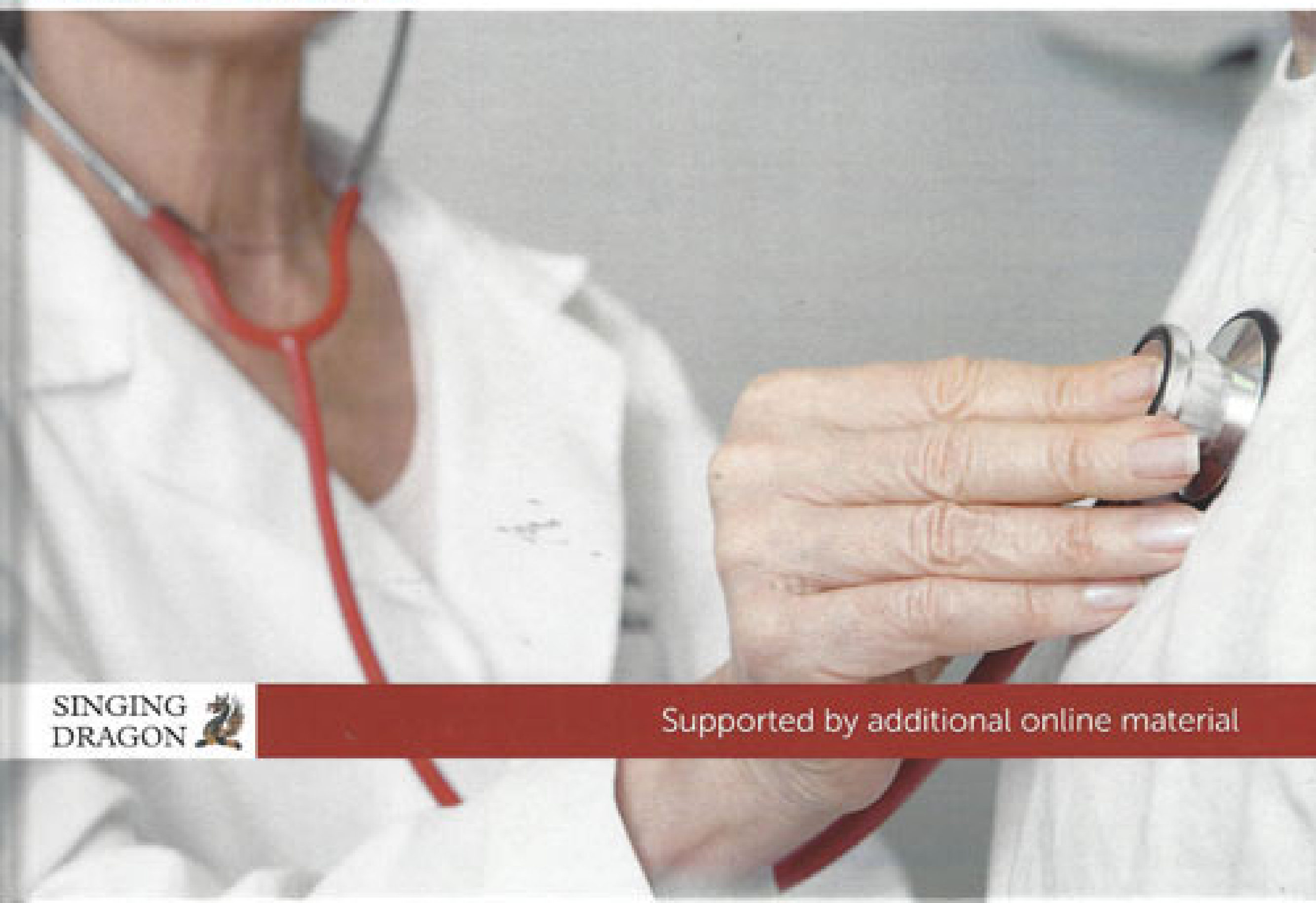
The Complementary Therapist's Guide to Conventional Medicine

Clare Stephenson

Foreword by
Angela Hicks and John Hicks



SINGING DRAGON

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Contents

3.1

Gastrointestinal disease

Chapter 3.1a The physiology of the gastrointestinal system

LEARNING POINTS

At the end of this chapter you will be able to:

- list the basic nutrients found in food
- explain the basic structure of the digestive tract
- recognise how each part of the digestive tract is adapted for its particular role in the digestive process
- understand the concepts of metabolism, anabolism and catabolism
- make comparisons between this conventional medicine view and the Chinese medicine interpretation of digestion.

Estimated time for chapter: Part I, 60 minutes; Part II, 60 minutes.

Introduction

This is the first chapter that will examine the physiology and diseases of a particular physiological system, in this case the digestive or gastrointestinal system. This chapter is concerned with the function of the digestive system in health, and provides a foundation for the study of the investigation and treatment of digestive diseases that is described in the next four chapters of this section.

Because of its length, this chapter is divided into Parts I and II. If you are using this book as a study course, then you are advised to work through the two sections of this chapter in separate study sessions.

PART I – From our food to the stomach

The digestive system and digestion

The function of the digestive system is to ensure that the water and nutrients present in the diet are absorbed adequately by the body and extraneous waste products are eliminated effectively. It also has a protective function in that it minimises damage from toxins and microbes in the diet. Digestion takes place along the length of a tube known variously as the 'gastrointestinal tract' or 'digestive tract', the 'gut' or the 'alimentary canal'. All these terms are used in medical language and are interchangeable.

Through the process of digestion, the complex contents of food are broken down to release nutrients in a form that can pass easily through the lining of the digestive tract and thence into the blood stream. Water taken in with the diet is absorbed into the blood stream at the same time. Not all of our food has value as a source of nutrients, and not all the water within it is absorbed. Some is left within the digestive tract to become waste material. This waste food material and water travels down the length of the digestive tract to be expelled in the form of faeces (see Q3.1a-1).

The nutrients in our diet

A nutrient is any substance that can be used by the body either to produce energy or to enable other vital chemical processes to take place. There are six basic nutrients: carbohydrates, fats, proteins, mineral salts, vitamins and water. A healthy diet should contain an ideal balance of these nutrients. In addition to these nutrients, a healthy diet also should provide 'fibre'. Fibre is indigestible cellulose from plant-derived foods. Fibre enables healthy transit and elimination of waste, as it provides bulk and water-retaining properties to the faeces.

A healthy diet will consist largely of starchy foods such as bread, rice, pasta and cereals, and fruit and vegetables. Current UK guidelines for the public are that about 60% of the energy value of food (calories) should come from starchy foods and that additional energy should come from at least five portions of fruit or vegetables a day. In addition, there should be some food containing protein, either from the meat/eggs/pulses food group or from the milk/cheese food group. Foods containing fats and sugars should be kept to a minimum. The UK Food Standards Agency 'eat well plate' summarises this advice in pictorial form as shown in Figure 3.1a-I.

Carbohydrates

Starchy foods and fruit and vegetables together provide the carbohydrates that the body needs. Carbohydrates contain the elements carbon, hydrogen and oxygen. These are the foods that, once broken down, provide the basic fuel for the energy-producing process of internal respiration (see Chapter 1.1b). Internal respiration takes place in the mitochondria of all living cells, where simple sugars react with oxygen to produce cellular energy. Carbon dioxide and water are the waste products. The energy produced is stored partly in the form of the 'charged' molecule adenosine triphosphate (ATP), and is partly released as heat.

The most simple carbohydrates are the monosaccharides, or simple sugars, such as glucose and fructose. These are in a perfect form to be utilised by the mitochondria, and so provide the most rapidly accessible form of energy. Monosaccharides taste sweet.

The molecules of the monosaccharides also occur bound as pairs in our food in the form of sweet-tasting disaccharides. Sucrose and lactose (the sugar in milk) are examples of disaccharides. The monosaccharides are also found in the form of chains known as 'polysaccharides', of which starch is an example. These do not immediately taste sweet, but can be broken down in the digestive tract to release the monosaccharides. Starches are, therefore, a form of slow-release energy for the body. Cellulose, which forms the fibrous parts of fruit and vegetables, is also a polysaccharide, but cannot be readily utilised by the human digestive tract. This is why it can perform its role as fibre. Grass-eating animals, however, do have the capability of breaking down cellulose and extracting its valuable food energy.

If carbohydrates are in excess in the diet, superfluous monosaccharides can be converted within the liver to a polysaccharide called 'glycogen'. Glycogen is held in the liver so that when blood sugar levels are low it can readily be converted back to accessible glucose. Any excess carbohydrate after this process has taken place is converted to fat for long-term energy storage.

Fats

Fats are non-soluble oily substances found in diverse foods in our diet, including meat, nuts, eggs, milk and some vegetables. Most fats consist of two components joined together: a fatty acid and glycerol. When broken down by the body, the fatty acids and glycerol are released to provide energy for the bodily processes.

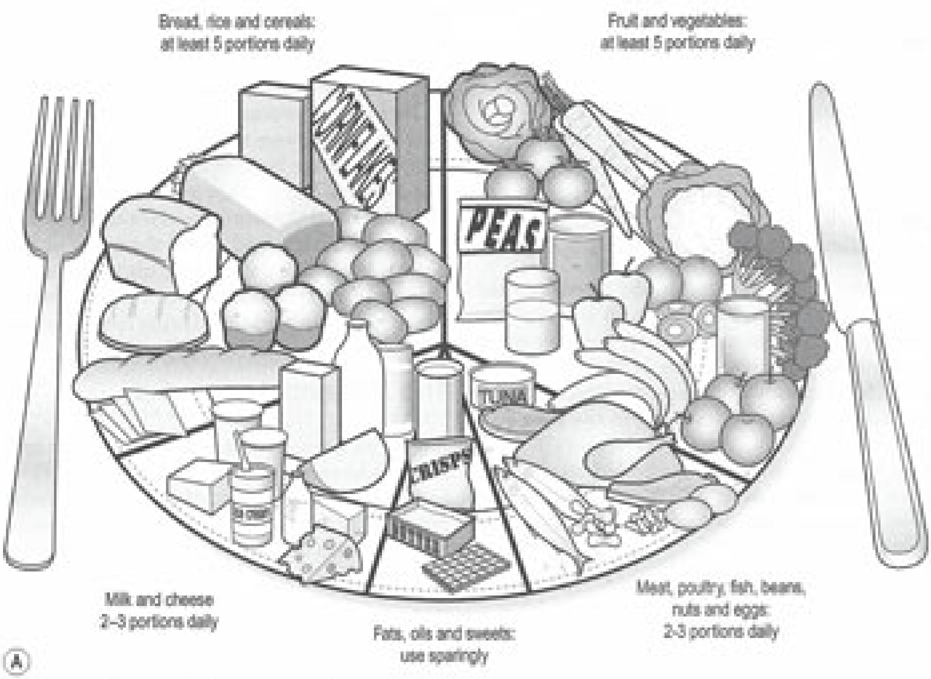


Figure 3.1a-I • The balance of good health.

Saturated fat is so called because of the nature of the chemical bonds in the fat molecules. It consists of molecules containing a saturated fatty acid and a glycerol. Saturated fat tends to form into a solid more readily than unsaturated fat. Lard from meat and butter are both largely saturated fats. Saturated fat is a good source of energy for the body, but an excess in the diet will cause cholesterol to be carried in the blood in the more unhealthy form of low-density lipoprotein and triglycerides (LDL and TGs).

Unsaturated fat is generally derived from vegetable matter, and tends to form a clear oil rather than a solid fat. It consists of molecules containing an unsaturated fatty acid and a glycerol. The omega-3, omega-6 and omega-9 fatty acids are all unsaturated fatty acids derived from unsaturated fats. These polyunsaturated fatty acids are essential components for cellular and intercellular communication processes and the building of cellular structures.

Vegetable, nut and olive oils contain unsaturated fat that provides omega-6 and omega-9 fatty acids. Fish oils contain unsaturated fat that provides omega-3 fatty acids. Most vegetable oils are made of polyunsaturated fats, but olive oil, canola oil and avocados contain a particular form of unsaturated fat known as a 'monounsaturated fat' (this contains omega-9 fatty acids).

Unsaturated fats and monosaturated fats in particular, seem to have the property of reducing the amount of cholesterol that is carried in the blood in the more unhealthy LDL form. For this reason, it is now considered important for a healthy diet that these forms of fats predominate over the saturated fats, and that monounsaturated fats predominate over polyunsaturated fats (as is found in the 'Mediterranean diet'). Unsaturated fats may protect against cardiovascular disease by providing more membrane fluidity than the more solid saturated fats.

Cholesterol is another oily substance that is particularly important for making hormones, including the steroids. Cholesterol is found in dairy products, meat and eggs. It can also be synthesised in the body, particularly in the liver, from more simple molecules. Cholesterol is carried in the blood in the form of complex molecules called LDL, very low-density lipoprotein (VLDL) and high-density lipoprotein (HDL). These structures package the cholesterol so that it is readily accessible to the cells. As mentioned, LDL (and VLDL) is associated with vascular ill-health, but HDL appears to be protective against vascular damage. The balance of these structures in the blood seems to be less affected by the amount of cholesterol in the diet than by the relative amounts of saturated and unsaturated fats (see above).

Trans fatty acids are only found in traces in a natural diet. However, they make up a significant proportion of many western diets because they are found in vegetable oils that have been processed (hydrogenated) to preserve their longevity for foods such as margarines, cakes and biscuits. The American Food and Drugs Administration (US FDA) has estimated that the average American eats 5.8 g of trans fatty acids a day. It is known that trans fatty acids alter the balance of cholesterol in the blood to an unhealthy state (they increase levels of LDL at the expense of the more healthy HDL). In some European states (e.g. Denmark and Switzerland) the use of trans fatty acids in food manufacturing has been banned. Many other countries now have policies whereby the proportion of trans fatty acids has to be described in food labelling.

Proteins

Proteins are complex chain-like structures that are made up of simple molecules called 'amino acids'. All amino acids contain the element nitrogen as well as carbon, hydrogen and oxygen. Some also contain trace minerals such as zinc, iron and copper. There are about 20 different amino acids, which can be combined in potentially infinite permutations to form protein chains. Proteins are made in animal and plant cells at the ribosomes as a result of decoding instructions held on the cellular DNA (see Chapter 1.1b). The ribosome is the site at which amino acids are linked together to form a unique and characteristic protein chain, after which the particular makeup of the protein chain encourages the structure to fold in a characteristic way. This means that proteins are large molecules that have a unique shape. The shape and form of a particular protein might give it special structural properties (e.g. the collagen in skin and hair) or make it soluble in water (e.g. the albumen found in blood and in egg white). In other proteins the shape is essential for communication, and this is the basis of how cell-membrane proteins 'recognise' the external stimulants, such as hormones, that bring about internal change in the cell itself. Antibody–antigen recognition also depends on the antibody having a unique shape that 'fits' the shape of the antigen.

Protein in food is found in meat, eggs, fish, cereals, nuts and pulses. All the essential amino acids can be derived from the complete proteins in meat, fish, eggs, milk and soya. Without soya products, a vegetarian will need to eat combinations of nuts, cereals and pulses to ensure that all amino acids are obtained from the diet.

Protein is converted to amino acids in the body, and these circulate dissolved in the blood so that they reach all the tissues. The ribosomes of the cells utilise amino acids to produce their own proteins so that they can reproduce and continue performing their unique functions. Proteins are used to make cellular and extracellular structures (such as the contractile fibres in muscle cells and the connective tissue fibres in cartilage), plasma proteins (such as the clotting factors and albumen), antibodies, enzymes and also some hormones.

In a state of starvation, proteins are broken down by the cellular mitochondria to produce energy. The by-products of this process include chemicals called 'ketones'. When excess ketones are produced, the body is said to be in a state of 'ketosis'.

Mineral salts

Mineral salts are simple inorganic substances that are required in small quantities to maintain bodily processes. Unlike carbohydrates, fats and proteins, they are not a source of energy. Essential minerals include calcium, sodium, potassium, iodine, phosphate, iron, chromium, zinc, selenium, magnesium and manganese. Certain minerals, such as calcium and phosphate (in bone) and sodium (as dissolved salt in the body fluids), constitute a significant proportion of the body mass, whereas others are required only in trace amounts.

Vitamins

Vitamins are more complex compounds than minerals, and are also essential for bodily processes. They are essential dietary components because either they cannot be made by the body at all or they cannot be made in sufficient quantities to sustain health. Vitamins are now broadly grouped into the four fat-soluble vitamins A, D, E and K, and the nine water-soluble vitamins B1–B8 and C. The lettering system approximately relates to the order in which the vitamins were discovered (beginning with vitamin A in 1909). Those substances initially called F–J were either reclassified as B vitamins or were subsequently deemed not to qualify as vitamins at all. The B vitamins are now recognised to be linked because they are all vital in the production of energy from nutrients by the mitochondria. The food sources and the functions of the 13 vitamins are summarised in Table 3.1a-I.

Water

Water is an essential part of the diet because the body is continually losing water through the urine, faeces, sweat and in exhaled air. About 60% of the adult body mass is water, and all the essential bodily processes take place in a watery milieu. Water has to be lost as it is the vehicle through which waste chemicals (in urine and sweat) and also waste food materials (in the faeces) are carried for expulsion from the body. It is also lost through the breath and sweat to aid with cooling of the body.

On average, about 2.5 litres of water need to be replaced by the diet every day. Much of this is contained in food, and so a human being can survive on about 1.5 litres of water in drinks per day. Any water excess to requirements is passed out of the body in the form of dilute urine. If insufficient water is drunk, the kidneys make dark concentrated urine from the fluid in the plasma, and the water required for excretion of waste is drawn from the tissues, which then become dehydrated.

Information Box 3.1a-I

The nutrients: comments from a Chinese medicine perspective

In Chinese medicine, each food has a characteristic energetic property and also a tendency to affect a particular bodily substance or organ. For this reason, food can be used as medicine, whereby a diet is recommended to suit the needs of the patient. The taste and the consistency of the food bear an important relationship to its energetic properties. Moreover, the freshness and the method of cooking can have a bearing on the value of the food.

For example, fresh grapes are recognised to Tonify the Qi and Blood, and affect the Lungs, Spleen and Kidneys. Beef is recognised to Tonify Yin and Qi and Blood, and affect the Large Intestine, Stomach and Spleen. Some foods, such as pears, are Cool, and so may be useful in moderation in Hot conditions, and some are Warm in nature, such as chicken liver, and so are used to in Cold conditions.

Despite the fact that most foods contain a complex array and unique balance of nutrients, these distinctions are not made in conventional medicine, in which rather broad statements are made about the six types of nutrients found in food groups. Furthermore, very little emphasis is also placed on how the food is prepared, apart from avoidance of overcooking, in that this might inactivate the vitamin C in fruits and vegetables.

Table 3.1a-I The 13 vitamins, their main food sources and their functions in the body

Vitamin	Food sources	Use in the body
A (retinol)	Green vegetables, milk, liver	Pigments in eye and health of skin
D (calciferol)	Milk, eggs, cod liver oil; ultraviolet light	Calcium absorption and bone formation
E (tocopherol)	Margarine, seeds, green leafy vegetables	Antioxidant: protects fatty acids and cell membranes from damaging oxidation
K (phylloquinone)	Green leafy vegetables	Formation of certain clotting factors
B_1 (thiamine)	Meats (pork), grains, legumes	Carbohydrate metabolism; also nerve and heart function
B_2 (riboflavin)	Milk, liver, eggs, grains, legumes	Energy metabolism
B_3 (niacin or nicotinic acid)	Liver, lean meats, grains, legumes	Energy metabolism
B_5 (pantothenic acid)	Milk, liver, eggs, grains, legumes	Energy metabolism
B_6 (pyridoxine)	Wholegrain cereals, vegetables, meats	Amino acid metabolism
B_7 (biotin)	Meats, vegetables, legumes	Fat synthesis and amino acid metabolism
B_9 (folic acid)	Wholewheat foods, green vegetables, legumes	Nucleic acid metabolism
B_{12} (cobalamin)	Red meats, eggs, dairy products	Nucleic acid production
C (ascorbic acid)	Citrus fruits, green leafy vegetables, tomatoes	Collagen formation in teeth, bone, and connective tissue of blood vessels; may help in resisting infection

The respiratory system

3

Chapter 3.3a The physiology of the respiratory system

LEARNING POINTS

At the end of this chapter you will be able to:

- describe the role of the respiratory system
- understand the structure of the upper respiratory tract, including the nose, sinuses, pharynx, larynx and trachea
- understand the structure of the lower respiratory tract, including the bronchi, bronchioles, alveoli and other structures of the lungs.

Estimated time for chapter: 100 minutes.

Introduction

This chapter concentrates on the physiology and pathology of the respiratory system, looking at the structure and function of the respiratory system in health.

The role of the respiratory system

The respiratory system is specialised to enable an adequate supply of oxygen to the tissues. As was described in Chapter 1.2b, oxygen is one of the essential ingredients for the process of cellular respiration. It is also the role of the respiratory system to allow carbon dioxide, a waste product of respiration, to be removed from the body.

In common usage, the term 'respiration' refers simply to the act of breathing. However, in physiology there are three aspects to respiration that can be clearly defined. These are external respiration, internal respiration and cellular respiration.

The respiratory system is primarily concerned with [illegible] respiration, which is the process of breathing leading [illegible] exchange of gases between the blood and the lungs.

Internal respiration is the exchange of gases between [illegible] blood and the cells of all the body tissues, and is one of [illegible] functions performed by the circulatory system.

Cellular respiration is the process (described in Chapter [illegible]) by which oxygen and nutrients are converted to cellular [illegible] (adenosine triphosphate (ATP)) and carbon dioxide within [illegible] cell itself. It is important to be clear about the [illegible] between these three processes, as these terms help [illegible] precise roles of the respiratory system.

The respiratory system is conventionally divided [illegible] sections, the upper and lower respiratory tract. A simple [illegible] resentation of the organs of the respiratory tract is [illegible] Figure 3.3a-1. The division between the upper and lower [illegible] occurs at the point at which the trachea splits into the [illegible] tubes called 'bronchi'.

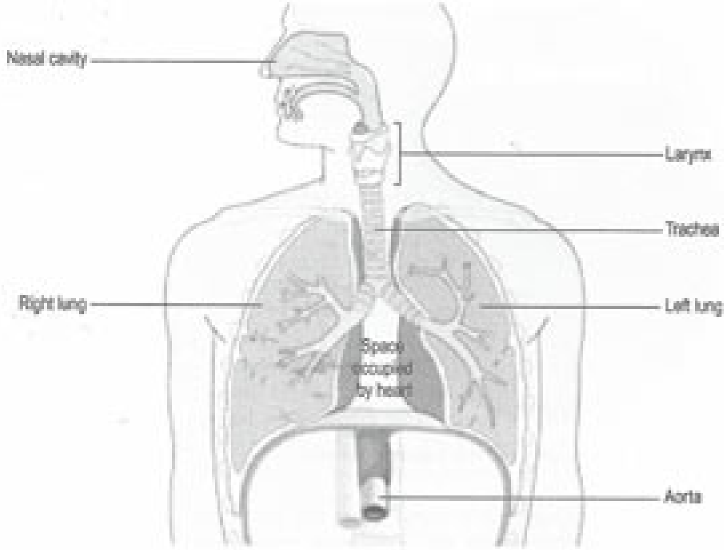
The diagram illustrates that this division occurs at a [illegible] level in the chest, just above the position of the heart. The [illegible] gram also illustrates the close physical relationship between the heart and the lungs. In fact, if the heart is [illegible] through dissection, an imprint of its shape is seen in the [illegible] of the lungs.

The upper respiratory tract

The upper respiratory tract leads from the entrance of [illegible] respiratory system at the nose to the end of the [illegible] the tube which directs the inhaled air into the chest [illegible] (thorax) towards the lungs.

The function of the upper respiratory tract is to [illegible] plentiful supply of warm, clean and moist air to the [illegible] To help it perform this function it consists of wide air [illegible]

Figure 3.3a-I • The organs of respiration.



and is lined by a specialised form of epithelium. The respiratory epithelium consists largely of ciliated columnar cells but it also has many mucus-secreting (goblet) cells.

The water-containing mucus moistens the air that rushes through the respiratory tract, and picks up dirt particles and other foreign bodies present in the air. Cilia are structures akin to microscopic hairs on the surface of cells. They are powered by the energetically charged molecule ATP to move in coordinated waves. In the respiratory tract the cilia beat in an upward direction. Their function is to cause an upward movement of the mucus, allowing the foreign material to be moved away from the delicate lung tissue and up to the back of the throat, from where it can be swallowed or expectorated.

The connective-tissue layer below the respiratory epithelium has a number of lymphocytes scattered throughout its length. These respond to foreign antigens by producing antibodies and attracting other immune cells. This is an important aspect of the protection of the respiratory tract from infection.

The important parts of the upper respiratory tract are the nose, the pharynx, the larynx and the trachea.

The nose

In the breathing of a healthy person at rest, all air is drawn in through the nostrils into the nasal cavity. This space has a deeply ridged surface which has a rich blood supply. This means that the current of air comes into contact with a large area of warm epithelium before its descent towards the lungs. In addition to the cilia on the epithelial cells, body hairs are present in the opening of the nose to filter out any large foreign particles.

Opening out into the nasal cavity are the sinuses. These are cavities deep within the facial bones that have narrow passageways leading into the nasal cavity. Their function is to give the voice a resonant quality, the loss of which is apparent in anyone who has suffered from a 'head cold', when the sinuses become filled with thick secretions. A tiny duct leading from each eye also opens into this space. This continually drains away tears from the eyes. The runny nose that accompanies a bout of crying is a result of the excess tears flooding into the nose through this duct.

The nose is the specialised sense organ for smell. To perform this function, delicate nerves originating from the base of the brain penetrate the bone above the nasal cavity to supply the nasal lining. These are sensitive to the chemicals in the incoming air, which become dissolved in the mucus. The sense of smell is also important to enrich the experience of taste. Occasionally, in a head injury, these nerves become permanently severed, even though there may be no other major brain damage. The person may recover fully but be left without a sense of smell and with a highly impaired sense of taste.

Other nerves in the nose are very sensitive to the irritation that can result from foreign particles and from inflammation of the lining of the nose. These nerves can trigger the protective reflex of the sneeze, which is a very effective mechanism for expelling unwanted material from the nasal cavity.

The pharynx

The pharynx is the space at the back of the nose that connects with the throat. The adenoids (nasal tonsils) are two collections of lymph-node tissue situated at the back of this space. The tonsils (palatine tonsils), which are similar collections of lymphoid tissue, are situated a little lower down. The palatine tonsils can be seen in most people on either side of the space behind the arch of the palate, as illustrated in Figure 3.1a-II, whereas the adenoids are hidden up behind the palatoglossal arch.

5.1

Diseases of the endocrine system

Chapter 5.1a The physiology of the endocrine system

LEARNING POINTS

At the end of this chapter you will:

- be able to describe the role of a hormone
- be able to describe the anatomical positions of the organs of the endocrine system
- understand the importance of the negative feedback loop in the function of the endocrine system
- be able to describe the function of those endocrine organs that are affected by the important endocrine diseases.

Estimated time for chapter: 120 minutes.

Introduction

The idea has already been introduced that the nervous and endocrine systems together can be considered as the foundation of that which makes the body an integrated whole. This is because they are both concerned with communication between one body part and another.

In the nervous system, the communication between one nerve and another takes place at a junction called the 'synapse'. At the synapse, the release of a tiny amount of a chemical known as a 'neurotransmitter' enables a change that has taken place in one nerve cell to be transmitted to other nerve cells. In the endocrine system, the communication is also based on the release of chemicals. These chemicals, released by specialised endocrine cells, are known as 'hormones'. Endocrine cells may be grouped together in organs known as 'endocrine glands', but also can be found loosely distributed within many of the organs and tissues of the body (see Q.5.1a-1).

In contrast to neurotransmitters, hormones can stimulate changes in bodily cells only after travelling to local tissues via the tissue fluid, or to distant sites through the bloodstream. However, once hormones reach their target cells, the way in which they lead to internal changes within those cells is remarkably similar to the effect of neurotransmitters on target nerve cells. Both hormones and neurotransmitters connect with protein 'receptors' on the target cell membrane. Through this connection, these chemicals lead to a change in the internal physiology of the cell. As increasing numbers of these chemicals are discovered by scientists and their functions described, it is becoming clear that many of those which act as hormones in the body can also be found within the nervous system, where they function as neurotransmitters.

Through communication by means of hormones, the endocrine system encourages the state of homeostasis to be maintained within the body. In order to fulfil this role, the endocrine system has always to be responsive to changes in the internal and external environments of the body (see Q5.1a-2).

Cholecystokinin (CCK) (originating from cells in the duodenum), adrenaline (from the adrenal medulla), erythropoietin (EPO) (from the substance of the kidney) and testosterone (from the testes) are examples of hormones that have their impact on the digestive, cardiovascular, blood and reproductive systems, respectively. CCK and EPO are examples of hormones that are not released from specific endocrine organs. CCK is released from endocrine cells scattered within the wall of the duodenum, and EPO is released from endocrine cells within the tissue of the kidney. In contrast, adrenaline and testosterone are examples of hormones that originate from specialised endocrine organs, namely the adrenal glands and the testes, respectively.

The organs of the endocrine system

Figure 5.1a-1 illustrates the anatomical location of the organs of the endocrine system. This chapter focuses on the most basic physiology of those endocrine organs that are affected in the important endocrine diseases. These are:

- the pituitary and the hypothalamus
- the thyroid gland

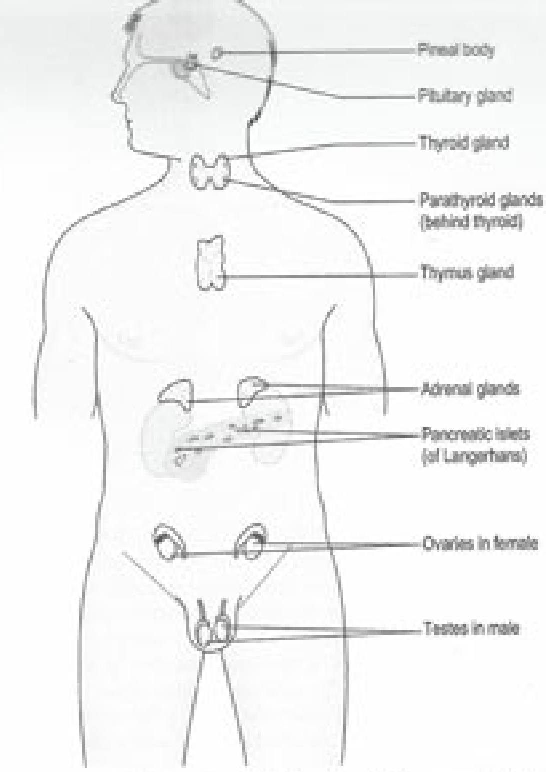


Figure 5.1a-I • The anatomical location of the organs of the endocrine system.

- the adrenal glands
- the endocrine part of the pancreas (pancreatic islets).

The role of the parathyroid glands in calcium homeostasis is described in Chapters 4.2a and 4.3a. The function of the ovaries and testes will be explored in Chapter 5.2a. The pineal gland and thymus gland will be not discussed further in this text.

The negative feedback loop

The negative feedback loop is the basic mechanism that underlies an important aspect of the action of these hormones. The negative feedback loop requires a detector to recognise a move away from balance, a control centre that recognises when the move has been so great that something has to be done about it, and an effector to bring about a change in the body to reverse the imbalance. A thermostat is a mechanical example of the negative feedback loop in action. The detector in this case is a thermometer. The control centre is the mechanism that is set to recognise when the temperature falls outside a desired range. The negative feedback loop is based on maximum desired temperature. When the temperature becomes too high, the effector, in this case the heating element, is switched off until the time when the temperature drops within the desired range once again.

Table 5.1a-I The release of cholecystokinin (CCK): an ... the negative feedback loop in the regulation of hormones

The endocrine cells of the duodenum are specialised to 'detect' ... levels of fat within the duodenum. They do this by means of ... proteins on their cell membranes which, when they come into ... with fat, lead to internal changes within the cells. In this case the ... change is the onset of the manufacture of cholecystokinin (CCK). The control aspect is that it is only when the amount of fat is at a ... that these cells are stimulated to release CCK into the bloodstream. CCK is the effector that travels within the bloodstream to lead to ... appropriate release of bile from the gallbladder, which in turn ... digest the fats. The release of CCK only ceases when all the fat has been digested and has left the duodenum. Incidentally, CCK also acts at the exocrine pancreas to stimulate the ... of fat-digesting enzymes (amongst others) into the duodenum. This ... another example of a negative feedback loop in action.

These rather abstract concepts, which were ... Chapter 1.1c, can now be placed in more ... Endocrine cells play the role of both detector and ... tre, while the release of hormone corresponds to the ... of the negative feedback loop. As a thermostat is ... keep ambient temperature constant, the endocrine ... feedback loops work to keep bodily variables ... blood sugar or blood calcium at a steady level. This ... offers many more examples of this negative feedback ... action (for example see Table 5.1a-I), as each of the ... endocrine organs is described in turn.

The pituitary and the hypothala...

The pituitary gland is a pea-sized organ that ... wards from an area at the base of the brain called the ... thalamus'. The site of the pituitary is deep within ... approximately at the level of the bridge of the ... (Figure 5.1a-II). The extra acupoint Yintang, which ... ered in Chinese medicine to have a profound ... mental functions, overlies the region of the ... hypothalamus.

A 'stalk' projects downwards from the ... through which nerve fibres pass into the pituitary. ... network of blood vessels connects the two areas ... stalk. These blood vessels carry hormones from the ... mus to the pituitary.

An alternative term for the pituitary gland is the ... The term 'adenohypophysis' refers to the anterior ... pituitary, which contains endocrine cells. The ... is the source of six different hormones. The term ... ysis' refers to the posterior portion of the pituitary ... This part receives nerve fibres from the hypothalamus ... the source of two additional hormones, which are ... directly into the bloodstream from the endings of these ...

Together, the hypothalamus and the pituitary ... vital control function in the endocrine system. The ... secreted by the hypothalamus and the pituitary ... function of other endocrine organs, including the ... gland, the adrenal gland and the sex organs.

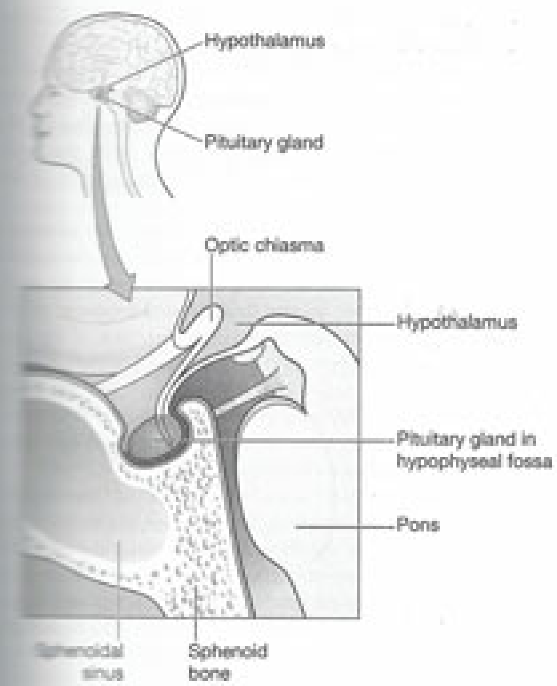


Figure 5.1a-II • The position of the pituitary gland and its associated structures.

The hormones of the hypothalamus are either secreted into the general bloodstream by the nerve endings of the neurohypophysis, or carried within the blood vessels of the pituitary stalk to act on the adenohypophysis. In contrast, all the hormones released by the pituitary gland travel within the bloodstream to have effects on distant endocrine organs as well as other parts of the body.

There are at least 13 hormones that are released by the hypothalamus and the pituitary gland. All of these are commonly described by conventional practitioners by their initials rather than their full medical names, and include growth hormone (GH), thyroid stimulating hormone (TSH), adrenocorticotrophic hormone (ACTH) from the pituitary and growth-hormone-releasing hormone (GHRH), corticotrophin-releasing hormone (CRH) and gonadotrophin-releasing hormone (GnRH) from the hypothalamus.

It is helpful to understand that the hormones of the hypothalamus are the mechanism by which the hormones of the pituitary are controlled. For example, the release of growth hormone (GH) from the pituitary gland can be increased and decreased by two different hormones (GHRH and GHIH) from the hypothalamus. This is one example of the close connection between the nervous system (hypothalamus) and the endocrine system (pituitary gland).

The hypothalamus lies deep within the substance of the brain, and thus can be influenced by complex internal factors, including the stage of psychological development and the emotions. This might explain why such factors can have profound effects on hormone-controlled events such as childhood growth, timing of puberty and breastmilk production.

Table 5.1a-II The hormones released from the anterior pituitary gland (adenohypophysis) and their functions

Hormone	Function
Growth hormone (GH)	Stimulates growth in many tissues
Thyroid-stimulating hormone (TSH)	Stimulates the production of thyroid hormones
Adrenocorticotrophic hormone (ACTH)	Stimulates the production of cortisol from the adrenal gland
Prolactin (PRL)	Stimulates breastmilk production
Follicle-stimulating hormone (FSH)	Stimulates the development of the ovarian follicle (the first half of the menstrual cycle)
Luteinising hormone (LH)	Stimulates ovulation and the maturation of the ruptured follicle (corpus luteum)

Table 5.1a-II lists the six hormones that are produced by the adenohypophysis.

The hormones oxytocin and antidiuretic hormone (ADH) are released from the neurohypophysis, but have their origins within nerve cells within the hypothalamus.

Growth hormone

Growth hormone is a hormone that stimulates the continued growth of the skeleton, muscles and soft tissues, including the major organs. This growth is not only essential during childhood, but is also important for the maintained health and liveliness of these tissues throughout adult life. Growth hormone affects the metabolism of the body, meaning that it alters the rate at which the complex chemical processes of the bodily tissues take place. Under the influence of growth hormone, the rate of protein and collagen synthesis increases, and the amount of sugar in the blood tends to rise to meet the body's increased requirements for energy.

Information Box 5.1a-I

Growth hormone: comments from a Chinese medicine perspective

A Chinese medicine energetic interpretation of this hormone has to be complex, as growth hormone affects the functioning of diverse tissues at a fundamental level.

Its role in continued growth suggests that its control is an aspect of Kidney Essence. Its role in the appropriate use of nutrients to build up the physical substance of the body suggests that it also plays a role in the transformation of Qi. Its control, therefore, can also be seen as an aspect of Original Qi and, in particular, Spleen Qi. Original Qi is, of course, closely related to Kidney Essence.

In excess, growth hormone leads to thickening of soft tissues and broadening of the bones (see Chapter 5.1e). This might be interpreted as accumulation of Damp and Phlegm. This again suggests that appropriate secretion of growth hormone is an aspect of the healthy function of the Spleen Organ.

Oxytocin

Oxytocin is important for contraction of the uterine muscle during labour and for the expression of breastmilk during suckling.

ADH, TSH, ACTH, FSH, LH and prolactin

The role of ADH was mentioned in Chapter 4.3a. This hormone is released in response to an increased concentration of the salts in the blood. It reduces the amount of water that is lost through the urine, and is important in the control of the homeostasis of the concentration of the blood. TSH and ACTH relate to the healthy function of the thyroid and adrenal glands, respectively. PRL, FSH and LH are all important in the physiology of the reproductive system. The function of these five pituitary hormones is described in more detail in Chapter 5.2a.

The thyroid gland

Figure 5.1a-III illustrates the thyroid gland, which is a bow-shaped organ situated just below the level of the laryngeal prominence (Adam's apple) in the neck. The bow shape is a result of the gland being formed by two lobes separated by a narrow bridge of tissue called the 'isthmus'. In health, the thyroid gland can be felt as a small region of vague softness below the voice box. This can be felt to rise and descend during swallowing.

The thyroid gland contains endocrine cells, which secrete two hormones, thyroxine (also known as T4) and tri-iodothyronine (T3). The thyroid gland draws upon iodine from the diet to manufacture sufficient quantities of these hormones. Iodine is found in seawater, and also in plant and animal products that originate from areas close to the sea. For this reason, iodine deficiency may occur in regions of the world that are distant from the sea, especially landlocked countries. However, in many developed countries, such as the UK, table salt contains additional iodine, meaning that iodine deficiency is rarely a problem.

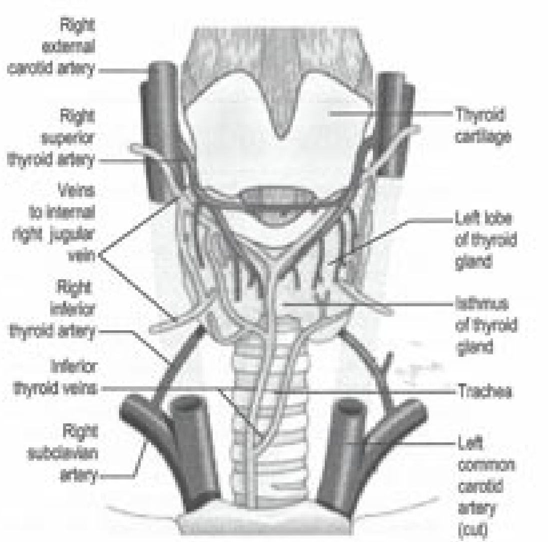


Figure 5.1a-III • The thyroid gland and its associated structures.

The thyroid hormones T4 and T3 are both released in response to TSH (thyroid-stimulating hormone) from the pituitary. The release of TSH is primarily controlled by the release of TRH (thyroid-releasing hormone) from the hypothalamus. This is the mechanism whereby the activity of the brain affects thyroid function.

Like growth hormone, the thyroid hormones play an important role in physical growth and the rate at which the cells of the body convert nutrients into energy (the metabolic rate). They are also important in the healthy development of the growing nervous system, the appropriate function of the cardiovascular system and the smooth functioning of the gastrointestinal system. If in excess, the thyroid hormones can cause an increased use of bodily nutrients, leading to the production of heat, weight loss, feelings of nervousness, a rapid heart rate and increased peristalsis in the bowel.

The negative feedback loop of control of the thyroid hormones is affected by factors such as exercise, stress, low blood glucose and malnutrition. All these factors increase the release of TSH from the hypothalamus, and thus increase the release of T4 and T3. Conversely, raised levels of thyroid hormones in the bloodstream will inhibit the release of TRH from the hypothalamus and TSH from the pituitary gland (see Q5.1a-3).

> **Information Box 5.1a-II**
>
> **Thyroid hormone: comments from a Chinese medicine perspective**
>
> The Chinese medicine energetic interpretation of the thyroid hormones is complex. The thyroid hormones are important for growth and the appropriate use of nutrients at a cellular level. Both these aspects of their role suggest that their control reflects an aspect of Kidney Essence and Original Qi.
>
> The consequence of an excessive secretion of thyroid hormones is the generation of a state similar to the general pattern described as Yin Deficiency (feelings of heat, anxiety and rapid heart rate). Insufficient secretion of thyroid hormones leads to a state that includes feelings of cold, lassitude, weight gain and slow heart rate (see Chapter 5.1c), which together can be compared to the pattern of Yang Deficiency. Thus these patterns suggest that the appropriate control of the thyroid hormones reflects an aspect of the fundamental balance of Yin and Yang.
>
> As the seat of Yin and Yang lies within the Kidney Organ, here is another example of how the function of the thyroid gland might be closely related to the Kidney Organ in Chinese medicine. This fits with the fact that the deep pathway of the Kidney Organ passes through the throat and ends at the root of the tongue. Interestingly, the root of the tongue is the origin of the tissue of the developing thyroid gland in the embryo.

Calcitonin

Calcitonin is another hormone secreted by the thyroid gland. Together with the parathyroid hormone (PTH), it plays a role in calcium homeostasis. PTH is secreted by the cells of the four tiny parathyroid glands situated deep within the tissue of the thyroid gland.

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Dr Clare Stephenson is a qualified medical practitioner who worked in hospital medicine, general practice and public health medicine before training in Traditional Chinese Medicine (TCM) and acupuncture. Over the course of a decade she developed and taught an undergraduate course for students of Chinese medicine on Western medicine and how it relates to TCM. She is currently a GP at an NHS practice in Oxford, UK.

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