风暴式医学教程 MOSBY'S CRASH COURSE (原版英文医学教程)

胃肠系统

Gastrointestinal System

Elizabeth Cheshire
with Daniel Horton-Szar as Series Editor

国际医学畅销书

- 揭秘国际医学教学
- 独创风暴式记忆新法
- 助你在竞争中胜出

科学出版社
Harcourt Asia
Mosby

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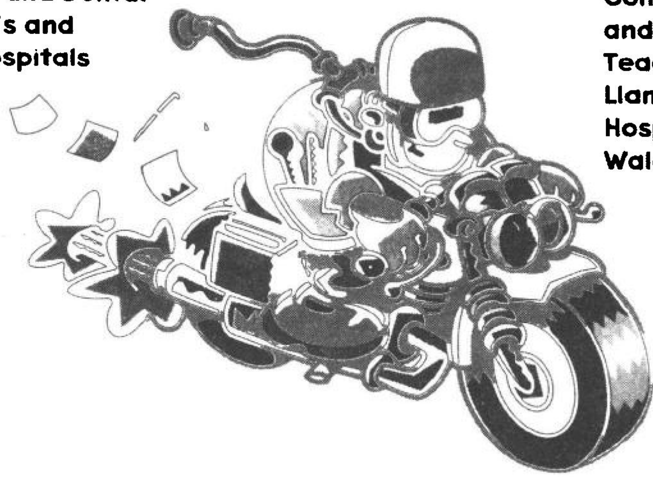

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Preface

Most medical students and junior doctors join firms which specialise in a system. We therefore need to know the anatomy, physiology, embryology, and pathology of that system, and how to examine it properly. Medical textbooks usually cover only one or two of these disciplines, and to learn about any particular system we have to refer to many different sources. Well, not with this book!

This *Crash Course* title has been designed to bring together everything students need to know about the gastrointestinal system to pass their Finals successfully—and to enjoy life on a gastrointestinal firm! This is all done in an up-to-date, comprehensive format that is small enough to be carried around and referred to during teaching and on the wards.

Crash Course: Gastrointestinal System also aims to provide a useful revision text for junior doctors.

I hope you find it useful!

Elizabeth Cheshire

This text is designed with the new medical curriculum in mind and interlinks basic science with clinical medicine. It has been written by Elizabeth Cheshire, a final year medical student, and I have revised the text from the viewpoint of a faculty advisor.

There are over 100 illustrations in this book and the text is concise, incorporating all the required core material. *Crash Course: Gastrointestinal System* should become a constant companion to the student both during revision and on the ward. Questions are included in every chapter which are designed to check the student's understanding of the information in the text. There is also an additional section of MCQs, short-answer questions and essay questions at the end of the book. Difficult and essential facts are emphasized in the text to assist in memorizing them easily. The text is fully comprehensive and any student mastering this book should pass Finals with ease.

Paul Smith
Faculty Advisor

Preface

OK, no-one ever said medicine was going to be easy, but the thing is, there are very few parts of this enormous subject that are actually difficult to understand. The problem for most of us is the sheer volume of information that must be absorbed before each round of exams. It's not fun when time is getting short and you realize that: (a) you really should have done a bit more work by now; and (b) there are large gaps in your lecture notes that you meant to copy up but never quite got round to.

This series has been designed and written by senior medical students and doctors with recent experience of basic medical science exams. We've brought together all the information you need into compact, manageable volumes that integrate basic science with clinical skills. There is a consistent structure and layout across the series, and every title is checked for accuracy by senior faculty members from medical schools across the UK.

I hope this book makes things a little easier!

Danny Horton-Szar
Series Editor (Basic Medical Sciences)

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Figure Credits

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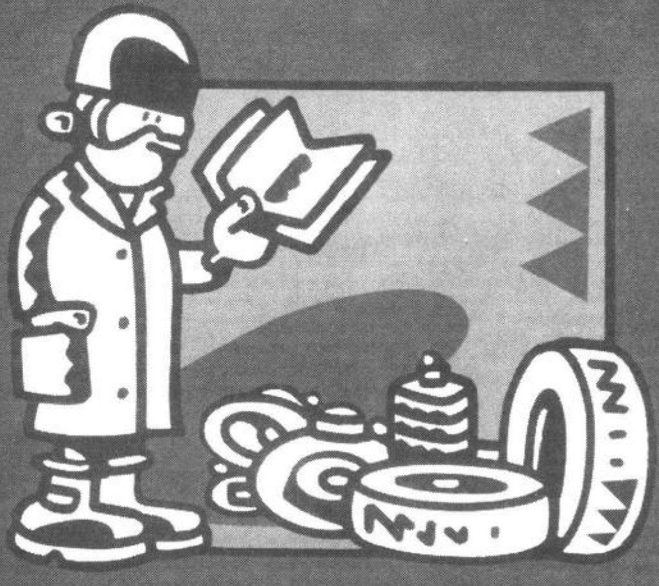

DEVELOPMENT, STRUCTURE, AND FUNCTION

1. Overview of the Gastrointestinal System

ANATOMICAL OVERVIEW

The gastrointestinal tract (Fig. 1.1) is a true system in that it develops from a single, continuous structure, and the entire tract, including the ducts, is endodermal. Its basic structure is the same throughout (Fig. 1.2), with a mucous layer, submucosa, muscular layer and adventitia or serosa, and intrinsic submucosal and mucosal nerve plexuses (Meissner's plexus and Auerbach's plexus), the activity of which is moderated by extrinsic innervation.

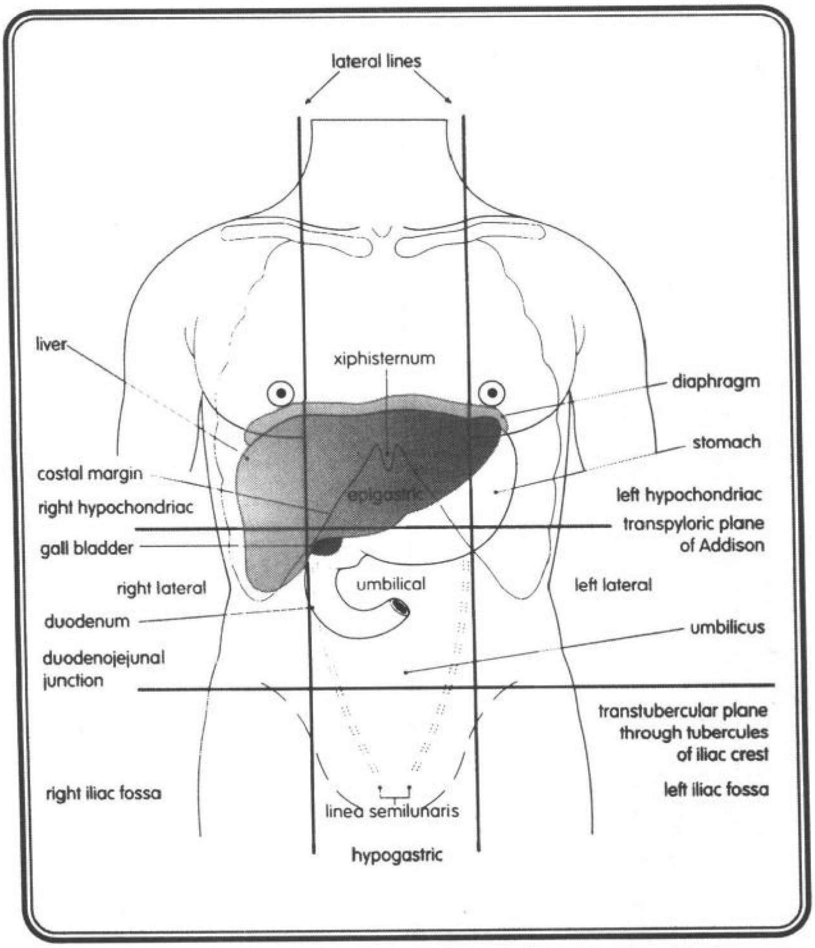

Fig. 1.1 Anatomy of the gastrointestinal tract showing its surface markings. The transpyloric plane of Addison passes midway between the jugular notch and the symphysis pubis, and midway between the xiphisternum and the umbilicus. It passes through the pylorus; the neck of the pancreas; the duodenojejunal flexure and the hila of the kidneys.

The gastrointestinal (GI) tract takes in, breaks down, and absorbs food and fluids. Different parts of the system are specialized to perform these different functions.

Food is moved through the tract by gravity and peristalsis. Peristalsis propels food by the coordinated contraction of muscle in one area and relaxation in the next. A series of sphincters prevent reflux (Fig. 1.3). Reflexes operating between different parts of the tract, together with hormonal and neuronal factors, determine the speed of food movement through the tract. In general, the contents only move through the tract at the rate at which they can be processed.

FUNCTIONS OF THE GASTROINTESTINAL TRACT

The principal function of the gastrointestinal tract is the intake, breakdown, and digestion of food and liquid to provide energy and nutrients, and to create a store of energy for use during short periods of abstinence.

Food and drink are generally not sterile. The gut is therefore presented with a large number of bacteria and other potentially harmful substances on a daily basis. The tract has a number of mechanisms to deal with these:

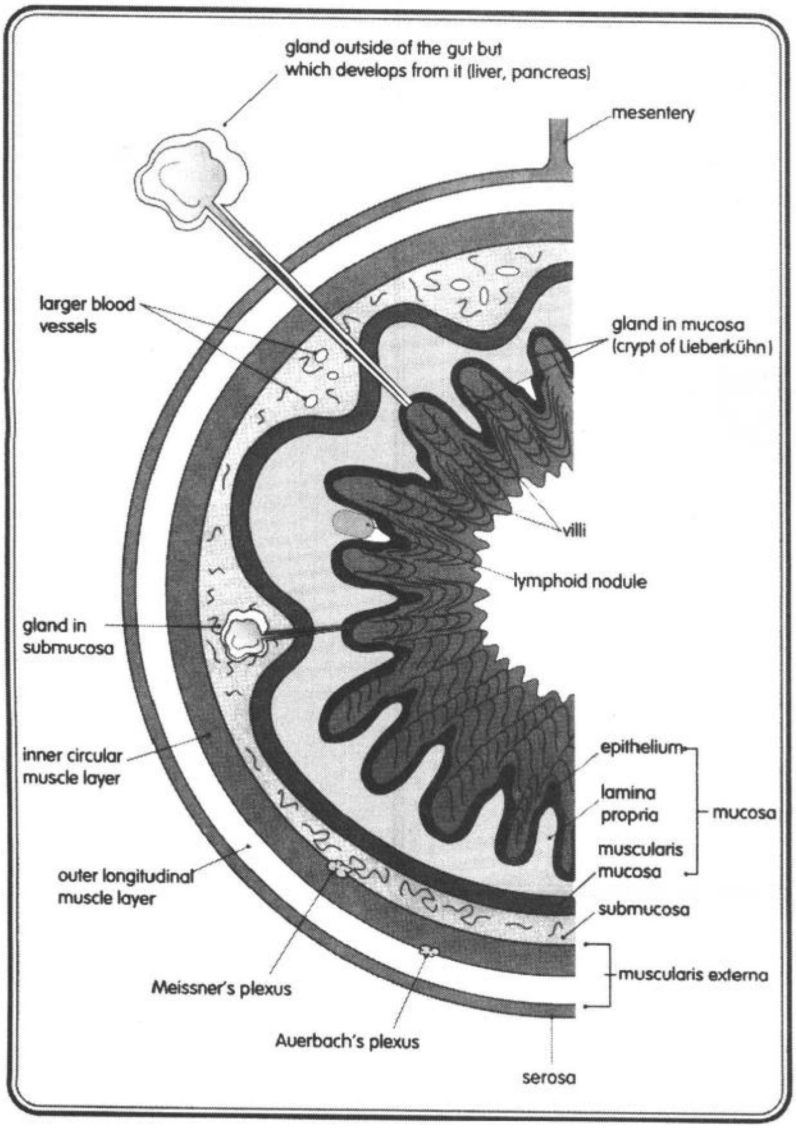

Fig. 1.2 The basic structure of the gastrointestinal tract.

- Sight and smell often alert us to the fact that something is contaminated. A vomit reflex exists to eject harmful material from the gastrointestinal tract.
- The stomach is an acid environment; most bacteria swallowed in the diet are killed by the acidity.
- Aggregations of lymphoid tissue (part of the body's immune system) are present in the walls of the tract, in the form of Peyer's patches. These counteract antigens present in the diet.
- A number of gastrointestinal hormones (mainly peptides) are produced in the gut (Fig. 5.11) and many of these have local as well as systemic effects.

Excretion of waste products is another important function of the gut.

CONSTITUENTS OF FOOD

The body needs food to provide energy. Vitamins and minerals are necessary to maintain good health. The main food groups are carbohydrate, fat, and protein. These are oxidized to generate high-energy bonds in ATP (adenosine triphosphate) and also to provide materials for building new tissues.

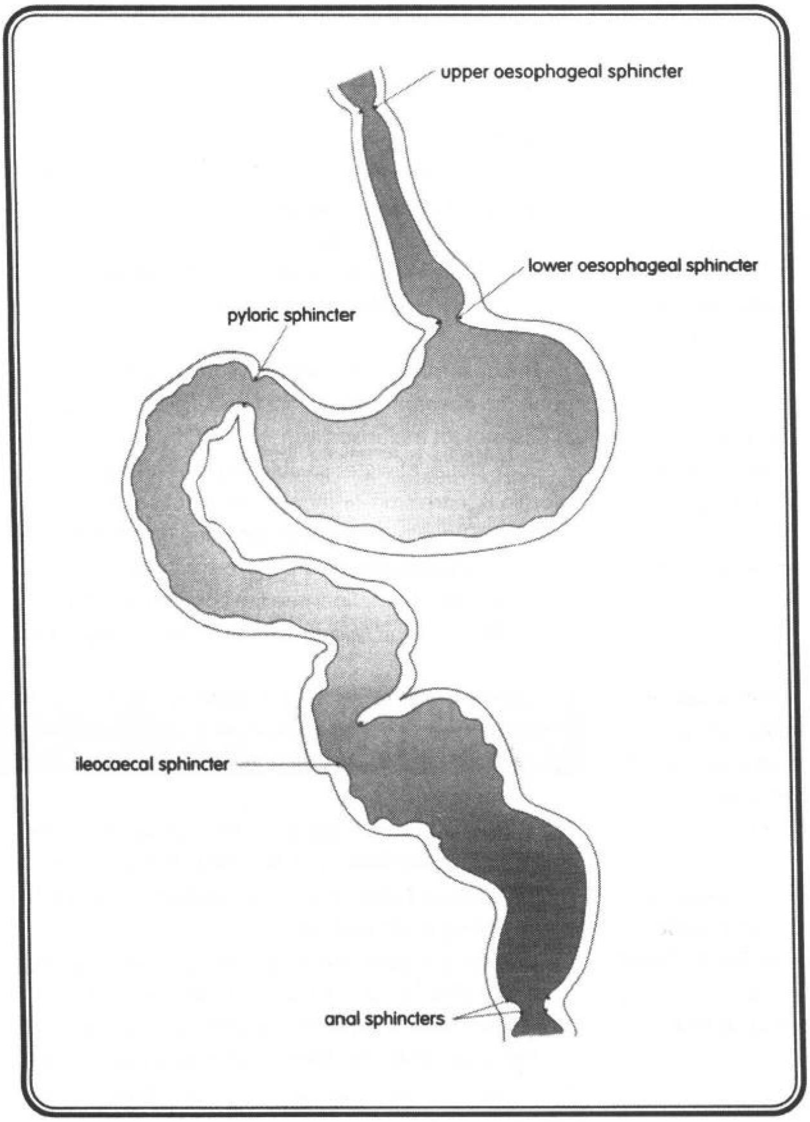

Fig. 1.3 Sphincters of the gastrointestinal tract.

Excess food, stored as fat, leads to obesity and associated diseases such as ischaemic heart disease and non-insulin-dependent diabetes. Men and women have different patterns of fat distribution in the body. When deprived of food, an average 70 kg man may survive for 5–6 weeks on body fat stores provided he is able to drink water. Blood glucose levels drop during the initial few days, then rise and stabilize (the brain needs a constant supply of glucose, although other organs are better able to utilize other forms of energy). During prolonged fasting, the body will also break down muscle, including heart muscle, to provide energy. This may lead to death from cardiac failure.

Fat

Dietary fat is chiefly composed of triglycerides (glycerol plus esters of free fatty acids, which may be saturated, monounsaturated, or polyunsaturated). With the exception of essential fatty acids, linoleic acid and α-linoleic acid, which we cannot manufacture and must obtain from our diet, we are efficient at manufacturing fats (triglycerides, sterols, and phospholipids) and will lay down subcutaneous stores, even on low-fat diets. Fat intake should be less than 35% of total energy intake.

Carbohydrate

The carbohydrates found in food are starch (a polysaccharide), some disaccharides (mainly sucrose), lactose, and non-starch polysaccharide (previously called fibre).

Excess of carbohydrates may limit the intake of other forms of food.

Protein

Protein is composed of amino acids, nine of which are essential for protein synthesis and nitrogen balance.

We need 0.75 g protein per kilogram of body weight per day, but in developed countries most people exceed this. Excess protein may lead to bone demineralization.

In developing countries, where protein is less readily available, combinations of certain foods can provide enough of the essential amino acids even though those foods, on their own, are low in amino acids.

Examples of good combinations are maize and beans, and baked beans on toast!

Water

Water in the body comes from fluid intake and the oxidation of food. We need about 1 L of water per day to balance insensible losses (more in hot climates).

Excess water is excreted by the kidneys; inadequate intake leads to dehydration.

Minerals

Minerals are chemicals that must be present in the diet to maintain good health; over twenty have so far been identified.

Trace elements are substances that, by definition, are present in the body in low concentrations (less than 100 parts per million) and include some minerals. It is not yet known whether all trace elements are essential for health, however.

Vitamins

Vitamins are classified as fat soluble or water soluble; vitamins A, D, E, and K are fat soluble, the other vitamins are water soluble.

Fat soluble vitamins are stored in fatty tissue in the body (mainly in the liver) and are not usually excreted in the urine.

The absorption of fat soluble vitamins is dependent upon the absorption of dietary fat: deficiency can occur in cases of fat malabsorption.

Body stores of water soluble vitamins (other than vitamin B_{12}) are smaller than stores of fat soluble vitamins. They are excreted in the urine and deficiencies of water soluble vitamins are more common.

For further information, see the companion volume on *Metabolism and Nutrition* in the *Crash Course* series.

OVERALL DEVELOPMENT OF THE GASTROINTESTINAL TRACT

The GI tract is the main organ system derived from the endodermal germ layer. The formation of the tube is largely passive; it depends on the cephalocaudal and lateral folding of the embryo.

The yolk sac produces blood cells and vessels, and is the site of haemoeisis for the first two months from conception. Later, it becomes inverted and incorporated into the body cavity. The folding of the embryo constricts the initial communication between the embryo and the yolk sac.

The remnant of this communication is the vitelline duct which normally disappears *in utero*. Where it persists (as it does in about 2% of the population) it is known as a Meckel's diverticulum.

The gut tube divides into foregut, midgut and hindgut, each of which has its own blood supply (Fig. 1.4). The superior mesenteric artery is in the umbilicus. The gut tube starts straight but twists during development and the midgut grows rapidly, with the developing liver occupying most of the space.

There is not enough room in the fetal abdomen to accommodate the rapidly developing gut. The gut herniates between weeks 7–11 of gestation, continuing its development outside the abdominal cavity.

It undergoes a clockwise rotation of 180° and what was the inferior limb becomes the superior limb (and vice versa). It then undergoes a 270° turn anticlockwise so that the caecum lies under the liver. The tube then elongates again so the caecum points downwards. Sometimes the caecum remains pointing up instead of down which makes diagnosis of appendicitis difficult!

The falciform ligament lies in front of the liver and the lesser omentum lies behind the liver. The liver and pancreas develop from endodermal diverticulae that bud off the duodenum in weeks 4–6 (Fig. 4.16).

Much of the mouth (including the muscles of mastication and tongue) and the oesophagus develop from the branchial arches.

The muscles of mastication, mylohyoid and anterior belly of digastric develop from the first (mandibular) arch, supplied by the trigeminal nerve (V).

The anterior two-thirds of the tongue develop from three mesenchymal buds from the first pair of branchial arches. The posterior belly of digastric develops from the second arch, supplied by the facial nerve (VII).

Stylopharyngeus develops from the third arch, supplied by the glossopharyngeal nerve (IX).

Cricothyroid, the constrictors of the pharynx, and the striated muscles of oesophagus develop from the fourth and sixth arches, supplied by branches of the vagus nerve (X). The fifth arch is often absent.

- **Summarize the basic organization of the gastrointestinal tract.**
- **What are the gastrointestinal tract's main functions? Where in the tract do these occur?**
- **Name the major food groups.**
- **Describe the embryological origins of the gut.**

Divisions of the primitive gut tube

Divisions of gut	Blood supply	Components
foregut	coeliac artery	pharynx oesophagus stomach proximal half of duodenum gives rise to: liver gall bladder pancreas
midgut	superior mesenteric artery	distal half of duodenum jejunum ileum caecum ascending colon proximal two-thirds of transverse colon
hindgut	inferior mesenteric artery	distal one-third of transverse colon descending colon sigmoid colon proximal two-thirds of anorectal canal

Fig. 1.4 Divisions of the primitive gut tube.