Diseases of the Gastrointestinal Tract and Liver

Edited by

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SECOND EDITION

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Preface

Several important factors contributed to the success of the first edition of *Diseases of the Gastrointestinal Tract and Liver*. Our readers tell us that these were the inclusion of gastrointestinal and liver diseases in one volume, the integration of these diseases into a unified structure using as simple and uniform a style as possible, a balance determined by a clinical approach to the specialty and extensive but selective referencing. In the second edition we have aimed to retain these strengths and principles and have sought to build upon them. Our aim, therefore, remains that of providing a clinically orientated text, based on a consensus between a rapidly expanding and often confusing medical literature and the practical experience of the editors and contributors. This approach will be of value to physicians in training, to general medical practitioners and to gastroenterologists. Physicians in training are often fascinated by investigations such as endoscopy but we have tried to present gastroenterology as a clinical specialty in which investigations serve rather than dominate our patients.

The number of contributors in this edition has increased but their contributions mainly embrace sections of several chapters, emphasizing the close coordination which we believe is an essential feature of this book. The importance of surgery to the development of gastroenterology and hepatology and to its clinical implementation is reflected in the appointment of David Carter as surgical editor. Likewise, the increasing impact on our specialty since 1982 of the various forms of imaging has led to an expansion of the chapter on this subject and to the recruitment of two radiologists as contributors. Other changes reflect increasing knowledge of pancreatic diseases, the success of liver transplantation and the need to include paediatric diseases which increasingly impinge on the practice of gastroenterologists and hepatologists. We would like to thank each of our contributors for bringing their individual skills to this book and for providing us with so much instruction. Their contributions have brought major improvements while any shortcomings remain our responsibility, for we are still the final common pathway into the text. Under 'Acknowledgements' we also pay tribute to numerous colleagues who have helped us with the first and the second editions. It is a deep sadness to us that Dr Mike Buist, who was so vital to the first edition, died prematurely in October 1986.

Finally, it has to be questioned why, having survived the rigours of the first edition, we should have subjected ourselves, and particularly our families, to a second edition. Quite simply, it is difficult to part with a successful book. Not only have our families continued to be understanding, they have even continued to contribute; typing and text and reference checking have been carried out by Dale Finlayson, Dr Duncan Finlayson and Clare Shearman, and the last has revised the index. We are deeply grateful.

D.J.C.S.

Adelaide and Edinburgh, 1989 N.D.C.F.

Preface to the first edition

The last decade has seen the evolution of gastroenterology into one of the most exciting of medical specialties. The impetus for this development has arisen from many sources, but particularly from the development of new endoscopic, radiologic, and ultrasonic methods of diagnosis, a rapid increase of knowledge about liver diseases epitomised by the discoveries regarding the viral causes of acute and chronic hepatitis, and the use of sophisticated methods for elucidating absorptive and secretory mechanisms in the intestines. This has led to the production of many books ranging from highly specialised multiauthor works to monographs on pathological, surgical, biochemical, immunological and other aspects of gastroenterology as well as to works on individual diseases. It is not surprising that many believe the general textbook outmoded, as it cannot reflect the latest views on every topic. We subscribe, on the contrary, to the view that a comprehensive text is particularly valuable in this situation as it provides an accessible overview for those training in the specialty and for those in clinical practice.

Our main intention has been to write a textbook which will be of practical value to general physicians, physicians and surgeons with a special interest in gastroenterology and especially to those training in this specialty. The book has been written mainly by two authors, and we have tried to ensure that it is well integrated by working together closely, by cross-referencing the text and by providing an extensive index. Almost all gastroenterologists are consulted on gastrointestinal and hepatological problems, and the book therefore covers gastrointestinal and liver diseases in the one volume; few gastroenterologists caring for adult patients are consulted about children, consequently no attempt has been made to cover gastrointestinal and liver diseases in childhood.

The text is designed primarily for clinicians. Such a book obviously needs information from the basic disciplines, but we have tried to restrict such material to that relevant to clinical matters. Radiographs, figures and photomicrographs have been used to illustrate principles as space did not permit that every disease be illustrated. A textbook must also be a stimulus and a source for further exploration of the literature: for this reason we have not stinted on references. We have aimed to include historical, research and clinical papers as well as review articles, monographs and books; our main restrictions have been to refer to articles in English and in the more widely available journals. The order of the text has a specific purpose. The first four chapters describe the important principles of investigational procedures. There are specialised texts on each of these investigations, but we aim to describe their main indications and complications and to relate them to the specialty as a whole. Thereafter, the chapters follow a conventional order, but with close integration of diseases of the liver with those of the pancreas and biliary tree.

In writing this book we have discovered and benefitted from the generosity of innumerable people who have aided our efforts. Most are acknowledged elsewhere, but others we would mention here. It is *de rigeur* for authors to pay tribute to their families to the extent that such tribute may easily ring hollow. However, we know now what demands the writing of a book such as this puts on an author's family: curtailed meals, evaded parental responsibilities, forgotten birthdays and anniversaries, social isolation and that wretched box of papers which even goes on the family holidays. The fact is that this book would never have been finished without the generous love and tolerance extended by our wives and children. Family members have also helped directly with our work: Clare Shearman has organised the references for the chapters on gastrointestinal disease, Dale Finlayson has done much emergency typing in what are now called antisocial hours and Dr Duncan Finlayson has organised the references for the chapters on liver disease and has frequently strained family unity by his insistence on accuracy. We have been assisted by contributors (listed separately) who have written chapters on subjects in which they have special expertise. No authors could have had contributors easier to work with and we would pay them all a special tribute here. Our publishers are also due special thanks; Andrew Stevenson, Robert Adam and Claire McLeod have proved patient, helpful and capable of goading in a way which led to tolerable productivity rather than despair.

D.J.C.S.

Adelaide and Edinburgh, 1982 N.D.C.F.

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We would like to record here our immense gratitude to the people who have given us help and advice in writing this book; the willingness with which they gave us their time in spite of many other commitments leaves us permanently in their debt.

In the second edition, extensive material was provided on the oesophagus and on motility by Dr R. Holloway (Adelaide), on transit, motility and endocrinology by Dr M. Horowitz (Adelaide), on coeliac disease by Ms J. Langman (Adelaide), on the physiology of the colon by Dr M. Lawson (Adelaide) and on small intestinal motility by Professor N. W. Read (Sheffield). We wish to record that Dr T. A. S. Buist (Edinburgh) died during the initial preparation of the radiology sections for the second edition. He made major contributions to his specialty and we are forever in his debt for his help and friendship.

Many colleagues read and criticized particular sections or chapters, and to them we are especially grateful, as this was never a small task. Their efforts led to several improvements and saved us from sundry errors; all the remaining shortcomings are wholly our responsibility. These benefactors included: Professor J. J. K. Best (Edinburgh), Dr T. A. S. Buist (Edinburgh), Dr H. M. Cameron (Edinburgh), Dr B. Chatterton (Adelaide), Professor J. G. Collee (Edinburgh), Dr A. C. Douglas (Edinburgh), Mr P. G. Gill (Adelaide), Dr H. M. Gilmour (Edinburgh), Dr R. Hecker (Adelaide), Dr D. J. Hetzel (Adelaide), Professor G. G. Jamieson (Adelaide), Dr R. D. Johnson (Adelaide), Dr A. Kerr Grant (Adelaide), Professor S. K. Lam (Hong Kong), Mr A. I. S. Macpherson (Edinburgh), Dr D. B. L. McClelland (Edinburgh), Professor V. I. Mathan (Vellore), Dr C. Mawdsley (Edinburgh), Dr A. Paull (Adelaide), Professor I. W. Percy-Robb (Glasgow), Dr J. F. Peutherer (Edinburgh), Dr L. F. Prescott (Edinburgh), Dr A. T. Proudfoot (Edinburgh), Dr C. O. Record (Newcastle-upon-Tyne), Dr I. C. Roberts-Thomson (Adelaide), Dr M. D. Sumerling (Newcastle-upon-Tyne), Mr J. W. W. Thomson (Edinburgh), Dr S. R. Wild (Edinburgh) and Dr J. R. Winney (Edinburgh). Others sought out and helped us select suitable illustrations. Dr T. A. S. Buist (Edinburgh), Dr D. H. Cummack (Edinburgh) and Dr G. M. Fraser (Edinburgh) provided many of the radiographs, Dr S. R. Wild (Edinburgh) provided some ultrasound scans and Dr H. M. Cameron (Edinburgh) and Dr H. M. Gilmour (Edinburgh) provided almost all the pathology slides. We owe these helpers a particular debt of gratitude. Other illustrations were provided by Mr P. J. Collins of Adelaide (Fig. 2.8), Dr M. Gabb of Adelaide (Figs 13.25, 18.3, 18.6 and 18.7), Dr R. Holloway of Adelaide (Figs 4.12, 4.13, 6.4 and 6.6), Mrs J. Jack of Edinburgh (Figs 31.3, 31.4 and 31.6), Dr R. J. Kellett of Edinburgh (Fig. 29.12), Mr A. I. S. Macpherson of Edinburgh (Fig. 29.20), Dr J. F. Peutherer of Edinburgh (Figs 22.1, 22.3 and 22.4), Dr J. Piris of Edinburgh (Fig. 13.20), Professor N. W. Read of Sheffield (Figs 12.17 and 12.18), Professor J. Richmond of Sheffield (Fig. 30.9), Dr I. C. Roberts-Thomson of Adelaide (Fig. 38.4), Dr R. Rowland of Adelaide (Figs 13.1, 13.3, 13.4, 13.6, 13.7, 13.8, 13.23, 13.24, 13.31, 18.1, 18.2, 18.4 and 18.9), Dr W. Sircus of Edinburgh (Fig. 44.8), Dr A. F. Smith of Edinburgh (Fig. 20.13), Professor A. N. Smith of Edinburgh (Fig. 44.8), Mr T. V. Taylor of Manchester (Fig. 2.6) and Dr A. J. A. Wightman of Edinburgh (Fig. 1.4).

Medical colleagues alone are not sufficient for the writing of a medical book and we would like to express our appreciation to others besides our families who are mentioned elsewhere. Our warmest thanks go to Mrs Isabel Fisher (Edinburgh) and Mrs Mary Marucci (Adelaide) for typing the first and second editions respectively.

A book such as this cannot be written without reproducing material reported in the medical literature. The origins of all such material are indicated in the captions of the relevant figures and tables, and the names of all the authors, the titles of the publications, the relevant volumes and, in the case of books, the publishers are recorded in the reference lists of individual chapters. We acknowledge here with gratitude the permission granted by individual publishers to reproduce material for which they hold the copyright: Figs 6.19 and 12.13 are reproduced by permission of Academic Press Inc. (New York) Ltd; Figs 38.6 and 38.7 are reproduced by permission of Acta Chirurgica Scandinavica; Fig. 14.3 is reproduced by permission of the

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Contents

1

Radiological investigations

Plain radiographs (Gough & Gear 1971, Frimann-Dahl 1974)

The plain radiograph is particularly valuable in the diagnosis of the 'acute abdomen', and is sometimes taken prior to other radiological procedures as it shows various soft tissue shadows and demonstrates opacities. However, with the development of more sophisticated techniques (e.g. ultrasound scanning and computerized tomography) to demonstrate individual organs in the abdomen, the value of the plain radiograph is decreasing (Hayward et al 1984, Simeone et al 1985).

Indications

A plain radiograph of the abdomen is sometimes required prior to other radiological examinations of the gastrointestinal tract as calculi or calcification in tissues may be obscured by contrast medium. Furthermore, opacities such as tablets, calcification or contrast medium retained after previous investigations may be interpreted as contrast medium introduced in the current examination. An abdominal radiograph should always be taken in patients with acute abdominal pain, and a plain radiograph of the chest should be taken at the same time since pain in the abdomen may have a cause in the chest, especially in children. Some abdominal conditions, for example pancreatitis, may cause secondary changes in the chest. The abdominal radiograph is also of value in management, for example in assessing the progress of severe ulcerative colitis, particularly toxic megacolon or subacute intestinal obstruction. The plain radiograph is insensitive in the detection of ascites (p. 845). Maximum benefit from the plain abdominal radiograph is obtained when it is reported by a senior radiologist (Lee 1976).

Procedure

The film should be taken in the radiology department if possible, since portable machines produce films of poorer quality. Films are taken with the patient erect and supine; the former must include both sides of the diaphragm and should be taken two minutes after the patient stands or sits up to allow free gas to accumulate under the diaphragm. A very ill patient may lie on the right and left side alternately, and a horizontal X-ray beam is used to take the radiograph (lateral decubitus films). It has been suggested that the erect abdominal film should be taken only when the supine film is normal in a patient suspected of having obstruction or when perforation is thought to complicate an obstruction (Simpson et al 1985).

Interpretation

Particular uses of plain abdominal radiographs will be described in relation to particular diseases. It is important to examine the radiograph systematically with attention to the following points:

Soft tissue shadows. The liver, spleen and kidneys can be identified because of their slightly different density to surrounding tissue. It is important to define the lateral borders of the psoas muscles (Fig. 1.1) and the layer of extraperitoneal fat in the flank ('flank stripe') because the disappearance of either may indicate an adjacent inflammatory process. Abnormal soft tissue shadows are caused by aneurysms, abscesses, cysts and tumours.

Gas shadows. The small amount of gas normally present in the small or large intestine has a characteristic pattern which allows the distribution of the bowel within the abdomen to be assessed. In addition, gas is normally seen in the gastric fundus and in the rectum. Gas acts as a contrast medium and occasionally delineates a tumour in the fundus, or a strictured or inflamed segment of the bowel (p. 1208). Obstruction or paralytic ileus may be indicated by fluid levels on the erect film and an excessive amount of gas in the bowel (Figs 1.2 and 1.3). In some cases, there may be a virtual absence of gas, as in high intestinal obstruction, acute pancreatitis and acute intestinal ischaemia.

'Medical' disorders can imitate the abdominal gas

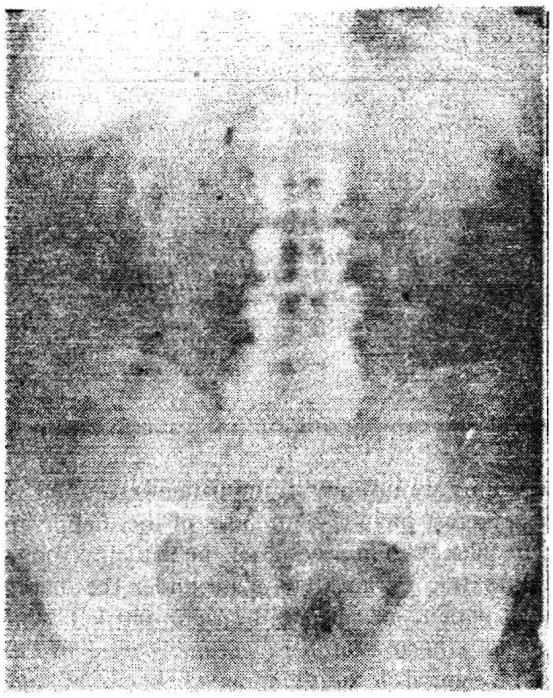

Fig. 1.1 Normal plain abdominal radiograph. The psoas shadows are seen running obliquely down on either side of the spine. There is a little gas in the stomach and in the colon and rectum but none in the small intestine. The opacity in the right hypochondrium is caused by the liver.

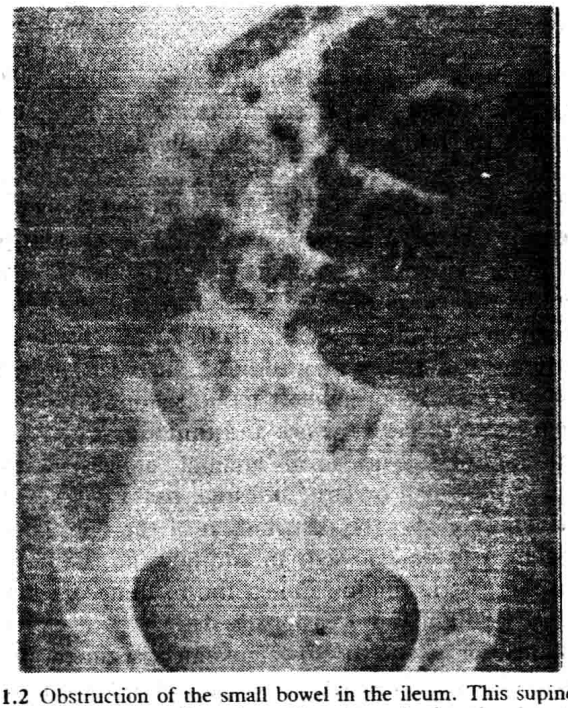

Fig. 1.2 Obstruction of the small bowel in the ileum. This supine radiograph shows gross distension of bowel proximal to the obstruction with typical cross-hatching. There is practically no gas in the colon. The erect film showed typical fluid levels.

patterns of acute surgical disease, particularly in infants, children and the elderly. Care is required in gastroenteritis, metabolic conditions such as uraemia and diabetic ketoacidosis, a history of medication particularly with

Fig. 1.3 Gross dilatation of the proximal colon, especially of the caecum, due to obstruction in the descending colon. No 'blow-back' into the terminal ileum which could have acted as a safety valve has occurred. In such cases, there is danger of caecal perforation. The obstruction was due to diverticulitis.

ganglion-blocking agents or anticholinergic drugs and in other rare conditions such as lead-poisoning, porphyria and some neurological disorders. All physicians ordering abdominal radiographs should be cautious in interpreting appearances in non-surgical conditions which may simulate an acute surgical emergency and lead to hazardous and unnecessary operations. In cases of doubt consultation with a radiologist and if necessary the performance of more specific investigations should be arranged.

Gas may occur in abnormal sites, in the peritoneal cavity as a result of perforation, in a subphrenic abscess, in the bile duct, gallbladder or portal venous system, in the bowel wall, as in pneumatosis intestinalis (p. 1267), or in the colonic wall in colitis or ischaemic disease.

Opacities. Opacification is usually due to calcium. About 20 % of biliary calculi (Fig. 1.21) and 80% of renal calculi are radio-opaque. Calcification may occur in the liver, gallbladder wall or pancreas (p. 1087), occasionally in cysts and tumours, such as mucoid cancers of stomach or colon, or in the aorta or iliac vessels and in aneurysms. Occasionally, confusion may be caused by calcified phleboliths or costochondral calcification and opaque material, including faeces, lying within the lumen of the bowel.

Bony structures. The bones should always be inspected for possible causes of abdominal root pain such as degenerative disease of the spine or metastatic deposits.

GASTROINTESTINAL RADIOLOGY (Margulis & Burhenne 1983)

Contrast materials

Barium sulphate. Proprietary barium suspensions are of high density and low viscosity (80–90% weight/weight),

and are designed to provide maximum adhesion to the gastrointestinal mucosa and to avoid flocculation in the presence of gastric or colonic mucus; these properties are important for producing high-quality radiographs in double-contrast studies. Generators of gas are available commercially mainly in the form of powders of suspensions capable of releasing large volumes of carbon dioxide when in contact with gastric acid.

Meglumine diatrizoate (Gastrografin). This is a water-soluble iodinated contrast medium which is poorly absorbed from the gastrointestinal tract. It is highly osmotic and is rapidly diluted as fluid is pulled into the bowel lumen. This osmotic effect can cause dehydration, and its use in children and the elderly must be carefully supervised. Gastrografin is usually given orally in the diagnosis of perforation or obstruction, and it can be helpful in demonstrating small intestinal fistulas, provided these are proximal. Gastrografin enemas can be used to investigate known or suspected colonic rupture and when colonic radiographs are required in the presence of a narrow stricture in the distal large bowel. Gastrografin enemas (p. 1059) have been used therapeutically in the management of meconium obstruction in newborn infants, but dehydration must be carefully avoided. Gastrografin must not be used if there is a risk of inhalation or fistula into the lungs, as fatal pulmonary oedema can be produced. The new, non-ionic, water-soluble contrast media such as meglumine and sodium ioxaglate (Hexabrix) and metrizamide (Amipaque) have been shown to be safe in the lungs in small quantities and not to cause significant reactions in the mediastinum when introduced experimentally (Ginai et al 1985).

Barium swallow

Indications

A barium swallow is carried out in nearly all patients with dysphagia, and when any disorder of the structure or function of the pharynx and oesophagus is suspected. It is used to demonstrate oesophageal varices and to provide information about adjacent abnormalities such as aortic aneurysms, vascular rings, and mediastinal lymph node enlargement.

Contraindications

Barium is not used if a perforation or leakage from a suture line is suspected. Under these circumstances, a water-soluble contrast medium is used. If a fistula between oesophagus and the respiratory system is suspected, the newer non-ionic products are indicated.

Preparation

The procedure is usually combined with radiological examination of the stomach and duodenum after the patient has been fasted for the preceding 12 hours. Combining the barium swallow with the barium meal examination is particularly important in disease of the lower oesophagus as gastric cancer infiltrating the oesophagus may simulate achalasia; furthermore the demonstration of hiatus hernia requires adequate filling of the stomach by barium.

Procedure

The details of the procedure, including the dilution of barium, vary with different radiologists; it is essential to provide adequate clinical information so that the radiologist can apply the measures appropriate to the problem. With both the pharynx and the oesophagus, it is usual to take anteroposterior and lateral radiographs while the oesophagus is distended with barium and has been cleared in order to define the mucosal pattern.

In general, high-density (80–90% weight/weight) barium is used to examine the pharynx and thoracic oesophagus. Initially, each sip is watched by the radiologist so that the stages of relaxation, contraction and resting can be observed. Spot films may be taken during swallowing; mucosal films are taken immediately after the barium has passed through the area. More barium is taken for maximum distension of the oesophagus, and a mixture of bread and barium, or marshmallows of known diameter, are sometimes used to demonstrate rings (p. 167) and to investigate dysphagia for solids. More elaborate manoeuvres are required for the study of hiatus hernia and gastro-oesophageal reflux (see below).

Double-contrast oesophograms are very helpful in detecting oesophagitis and small neoplasms. The patient is asked to swallow rapidly alternate mouthfuls of barium and water in the prone position, or gas-producing granules are given in water followed by rapid swallows of barium in the erect position. Usually sufficient gas is released in the latter technique to distend the oesophagus to produce double-contrast films of the oesophagus (Goldstein & Dodd 1976).

The pharynx is difficult to examine because the swallowing process is completed quickly. Thus, for the demonstration of neuromuscular problems and webs, rapid sequence filming or videorecording (p. 7) is necessary. However, it is possible to obtain information from the mucosal pattern after thick barium has been swallowed and from the distensibility seen with the patient blowing against closed lips (Valsalva manoeuvre). A lateral view with a large bolus of barium will demonstrate the posterior wall in the search for vertebral osteophytes and cricopharyngeal hypertrophy. In contrast laryngopharyngography (Jing 1970), a radio-opaque medium is dripped into the pharynx under local analgesia, multiple films being taken in varying phases of distensibility and phonation.

Cineradiography has been largely replaced by videorecording because of the high radiation dose given by this technique and the relative inconvenience.

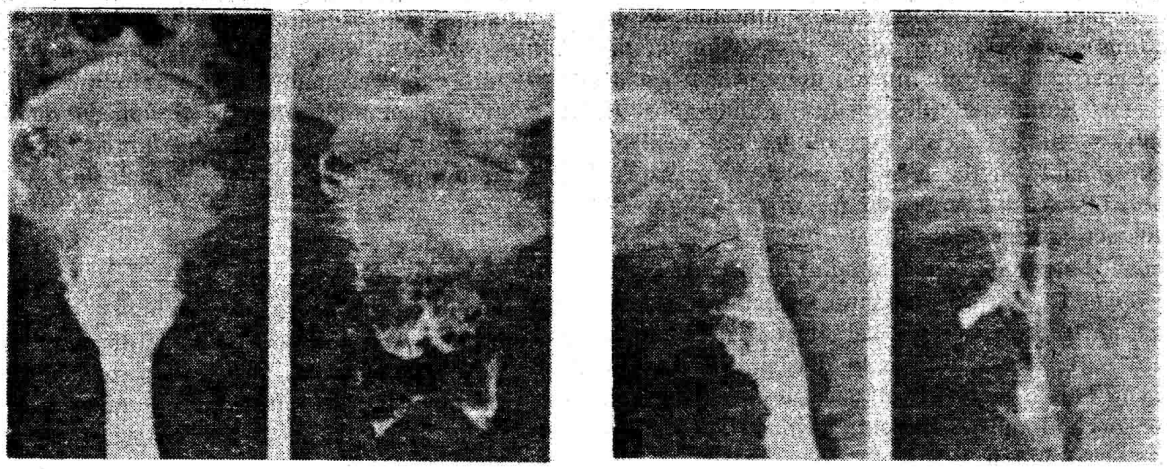

Fig. 1.4 Radiographs of the normal pharynx during (left) and after (right) a swallow of barium. Anteroposterior (left pair) and lateral (right pair) films are shown.

Interpretation

A radiograph of the pharynx is shown in Figure 1.4 and a diagram in Figure 6.1. When the pharynx and upper oesophagus are filled with barium, the posterior wall is straight and runs parallel to the spine; the anterior wall has irregularities at the level of the vallecula, epiglottis and laryngeal vestibule. Contrast films are important to assess the structure and distensibility of the pharynx. A tumour is usually detected visually or by endoscopy, but radiology is used to assess the precise location of the tumour and its extent.

Neuromuscular disorders are often difficult to demonstrate by taking isolated films during the barium swallow examination, and thus fluoroscopic observation, rapid-sequence films and videorecording are used. Normally, the bolus is squeezed out of the oral cavity by pressure from the tongue so that it passes through the fauces into the oropharynx. The hyoid and lateral walls of the pharynx are elevated to enclose the bolus, and at the same time the posterior part of the tongue obliterates the upper part of the nasopharynx. As the bolus passes further, the epiglottis and the laryngeal musculature prevent entry into the larynx, and a rise in pharyngeal pressure accompanied by relaxation of the cricopharyngeus allows the bolus to move into the oesophagus. Neuromuscular disturbance may allow barium to enter the larynx or nasopharynx or to re-enter the mouth. Barium may pool in the pharynx because of inability to contract the pharynx or to relax the cricopharyngeus.

In the examination of the oesophagus, the radiologist assesses the normal position of the oesophagus, its motility and its mucosal features (Figs 1.5 and 1.6). Radiographs are usually taken in oblique positions in the erect, supine and prone postures. Obstructive lesions are best demonstrated with the patient erect, but the recumbent position is used to detect hiatus hernia and motor abnormalities, as the transit of swallowed barium is slower, hence easier to study and record. The relation of the oesophagus to the great vessels and main bronchi is shown in Figure 1.7. The aortic arch indents the oesophagus (Fig. 1.6). Abnormalities are seen with aneurysm of the aorta, aberrant right subclavian artery and right sided aorta (p. 184). At a

Fig. 1.5 Normal cervical oesophagus. The posterior border of the oesophagus is parallel to the cervical spine and separated from it by only a few millimetres.

Fig. 1.6 Normal oesophagus. Right anterior oblique view showing extrinsic impressions caused by the aortic arch (above) and the left main bronchus (below).

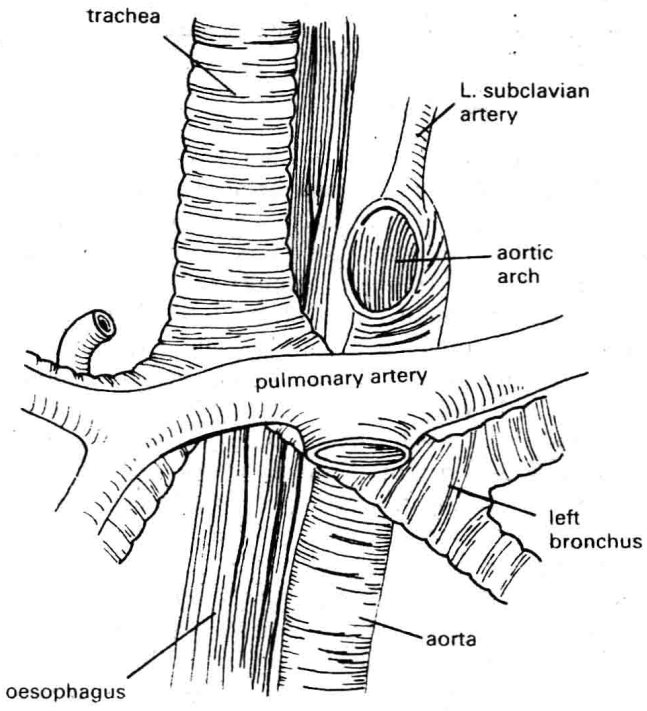

Fig. 1.7 The relation of the oesophagus to the great vessels and main bronchi.

slightly lower level, the oesophagus is indented by the left main bronchus. Between these two indentations is a small area which is liable to develop pulsion diverticula (p. 166). Below the bronchial indentation, the oesophagus is surrounded by lymph nodes, and diseases of these nodes may result in traction diverticula (p. 166). Below this, it has close contact with the left atrium.

Under normal circumstances, when liquid barium is swallowed by the erect patient, the oesophagus relaxes and the barium momentarily fills its entire length before a primary peristaltic wave empties the oesophagus. Relaxation then occurs, and any remaining barium is cleared by secondary peristaltic waves. Tertiary contractions are spontaneous non-peristaltic contractions seen in the lower oesophagus. They are common in healthy older patients (p. 162). These progressive oesophageal movements are best recorded by studying the passage of a single swallow of barium as it proceeds distally. The normal sequence of events is nearly always disrupted in the primary motility disorders of diffuse spasm (p. 160) and achalasia (p. 156), and disturbance in motility may also be secondary to organic diseases, such as tumours and peptic oesophagitis. Motor disturbances and ring formation (p. 3) may be accentuated by studying the swallowing of solid material.

Tumours are detected by a break in the continuity of the barium column and by the demonstration of a filling defect in the lumen (p. 188). Benign tumours cause a smooth filling defect and do not alter peristalsis; malignant tumours form irregular filling defects and the oesophageal walls are rigid. Submucosal infiltration by tumour in the lower part of the oesophagus may be difficult to distinguish from achalasia (p. 188) or peptic oesophagitis. In such circumstances computerized tomography can be used to study the thickness of the oesophageal wall and involvement of neighbouring structures.

The normal mucosal pattern consists of parallel longitudinal folds which are best seen after the barium has passed through the oesophagus or by utilizing double-contrast techniques. Varices appear as beadlike filling defects (see Fig. 29.6). In the early stages, they occur on the anterolateral wall, and thus anterior oblique films are taken, often in deep inspiration, as this lowers the diaphragm and exposes the lowest few centimetres of the oesophagus. The demonstration of varices frequently requires multiple films in different positions, particularly in the supine and prone postures and in varying phases of respiration.

Inflammation of the oesophagus may thicken or disrupt the longitudinal folds, and there may be motility disturbances. Later, there is narrowing of the oesophagus

(p. 175 and 177), frequently due to prolonged spasm but also by fibrosis if submucosal disease is present.

The oesophagogastric region

The normal anatomy (Fig. 1.8) and physiology of this region are difficult to understand because different terms have been adopted by radiologists, endoscopists and by those describing the motility of the region. The tubular oesophagus joins the (phrenic) ampulla about 3 cm above the diaphragmatic hiatus. During swallowing, the oesophagus closes at its junction with the (phrenic) ampulla, leaving the latter filled with barium which then empties into the stomach. Between the lower limit of the (phrenic) ampulla and the stomach, the oesophagus is referred to as the submerged segment because it lies within the abdomen. This segment is narrowed because of the relatively high intra-abdominal pressure. The oesophagogastric mucosal junction lies in the submerged segment, but its position cannot be determined radiologically and it cannot be related to the position of the diaphragm. Anatomical terms are also sometimes used. The term vestibule denotes the squamous part of the oesophagogastric region (Fig. 1.9), and the term cardiac antrum denotes the area lined by glandular epithelium. Thus, the stomach includes a short tubular segment of about 1 cm proximal to the cardiac orifice. The high-pressure zone is defined by manometry as the zone of intraluminal pressure which exceeds the pressure within the fundus. It extends above and below the diaphragmatic hiatus for 1–2 cm, the distal margin being the cardiac orifice; the proximal margin is in the region of the junction between oesophagus and vestibule which is recognizable at oesophagoscopy by the mucosal rosette (p. 94). The term lower oesophageal sphincter has been used for the high-pressure zone. The term inferior oesophageal sphincter also requires defining; Wolf (1967) suggests that the term be reserved for the contractile band occasionally seen on radiographs between the oesophagus and the vestibule.

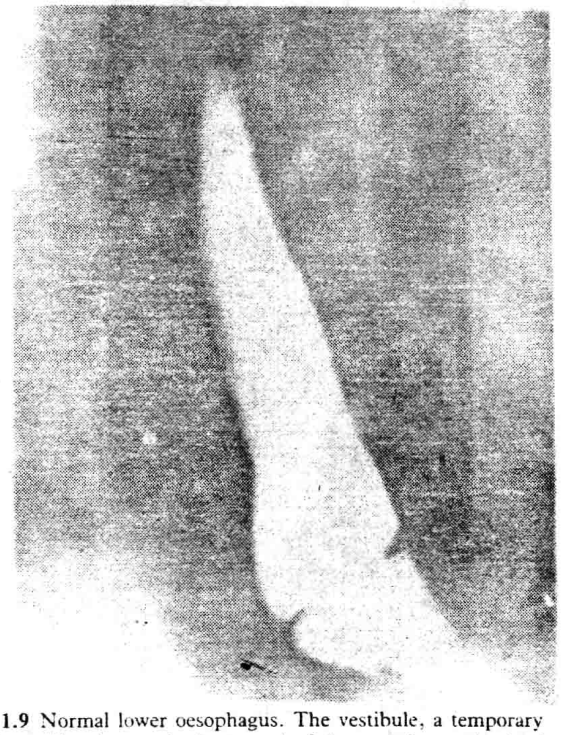

Fig. 1.9 Normal lower oesophagus. The vestibule, a temporary fusiform dilatation at the lower end of the oesophagus, is clearly seen. Indentation in the middle in the vestibule is now considered to be due to a prominent ridge of mucosa at the junction between squamous and columnar epithelium.

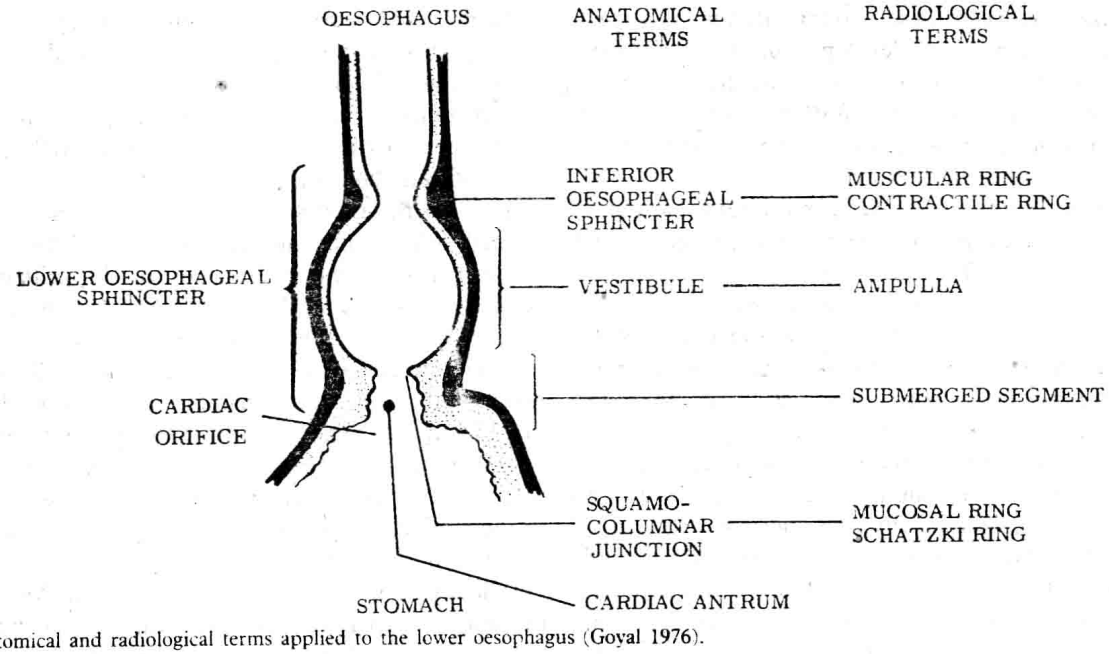

Fig. 1.8 Anatomical and radiological terms applied to the lower oesophagus (Goyal 1976).

The oesophagogastric junction radiologically is a complex region and its definition is important in the diagnosis of hiatus hernia and reflux oesophagitis. The specific landmark for the squamocolumnar junction is the transition from smooth oesophageal to nodular gastric mucosa at the 'z' line. The 'z' line is normally at the level of the hiatus and can quite frequently be identified on double contrast films. Upward displacement of this junction is a diagnostic sign of hiatus hernia (Gelfand & Ott 1979). The gastric sling fibres may also notch the lateral aspect of the oesophagogastric junction and this may be seen in hiatus hernia (Friedland 1978).

The transverse mucosal fold or B ring may indent the oesophagus at the junction (Wolf 1970). It is likely that a Schatzki ring (Schatzki & Gary 1953) is an exaggerated weblike form of the transverse mucosal fold. Another ring indentation can be demonstrated at the proximal end of the vestibule and has been labelled as the muscular ring, the contractile ring or A ring (Wolf 1970).

Radiological definition of a small hiatus hernia can be difficult, firstly because the oesophagogastric mucosal junction cannot be seen, and secondly because the (phrenic) ampulla may mimic a small hernia by retaining barium which can run back up the oesophagus, simulating reflux.

Videorecording/rapid sequence filming

These techniques provide a detailed and sequential record of the radiological procedures. Videorecording can be repeated slowly or stopped at any point so that interpretation becomes easier. This is the best radiological way of studying the pharynx and some areas of the oesophagus. Videotape systems, which are cheaper and use less radiation, are used to record and display the fluoroscopic image during screening and have largely supplanted cineradiology, though storage is less convenient. Using a photofluorographic camera attached to the image intensifier, up to six frames a second can be recorded on a conveniently stored 100 mm film format.

Videotape studies of the pharynx should always be used to demonstrate neuromuscular disorders (p. 165) and lesions such as small tumours, webs and diverticula. Frontal and lateral views of the pharynx should be recorded routinely and oblique views are sometimes helpful. The technique is also useful in the diagnosis of disorders of motility in the oesophagus as it aids the recognition of normal and abnormal contractions. Finally, it has been used to define more precisely abnormalities of motility and rings in the lower oesophagus seen on barium swallow (Wolf 1970).

Barium meal

Indications

The barium meal is used to diagnose diseases of the stomach and duodenum, and to delineate fully disorders of the lower oesophagus, such as hiatus hernia and oesophageal reflux. The radiologist is concerned mainly with the demonstration of the mucosal surfaces, the detection of ulcer craters and filling defects in the stomach and with observing the motility of the stomach. The use of antispasmodic agents advocated by many for double-contrast examinations precludes observations of peristaltic activity. The barium meal may give information about adjacent masses or viscera, such as the spleen, liver and pancreas, which may displace the stomach and duodenum, though other scanning modalities will give much more accurate information.

Fibreoptic endoscopy has shown that the standard barium meal is an inaccurate procedure. However, most studies of the accuracy of double-contrast barium meals indicate a sensitivity of 80–90% (Pyhtinen et al 1982, Gelfand et al 1984). One study (Dooley et al 1984) suggests that the sensitivity of double-contrast barium meal was only 54% against 92% for endoscopy, though specificity was almost as accurate (91–100%).

Realistically, barium examination will not be as sensitive or specific as endoscopy for the evaluation of small mucosal lesions, nor will it compete with computerized tomography, sonography or magnetic resonance imaging in evaluating diseases outside the tubular gastrointestinal tract (Maglinte & Miller 1984). However, there is every reason to believe that reproducible, accurate and cost-effective barium examinations will be required for investigation for years to come, remembering that radiology and endoscopy are complementary (Fraser & Earnshaw 1983) and are not mutually exclusive. Whenever there is doubt about the interpretation of the appearance at double-contrast barium meal, an endoscopic opinion should be sought. Similarly the radiologist should be aware of the limitations of endoscopy imposed by observer error and the inadequacy of forceps biopsy.

Contraindications

Barium should not be used when gastroduodenal perforation is suspected, or when pyloric stenosis is likely, as the examination rarely defines the cause of the stenosis and barium may become inspissated in the stomach. However, preliminary intubation, stomach wash-outs and subsequent aspiration of barium may result in a diagnostic examination, especially when pyloric narrowing prevents diagnostic endoscopy.

Preparation

The patient should be fasted for 12 hours prior to the procedure. As with examination of the oesophagus, it is essential to inform the radiologist of suspected abnormalities so that a particular search is made for these. Previous