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section 15 Gastroenterological disorders 2740 assurance is essential and international efforts to encourage audit and set key performance indicators are underway. Colonoscopists should be aware of their own adenoma detection rates. Flexible endoscopy leaves only gas (air or CO2) in the colon, and can immediately be followed by scanning if incomplete. Total colonoscopy, its accuracy increasing to near microscopic levels with newer and more agile instruments, is likely to remain the diagnostic ‘gold standard’ for the foreseeable future. However, evolving newer methods such as virtual colonoscopy by scanning will be more acceptable to some patients and so have an invaluable role in screening and selection, in spite of their lack of tissue diagnosis or therapy. Since endoscopy can check an abnormal scan immediately, it is quite likely that colonoscopy will lose some of its present front-line diagnostic role. Nonetheless, it is equally likely that requirements for colonoscopy will increase overall as population screening for colorectal cancer prevention becomes an accepted routine. FURTHER READING Allison MC, et al. (2009). Antibiotic prophylaxis in gastrointestinal endoscopy. Gut, 58, 869–80. Atkin W, et al. (2010). Once-only flexible sigmoidoscopy screening in prevention of colorectal cancer: a multicentre randomised con- trolled trial. Lancet, 375, 1624–33. Corley DA, et al. (2014). Adenoma detection rate and risk of colorectal cancer and death. N Engl J Med, 370, 1298–306. Johnson DA, et al. (2014). Optimizing adequacy of bowel cleansing for colonoscopy: recommendations from the US multi-society task force on colorectal cancer. Gastroenterology, 147, 903–24. Waye JD, et al. (eds) (2009). Colonoscopy: principles and practice. Wiley-Blackwell, Oxford. 15.3.2 Upper gastrointestinal endoscopy James E. East and George J. Webster ESSENTIALS Endoscopy is the procedure of choice in patients with retrosternal or upper abdominal symptoms who require investigation, and is essential in significant

gastrointestinal bleeding to identify and— in most cases—treat the cause, with various therapeutic methods possible for erosions, ulcers, and oesophageal varices. More recent developments in the practice of upper gastro- intestinal endoscopy include the use of enteroscopy for direct vision of the small bowel, video capsule endoscopy for diag- nosis of obscure bleeding lesions, and an expanding range of minimally invasive therapeutic techniques. Endoscopic retro- grade cholangiopancreatography is the standard of care for the removal of gallstones from the common bile duct, and palliating obstructing pancreatobiliary tumours. Introduction Development of endoscopes Flexible fibreoptic endoscopes were developed in the mid 1960s, leading to the growth of gastrointestinal endoscopy as we now know it. The recent availability of cheaper, miniaturized charge coupled devices (video chips) has led to the development of video endo- scopes, providing an excellent clear view that does not deteriorate with age (as it does with fibreoptic devices). The external specifications and handling of the new video endo- scopes are similar to their earlier fibreoptic counterparts and thus the techniques for disinfection and endoscopy are similar for both ranges of equipment. The disadvantage of the modern equipment is that the video endoscopy system needs considerable hardware. In most instances, a video monitor, a light source, and a processor are located in an endoscopy unit and are less easily moved to a different location such as the intensive therapy unit or operating theatre for emergency endoscopy. With improvements in video processors and endoscopes, the endoscopic video image can be magnified: modern instruments will zoom up to 100 times magnification, and mucosal detail can also be enhanced electronically so that small lesions a few milli- metres in size can be seen quite clearly. The modern video endo- scope image can be instantly printed out or archived digitally on a computer system. The latest types of high-definition endoscope, processor, and monitor can also be used for two new techniques, narrowed spectrum endoscopy (narrow band imaging, Fujinon intelligent colour enhancement, and iScan) and autofluorescence imaging. Narrowed spectrum endoscopy enhances the visualization of mu- cosal patterns and microcapillaries in the superficial mucosa with short-wavelength (blue light) illumination using optical or digital filters. This enhances the visualization and diagnosis of otherwise poorly identifiable lesions. Autofluorescence imaging utilizes the property of short-wave light in the blue area of the spectrum to ex- cite green autofluorescence from normal mucosa, predominantly from collagen. Thickening of the mucosa by malignant infiltration tends to inhibit this and abnormal tissue may fluoresce less, al- lowing for endoscopic detection of a subtle abnormality in a false colour image. Endoscopy units It is now well recognized that the care of the instruments and other equipment, together with the important aspects of patient safety, are greatly improved by having a purpose-built endoscopy unit staffed by experienced endoscopic nursing staff who are trained in handling and disinfecting endoscopes and in patient safety during and after intravenous sedation. Most endoscopy units have a purpose-built disinfecting machine which can take single or multiple instruments. After suitable mech- anical cleaning, a disinfecting agent will be automatically pumped through the channels of the instrument for a given period of time and flushed out afterwards. The choice of disinfecting agent varies between units but the trend has been away from hazardous agents such as glutaraldehyde (Cidex) to less harmful agents, such as Nu- Cidex, Tristel, or Sterilox, that do not need sophisticated extraction and ventilation.

15.3.2 Upper gastrointestinal endoscopy 2741 Endoscopy procedure For routine, straightforward diagnostic upper gastrointestinal en- doscopy, many patients are now routinely endoscoped without sed- ation, after local anaesthetic spray to the pharynx only. ‘Unsedated endoscopy’ is suitable for high-throughput diagnostic services. The development of transnasal upper

gastrointestinal endoscopy with slim (4–5-mm diameter) endoscopes has improved tolerability. However, large numbers of endoscopies, particularly in apprehen- sive or sick inpatients and those needing more complex procedures, are still performed under intravenous sedation. There are now clear guidelines, such as those drawn up by the British Society of Gastroenterology, for the practice of adminis- tering intravenous sedation for endoscopic procedures. Patients are now monitored with pulse oximetry and oxygen is given rou- tinely to ill or elderly patients, and to other patients if oxygen sat- uration falls during the procedure. The precise choice of sedation varies between units and will depend on the patient and the type of procedure performed; however, benzodiazepines (e.g. midazolam) are the most common sedative agents used, often combined with an opiate (e.g. fentanyl) for more lengthy or invasive procedures. On rare occasions, general anaesthesia will need to be used for endos- copy, usually for children or adults with ventilatory problems. There is an increasing trend in some countries for complex procedures to be performed under propofol anaesthesia. Endoscopic retrograde cholangiopancreatography (ERCP) particularly benefits from deep sedation. Specially trained anaesthetic nurses can administer this. Specific risks of infection with endoscopy Current disinfecting agents and schedules will eradicate hepatitis B and C and HIV. All endoscopic staff wear disposable gloves and the nurse nearest the patient's mouth will usually wear a visor to cover eyes, nose, and mouth, particularly with a patient of known infective risk. As there is no effective way of sterilizing an endoscope against prions (at present thought to be the transmissible agent in variant Creutzfeldt–Jakob disease (vCJD)), the current United Kingdom Department of Health guidelines make it clear that all equipment used for invasive endoscopic procedures, that is, not simple visually diagnostic procedures, on patients with known or suspected vCJD should be quarantined afterwards; however, 'invasive' procedures in a patient at risk of vCJD due to receipt of pooled plasma concen- trates is no longer deemed to confer a high risk of endoscope con- tamination and standard decontamination is acceptable. Patients with suspected or known vCJD therefore should not be endoscoped unless no alternative way of diagnosis or treatment is available. In the past, patients with heart murmurs or prosthetic valves were routinely given antibiotics to cover endoscopic procedures related to a perceived risk of endocarditis. However, international guide- lines now do not recommend prophylaxis for diagnostic procedures, which is reserved for ERCP, endoscopic ultrasound (EUS)-guided cyst aspiration, those with neutropenia, and those undergoing per- cutaneous endoscopic gastrostomy (PEG). Diagnostic endoscopy of the upper gastrointestinal tract In recent years, it has become routine to take gastric biopsies in pa- tients with peptic problems to detect the presence of Helicobacter pylori. The routine use of a CLO test, where mucosal biopsies are inserted into a gelatin well containing a colouring agent that turns yellow to red in the presence of helicobacter urease is cheap and accurate (Fig. 15.3.2.1). In some patients with infection resistant to multiple eradication therapies, gastric biopsies may be needed in this situation for culturing the bacteria to ascertain sensitivity. In younger patients where malignant disease is less of a concern, serum, faecal, or breath test analysis is an acceptable alternative to establishing helicobacter infection and thus such patients could be treated initially without endoscopy and gastric biopsy, the so-called test and treat strategy, saving resources. Most oesophagogastric cancers in the United Kingdom are diagnosed when the patient is symptomatic (Fig. 15.3.2.2, Video 15.3.2.1) and thus the finding of a mucosal cancer is rare. Endoscopists in Asia, however, commonly find mucosal gastric cancers, and these may be underdiagnosed in the West. Dysplastic lesions and early cancers in Barrett's oesophagus are increasingly common. Although most lesions are straightforward to diagnose endoscopically and biopsies are usually confirmatory, more subtle early cancers can be found with high-quality examination, making organ-preserving endoscopic therapy possible. Missed or interval upper

gastrointestinal cancers occur at a similar rate to those in the lower gastrointestinal tract (10% of all cancers found within 3 years of a normal gastroscopy), leading to a renewed interest in quality at upper gastrointestinal endoscopy. Cancers that infiltrate the wall of the stomach below the mucosa are difficult to diagnose endoscop- ically as endoscopic biopsies are usually quite superficial. In this situation, a ‘double-punch’ type technique is useful, where a second biopsy is taken from the deeper submucosa through the small defect of the first biopsy. Linitis plastica is difficult to assess endoscopically, particularly where anticholinergic and other agents may have been used routinely to inhibit peristalsis at the start of the endoscopy. In such patients, cross-sectional imaging with CT can demonstrate widespread gastric thickening. Fig. 15.3.2.1 A negative (top) and positive (bottom) CLO test result, obtained within 1 h of placing gastric biopsies on the test cards. From Medical masterclass, 2nd edition, RCP London (2008) with permission.

section 15 Gastroenterological disorders 2742 Small bowel endoscopy (push and balloon-assisted enteroscopy) For many years, routine upper gastrointestinal endoscopes were not of sufficient length to pass beyond the duodenojejunal flexure into the small bowel. Enteroscopes are now made that can be advanced under direct vision down the upper small intestine or, alternatively, a paediatric colonoscope may be used. Direct visualization of the deep small bowel can be achieved using single- or double-balloon enteroscopes, where a balloon on an overtube, and on the tip of the scope in the double-balloon technique, allows the small bowel to be concertinaed over the enteroscope. Bidirectional approaches (oral and anal) can allow direct visualization, biopsy, and therapy to the entire small bowel in skilled hands. Sonde enteroscopy where a thinner endoscope is allowed to pass down the small bowel spon- taneously with the help of an inflated balloon and then the bowel lumen is visualized on withdrawal is now obsolete. Use of a standard upper gastrointestinal endoscope up and down the small intestine through small enterotomies at the time of laparotomy, with a sur- geon concertinaing the small bowel over the shaft of the endoscope to find bleeding points, is now rarely used and carries significant morbidity. Small bowel biopsy using a Crosby capsule has been completely superseded by routine upper gastrointestinal endoscopy with biop- sies from the distal duodenum. Such biopsies have been shown to be very representative of the upper jejunal mucosa. This technique is now used as standard in the diagnosis of coeliac disease. Video capsule endoscopy of the small bowel In the last decade, a new technique of visualizing the small intestine has been developed and, although relatively expensive, is now widely available and has revolutionized small bowel imaging. A small cap- sule containing a miniature video chip and transmitter can be swal- lowed by the patient or released at the time of endoscopy. Providing the small intestine has been cleared with a colonoscopy-type bowel preparation, the capsule transmits individual images of high quality every 0.5 s to a receiver strapped on the abdomen. The capsule takes about 4 h to pass down the small intestine. This technique is particularly useful in the detection of superfi- cial mucosal lesions, such as angiodysplasia in obscure gastrointes- tinal bleeding or early Crohn’s disease, that might otherwise be undetected by X-ray examination using barium, or CT or magnetic resonance enterography, and to guide use of the much more invasive balloon-assisted enteroscopy. Caution is needed as capsules may get stuck in strictured small bowel, leading to intestinal obstruction. Endoscopic ultrasound The development of endoscopes with dual capability of endoscopic and ultrasound imaging has led to a growing range of applications for diagnostic and therapeutic EUS. Either a rotating or a fixed linear-array transducer provides an ultrasound image at a point where the endoscopist can accurately direct the probe in the lumen of the oesophagus, stomach, or duodenum. Although CT scanning will stage most larger tumours of the upper gastrointestinal

tract, pancreas, and bile duct, EUS is particularly useful in staging small tumours and mucosal tumours. The use of contrast media may enhance the EUS definition of discrete lesions. Therapeutic endoscopy of the upper gastrointestinal tract Over the last 30 years, a wide range of therapeutic manoeuvres have been developed for use in various situations in the upper gastrointestinal tract. Gastrointestinal bleeding Oesophageal and gastric varices (Fig. 15.3.2.3) can cause torren- tial bleeding and are now most commonly treated by endoscopic banding (Fig. 15.3.2.4). With this technique the varix is sucked into a cap on the tip of the endoscope and a tight elastic band slipped over the varix. Multiple bands can be applied to obliterate the variceal columns. Gastric varices are better treated by the use of cyanoacrylate glue or thrombin to obliterate the larger variceal Fig. 15.3.2.3 Oesophageal varices at risk of bleeding. From Marks D, Harbord M (2013). Emergencies in gastroenterology and hepatology. By permission of Oxford University Press. Fig. 15.3.2.2 Exophytic oesophageal adenocarcinoma causing stenosis and dysphagia.

15.3.2 Upper gastrointestinal endoscopy 2743 lumen. Sclerotherapy with ethanolamine oleate under direct vi- sion is now generally avoided due to the risk of secondary bleeding from mucosal ulceration and sometimes later oesophageal stric- ture formation. Bleeding erosions and ulcers can be injected with dilute adren- aline (1:10 000), but international guidelines now recommend dual therapy with the addition of a second technique, either multicontact diathermy probes or heater probes to coapt the vessel walls, or endo- scopic clips to provide mechanical tamponade. Bleeding vascular abnormalities, such as angiodysplasia, can be treated with thermal probes, endoscopic clips, or more recently with argon plasma coagulation. An ionized stream of argon gas provides a safe and predictable way of coagulation without direct contact with the mucosa, and although more costly, it is more ef- fective than simple touch diathermy devices and has replaced thermal laser coagulation. The most recent addition to the thera- peutic armamentarium for gastrointestinal bleeding are haemo- static powders delivered via a catheter, which can be useful for bleeding in difficult positions, for diffuse tumour bleeding, or as a rescue therapy. Benign oesophageal strictures Commonly, a peptic stricture above a hiatus hernia secondary to reflux will produce dysphagia but benign strictures due to other causes, such the swallowing of corrosive substances and postsurgical anastomotic strictures, can be treated by the same endoscopic tech- niques. In the past, bougies of increasing size were passed over a previously endoscopically placed guide wire and the stricture slowly dilated. More recently, high-pressure dilating balloon catheters, passed directly through the scope under direct endoscopic vision, or over a wire under radiological screening, have been used. These are useful for short strictures, but there may still be a place for over-the- wire bouginage in very long or complex strictures. Recurrent benign strictures can now be stented with removable covered metal mesh stents for 6 to 8 weeks to try to prevent restricturing. Biodegradable stents are being developed. Achalasia of the cardia can be treated with balloon dilatation using a larger balloon 30 to 40 mm in diameter, where the aim is to rupture muscle fibres to weaken the circular muscle sphincter. Alternatively, botulinum toxin can be injected through the mucosa into the muscle sphincter circumferentially at the time of endoscopy. The improvement in swallowing after this procedure is limited, and it may need to be repeated every 6 months. Malignant gastro-oesophageal strictures Most patients with nonoperable tumours of the stomach or oe- sophagus producing dysphagia are palliated by the insertion of some sort of oesophageal stent. The older silicon rubber prostheses have been replaced by self-expanding metal mesh stents which can be very easily and safely placed through a malignant stricture, often without the need for prior dilatation, thus reducing the risk of perforation. Most of these stents now

have a membrane to prevent tumour in- growth through the mesh (‘covered stents’) but this will sometimes occur at one or either end. Such tumour overgrowth can be treated with argon plasma coagulation or restenting. Brachytherapy can be given via an endoscopically sited tube through the stricture before or after stenting. Postoperative anastomotic strictures after oesophagogastric re- section, sometimes associated with a leak, can now be managed with covered self-expanding metal stents. The newer stents are po- tentially removable a few months later when the stricture and leak have sealed. Removal of foreign objects Most solid objects such as marbles, rings, and coins should pass spontaneously. The need for removing foreign bodies is usually be- cause they are sharp and may cause damage if left in situ. Most ob- jects can be snared or trapped in a basket and removed intact. Sharp objects can be pulled into an endoscopic overtube to protect the oe- sophagus from damage during removal. Polyps and mucosal cancers Most gastric polyps are entirely benign and do not need removing, but should be biopsied to confirm their benign nature. Leiomyomas of the stomach or duodenum can be watched if small, but if more than 5 cm in size should probably be removed. Endoscopic mucosal resection and endoscopic submucosal dissection Patients with larger mucosal tumours usually used to undergo open or laparoscopic surgery but newer endoscopic mucosal resection techniques can successfully curatively treat lesions that do not infil- trate beyond the submucosa. Careful prior assessment with EUS is sometimes needed to make sure that a small tumour can be technic- ally removed in this way. Lesions can be elevated by the submucosal injection of saline and then removed en bloc or piecemeal, as for polyps in the colon. This can be done for small mucosal cancers or dysplastic lesions in Barrett’s oesophagus or similar lesions of the stomach, duodenum, or ampulla of Vater. Newer accessories with a suction cap and banding device, similar to that used with varices, allow the mucosal lesion to be trapped and removed with a snare Fig. 15.3.2.4 Variceal band ligation: a tight rubber ring has been placed around the base of the varix. Note transparent cap is part of banding device. Courtesy Dr. Sreelakshmi Kotha, Royal Free Hospital, London.

 without damage to the muscle layer and therefore with a lower risk of perforation. The technique of endoscopic submucosal dissection has become increasingly used for gastric mucosal dysplastic lesions, especially in the Far East, where the lesion is isolated with a modified endoscopic needle knife and resected en bloc, even for large lesions, reducing recurrence rates and providing definitive pathology. Ablative therapy Although endoscopic mucosal resection and endoscopic submucosal dissection can resect focal lesions effectively, in Barrett’s oesophagus a potentially large area of at risk columnar (Barrett’s) mucosa will remain. Repeated resection can lead to strictures; however, recently radiofrequency ablation balloon devices have become available. A radiofrequency balloon that tightly conforms to the oesophageal lumen is placed to cover the Barrett’s segment after resection of any nodular dysplastic areas. Radiofrequency energy is then applied to ablate the superficial Barrett’s mucosa, which then re-epithelializes with squamous mucosa reducing but not eliminating future cancer risk. Other techniques such as argon plasma coagulation can be used to ablate smaller Barrett’s areas. Assisted nutrition There are now many types of enteral feeding tube that can be sited in the upper gastrointestinal tract. Although most fine-bore feeding tubes can be passed on the ward or under radiological control, the prior passage into the stomach of an endoscopic guide wire that is then rerouted through the nose can allow feeding tubes to be posi- tioned accurately, often through an oesophageal stricture or difficult anastomosis, or positioned in the duodenum in patients with gas- tric stasis. The endoscopic positioning of a nasojejunal feeding tube, beyond the duodenojejunal flexure, is now becoming a common alternative to intravenous feeding in patients with complicated

pancreatitis. Techniques for placing a gastrostomy tube endoscopically (PEG) are now routine and straightforward. After transabdominal puncture into a distended stomach under direct endoscopic vi- sion, a PEG tube with diameter from 8 to 24 F can be pulled back down the oesophagus through the stomach and a flange, balloon, or button will allow the tube to be anchored firmly up against the gastric mucosa. In patients where there is gastric stasis, or in pan- creatitis, a small jejunal extension tube can be inserted through the PEG tube and positioned endoscopically into the distal duo- denum or beyond the duodenojejunal flexure. Balloon-assisted enteroscopy can be used to place percutaneous feeding tubes dir- ectly into the jejunum. Endoscopy and disorders of the pancreas and biliary tree Endoscopic retrograde cholangiopancreatography ERCP is performed using a combination of a side-viewing duodenoscope (necessary to visualize the ampulla and access the pancreaticobiliary ducts on the medial wall of the duodenum), and a dynamic X-ray (fluoroscopy) screening facility. Modern duodenoscopes are approximately 13 mm in diameter at the tip, with 120o four-way tip angulation, and a 4.2-mm working channel down which wires, contrast injection catheters, and stents, may be inserted. ERCP is an important tool in the care of patients with a range of problems, including bile duct stones, biliary stricturing diseases (e.g. primary sclerosing cholangitis, IgG4-related cholangitis), malignant obstruction (e.g. pancreatic cancer, cholangiocarcinoma), and chronic pancreatitis (Fig. 15.3.2.5). Given the inherent risks associated with ERCP, and improved and alternative imaging modalities, ERCP should no longer be used as a diagnostic tool per se. Its primary role is in delivering therapy, at which time it may be used for tissue acquisition. Gallstones Gallbladder stones occur in 10 to 15% of the adult population, but remain asymptomatic in 80% of patients. Migration of stones into the bile duct (choledocholithiasis) may lead to obstructive jaundice, biliary colic, cholangitis, and acute pancreatitis. Bile duct stones require removal, and this is most usually performed through ERCP. Having positioned the tip of the duodenoscope within the duodenum, opposite the duodenal papilla (ampulla of Vater), a thin wire is passed through the sphincter and into the bile duct. Contrast dye is carefully injected into the duct to de- fine the exact number, site, and size of the bile duct stones. A dia- thermy cut is then applied through a wire on the end of the catheter (sphincterotome), which results in cutting through the ring of muscle within the ampulla (sphincterotomy). This may then allow the stones to be removed, by means of 8 to 15-mm balloon trawls, or baskets (Fig. 15.3.2.6). Fig. 15.3.2.5 ERCP showing intrahepatic biliary strictures (bold arrow) and dilatation (dashed arrow) in IgG4-related sclerosing cholangitis. From Medical masterclass, 2nd edition, RCP London (2008) with permission.

 Large (>15 mm) stones may require additional approaches, including further balloon dilatation of the sphincter (e.g. 10–18-mm balloon sphincteroplasty) or baskets with metallic sheaths to crush the stones (mechanical lithotripsy). Difficulty in endoscopic stone clearance may relate to stone number, size (>10 mm), location (intrahepatic, within cystic duct, stones above strictures). For the approximate 10% of patients in whom stone clearance is not possible by conventional ERCP techniques, new innov- ations in cholangioscopy (small endoscopes, 3–6 mm in diameter, which may be passed into the bile duct) allow direct visualization of stones, and intraduct laser or electrohydraulic lithotripsy are gaining wider use, and may avoid the need for surgical bile duct exploration. In patients with bile duct stones, cholecystectomy should be per- formed following ERCP and bile duct clearance. Sphincterotomy and pigtail stent insertion into the bile duct, alongside the stones, is an effective means to ensure relief of biliary obstruction and cholangitis. However, attempt should be made to clear the duct of stones, and biliary stenting (i.e. without duct clearance) is rarely an acceptable

long-term solution, except in the setting of extreme infirmity. A biliary leak may occur following 1 to 2% of cholecystectomies. This may occur from the cystic duct stump or relate to trauma to the bile duct or liver. ERCP may both define the site of leakage and allow closure of the leak by means of stent placement. Biliary strictures ERCP has an important role to play in the assessment and man- agement of biliary strictures. These may relate to a wide range of causes, which may be benign (e.g. postoperative anastomotic or iatrogenic strictures, primary sclerosing cholangitis, secondary to chronic pancreatitis) or malignant (e.g. cholangiocarcinoma, car- cinoma of head of the pancreas, hilar lymph nodes). Advancing the diagnosis may be achieved with noninvasive imaging (CT, mag- netic resonance cholangiopancreatography), and EUS, but ERCP remains central in most cases for endobiliary tissue acquisition and relief of biliary obstruction. Tissue acquisition Exfoliative biliary brush cytology has been the standard tech- nique for tissue sampling of biliary strictures at ERCP for more than 30 years. While providing high specificity (>95%), it carries low sensitivity (approximately 40%) for malignancy. Combining fluoroscopically directed endobiliary biopsies with brush cy- tology may improve sensitivity, as may additional tissue analysis techniques, such as fluorescence in situ hybridization, which uses fluorescently labelled DNA probes to evaluate the presence of chromosomal alterations. Direct intraductal visualization of strictures, using cholangioscopy, allows better targeted tissue sampling, and enhanced mucosal visualization techniques, such as confocal laser endomicroscopy, may help in the assessment of indeterminate strictures. Stricture management The management of biliary strictures depends on a range of fac- tors, including the stricture aetiology, site, complexity, and the ex- tent of biliary obstruction. ERCP plays an important role in the treatment of dominant biliary strictures (those causing significant obstruction, i.e. jaundice). a bb a c (a) (b) Fig. 15.3.2.6 Panel A: a duodenoscope is seen in position within the duodenum (a), from where a thin catheter is passed into the bile duct (b). Radiopaque contrast injection and X-ray screening reveals multiple stones within the bile duct (arrows). Panel B: following cutting of the biliary sphincter using electrocautery (sphincterotomy), a balloon allows the stones to be cleared from the bile duct into the duodenum (c).

section 15 Gastroenterological disorders 2746 Balloon dilatation alone (using 4–10-mm balloons) may be an op- tion in some patients with known benign strictures (e.g. postsurgical stricture or primary sclerosing cholangitis), but biliary stenting is almost always required when strictures result in jaundice. A range of stents are available, with different indications. The wider a stent, the longer its likely patency. Straight plastic 6 to 18 cm long, 2 to 3 mm in diameter (7–10 F) stents are inexpensive and effective, and may be used for strictures of any type, and at any location within the biliary tree. Stent patency is usually 3 to 6 months, hence these stents may be an appropriate choice for patients with malignant obstruction and expected poor prognosis. Biliary self-expandable mesh metal stents are available, 4 to 10 cm long, 8 to 10 mm in diameter (Fig. 15.3.2.7). Fully covered self-expandable mesh metal stents may be used to treat benign and malignant extrahepatic strictures (but not across the liver hilum, as they may block the contralateral liver ducts). They carry an ad- vantage of being removal up to 12 months after deployment. Fully covered self-expandable mesh metal stents for benign disease may lead to stricture remodelling over 6 to 9 months, precluding the need for long-term stenting or surgical management. Uncovered self-expandable mesh metal stents should only be used in patients with known malignancy, who are not planned for surgery (as they are not generally removable), but provide good long-term patency (>9 months). Tissue ingrowth through the stent, or overgrowth over the proximal end of the stent, can occur over time, requiring reintervention via ERCP. In patients with malignant stricturing at the liver hilum (e.g. cholangiocarcinoma), bilateral stents may be required,

and the choice, location, and best route of deployment (i.e. ERCP or percutaneously) should be carefully coordinated through a spe- cialist multidisciplinary team. Pancreatic disease ERCP in patients with pancreatic disease should be confined to patients with clearly defined anatomical disease and significant symptoms, and these procedures should optimally be performed in specialist units. There may also be surgical options, which should be considered. In patients with chronic or recurrent pancreatitis, with pancreatic ductal obstruction due to a stricture or stone near to the ampulla, pancreatic sphincterotomy with stone removal or pancreatic duct stenting (5–7-F plastic stents) may be considered. Additional approaches to stone management, including extra-corporeal shock wave lithotripsy or intraductal lithotripsy, may be needed. Pancreatic fluid fistulae following acute pancreatitis, trauma, or surgery may sometimes benefit from ERCP and pancre- atic duct stenting. Drainage of peripancreatic fluid collections and pseudocysts may require EUS-guided cystgastrostomy. Malignant duodenal obstruction Approximately 10% of patients with pancreatobiliary tumours will develop gastric outlet obstruction as a late complication, as tumour infiltrates the duodenum. While a surgical gastric bypass may relieve this obstruction, many patients are frail on presen- tation, with advanced malignancy, and avoiding surgery is op- timal. Uncovered self-expandable mesh metal stents, 6 to 12 cm long, 20 to 22 mm in diameter, may be placed endoscopically using a therapeutic gastroscope/duodenoscope, under direct vi- sion and fluoroscopic guidance. This may allow return to a soft or semiliquid diet, and a resolution of vomiting. c d a (a) (b) b Fig. 15.3.2.7 Panel A: a duodenoscope is seen in position within the duodenum (a), from where a balloon catheter is passed into the bile duct (b). Radiopaque contrast injection and X-ray screening reveals a stricture of the bile duct (arrow) and pancreatic duct (dashed arrow), due to a tumour in the head of pancreas. Panel B: biliary obstruction is managed with a mesh metal biliary stent (c), deployed with distal flange in the duodenum (d).

15.3.2 Upper gastrointestinal endoscopy 2747 Endoscopic ultrasound Linear EUS and fine needle aspiration now plays a central role in the assessment of solid and cystic lesions within the pancreaticobiliary system. Using thin 18 to 22-gauge fine needle aspiration needles, a definitive diagnosis may be obtained in 80 to 94% of solid pancreatic lesions. Larger core needles may provide formal histological samples, with high diagnostic yield. EUS now allows formal assessment of lesions within several centi- metres of the upper gastrointestinal tract, including oesophagus, mediastinum, gastric wall, retroperitoneum, pancreas, liver, gallbladder, and adrenal glands. EUS is increasingly being used for therapy, including coeliac plexus neurolysis for painful pancreatic disease, drainage of pancreaticobiliary collections (e.g. cystgastrostomy), targeted cancer therapies (e.g. placement of radiopaque fiducials to lo- calize radiotherapy, or EUS-guided radiofrequency ablation), and drainage of obstructed pancreaticobiliary ducts, where not feasible through conventional endoscopy. Risks and complications of endoscopic procedures Risks associated with upper gastrointestinal endoscopy, EUS, and ERCP relate largely to issues of sedation, scope trauma during in- sertion, and complications specific to the particular intervention performed. Diagnostic upper gastrointestinal endoscopy carries very few risks. With careful attention to nursing techniques and sedation protocol, cardiorespiratory problems, such as hypoventilation or as- piration pneumonia, should be very rare, although they account for 60% of complications of upper gastrointestinal endoscopy. Perforation during diagnostic endoscopy occurs in approximately 1:10 000, and may relate to anterior osteophytes in the region of the cricopharyngeus, a malignant stricture, or an unrecognized pha- ryngeal or oesophageal pouch (a particularly hazard using the side- viewing duodenoscope). It carries a 2 to 36% mortality rate. Interventional upper gastrointestinal endoscopy The overall risk of oesophageal perforation following balloon or bougie dilatation of benign strictures is less than 2%, 2 to 5% for

achalasia balloon dilatation, and up to 10% for malignant strictures. Endoscopic mucosal resection of oesophagogastric early neoplasia carries a 1 to 5% risk of bleeding/perforation, but endoscopic sub- mucosal dissection, with en bloc resection, carries increased risks (2–6% perforation, 11% bleeding). Oesophageal perforation may be suspected in the setting of pain or discomfort after oesophageal dilatation (palpable crepitus of the soft tissues of the neck, ‘surgical emphysema’, makes it a virtual cer- tainty), and is confirmed with an emergency CT scan. Management is by putting the patient nil by mouth, giving parenteral antibiotics, and intravenous feeding. Surgery or specialist endoscopic interven- tion may be necessary. PEG is associated with a 2 to 9% complication rate, including aspiration, free perforation, injury to internal organs (e.g. liver), wound infection, and 0.5% procedure-related mortality (the overall 15% 30-day mortality largely reflects underlying comorbidity linked to the indication for PEG placement). Endoscopic ultrasound Diagnostic EUS carries risks comparable with standard upper gastrointestinal endoscopy. Tissue or cyst sampling using fine needle aspiration is very safe, carrying less than a 1% risk of com- plications. The emerging field of interventional EUS is associated with increased risks of complications (10–16% for EUS-guided biliary or pancreatic duct intervention/stenting), but this is likely to fall with experience. EUS-guided cystgastrostomy carries a 2 to 10% risk of complications, most commonly bleeding, perforation, or infection. ERCP ERCP carries an overall 5% risk of complication, including post-ERCP pancreatitis, bleeding, perforation, and infection. Pancreatitis may occur after any ERCP, irrespective of endosco- pist skill or experience, with the risk related largely to patient fac- tors. While the pancreatitis is mild/moderate in the majority, it can be severe in 8 to 10%, and occasionally fatal. The useful adage that ‘ERCP is most dangerous in those who need it least’ reflects the 3- to 10-fold increased risk of pancreatitis (to >20%) in cer- tain groups (e.g. female, <40 years, absence of jaundice, suspected functional pain), and reinforces the use of ERCP as a therapeutic, not a diagnostic, tool. While the use of prophylactic 5-F plastic pancreatic stents may reduce the risks of postprocedural pancreatitis in high-risk pa- tients, the most important recent change in practice is the uni- versal use of a single rectal nonsteroidal anti- inflammatory suppository (e.g. 100 mg of indomethacin or diclofenac) at the time of ERCP. Significant bleeding occurs in less than 1% of patients, usually fol- lowing biliary sphincterotomy and inadvertent cutting of a branch of the gastroduodenal artery. Endoscopic haemostasis is usually achieved, but angiographic embolization, or even surgery, may rarely be necessary. Retroperitoneal perforation occurs in less than 1%, almost al- ways following sphincterotomy or balloon sphincter dilatation. It is difficult to diagnose clinically (CT is essential), and may present late with retroperitoneal abscess formation. It should be managed by putting the patient nil by mouth, intravenous antibiotics, radio- graphic drainage of collections, and parenteral nutrition until the perforation closes. Surgery is rarely indicated. Infection (usually cholangitis) following ERCP usually occurs due to inadequate biliary drainage. Prophylactic antibiotics are no longer indicated for all ERCPs, but should be given in cases where poor drainage may be predicted (e.g. primary sclerosing cholangitis, complex hilar biliary strictures), or in immunosuppressed patients, and should be given during/after the procedure (and continued for 3–5 days) if adequate drainage is not achieved. Cholangioscopy ap- pears to carry a slight increased risk of cholangitis (likely due to the need for retrograde fluid infusion), hence prophylactic antibiotics are given.

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