ERCP and Therapy

Risks and Indications

8

The techniques of diagnostic and therapeutic endoscopic retrograde cholangiopancreatography (ERCP) have been described separately in previous chapters. However, it is logical to discuss their application together. There are very few indications for ERCP which may not sometimes lead to a therapeutic manoeuvre. For this reason, we do not support training in diagnostic ERCP alone.

ERCP is perhaps the most rewarding endoscopic procedure performed by gastroenterologists. It is also the most dangerous. Consideration of its role involves careful balancing of its risks and benefits, with full knowledge of the alternative management methods, especially interventional radiology and surgery. Which technique to use is also influenced considerably by the stage of the disease (e.g. the extent of the tumour) and by the general health of the patient. Some general aspects of risks are covered in Chapter 3 and outcome definitions in Chapter 12.

This chapter discusses the place of ERCP in pancreatic and biliary diseases (as viewed in 1996). First, the known risks associated with ERCP procedures are reviewed.

Complications

ERCP carries the same (rare) risks associated with all endoscopic procedures, including medication reactions, cardiopulmonary accidents and intestinal perforation. Risk factors for some of these complications and patient safety aspects related to prevention are detailed in Chapter 3. Attempted duct cannulation can cause pancreatitis and sepsis. Therapeutic procedures add additional risks, especially retroduodenal perforation, bleeding, stone impaction and stent dysfunction.

The incidence of complications depends on many factors, including the definitions which are used (see Chapter 3). Many patients have some discomfort after pancreatography and the serum amylase is usually raised; what constitutes pancreatitis? Equally, some oozing of blood is not unusual after sphincterotomy; when is it called 'bleeding'? Consensus definitions and stratification for severity have been published (Table 8.1).

Many older series of sphincterotomy reported complication rates of approximately 10%, with 1% fatality rates. Recent publications indicate a lower overall complication rate of about 5%, of which 3% are mild, 1% moderate and 1% severe. In expert hands,

	Mild	Moderate	Severe
Bleeding	Clinical (i.e. not just endoscopic) evidence of bleeding Haemoglobin drop < 3 g, and no need for transfusion	Transfusion (4 units or less), no angiographic intervention or surgery	Transfusion 5 units or more, or intervention (angiographic or surgical)
Perforation	Possible, or only very slight leak of fluid or contrast, treatable by fluids and suction for 3 days or less	Any definite perforation treated medically for 4–10 days	Medical treatment for more than 10 days, or intervention (percutaneous or surgical)
Pancreatitis	Clinical pancreatitis, amylase at least three times normal at more than 24 h after the procedure, requiring admission or prolongation of planned admission to 2–3 days	Pancreatitis requiring hospitalization of 4–10 days	Hospitalization for more than 10 days, or haemorrhagic pancreatitis, phlegmon, or pseudocyst, or intervention (percutaneous drainage or surgery)
Infection (cholangitis)	> 38°C for 24–48 h	Febrile or septic illness requiring more than 3 days of hospital treatment or endoscopic or percutaneous intervention	Septic shock or surgery
Basket impaction	Basket released spontaneously or by repeat endoscopy	Percutaneous intervention	Surgery

Any intensive care unit admission after a procedure grades the complication as severe. Other rarer complications can be graded by length of needed hospitalization.

Table 8.1 Grading system for the major complications of ERCP and endoscopic sphincterotomy.

the very rare deaths occur only in patients with severe co-morbidities (e.g. patients already septic and in intensive care). There has been particular concern about the risks in younger patients and in those with smaller ducts. Data concerning sphincterotomies (for stones only) were collected prospectively from seven centres in the USA recently (Table 8.2). The results are somewhat reassuring. Contrary to some opinions (and one paper related mainly to sphincter of Oddi dysfunction), sphincterotomy did not appear to be more dangerous in small ducts; short-term complications in younger patients were rare (Table 8.2).

Pancreatitis

Pancreatitis is the commonest complication of diagnostic and therapeutic ERCP procedures. Using the agreed definitions, the

	All patients (%)	Patients < 60 years with ducts < 9 mm
Total no. patients	**1921**	**238**
Complications	112 (5.8)	10 (4.2)
Mild	70 (3.6)	7 (2.9)
Moderate	26 (1.3)	2 (0.8)
Severe	12 (0.6)	1 (0.4)
Fatal	4 (0.2)	0 (0)

Table 8.2 Complications of sphincterotomy for stone; prospective study of seven centres in the USA, 1994.

incidence is around 3% in most series. Most attacks are mild, settling within a few days with conservative management, but life-threatening complications can develop and deaths have resulted. Pancreatitis can occur even without pancreatography, but it is clear that the incidence increases with repeated injections of contrast. The risk is definitely increased in the context of sphincter dysfunction, is slightly higher in patients with a prior diagnosis of pancreatitis, and is lower when Santorini's duct is patent. Surprisingly, one study showed that the risk was not significantly higher in patients who had already experienced an attack of ERCP-induced pancreatitis. Randomized studies have shown no prophylactic benefit from non-ionic contrast agents or various prophylactic medications (e.g. Glucagon, somatostatin).

Sepsis (cholangitis and septicaemia)

Sepsis can result from cholangiography in the presence of infected bile. The risk can be minimized by avoiding excessive bile duct pressure (exchanging bile for contrast) and by prior use of antibiotics. However, the most important factor is relief of obstruction by removing stones or providing nasobiliary or stent drainage. When these fail, percutaneous or surgical intervention may be necessary as a matter of urgency.

Serious sepsis (due to *Pseudomonas* and *Serratia*) has resulted from contaminated endoscopes and accessories (such as the water bottle). Any such incident should result in an immediate review of disinfection procedures. Nosocomial sepsis is more common in the presence of duct strictures or pseudocysts, but deaths have occurred after a normal-appearing ERCP. The risk of performing ERCP in the presence of a pseudocyst has been

overstated; ERCP is indicated (with proper disinfection regimens) when information about the ductal systems will affect management decisions.

Retroduodenal perforation

Retroduodenal perforation is reported in less than 1% of endoscopic sphincterotomies. It may be recognized immediately by the unusual endoscopic and radiographic appearances; the earliest sign is a diffuse leak of contrast behind the duodenum (Fig. 8.1). Further manipulation will drive air into the retroduodenal space, which may be recognized immediately on fluoroscopy or subsequently on plain radiology.

The risk of perforation is presumably greater with longer incisions. Patients with 'papillary stenosis' are at higher risk, but the assumption that small ducts are more dangerous has not been substantiated recently. Some series show that needle-knife pre-cut sphincterotomy carries an increased risk.

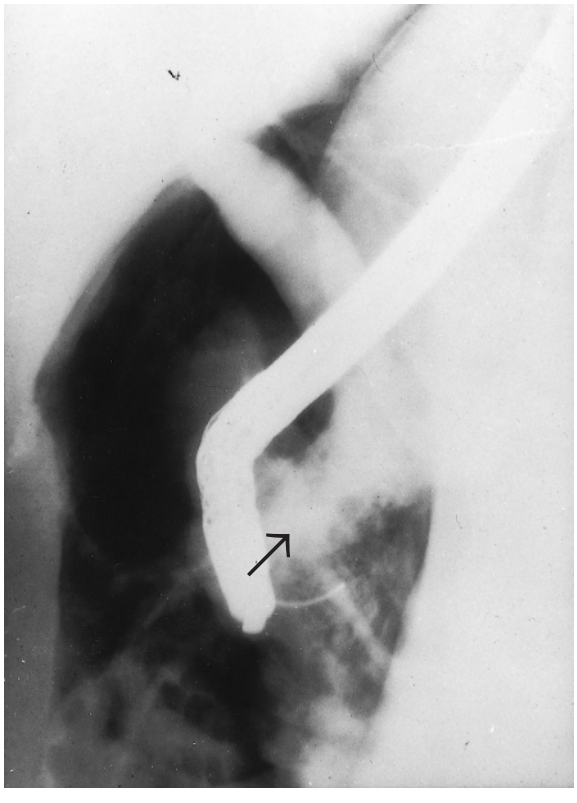


Fig. 8.1 Retroduodenal air and contrast (arrow) after sphincterectomy perforation.

Perforation should be considered in any patient who develops abdominal pain within hours of sphincterotomy although pancreatitis is far more common. A relatively normal serum amylase level in the presence of patient distress is an added pointer. If a plain abdominal film shows no air, computed tomography (CT) scanning is a very sensitive method for detecting perforation.

The management of perforation calls for early detection and a measured therapeutic approach in collaboration with a surgical colleague. Immediate operation is rarely indicated and most retroduodenal perforations after sphincterotomy have been managed conservatively. If the patient still has a problem of biliary obstruction when the perforation is recognized (e.g. with stones in the duct and gallbladder), it may be logical to proceed directly to surgery to clear the duct, place a T-tube and drain the retroperitoneal space. When there is no residual biliary disease or obstruction, most patients have been treated successfully using gastric suction, 'nil-by-mouth' and antibiotics. Some experts suggest adding nasobiliary drainage, but this is not of proven benefit. The patient's progress should be monitored carefully by the endoscopist and surgical colleague at least once a day. Conservative management should be continued only so long as the patient appears to be responding. A gastrografin swallow showing no continuing leak may be reassuring. Patients who develop a retroperitoneal abscess will require percutaneous or surgical drainage.

Bleeding

Bleeding after sphincterotomy sufficient to require blood transfusion is now very rare — possibly because smaller sphincterotomies are made and/or because of the increased use of coagulation/blended current. Bleeding most often results from cutting too quickly (the 'zipper'). The incision should be made slowly with adequate coagulation of the margins. Most bleeding stops spontaneously. A small ooze can be controlled by flushing adrenaline (epinephrine), at a dilution of 1 : 100 000 over the sphincterotomy site. If bleeding continues, we inject adrenaline (epinephrine), at a dilution of 1 : 10 000 into the sides of the raw sphincterotomy using a standard sclerotherapy needle. Alternatively, a stone-retrieval balloon is inflated in the bile duct above the sphincterotomy, and then pulled down firmly to tamponade the bleeding site against the face of the endoscope.

Bleeding sufficient to obscure the view within 1–2 min is unlikely to stop spontaneously. Skilled angiographic embolization is usually effective. Unfortunately, bleeding may recur after surgical oversewing alone; the use of non-absorbable sutures and ligation of the major feeding vessel have been recommended.

Stone impaction

Stone impaction can nowadays be avoided by the use of lithotripsy sleeves and baskets (see Chapter 7). If a stone and basket do become impacted and cannot be removed by standard means, it may be permissible to observe the patient overnight; spontaneous disimpaction has sometimes occurred.

Stent dysfunction

Stent dysfunction occurs when stents migrate (up or down) or become blocked with biliary debris. Patients present with obstructive cholangitis. Details are provided in Chapter 7.

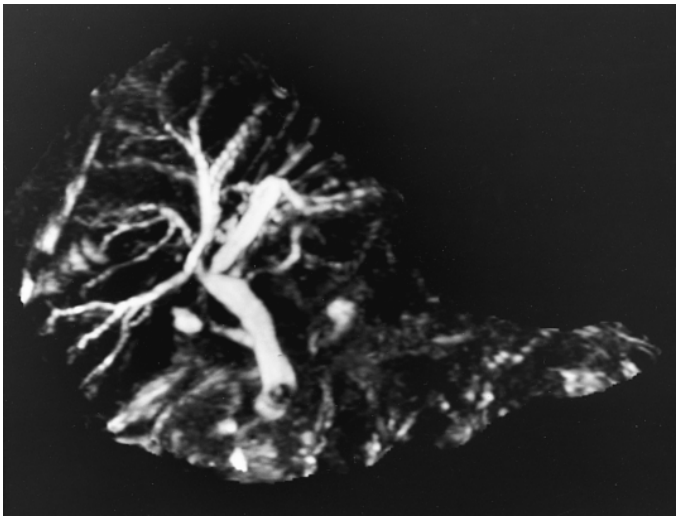
Delayed complications

Most complications of diagnostic and therapeutic ERCP are obvious within 12 h, but there are potential delayed problems, about which patients and their physicians should be advised. These include late bleeding, gallstone ileus (after removing very large stones), cholangitis (if stones have been left in place) and acute cholecystitis in patients with gallbladders.

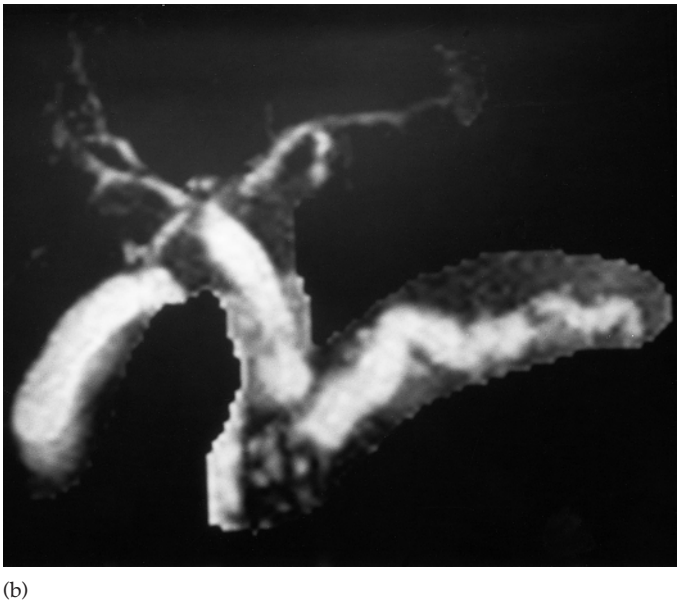
Follow-up studies at 5–15 years after sphincterotomy demonstrate that 15–25% of patients develop late biliary problems — usually new stones, with or without sphincterotomy stenosis. Most of these cases have been managed endoscopically. Gallbladder symptoms sufficient to warrant cholecystectomy occur in about 20% of patients in whom the gallbladder is left in place for follow-up periods of 5–10 years.

Alternatives

The first ERCP treatments (such as sphincterotomy for stones) were developed at a time when surgical intervention was hazardous. Improvements in anaesthesia and perioperative care (as well as the laparoscopic revolution) have reduced the risks considerably. Similarly, interventional radiology techniques have developed markedly over the last two decades. Although transhepatic puncture remains uncomfortable and potentially hazardous, the use of smaller catheters and expandable metal stents has reduced this negative aspect of percutaneous biliary work. Application of ERCP is also affected by developments in non-invasive imaging. Magnetic resonance cholangiopancreatography (MRCP) can provide excellent images (Fig. 8.2). Its impact on reducing (or even increasing) the use of ERCP has yet to be determined.



(a)



(b)

Fig. 8.2 Magnetic resonance cholangiography and pancreatography. (a) Dilated bile duct (post-cholecystectomy) showing a distal stone above a stricture—previously failed ERCP. (b) Small tumour in pancreatic head causing double duct dilation.

Influence of disease stage and co-morbidities

Our management approach to biliary and pancreatic problems is greatly influenced by the stage of disease and the general condition of our patients. There are many patients in whom anaesthesia and surgery are hazardous (e.g. severe sepsis, recent myocardial infarction, extensive malignancy). There are scales which can be used to measure co-morbidities, e.g. the American Society of Anesthesiology (ASA) grades. These are rather crude and more sensitive measures are needed. There are also specific risk factors for different therapeutic approaches; for example, percutaneous transhepatic procedures are more hazardous in patients with coagulopathy.

The role of ERCP techniques will be discussed in broad clinical contexts.

Clinical role of ERCP and therapy

Jaundice and malignancy

The patient presenting with jaundice is at the intersection of many disciplines, and a plethora of tests and treatments are available. This is a prototype challenge to multidisciplinary collaboration and the development of cost-effective care and algorithms.

Patients with jaundice used to be classified as 'medical' or 'surgical'. The latter category is now better called 'obstructive' since most obstructions are not treated surgically. Making the distinction between hepatocellular and obstructive jaundice is the crucial first task, which can usually be achieved early with percutaneous ultrasound scanning. This is usually (and reasonably) the first-line imaging test. However, as usually performed, CT scanning gives more information, particularly concerning surrounding organs (e.g. liver metastases). Bile duct dilatation may not be detected at an early stage in some patients with obstruction, especially when this occurs at the liver hilum, or in rarer conditions such as sclerosing cholangitis. A negative scan therefore does not rule out an obstructive aetiology. This can only be done by invasive cholangiography at the present time, although magnetic resonance cholangiography is making astonishing progress.

Cholangiography can be obtained in the jaundiced patient by ERCP or by percutaneous transhepatic cholangiography (PTC). Where both of these techniques are available, ERCP is usually preferred. It provides more diagnostic information (including a view of the papilla and pancreas as well as the bile duct) and has a broader therapeutic spectrum, e.g. in the management of stones and tumours. Certainly, the patient suspected of having obstructive jaundice due to stones (on clinical and ultrasound

evidence) should go straight to ERCP for definitive diagnosis and management.

When the clinical situation and initial scans strongly suggest malignant obstruction, other considerations come into play, especially the potential for surgical cure. This depends on two important but separate factors — the extent of the tumour and the health of the patient. Surgery (and perioperative care) have made remarkable strides, but it is still not logical to consider a major resection (e.g. a Whipple procedure) in an elderly patient with severe co-morbid disease. If the patient is not an operative candidate on health grounds alone, there is no need to spend time and money on investigating the second important question — whether or not the lesion is potentially resectable. In general, this depends on whether the tumour is still localized or whether it has spread locally or metastasized.

Numerous techniques are now available to help in the staging process and it is not difficult to consume a great deal of time (and money) in staging a tumour.

Staging

Staging is unnecessary in patients who are not fit for surgery. It is also less important in young and fit patients in whom a trial of surgery may be the correct approach. However, staging is crucial in the middle-ground patients who are acceptable, but not good, operative candidates. Surgery is appropriate in elderly patients when the tumour is certainly localized (e.g. in the papilla of Vater), but not when there is good radiological evidence of local vessel involvement. Here there are more tools than maps. Techniques available include ultrasound scanning with Doppler, CT, magnetic resonance imaging, endoscopic ultrasonography and laparoscopy. CT is the simplest and most readily available way of detecting major tumour spread. Endoscopic ultrasound appears to be the most sensitive staging tool in expert hands.

The decision whether or not to operate depends on integrating data on health status and tumour staging. Some patients may require surgery because of duodenal obstruction.

Preoperative stenting

The value of preoperative drainage has been debated vigorously. With careful selection of patients (and earlier operations), the risks of attempted resection are now so low that it would be difficult to prove that preoperative endoscopic stenting provides any benefit. However, when ERCP is performed in a patient with malignant biliary obstruction, it seems reasonable to place a stent even if resection may be attempted later. This eliminates the risk of obstructive cholangitis and starts the treatment

should the patient prove not to be a surgical candidate. The argument that preoperative stenting makes the surgery more difficult does not seem to be universally accepted by surgical experts.

Tissue diagnosis

When the decision has been made *not* to operate on a patient with presumed malignancy, there is a strong obligation to prove the diagnosis. Occasionally, localized inflammation, islet cell tumours and lymphoma can mimic malignancy on imaging studies. If ERCP is part of the treatment protocol, the diagnosis can usually be confirmed by taking brush biopsy or needle samples up the bile or pancreatic duct. Tissue can also be obtained by fine-needle aspiration cytology under ultrasound or CT guidance. However, many surgeons planning to operate on a patient with malignant obstructive jaundice do not now advocate preoperative percutaneous tissue confirmation. A negative result will not change the approach, and there is some concern about tumour seeding.

Palliation

Approximately only 20% of patients with malignant obstructive jaundice are nowadays operated on (at least at specialist centres). Half of these will undergo resection, the others some form of palliative bypass. This leaves 80% of the patients to be managed by non-operative methods. For low lesions, stenting at ERCP is the preferred method, using standard polyethylene stents. The role of expandable metal stents is not yet fully established. Although they stay patent longer than plastic stents, the additional duration may not be worth the cost (depending on the patient prognosis). This situation is more difficult in patients with tumours obstructing the liver hilum. More than one stent may be needed and the results may be better by the percutaneous transhepatic route (Fig. 8.3). A randomized trial is in progress.

Surgical bypass remains a legitimate palliative technique, and is certainly appropriate when there is any evidence of duodenal obstruction. A recent randomized trial confirmed that endoscopic stenting was safer and cheaper than surgical intervention, although more patients needed to return after a few months because of recurrent jaundice (due to stent clogging). Laparoscopic bypass of the biliary tree is a potential new player. Laparoscopic anastomosis of the gallbladder to jejunum is technically simple, but indications are few, since most tumours involve the cystic duct. Laparoscopic choledochojejunostomy may become technically viable.

Fig. 8.3 A hilar tumour with bilateral metal stents placed percutaneously.

Laparoscopic cholecystectomy

The rapid and widespread acceptance of laparoscopic cholecystectomy has had a major impact on the practice of ERCP. The indications for ERCP *after* cholecystectomy remain unchanged; the controversy concerns its use *beforehand*. The problem is that most laparoscopic surgeons cannot perform laparoscopic duct exploration. There was a tendency in the early phase for surgeons to request ERCP before operation in most cases, to rule out (or treat) duct stones and also to define aberrant biliary anatomy. This widespread use of ERCP before laparoscopic cholecystectomy is clearly unjustified since the vast majority of examinations are negative; its risks and costs outweigh the benefits.

Most authorities argue for a selective approach, using ERCP before laparoscopic cholecystectomy only when there is a significant suspicion of duct pathology. The problem is to define the level of suspicion. Patients with jaundice and acute biliary sepsis are obvious candidates. Other predictors (abnormal liver tests, dilated ducts and a history of biliary-type pain) have been analysed and it is now possible to allocate a probability score for the presence or absence of a duct stone for most patients. By this means we separate them into three categories: a high-risk group (patients very likely to have duct stones on the basis of jaundice or multiple predictive factors), a low-risk group with no predictive factors (in which unexpected stones are found in less than 3% of cases) and a difficult intermediate-risk group with some suspicion. Here the approach will depend upon the relative expertise with laparoscopy and endoscopy. Paradoxically, ERCP is less necessary before laparoscopy when expertise is high; the endoscopist can (almost) guarantee to clear the duct afterwards

if necessary. Surgeons working with less expert endoscopists may tend to 'give it a try' beforehand more often, leaving themselves the option of open duct exploration when necessary.

It is clear that a close collaborative understanding between laparoscopists and ERCP endoscopists is essential in order to provide patients with optimal cost-effective care. It is also obvious that one-stage laparoscopic treatment is preferable, once the techniques have been perfected and disseminated.

A few centres have used ERCP-sphincterotomy actually during laparoscopic cholecystectomy. This is difficult to arrange and to perform, and has not become popular.

Acute biliary sepsis

Spontaneous acute cholangitis is almost always due to a bile duct stone impacted in the papilla (rarely in the cystic duct—the Mirizzi syndrome). Decompression should be performed urgently in patients who do not improve rapidly after a few hours of conservative treatment. Several studies have now indicated that urgent ERCP is the safest drainage method, particularly in patients with suppurative cholangitis. Emergency ERCP can be performed in an intensive care unit where necessary, using only C-arm fluoroscopy. Sphincterotomy and stone extraction is the ideal; however, unstable patients may be managed temporarily with a nasobiliary drain or stent. Percutaneous and/or surgical drainage must be considered if endoscopic management fails. Cholangitis resulting from ERCP intervention (impacted stone or stent dysfunction) requires intervention of equal urgency.

Acute cholecystitis has been managed endoscopically (by placing a stent through the cystic duct). The role of this approach is not yet established. Most patients will be treated surgically, or with temporary percutaneous drainage if seriously unfit.

Problems after biliary surgery

Patients who present after cholecystectomy with pain, fever or abnormalities of liver function tests should undergo ERCP to clarify the situation. Stones can be removed by standard endoscopic techniques in up to 95% of cases. Early postoperative pain may be due to leakage from the cystic duct stump; this has become more common with the widespread use of laparoscopic cholecystectomy. Leakage may be recognized by isotope scanning, and a bile collection documented by ultrasound or CT; percutaneous drainage may be necessary. Cystic duct leaks are best treated by removing any distal obstruction (e.g. stone). However, leakage may persist in the absence of obstruction and can be relieved by removing normal sphincter activity. Although this can be done by sphincterotomy, we prefer to place a short,

straight 7 French gauge stent across the sphincter. This is removed as an out-patient procedure after a few weeks. Nasobiliary drainage (with suction) is also effective but may need to remain in place for several days.

Laparoscopic cholecystectomy has also led to an increased incidence of bile duct injuries. Complete transection of the common bile duct or a major branch requires expert surgery. Injuries to the main duct which remain in continuity can be managed by endoscopic stenting, after balloon dilatation of any stricture. The stent is removed after 3–4 months, the stricture is dilated again and *two* stents are then placed if possible. All stents are removed at 8–12 months and the patient is observed carefully. With lesions below the hilum of the liver, the relapse rate appears to be less than 20%. It is important to emphasize that expert surgery provides good treatment for this injury, and that attempts at endoscopic management should not be unnecessarily prolonged; costs and risks multiply. Patients should have the benefit of surgical consultation before a course of endoscopic management is initiated.

Sphincter of Oddi dysfunction

Patients who present with biliary-type pain some months or years after cholecystectomy are often suspected to have papillary stenosis or sphincter of Oddi dysfunction (once stones and other local diseases have been excluded). If sphincter dysfunction exists, sphincterotomy should provide good treatment, but the complication rate is significantly higher than when performed for stones. Thus, it is crucial to select patients carefully—which is the crux of the problem. Most experts pay attention to objective evidence of duct pathology, e.g. abnormal liver function tests in attacks, a dilating bile duct (ducts do not get bigger just because of cholecystectomy unless there is obstruction) or substantially delayed drainage. Endoscopic sphincter manometry is used by many as a gold standard but it is not universally accepted (or practised) — partly because it is difficult for both doctors and patients. Better predictive discriminants are required. Unfortunately, non-invasive imaging studies (e.g. nuclear medicine scans) have not yet proved to be sufficiently sensitive and specific. Temporary stenting is not a good therapeutic trial method; the pancreatitis rate is substantial.

Problems after liver transplantation

Biliary complications occur in up to 25% of patients after orthotopic liver transplantation. Strictures and leaks can be managed by endoscopic balloon dilatation and stenting, which may have to be continued for many months since healing is slow. Stones can develop above anastomotic strictures in this context.

Sclerosing cholangitis

Some strictures are tortuous and very tight, making guidewire passage difficult. Once the guidewire has been placed, it is usually relatively simple to dilate dominant extrahepatic strictures with stepped dilators and balloons. Every effort should be made to reduce the risk of introducing infection. For this reason, we do not routinely perform a sphincterotomy, and use stents sparingly and only for a few weeks. The long-term value of endoscopic manipulation is speculative; however, patients with dominant strictures presenting with recurrent attacks of acute cholangitis can derive useful short-term benefit. Many of these patients have small pigment stones which impact in the strictures.

Biliary obstruction in chronic pancreatitis

Patients with acute biliary obstruction in the context of active pancreatitis (with or without a pseudocyst in the head of the pancreas) can be managed effectively by temporary biliary stenting. Established biliary strictures in end-stage calcific pancreatitis should not be managed endoscopically since the problem will always recur. Surgery should be performed wherever possible.

Endoscopy and pancreatitis

Any patient with pancreatitis whose cause cannot be determined by simpler methods should undergo ERCP to detect or exclude abnormalities of the papilla and ductal systems. Causes include papillary tumours and sphincter dysfunction, congenital anomalities (such as choledochal cysts and pancreas divisum) and gallstones. Examination is traditionally delayed for a few weeks after an acute attack, but the risk of exacerbation appears minimal, even when performed earlier. Indeed some enthusiasts recommend urgent ERCP in all patients with acute pancreatitis, whatever the suspected cause. Most restrict themselves to patients with suspected gallstone pancreatitis.

Gallstone pancreatitis

Many reports indicate that ERCP and sphincterotomy can be performed in the acute phase of gallstone pancreatitis with remarkable safety, and that it is usually easy to remove small impacted stones with impressive clinical recovery. The problem in defining the role for urgent endoscopy is that most patients settle spontaneously within 48 h; they are well managed by standard conservative measures, usually leading to elective cholecystectomy. Randomized studies indicate that urgent

ERCP-sphincterotomy is preferable to a standard conservative and surgical approach, at least in patients who had admission characteristics predicting a severe outcome. A reasonable approach is to recommend the ERCP-sphincterotomy if the patient is not improving after 24–48 h, and especially if there is evidence of increasing biliary obstruction and sepsis.

Standard techniques are employed and pancreatography should be performed if no stone is found within the bile duct; occasionally, gallstones migrate into the pancreatic duct.

Pancreatic duct sphincterotomy for stones and stenosis

Solitary stones in the main duct in the pancreatic head can be removed endoscopically with baskets and balloon catheters after pancreatic orifice sphincterotomy; extracorporeal lithotripsy may also be required. Extracting stones appears to be worthwhile in patients suffering from acute attacks of pancreatitis (or pancreatic pain) with spontaneous symptom-free intervals, particularly if the initiating cause (e.g. alcohol) has been removed. Further long-term studies are required. Sphincterotomy is also sometimes performed in patients with idiopathic recurrent pancreatitis judged to be due to sphincter stenosis or dysfunction—but this entity is difficult to define and the results hard to evaluate.

Pancreatic duct strictures

The clinical value of dilatation/stenting of the pancreatic duct (or orifice) has not been established. Currently, experts treat patients suffering from acute recurrent attacks of pancreatitis when there is some evidence of duct obstruction; stents should be left in place only for a few weeks because of the risk of inducing ductal abnormalities. Further research is necessary to establish which (if any) patients obtain long-term benefit.

Pseudocysts and leaks

ERCP may be useful in patients with pseudocysts to define the integrity of the duct system and to show whether or not the cyst is communicating. The risk of introducing infection is minimal if properly disinfected equipment (and antibiotics) are used. If the pseudocyst communicates with an intact duct system, the endoscopist may consider placing a nasopancreatic drain (on continuous low-pressure suction), with subsequent temporary stenting once the cyst has collapsed. Pseudocysts adjacent to, and compressing, the wall of the duodenum or stomach can be managed by direct endoscopic cyst puncture. This method should not be employed unless it is clear that the cyst and gastric or duodenal wall are in intimate contact, as judged by CT scan-

ning or endoscopic ultrasound. Short-term results appear good in selected cases, but there is significant risk of haemorrhage; these techniques should be used only by experts.

Spontaneous pancreatic fistulae and postoperative leaks can be managed by temporary duct decompression (nasopancreatic drain or stent). The analogy with the cystic duct leak is close, and the results appear almost as good. Attempts are being made to close leaks mechanically at ERCP.

Pancreas divisum

The clinical relevance of the congenital anomaly pancreas divisum remains a subject of controversy. The hypothesis that pancreas divisum can result in obstructive pancreatic pain and pancreatitis rests on the assumption that the accessory papilla orifice may be insufficient to allow the full flow of pancreatic juice. This belief has led many endoscopists to attempt treatment by improving drainage at the accessory papilla. Initial attempts at accessory sphincterotomy resulted in an unacceptably high rate of re-stenosis. Currently, selected patients with recurrent acute pancreatitis are being managed by accessory stenting, with or without needle-knife sphincterotomy. The stent is usually removed within a few weeks. Short-term results appear good but long-term efficacy remains to be established.

Obscure abdominal pain

The diagnostic yield of ERCP is small in patients with no abnormalities of abdominal imaging, liver function tests or amylase. Chronic pancreatitis can be detected by duct abnormalities when other tests are negative, but the interpretation of minor abnormalities of the branches remains controversial. It is unusual to detect pancreatic cancer in the presence of a normal CT scan (or good-quality ultrasound study). Even if such scans do not detect the mass lesion itself, they usually show pancreatic duct dilatation upstream, indicating the presence of a lesion. ERCP is of limited value in investigating patients with *known* pancreatic mass lesions, since the duct appearances (obstruction or stricture) may be similar in patients with benign and malignant disease. ERCP may detect pancreas divisum or other rare anomalies which can have clinical significance. ERCP occasionally shows gallbladder stones which had previously escaped detection and the procedure allows sampling of bile for crystals or more sophisticated biochemical analyses.

ERCP in children

The spectrum of problems encountered in children (especially small children and neonates) is different from that seen in adults,

but the principles of diagnostic and therapeutic intervention are the same. Congenital anomalies of the biliary tree and pancreas are seen rather frequently; surprisingly, gallstones are not unusual. Several sphincterotomies have been reported in children under the age of 1 year.

Multidisciplinary team work

It is clear from the above brief review that the management of patients with pancreatic and biliary problems continues to evolve and requires a collaborative multidisciplinary approach. Specialist gastroenterologists and surgeons must work together, and in close association with imaging and interventional radiologists, pathologists, oncologists, etc. The extent of this collaboration will determine the quality and efficiency of patient care, and will provide an environment for the objective research which is required.

Further reading

Techniques and general reviews

American Society for Gastrointestinal Endoscopy. *Radiographic Contrast Media used in ERCP*. Technology Assessment Status Evaluation. Manchester: American Society for Gastrointestinal Endoscopy, 1995.

Baillie J. *Pancreatography*. Gastrointestinal Endoscopy Clinics of North America, Vol. 5(1) (series ed. Sivak MV). Philadelphia: WB Saunders, 1995.

Berci G. *Laparoscopic Cholecystectomy and Surgical Endoscopy*. Gastrointestinal Endoscopy Clinics of North America, Vol. 3(2) (series ed. Sivak MV). Philadelphia: WB Saunders, 1993.

Cotton PB. Precut papillotomy—a risky technique for experts only. *Gastrointest Endosc* 1989;**35**:578–9.

Hogan WJ, ed. *Sphincter of Oddi Prime for the Pancreatico-biliary Endoscopist*. Gastrointestinal Endoscopy Clinics of North America, Vol. 3(1) (series ed. Sivak MV). Philadelphia: WB Saunders, 1993.

Kozarek RA, ed. *Endoscopic Approach to Biliary Stones*. Gastrointestinal Clinics of North America, Vol. 1(1) (series ed. Sivak M). Philadelphia: WB Saunders, 1991.

Lambert ME, Betts CD, Hill J *et al*. Endoscopic sphincterotomy: the whole truth. *Br J Surg* 1991;**78**:473–6.

Leung JWC, Cotton PB. Endoscopic nasobiliary catheter drainage in biliary and pancreatic disease. *Am J Gastroenterol* 1991;**86**:389–94.

Lygidakis NJ, Tytgat GNJ. *Hepatobiliary and Pancreatic Malignancies*. Thieme, 1989.

May GR, Cotton PB, Edmunds SE *et al.* Removal of stones from the bile duct at ERCP without sphincterotomy. *Gastrointest Endosc* 1993;**39**:749–54.

Parsons WG, Howell DA. Progress in tissue sampling at ERCP. In: Cotton PB, Tytgat GNJ, Williams CB, eds. *Annual of Gastrointestinal Endoscopy*. London: Current Science, 1995:9–20.

Pott G, Schrameyer B. *ERCP Atlas*. Toronto: Decker, 1989.
Silvis SE, Rohrmann CA, Ansel HJ. *Text and Atlas of ERCP*. New York: Igaku-Shoin, 1995.
Sivak MV. *Gastroenterologic Endoscopy*. Philadelphia: WB Saunders, 1987.
Vaira D, Ainley C, Williams S. Endoscopic sphincterotomy in 1000 consecutive patients. *Lancet* 1989;**2**:431–3.

Stones

Baillie J, Cairns SR, Cotton PB. Endoscopic management of choledocholithiasis during pregnancy. *Surg Gynecol Obstet* 1990;**171**:1–4.
Cotton PB. Endoscopic management of bile duct stones (apples and oranges). *Gut* 1984;**25**:587–97.
Cotton PB. Retained bile duct stones: T-tube in place, percutaneous or endoscopic management? *Am J Gastroenterol* 1990;**85**:1075–8.
Cotton PB. Difficult bile duct stones. In: Kozarek RA, ed. *Endoscopic Approach to Biliary Stones*. Gastrointestinal Endoscopy Clinics of North America, Vol. 1(1) (series ed. Sivak MV). Philadelphia: WB Saunders, 1991:51–63.
Cotton PB, Chung SC, Davis WZ *et al*. Issues in cholecystectomy and management of duct stones. *Am J Gastroenterol* 1994;**89**:S169–76.
Cotton PB, Kozarek RA, Schapiro RH *et al*. Endoscopic laser lithotripsy of large bile duct stones. *Gastroenterology* 1990;**99**:1128–33.
Fan S-T, Lai ECS, Mok FPT *et al*. Early treatment of acute biliary pancreatitis by endoscopic papillotomy. *N Engl J Med* 1993;**328**:228–32.
Hawes RH, Cotton PB, Vallon AG. Follow-up at 6–11 years after duodenoscopic sphincterotomy for stones in patients with prior cholecystectomy. *Gastroenterology* 1990;**98**:1008–12.
Lai ECS, Mok FPT, Tan ESY *et al*. Endoscopic biliary drainage for severe acute cholangitis. *N Engl J Med* 1992;**326**:1582–6.
Neuhaus H, Hoffman NW, Gottlieb K *et al*. Endoscopic lithotripsy of bile duct stones using a new laser with automatic stone recognition. *Gastrointest Endosc* 1994;**40**:708–15.
Strasberg SM, Clavien P-A. Cholecystolithiasis: lithotherapy for the 1990s. *Hepatology* 1992;**16**:820–39.

Benign biliary strictures

Benhamou Y, Caumes E, Gerosa Y *et al*. AIDS-related cholangiopathy. Critical analysis of a prospective series of 26 patients. *Dig Dis Sci* 1993;**38**:1113–18.
Davids PHP, Rauws EAJ, Coene PPLO, Tytgat GNJ, Huibregtse K. Endsocopic stenting for post-operative biliary strictures. *Gastrointest Endosc* 1992;**38**:12–18.
Kozarek RA, Ball TJ, Patterson DJ *et al*. Endoscopic treatment of biliary injury in the era of laparoscopic cholecystectomy. *Gastrointest Endosc* 1994;**40**:10–16.
Lee JG, Schutz SM, England RE, Leung JW, Cotton PB. Endoscopic therapy of sclerosing cholangitis. *Hepatology* 1995;**21**(3):661–7.
Liguory C, Vitale GC, Lefebre JF, Bonnel D, Cornud F. Endoscopic treatment of postoperative biliary fistulae. *Surgery* 1991;**110**:779–84.
Pitt HA, Kaufman SL, Coleman J *et al*. Benign postoperative biliary strictures. Operate or dilate? *Ann Surg* 1989;**210**:417–27.
Qoquo PC, Lewis WD, Stokes K *et al*. A comparison of operation, endoscopic retrograde cholangiopancreatography, and percutaneous transhepatic cholangiography and biliary complications after hepatic transplantation. *J Am Coll Surg* 1994;**179**:177–81.

Vallera RA, Cotton PB, Clavien P-A. Biliary reconstruction for liver transplantation and management of biliary complications. *Liver Transplant Surgery* 1995;**1**(3):143–52.

Malignancy

Ballinger AB, McHugh M, Catnach SM *et al.* Symptom relief and quality of life after stenting for malignant bile duct obstruction. *Gut* 1994;**35**:467–70.

Bismuth H, Castaing D, Traynor O. Resection or palliation: priority of surgery in the treatment of hilar cancer. *World J Surg* 1988;**12**:39–47.

Cotton PB. Management of malignant bile duct obstruction. *J Gastroenterol Hepatol* 1990;Suppl. 1:63–77.

Cotton PB, Schmitt C. Quality of life in palliative management of malignant obstructive jaundice. *Scand J Gastroenterol* 1993;**28**(Suppl. 199): 44–6.

Lai ECS, Mok FPT, Fan ST *et al.* Preoperative endoscopic drainage from malignant obstructive jaundice. *Br J Surg* 1994;**81**:1195–8.

Polydorou AA, Chisolm EM, Romanos AA *et al.* A comparison of right versus left hepatic duct endoprosthesis insertion in malignant hilar biliary obstruction. *Endoscopy* 1989;**21**:266–71.

Smith AC, Dowsett JF, Russell RCG, Hatfield ARW, Cotton PB. Randomised trial of endoscopic stenting versus surgical bypass in malignant low bile duct obstruction. *Lancet* 1994;**344**:1655–60.

Speer AG, Russell RCG, Hatfield ARW *et al.* Randomized trial of endoscopic versus percutaneous stent insertion in malignant obstructive jaundice. *Lancet* 1987;**2**:57–62.

Pancreatic therapy

American Society for Gastrointestinal Endoscopy Technology Assessment. Endoscopic pancreatitis therapy. *Gastrointest Endosc* 1993; **39**:881–4.

Coleman SD, Eisen GM, Troughton AB, Cotton PB. Endoscopic treatment in pancreas divisum. *Am J Gastroenterol* 1994;**89**:1152–5.

Cotton PB. Pancreas divisum—curiosity or culprit? *Gastroenterology* 1985;**89**:1431–5.

Cremer M, Deviere J, Delhaye M, Baize M, Vandermeeren A. Stenting in severe chronic pancreatitis: results of medium-term follow-up in seventy-six patients. *Endoscopy* 1991;**23**:171–6.

Delhaye M, Vandermeeren A, Baize M, Cremer M. Extracorporeal shockwave lithotripsy of pancreatic calculi. *Gastroenterology* 1992; **102**:610–20.

Eisen G, Chutz S, Metzler D *et al.* Santorinicele: new evidence for obstruction in pancreas divisum. *Gastrointest Endosc* 1994;**40**: 73–6.

Guelrud M, Mujica C, Jaen D *et al.* The role of ERCP in the diagnosis and treatment of idiopathic recurrent pancreatitis in children and adolescents. *Gastrointest Endosc* 1994;**40**:428–36.

Kozarek RA, Ball TJ, Patterson DJ *et al.* Endoscopic pancreatic duct sphincterotomy: indications, technique, and analysis of results. *Gastrointest Endosc* 1994;**40**:592–7.

Lans JI, Geenen JE, Johanson JF *et al.* Endoscopic therapy in patients with pancreas divisum and acute pancreatitis: a prospective, randomized, controlled clinical trial. *Gastrointest Endosc* 1992;**38**:430–4.

Sphincter dysfunction

Gilbert DA, DiMarino AJ, Jensen DM *et al*. Status evaluation: sphincter of Oddi manometry. *Gastrointest Endosc* 1992;**38**:757–9.

Guelrud M, Mendoza S, Rossiter G *et al*. Sphincter of Oddi manometry in healthy volunteers. *Dig Dis Sci* 1990;**35**:38–46.

Sherman S, Lehman GA. Opioids and sphincter of Oddi. *Gastrointest Endosc* 1994;**40**:105–6.

Complications and outcomes

Asbun HJ, Rossi RL, Heiss FW, Shea JA. Acute relapsing pancreatitis as a complication of papillary stenosis after endoscopic sphincterotomy. *Gastroenterology* 1993;**104**:1814–17.

Cotton PB. Therapeutic gastrointestinal endoscopy. Problems in proving efficacy. *N Engl J Med* 1992;**326**:1626–8.

Cotton PB. Outcomes of endoscopy procedures: struggling towards definition. *Gastrointest Endosc* 1994;**40**:514–18.

Cotton PB, Lehman G, Vennes J *et al*. Endoscopic sphincterotomy, complications and their management. An attempt at consensus. *Gastrointest Endosc* 1991;**37**:383–93.

Neoptolemos JP, Shaw DE, Carr-Locke DE. A multivariant analysis of preoperative risk factors in patients with common bile duct stones. Implications for treatment. *Ann Surg* 1989;**209**:157–61.

Sherman S, Lehman GA. ERCP and endoscopic sphincterotomy-induced pancreatitis. *Pancreas* 1991;**6**:350–67.