The Royal College of Surgeons of England

Ann R Coll Surg Engl 2003; **85**: 167–173

Audit

Selective cholangiography in 600 patients undergoing cholecystectomy with 5-year follow-up for residual bile duct stones

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***Background*: The need for cholangiography to identify possible bile duct stones in all patients undergoing cholecystectomy is controversial.**
***Aims*: To assess the results of a policy for selective pre-operative endoscopic retrograde cholangiography (ERC) in patients undergoing laparoscopic cholecystectomy and to determine the incidence of postoperative symptomatic bile duct stones.**
***Patients and Methods*: Between 1993 and 1998, 600 patients underwent laparoscopic cholecystectomy under one consultant surgeon. Patients were selected for pre-operative or postoperative ERC based on symptoms, liver function tests and/or abnormalities on ultrasonography. A general practitioner questionnaire was used to assess follow-up of patients with postoperative stones.**
***Results*: Of 600 patients, 107 (18%) with a median age of 57 years and male:female ratio of 1:2.1 were selected to undergo pre-operative ERC; of these, 41 patients (38%) had bile duct stones. Postoperative ERC was performed in 30 patients (5%) and stones were identified in seven (23.3%). Three patients (0.5%) had stones removed within 15 days of operation and four (0.7%) between 2.6 months and 1.8 years. Median follow-up was 5.0 years (range, 2.5–7.5 years). The overall incidence of bile duct stones was 48 cases (8%). The stone rate was 11% in males and 7.3% in females. Stones were successfully extracted at ERC in 43 patients (89.6%).**
***Conclusions*: A policy of selective pre-operative ERC is the most effective technique for identifying and removing bile duct stones and the incidence of symptomatic gallstones following laparoscopic cholecystectomy is very low. With an overall stone rate of 8%, routine peroperative cholangiography is unnecessary and, in a surgical unit providing an ERC service, laparoscopic exploration of the bile duct is not a technique required for the management of bile duct stones.**

Key words: Endoscopic retrograde cholangiography – ERC – Laparoscopic cholecystectomy – Bile duct stones

Laparoscopic cholecystectomy is the treatment of choice for patients with symptomatic gallstones, but the management of bile duct stones in these patients is controversial.[1] The use of selective cholangiography has been criticised because of the risk of missing bile duct stones that will cause significant complications later in

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life. The incidence of asymptomatic bile duct stones in patients undergoing cholecystectomy is 3–12%, but it is probable that only stones causing symptoms require treatment and that other stones pass spontaneously or remain silent.[2,3] With modern techniques, it should rarely be necessary to perform an open operation to remove a stone from the bile duct. Using endoscopic retrograde cholangiography (ERC) and sphincterotomy, bile duct stones can be successfully removed in about 90% of patients and the principle of minimally invasive surgery is maintained.[4]

The experience of a single-surgeon unit performing selective ERCs in the diagnosis and treatment of bile duct stones in patients undergoing laparoscopic cholecystectomy is described. The incidence and management of post-operative symptomatic bile duct stones with median 5-year follow-up are reported.

Patients and Methods

Patients

A total of 913 patients underwent cholecystectomy for stone disease at the Luton and Dunstable Hospital, serving a population of 300,000, from September 1993 to September 1998. Data were collected for 600 consecutive patients under the care of one consultant. Nearly all patients with complicated stone disease needing ERC were transferred to the care of that consultant. The median age was 45 years (range, 8–89 years) with male to female ratio of 1:4. The outcome of patients selected for laparoscopic cholecystectomy is shown in Figure 1. Patients with acute cholecystitis are included in the results and the majority were managed conservatively. No patient required bile duct exploration except the five failures following ERC. Patients with gallstones undergoing cholecystectomy as part of another procedure such as pancreatic surgery, and emergency laparotomy for perforated gallbladder or gallstone ileus were not selected for laparoscopic cholecystectomy and are excluded. Some elderly patients managed with endoscopic sphincterotomy and stone extraction leaving the gallbladder *in situ* also are excluded.

Patient selection for pre-operative ERC

Patient selection for ERC depended on symptoms, liver function tests and ultrasound scan of the biliary tree. Patients were selected for ERC if they had: (i) obstructive jaundice; (ii) cholangitis; (iii) acute pancreatitis with obstructive jaundice or abnormal liver function tests; and (iv) biliary colic with abnormal liver function tests, but not clinical jaundice and/or an abnormal ultrasound scan of the bile duct. Liver function tests were regarded as representing obstructive jaundice with bilirubin 40 µmol/l or more associated with elevation of alkaline phosphatase and/or aspartate transaminase. Liver function tests were regarded as abnormal without clinical jaundice when the bilirubin was raised (but less than 40 µmol/l) and associated with elevation in alkaline phosphatase. Patients with acute pancreatitis were not selected for ERC if the bilirubin was transiently raised (but less than 100 µmol/l) with normal liver enzymes.

Most routine ultrasound scans were performed by radiographers. Radiologists including two biliary specialists performed scans when there was clinical suspicion of a bile duct abnormality. Features suggestive of the presence of bile duct stones on ultrasound scan were diameter of the bile duct greater than 6 mm and a stone(s) in the bile duct.[5]

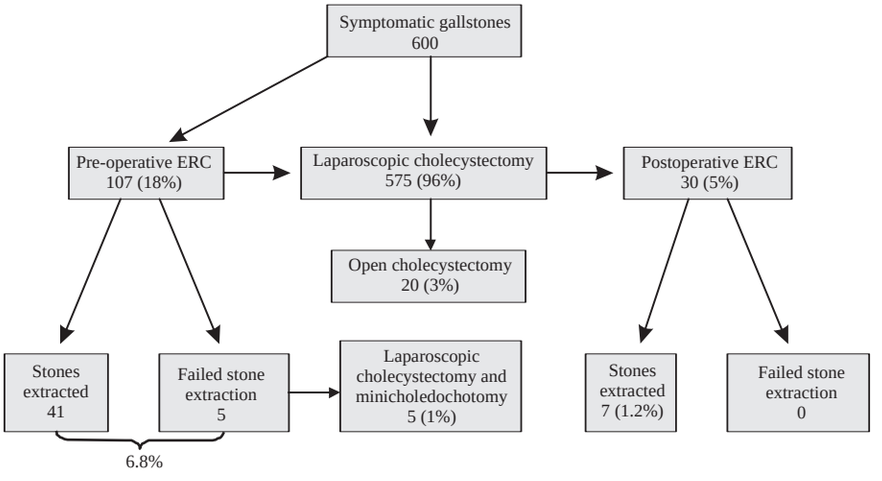

Figure 1 Outcome of patients with symptomatic gallstones.

Selection for postoperative ERC

The criteria for selecting patients for postoperative ERC were the same as for pre-operative ERC with the addition of a diagnostic group of biliary-type pain with normal liver function tests and ultrasound scan of the bile duct.

Endoscopic retrograde cholangiography

ERCs were performed by the consultant surgeon at a weekly session. Patients with non-resolving jaundice underwent ERC on the next available list. Patients who recovered from the acute episode with conservative management underwent ERC with an overnight stay 48 h before laparoscopic cholecystectomy. Prophylactic antibiotics were given. The cholangiogram was regarded as abnormal if a stone(s) was present in the bile duct with or without dilatation of the biliary tree. Certain findings were indicative of the recent passage of a stone such as a dilated duct, oedematous papilla and easy deep cannulation of the bile duct, but only a papillary fistula was regarded as definite evidence of spontaneous passage of a stone.

Follow-up

Patients were reviewed 6 weeks following cholecystectomy. Patients with post-cholecystectomy symptoms were re-referred by their general practitioner (GP) for assessment. To ascertain whether all patients with post-cholecystectomy symptoms were referred back to the same consultant and hospital, a questionnaire was sent to all the patients' GPs and responses were obtained between March and July 1999. GPs were asked whether: (i) their patient had consulted them with upper abdominal symptoms or jaundice; (ii) investigations had been performed; and (iii) they had referred them to another specialist or hospital for further investigation including ERC.

Results

Of 600 patients with symptomatic gallstones, 107 (18%) were selected to have pre-operative ERC (Table 1) and 30 (5%) postoperative ERC (Table 2). Four patients had both pre-operative and postoperative ERC. The overall median age for patients undergoing ERC was 55 years (range, 14–84 years) with male to female ratio of 1:2.2.

Diagnostic ERC

Diagnostic cholangiography was successful in 131 cases (95.6%). Following failure, normal ducts were demonstrated in four patients by intravenous (2) or peroperative (2) cholangiography. One patient with poor views of the bile duct at ERC presented 1.8 years after cholecystectomy and had a stone extracted at ERC. Post-operative ERC failed in a patient with a duodenal ulcer that prevented entry into the duodenum and was not repeated as the cause for pain had been identified.

Table 1 Indications and results for pre-operative ERC including interval between presentation and ERC

	All ERCs				Bile duct stone				
	Indication		Time to ERC		Stones		Time to ERC		Stone rate/
	n = 107	%	Median (days)	Range (days)	*n* = 41	%	Median (days)	Range (days)	indication %
Obstructive jaundice	**59**	**55.1**			**27**	**65.9**			**46**
Static/increasing	*15	14.0	6	0–15	12	29.3	5	1–15	80
Resolving	17	15.9	6	1–60	9	22.0	9	1–60	53
Resolved + abnormal LFTs	17	15.9	20	4–54	5	12.2	50	7–54	29
Resolved/history	10	9.3	55	27–202	1	2.4	85	–	10
Cholangitis with jaundice	**6**	**5.6**			**5**	**12.2**			**83**
Static/increasing	4	3.7	7	2–26	3	7.3	7	2–26	75
Resolving	2	1.9	7	7,32	2	4.9	7	7,32	100
Acute pancreatitis with jaundice	**19**	**17.8**			**2**	**4.9**			**10.5**
Static/increasing	#2	1.9	13	13,30	1	2.45	30	–	50
Resolving	2	1.9	4	4,29	–	–	–	–	–
Resolved + abnormal LFTs	8	7.5	15	2–51	1	2.45	45	–	14
Resolved	7	6.5	49	28–400	–	–	–	–	–
Biliary colic	**23**	**21.5**			**7**	**17.0**			**30**
Abnormal LFTs	12	11.2	38	10–330	–	0	–	–	0
Abnormal LFTs + ultrasound	5	4.7	38	6–76	4	9.7	38	36–50	67
Abnormal ultrasound	6	5.6	20	1–121	3	7.3	20	18–121	60

*One duodenal tumour, #one papillary fistula.

Table 2 Indication and results for postoperative ERC including interval from cholecystectomy to ERC

	All ERCs				Bile duct stone			
	Indication		Time to ERC		Stones		Time to ERC	Stone rate/
	n = 30	%	Median (days)	Range (days)	*n* = 7	%	Days	indication %
Obstructive Jaundice	**7**	**23.0**	**109**	**77–596**	**3**	**42.9**	**–**	**57**
Static/increasing	1		79	–	1		79	
Resolving	2		–	109,274	–		–	
Resolved + abnormal LFTs	2		–	443,672	1		672	
Resolved/history	2		–	323,596	1		596	
Cholangitis with jaundice	**1**	**3.3**	**15**	**–**	**1**	**14.2**	**15**	**100**
Acute pancreatitis with jaundice	**2**	**6.7**	**–**	**–**	**–**	**0**	**–**	**0**
Resolved + abnormal LFTs	1		333	–	–		–	
Resolved	1		112	–	–		–	
Biliary colic	**20**	**67.0**	**–**	**–**	**3**	**42.9**	**–**	**15**
Abnormal LFTs	[#]10		108	7–1620	2		7,8	
Abnormal ultrasound	1		987	–	–		–	
Normal investigations	9		172	60–920	1		88	

[#]One papillary fistula.

Abnormal cholangiogram

In all, 48 patients (35%) had bile duct stone(s); 41 (38.3%) pre-operatively and 7 (23.3%) postoperatively. The overall incidence of bile duct stones was 8% – 6.8% pre-operatively and 1.2% postoperatively (Fig. 1). The stone rate in males was 13 of 118 (11%) compared to 35 of 482 (7.3%) in females. Stones were successfully extracted in 43 patients (89.6%). Failure to extract stones was due to impacted stones in the pancreatic portion of the bile duct (3), Mirizzi syndrome and a large stone with cholangitis. These patients had temporary stenting and underwent laparoscopic cholecystectomy with minicholedochotomy. Of 22 other patients with abnormal cholangiograms, two had papillary fistulae and 13 had other features suggestive of the recent passage of a stone.

Complications of ERC

ERC resulted in 5.1% morbidity. Five (3.65%) patients developed acute pancreatitis, one (0.73%) infection in a pre-existing pancreatic pseudocyst and another anaemia post-sphincterotomy and stone extraction. Sixty-eight sphincterotomies were performed. There was no procedure related cholangitis or mortality.

Pre-operative ERC

The male to female ratio varied according to diagnosis; 1:1.7 in obstructive jaundice and cholangitis, 1:1.8 in acute pancreatitis and 1:4.8 in biliary colic. The indications for and results of ERC are shown in Table 1. Forty-one patients (38%) had bile duct stones of which 36 were extracted successfully in a median of 13 days (range, 1–121 days). Fifty-five patients presenting with obstructive jaundice and/or cholangitis underwent ERC at a median of 7 days (range, 0–60 days) and 31 (56.4%) had ductal stones. Only one of 10 patients (10%) with a history of jaundice and normal liver function tests had a bile duct stone and these patients underwent ERC at a median of 55 days (range, 27–202 days). Of 19 patients with acute pancreatitis and jaundice, only two (10.5%) had a stone in the duct and one had a papillary fistula. There were 23 patients with biliary colic. Seven of 11 with ultrasound evidence of a bile duct stone had a stone at ERC but only four of the seven had abnormal liver function tests. The 12 patients with abnormal liver function tests and a normal ultrasound scan at presentation usually had normal liver function tests by the time of ERC and none had a bile duct stone. No patient developed stones in the interval between ERC and laparoscopic cholecystectomy, which was a median of 41 days (range, 1–730 days).

Postoperative ERC

The indications for, and results of, ERC are shown in Table 2. Seven patients had stones identified and extracted at a median of 2.6 months (7 days to 1.8 years). Four patients (0.5%) had an ERC within 15 days of cholecystectomy due to an indication arising peri-operatively. Three had a stone in the bile duct and the fourth a papillary fistula. Two patients had ERC because of recurrent pancreatitis. The remaining patients were referred by their GP with jaundice or pain.

Stones were present in three patients with post-operative jaundice and one with a pre-operative history of jaundice presumably missed at a pre-operative ERC. There were 20 patients with post-cholecystectomy biliary type pain. Of 10 patients with abnormal liver function tests, only the three who presented peri-operatively had a stone (2) or papillary fistula (1). One stone was identified among nine patients with recurrent pain and normal investigations.

Follow-up

Fifty-four patients were investigated for upper abdominal symptoms following laparoscopic cholecystectomy and ERC was performed on 30 patients. The response to the GP questionnaire provided follow-up on 438 patients (73%) with a median of 3 years (range, 0.5–5.5 years) from cholecystectomy. No patient had been referred to another hospital or specialist for investigation of possible bile duct stones. Two patients had been seen by a gastroenterologist for non-biliary upper gastrointestinal symptoms. The patients investigated by us are likely to represent all patients treated with postoperative bile duct stones. In the two years since the GP questionnaire, no other patients with postoperative bile duct stones were identified resulting in a median interval from cholecystectomy of 5.0 years (range, 2.5–7.5 years). Only seven patients (1.2%) had stones in their bile duct and three (0.5%) of these were identified and extracted within 15 days of laparoscopic cholecystectomy.

Number of ERCs

Diagnosis and treatment were completed in one session in 118 patients (86%). Reasons for repeating an ERC included failure to obtain a diagnostic ERC, incomplete stone extraction, to ensure the duct was clear following stone extraction and following temporary stenting after stone extraction in a pregnant woman. Eight repeat ERCs were needed to extract multiple stones from the duct; one patient had 18 stones.

Discussion

In this study, the incidence of bile duct stones that did not pass spontaneously and required removal was 8%. Forty-four patients (92%) were diagnosed pre-operatively or in the immediate postoperative period. Only four of 54 patients referred by their GP with post-cholecystectomy symptoms had stones that were removed at a maximum of 1.8 years.

The incidence of bile duct stones in the era of open cholecystectomy was 8-15% in patients under 60 years old and 15–40% in those over 60 years of age.[6] The median age for ERC in this study was 55 years, which was 10 years older than the whole group selected for laparoscopic cholecystectomy. Symptomatic gallstones are much more common in women, but this study has shown that men are more likely to have complicated stone disease. In the study group, 15% of females and 30% of males had complicated stone disease requiring ERC: males were much more likely to present with jaundice, cholangitis or acute pancreatitis. Of males, 11% had bile duct stones compared to 7.3% of females.

The rate of pre-operative ERC (18%) was comparable to other studies (17–20%) although the proportion of patients presenting with jaundice was high at 15.5%.[7–9] The diagnostic yield of pre-operative ERC was 38%, which compared favourably with other reported series of 23–53%.[7–9] The stone rate is dependent on the selection criteria used, but is influenced by the interval between presentation and ERC as many stones pass spontaneously. In patients with obstructive jaundice or cholangitis, the yield of stones was high being at least 80% in patients with non-resolving jaundice or cholangitis and reducing sequentially as the jaundice resolved and the liver function tests returned to normal. There was a residual 10% stone incidence in patients with a history of jaundice. Only two patients (10.5%) with acute pancreatitis in the pre-operative group had a bile duct stone which accounted for 4.9% of stones compared with 32 (78%) stones in patients presenting with jaundice or cholangitis. High stone yields are found in severe acute pancreatitis if ERC is performed during the first 72 h, but not after the acute episode has resolved or in patients with mild pancreatitis.[7,10] Therefore, ERC seems to be unnecessary in uncomplicated acute pancreatitis with jaundice or abnormal liver function tests that resolve. Ultrasound scanning was the best predictor of bile duct stones in patients with biliary colic. Bile duct stones may be detected with a high degree of accuracy by experienced ultrasonographers,[5] but the overall sensitivity of ultrasound for the detection of bile duct stones is reported as 19–55% being highest in jaundiced patients.[11] In this study, 54% of bile duct stones were identified pre-operatively by a variety of radiographers and radiologists.

ERC produced excellent visualisation of the biliary tree in over 95% of patients, but its therapeutic capacity was only needed to extract stones in 35% of patients. The complication rate for ERC of 5.1% with no mortality is comparable to published results of 1.8–6.4% with a mortality rate of 0.05% and for endoscopic sphincterotomy of 6–10% and 1.3%, respectively.[12,13] Magnetic resonance cholangiography (MRC) or peroperative cholangiography should be considered in patients with biliary colic or resolved jaundice including those with pancreatitis, reserving ERC for patients with a definite diagnosis of ductal stones. MRC offers a non-invasive diagnostic modality without the use of contrast

or endoscopic intervention and avoids the complications associated with diagnostic ERC.[14] For peroperative cholangiography, the complication rate was less than 0.25%, but the frequency of false positive results leading to unnecessary duct exploration was 3–5% and stones were missed in about 2% of cases.[15–17]

ERC with stone extraction followed by laparoscopic cholecystectomy gives the patient the benefits of minimally invasive surgery. The stone clearance rate of 89.6% compares favourably with reported rates of median 88% (range, 78–98%).[4] Stone extraction at ERC is only likely to fail in 10% of patients, resulting in the need for very few open explorations of the bile duct – five in 5 years in this study. Peroperative cholangiography with laparoscopic exploration of the bile duct has the advantages of minimally invasive surgery and of being performed at the time of cholecystectomy with treatment completed during one hospital admission. With only 8% of patients needing duct exploration, it is difficult to obtain experience to perform the technique, but success rates are reported with duct clearance rates of 75–89%.[18–20] Two randomised trials, comparing two stage pre-operative or postoperative ERC and laparoscopic cholecystectomy with single stage laparoscopic exploration of the bile duct and cholecystectomy, have claimed a shorter hospital stay following the laparoscopic approach, but this is largely artificial as patients were kept in hospital between ERC and cholecystectomy.[18,20] Rhodes *et al*.[20] explored 17% of patients for bile duct stones, which is consistent with our finding of 18% patients with probable bile duct stones selected for pre-operative ERC. By having an interval between diagnosis and ERC, only 38% of these patients needed stones extracting, as the majority of stones seem to pass spontaneously and unnecessary manipulation of the bile duct is avoided. Open exploration of the bile duct at the time of cholecystectomy has been shown to have a significantly higher morbidity and mortality than cholecystectomy alone.[21] Retained bile duct stones are reported to occur in 4–16% of cases, but with peroperative choledochoscopy the incidence can be less than 5%.[1] Concern has been raised about the safety of ERC over open cholecystectomy in younger patients, but this was contradicted by a study of the complications of endoscopic stone extraction in 1921 patients, which showed a trend towards increased safety with younger patients and smaller ducts.[22]

With selective ERC, asymptomatic stones in patients undergoing cholecystectomy are ignored. The natural history of many bile duct stones is spontaneous passage into the duodenum, but some will remain and may present with complications later in life. Two randomised studies have shown a 3–12% incidence of unsuspected bile duct stones on peroperative cholangiography. The stones were not removed and none of the patients developed symptoms after 1–8 years follow-up.[2,3] In this study, patients were followed for 2.5–7.5 years and only 1.2% of patients developed symptomatic stones. Three (43%) of these presented peri-operatively and the longest interval was 1.8 years after laparoscopic cholecystectomy.

Conclusions

Pre-operative ERC is the best diagnostic and therapeutic investigation in patients with jaundice, cholangitis and radiological evidence of a stone in the bile duct. Patients with a history of jaundice, acute pancreatitis or biliary colic with abnormal liver function tests should be considered for other methods of cholangiography as the incidence of bile duct stones in these diagnostic groups is very low. A policy of selective ERC is effective in identifying and removing bile duct stones with a low incidence of patients presenting postoperatively with symptomatic stones. This policy avoids the need for open exploration of the bile duct except for failed stone extractions at ERC.

Acknowledgement

Based on paper given at the Association of Surgeons' Annual Meeting, 1999.

References

1. Perissat J, Huibregtse K, Keane FBV, Russell RCG, Neoptolemos JP. Management of bile duct stones in the era of laparoscopic cholecystectomy. *Br J Surg* 1994; **81**: 799–810.
2. Hauer-Jensen M, Karesen R, Nygaard K, Solheim K, Amlie E, Havig O. Consequences of routine perioperative cholangiography during cholecystectomy for gallstone disease – a prospective randomised study. *World J Surg* 1986; **10**: 996–1002.
3. Murison MCS, Gartell PC, McGinn FP. Does selective peroperative cholangiography result in missed common bile duct stones [Abstract]? *Br J Surg* 1989; **76**: 1343.
4. Somnay K, Carr-Locke DL. Stones in the bile duct: endoscopic approaches. In: Blumgart LH, Fong Y. (eds) *Surgery of the Liver and Biliary Tract*, 3rd edn. London: WB Saunders, 2000; 749–69.
5. Gillams A, Cheslyn-Curtis S, Russell RCG, Lees WR. Can cholangiography be safely abandoned in laparoscopic cholecystectomy? *Ann R Coll Surg Engl* 1992; **74**: 248–51.
6. Esber EJ, Sherman S. The interface of endoscopic retrograde cholangiopancreatography and laparoscopic cholecystectomy. *Gastrointest Endosc Clin North Am* 1996; **6**: 57–80.
7. Rijna H, Borgstein PJ, Meuwissan SGM, Brauw LM, Wildenborg NP, Cuesta MA. Selective preoperative endoscopic retrograde cholangiopancreatography in laparoscopic biliary surgery. *Br J Surg* 1995; **82**: 1130–3.
8. Welbourn CRB, Mehta D, Armstrong CP, Gear MWL, Eyre-Brook IA. Selective preoperative endoscopic retrograde cholangiography with sphincterotomy avoids bile duct exploration during laparoscopic cholecystectomy. *Gut* 1995; **37**: 576–9.
9. Taylor OM, Sedman PC, Jones BM, Royston CM, Arulampalam T, Wellwood J. Laparoscopic cholecystectomy without operative

cholangiogram: 2038 cases over a 5-year period in two district general hospitals. *Ann R Coll Surg Engl* 1998; **80**: 376–80.
10. Neoptolemos JP, Carr-Locke DL, London NJ, Bailey IA, James D, Fossard DP. Controlled trial of urgent endoscopic retrograde cholangiopancreatography and endoscopic sphincterotomy *versus* conservative treatment for acute pancreatitis due to gallstones. *Lancet* 1988; **ii**: 979–83.
11. Cronan JJ. Ultrasound diagnosis of choledocholithiasis: a reappraisal. *Radiology* 1986; **161**: 133–4.
12. Classen M, Phillip J. Endoscopic retrograde cholangiography (ERCP). A study of 1000 cases. *Gastroenterology* 1976; **70**: 314–20.
13. Cotton PB, Lehman G, Vennes J, Geenen JE, Russell RCG, Meyers WC *et al*. Endoscopic sphincterotomy complications and their management: an attempt at consensus. *Gastrointest Endosc* 1991; **37**: 383–93.
14. Schwartz LH, DeCorato DR. Magnetic resonance imaging of the liver and biliary tract. In: Blumgart LH, Fong Y. (eds) *Surgery of the Liver and Biliary Tract*, 3rd edn. London: WB Saunders, 2000; 355–6.
15. Hunter JG. Laparoscopic transcystic bile duct exploration. *Am J Surg* 1991; **163**: 53–8.
16. Mofti AB, Ahmed I, Tandon, Al-Tameem MM, Al Khudairy NN. Routine or selective preoperative cholangiography. *Br J Surg* 1986; **73**: 548–50.
17. Shivel EH, Wieman TJ, Adams AL, Romines RB, Garrison RN. Operative cholangiography. *Am J Surg* 1990; **159**: 380–4.
18. Cuschieri A, Lezoche E, Morino M, Croce E, Lacy A, Toouli J *et al*. E.A.E.S multicenter prospective randomized trial comparing two-stage management of patients with gallstone disease and ductal calculi. *Surg Endosc* 1999; **13**: 952–7.
19. Keeling NJ, Menzies D, Motson RW. Laparoscopic exploration of the common bile duct: beyond the leaning curve. *Surg Endosc* 1999; **13**: 109–12.
20. Rhodes M, Sussman L, Cohen L, Lewis MP. Randomised trial of laparoscopic exploration of bile duct *versus* postoperative endoscopic retrograde cholangiography for common bile duct stones. *Lancet* 1998; **351**: 159–61.
21. McSherry CK. Cholecystectomy: the gold standard. *Am J Surg* 1989; **158**: 174–8.
22. Cotton PB, Geenen JE, Sherman S, Cunningham JT, Howell DA, Carr-Locke DL *et al*. Endoscopic sphincterotomy for stones by experts is safe, even in younger patients with normal ducts. *Ann Surg* 1998; **227**: 201–4.