

Laparoendoscopic “rendezvous” versus laparoscopic antegrade sphincterotomy for choledocholithiasis

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Background. The ideal management of common bile duct stones in the era of laparoscopic cholecystectomy is controversial. With rapid advances in technology and more experience in laparoscopic skills, many surgeons are now routinely performing single-stage procedures and questioning the wisdom of preoperative endoscopic retrograde cholangiopancreatography, with or without sphincterotomy. The purpose of this study was to compare the success rate, duration of operating time, clinical results, and duration of hospital stay of a laparoendoscopic “rendezvous” technique versus antegrade sphincterotomy in patients with cholecystitis-choledocholithiasis.

Methods. Patients with gallbladder and common bile duct stones undergoing laparoscopic cholecystectomy plus retrograde sphincterotomy (group A; $n = 35$) were compared retrospectively with those undergoing laparoscopic cholecystectomy plus antegrade sphincterotomy (group B; $n = 41$) at a single institution.

Results. Ductal stone clearance was equivalent in the 2 groups (94% vs 95%; $P = .979$), as was morbidity (9% vs 5%; $P = .545$) and conversion (6% vs 5%; $P = .877$). The median operating time was less in group B (89 vs 117 minutes; $P < .0001$). There was no significant difference in hospital stay between the 2 groups ($P = .140$).

Conclusion. This study suggests that intraoperative sphincterotomy with a combined endoscopic-laparoscopic approach for the removal of common bile duct stone(s) is safe and effective in routine surgical practice. Ductal stone(s) clearance, morbidity, and conversion were equivalent in the 2 groups; antegrade sphincterotomy had a shorter operative time compared with the rendezvous technique. (Surgery 2008;144:442-7.)

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CHOLEDOCHOLITHIASIS occurs in $\leq 15\%$ of patients undergoing cholecystectomy.¹⁻³ Several options are available for the diagnosis and treatment of choledocholithiasis, but there is no consensus on the optimal management strategy. Diagnostic and treatment approaches depend on multiple factors, including the level of suspicion for choledocholithiasis, preferences (patient and physician), resources, and the expertise of the surgeons, endoscopists, and radiologists.

Transabdominal ultrasonography (US) is the most commonly used screening method; it is widely available, noninvasive, and inexpensive. US is highly operator-dependent, but it can provide

useful information if performed by experienced individuals. Clinical, ultrasonographic, and serum chemistry data are sensitive in 96%–98% of patients and specific in 40%–75% for the determination of choledocholithiasis.²⁻⁵ When these studies are used for patient selection for endoscopic retrograde cholangiopancreatography (ERCP), many patients have no common bile duct (CBD) stones identified during the procedure.⁵⁻⁷ ERCP is effective for the diagnosis and clearance of CBD stones, but the procedure is associated with patient discomfort, inconvenience, and complications.⁸ Many patients undergo unnecessary ERCP with the attendant potential for morbidity (and even mortality). Magnetic resonance cholangiopancreatography (MRCP) is an accurate, noninvasive diagnostic method for investigating the biliary and pancreatic ducts. It has been recommended by some authors as the first-line preoperative procedure for detection of CBD stones.^{9,10}

There are many approaches for the management of choledocholithiasis associated with symptomatic

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gallstones: (1) ERCP followed by laparoscopic cholecystectomy (LC); (2) intraoperative laparoscopic “rendezvous” (LER) or laparoscopic antegrade sphincterotomy (LAS); (3) LC and laparoscopic CBD exploration (LCBDE) by choledochotomy; (4) transcystic stone removal during LC; and (5) LC followed by postoperative ERCP; and (6) open cholecystectomy + choledochotomy ± transduodenal papillotomy if any of the procedures described above are unsuccessful. If any of these procedures are unsuccessful, a sixth approach—open cholecystectomy plus choledochotomy with or without transduodenal papillotomy—is used. The proven method for management of biliary duct stones is ERCP with sphincterotomy, but it is associated with serious complications such as acute pancreatitis in 2%–9% of patients.^{8,11,12} In recent years, some reports have shown the effectiveness of the one-step combined LER technique in the gallbladder and biliary duct lithiasis.^{13–18} In this study, we evaluated the effectiveness and safety of the intraoperative LAS technique compared to the LER technique in cholecystitis-choledocholithiasis.

MATERIALS AND METHODS

Between October 2002 and August 2007, patients with cholecystitis-choledocholithiasis undergoing LC plus LER (group A; $n = 35$) were compared retrospectively to those undergoing LC plus LAS (group B; $n = 41$) at a single institution. In 89 consecutive hospitalized patients, gallbladder stones and CBD stones were detected by transabdominal US and MRCP. Of the 89 patients, 4 had severe cholangitis. These patients were treated initially with urgent ERCP, and interval LC was done once sepsis had resolved. The other patients underwent a single-stage procedure. Transcystic CBD stone clearance was attempted in selected patients (ie, single stone < 6 mm in diameter, cystic duct > 4 mm diameter; $n = 9$). CBD stone clearance was accomplished in 7 of these patients; 2 patients who had unsuccessful transcystic stone removal were managed with LER. The other 76 patients underwent LER or LAS without specific selection criteria. Our initial experience was with LER, but we preferred LAS during the last 2 years of this study. Endoscopic procedures in both groups were done by the same endoscopist (A.T.), an experienced laparoscopic surgeon and a member of our surgical team. (Before this study, A.T. had performed more than 80 conventional ERCPs per year.)

Clinical, demographic, and biochemical findings are shown in Table I. There were no significant differences between the groups. Preoperative

Table I. Clinical and demographic details of patients in groups A and B

	Group A ($n = 35$)	Group B ($n = 41$)	<i>P</i> value
Age range (y)	46 ± 2.1	47.2 ± 3	NS
Females, n (%)	27 (77.1)	30 (73.1)	NS
Abnormal LFT, n (%)	31 (88.8)	35 (85.4)	NS
Hyperbilirubinemia, n (%)	16 (45.7)	21 (51.2)	NS
Acute admission, n (%)	8 (22.8)	10 (24.4)	NS
Single CBD stone, n (%)	10 (28.5)	16 (39)	NS
Pancreatitis, n (%)	5 (14.2)	3 (7.3)	NS
Previous upper abdominal surgery, n (%)	1 (2.8)	2 (4.9%)	NS

LFT, Liver function test; CBD, common bile duct; NS, not significant.

investigations included liver function tests, US, and MRCP. None of the patients had preoperative ERCP.

The rendezvous technique was used in group A. Patients were placed in the supine position on the operating table. After creating a pneumoperitoneum, intraoperative cholangiography (IOC) was performed using a 10-gauge catheter maintained in place with a clip on the cystic duct to confirm the duct stone(s) already detected by US and MRCP. After partial deflation of the pneumoperitoneum, a videoendoscope and monitor were placed behind the anesthesia drapes. A 0.025- or 0.035-inch guidewire (Jagwire high-performance guidewire; Boston Scientific, Boston, Mass) was introduced into the cystic duct and advanced through the sphincter of Oddi and into the duodenum through the IOC catheter. At the start of the endoscopic procedure, the guidewire was caught by a polypectomy snare and pulled through the working channel of the endoscope. A sphincterotome (Microvasive Autotome RX Cannulation Sphincterotome; Boston Scientific) was introduced over the guidewire; the latter greatly facilitated cannulation of the bile duct. Retrograde cholangiography was done. Sphincterotomy was performed when the CBD was identified. Stones and debris were flushed out by injection with saline through the cholangiocatheter. A retrieval balloon or stone retrieval basket was used to remove the retained stone(s). At the end of sphincterotomy, care was taken to remove all stomach gas to facilitate LC completion.

An antegrade technique was used in group B. Cholangiography was obtained with a 12-G catheter (Fig 1). A sphincterotome was advanced down into the sphincter of Oddi (Figs 2, A, B). A videoendoscope was passed through the mouth into the duodenum. Using the endoscopic image,



Fig 1. Intraoperative cholangiography showing an impacted distal common bile duct stone.

the sphincterotome was manipulated until it was in the 12-o'clock position. The sphincterotomy was completed by traction on the sphincterotome while applying electrocautery. The cystic duct catheter was flushed with saline to move the stone(s) through the widened ampulla. This procedure cleared the duct in most patients. If it did not, however, a retrieval balloon or a stone retrieval basket was used. Routine IOC was repeated to confirm CBD clearance after both techniques (Fig 3).

Statistical analysis. Continuous variables were presented as mean $\pm$ SD; categorical variables are presented as percentages. Comparison of postoperative stay (days) and operative time (minutes) between the 2 groups were performed by unpaired *t* test. Categorical variables such as CBD stone clearance, conversion, and morbidity were compared by chi-square test. All tests of statistical significance were 2-tailed and were considered to be significant at a level of 0.05. Statistical analyses were carried out using SPSS statistical software (version 10.0; SPSS, Chicago, Ill).

RESULTS

In group A (LER), ductal stone clearance was successful in 33 of 35 patients (94%). Two patients required conversion to open surgery (6%; Table II). In one, the guidewire could not be passed through the papilla due to a prepapillary, giant, impacted

stone, and the guidewire was seen to penetrate the CBD; conversion to open operation was indicated because of microperforation. The other patient had acute cholecystitis; dissection and cannulation of the cystic duct was not successful due to dense adhesions. In group B (LAS), ductal stone clearance was successful in 39 of 41 patients (95%). Two patients required conversion to open operation (5%; Table II). One patient had bleeding at sphincterotomy; in the other patient, we were unable to cannulate the CBD.

Postoperative complications related to the 2 procedures were recorded in 5 patients (Table II). In group A, 1 patient each experienced an episode of post-ERCP cholangitis which was treated with antibiotics. (i.v.), 1 patient had pneumonia, and 1 patient had postoperative atrial fibrillation. In group B, 1 patient had post-sphincterotomy bleeding, and 1 patient had mild pancreatitis. The latter was probably related to reflux filling and acinarization of the pancreatic duct during high-pressure transcystic IOC while attempting to flush out impacted CBD stones. No late complications or procedure-related deaths were recorded.

Statistical analysis and comparison between groups A (LER) and B (LAS) are presented in Table II. Ductal stone clearance was equivalent in the 2 groups (94% vs 95%), as was morbidity (9% vs 5%), and conversion (6% vs 5%). Operating time was less in group B (median, 89 minutes vs 117 minutes; $P < .0001$). There was no significant difference in hospital stay between the 2 groups.

DISCUSSION

The diagnosis of lithiasis of the gallbladder is usually made by transabdominal US. The main biliary duct is studied by US and, if possible, MRCP (diagnostic ERCP has been abandoned in referral centers to avoid the additional risk of acute post-ERCP pancreatitis). MRCP has a diagnostic accuracy comparable to that of ERCP.^{9,10,19} After definitive diagnosis of cholecystitis-choledocholithiasis by US and MRCP, the ideal treatment strategy is controversial. Preoperative ERCP followed by LC seems to be the most common but necessitates 2 successive interventions; LC followed by ERCP presents the risk of a third therapeutic procedure if endoscopy fails to clear the CBD. Simultaneous LC and ERCP or CBDE should be the best therapeutic strategy,¹⁴⁻¹⁸ increasing comfort for the patients who undergo a single, minimally invasive procedure. Preoperative ERCP followed by LC is indicated in severe acute cholangitis. Single-stage and open procedures are not recommended for severe

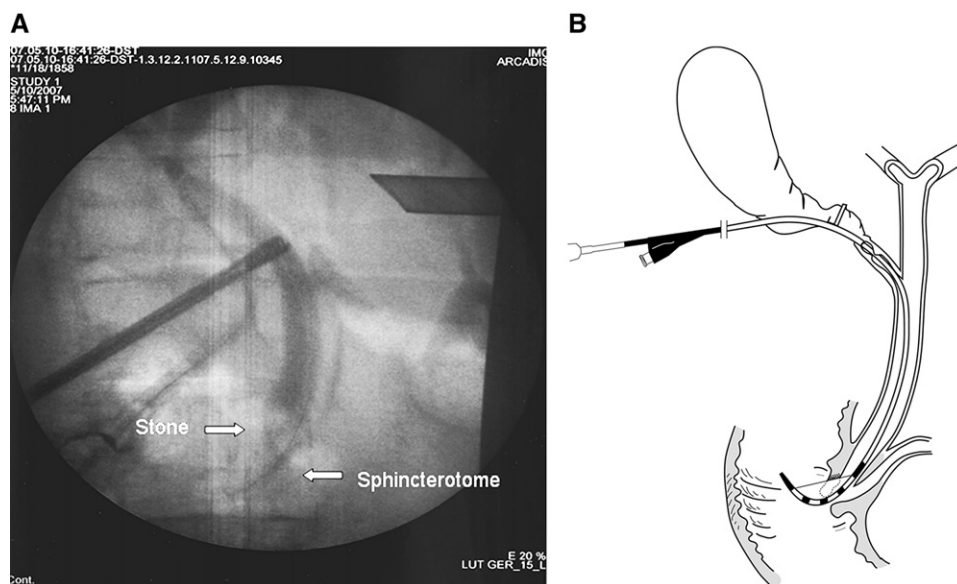


Fig 2. A, Antegrade position of the sphincterotome. B, Antegrade sphincterotomy (schematic).

acute cholangitis, because preoperative ERCP followed by LC carries less morbidity and mortality than single-stage and open procedures.^{20,21}

In recent years, different reports have presented encouraging results for single-stage LC and ERCP, but organizational and technical problems have discouraged the widespread use of this combined approach. Organizational problems include availability of an endoscopist and necessary equipment in the operating room. Having an experienced biliary endoscopist among our surgical staff facilitated the laparoendoscopic single-stage technique in this series, decreasing an organizational conflict between surgeons and gastroenterologists. In our study, MRCP was used routinely to confirm a suspected diagnosis of CBD stones. Routine use of MRCP avoids the diagnostic use of ERCP and allows the timely coordination of an endoscopist, the videoendoscopy unit, and the necessary equipment in the operating room during LC.

Cannulation of the CBD in patients undergoing intraoperative conventional ERCP is more difficult because the patient is supine. To facilitate cannulation, Cavina et al²² introduced a technique in which a Dormia basket is passed into the duodenum through the cystic duct; with a rendezvous procedure, the sphincterotome is retrieved from the duodenoscope and guided into the bile duct. In our series (group A) of 35 patients with CBD stone(s), we used a modification of this technique and introduced a guidewire through the IOC catheter and into the cystic duct. The bile duct stone clearance was 94% and the mean duration of

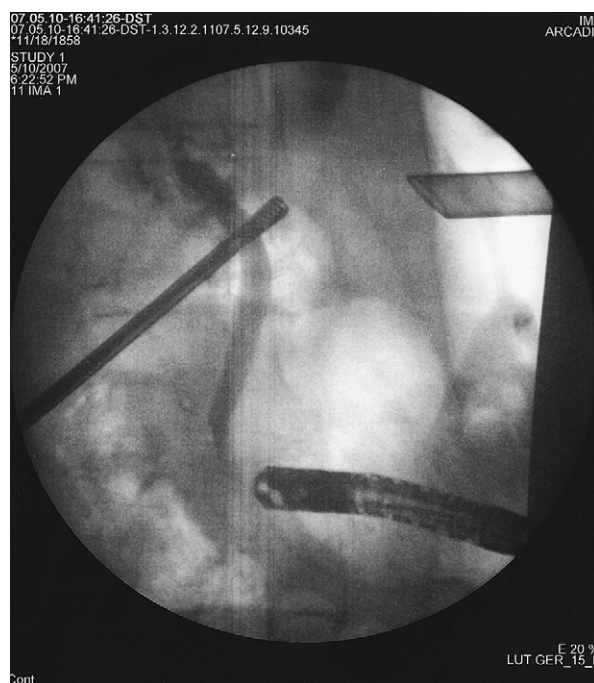


Fig 3. Intraoperative cholangiography showing common bile duct clearance after the procedure.

operation was 117 ± 5 minutes. The antegrade technique was popularized by DePaulo et al²³ and Curet et al.²⁴ This technique involves antegrade introduction of an endoscopic sphincterotome via the cystic duct through the ampulla. A side-viewing duodenoscope confirms the position of the sphincterotome. We applied the antegrade technique in 41 patients (group B). The bile

Table II. Comparison of outcome between groups A and B

	Group A (n = 35)	Group B (n = 41)	P value
CBD stone clearance, n (%)	33/35 (94.2)	39/41 (95.1)	.979*
Conversion to open surgery, n (%)	2/35 (5.7)	2/41 (4.8)	.877*
Morbidity, n (%)	3 (8.5)	2 (4.8)	.545*
Postoperative stay (d)	3 ± 0.7	3.3 ± 1	.140†
Operative time (min)	117 ± 5	89 ± 3	.0001†
Intraoperative complications, n (%)	1 (2.8)	1 (2.4)	.912*

CBD, Common bile duct.

*Chi-square test.

†Unpaired *t* test

duct stone clearance was 95%, and the mean operative time was 89 ± 3 minutes.

Although there was no significant difference in the CBD clearance between the 2 groups, the antegrade technique had a lesser operative time ($P < .0001$). There are 2 reasons for the prolonged operative time for the retrograde technique. First, the retrograde technique requires more maneuvers, such as introducing the guidewire via the cystic duct into the duodenum, inserting a polypectomy snare through the working channel and into the duodenum, catching the guidewire with a polypectomy snare, pulling the guidewire through the working channel of the duodenoscope, and introducing a sphincterotomy over the guidewire. Second, prolonged duodenoscopy produces more gas in the bowel loops, possibly resulting in a longer operative time for the following cholecystectomy. Currently, when appropriately selected before a dual procedure approach, most endoscopists perform the LER (not LAS) procedure for sphincterotomy.^{13,15,16,18} In our opinion, this approach has been adopted based on previous experience of preoperative ERCP.

Both procedures were safe. There was no mortality, and the overall morbidity was similar in the 2 groups (9% in LER; 5% in LAS; $P = .545$). There was only 1 case of pancreatitis in the 2 groups (1%). In other LER series, postoperative pancreatitis was 0%–1.5%,^{15,16,18} whereas post-ERCP pancreatitis occurred in 2%–9% of cases.^{8,11,12} Conventional ERCP has more risk factors compared to intraoperative LER or LAS, such as pancreatic duct cannulation or opacification,^{8,11} small bile ducts,^{8,25} multiple cannulation attempts or difficult cannulations,^{12,26} development of abdominal pain during the procedure,²⁴ and a precut sphincterotomy.^{12,27} Intraoperative techniques (rendezvous or antegrade) eliminate most of these risk factors. ERCP-induced pancreatitis remains an important clinical problem, even in diagnostic ERCP. Memon et al¹⁴ reviewed the

advantages and disadvantages of single-stage versus two-stage procedures in the literature and found that single-stage procedures produce a lesser hospital stay and cost less than two-stage procedures. Morino et al¹⁸ and Rábago et al²⁸ performed a prospective, randomized study between preoperative ERCP followed by LC and rendezvous plus LC. Both teams found that rendezvous plus LC produces a lesser hospital stay and is cheaper.

The other single-stage approach for the management of cholecystitis-choledocholithiasis is LCBDE, which can be attempted through the cystic duct or through the CBD. For transcystic LCBDE, the duct can be dilated up to a diameter of 7 mm without rupturing the duct. Stones can be removed using a choledochoscope or fluoroscopically guided wire basket; ampullary balloon dilatation with high-flow saline irrigation; pushing the stones into the duodenum with a choledochoscope; and forcibly flushing the stones into the duodenum after pharmacologic (glucagon or nitroglycerin) manipulation. The most popular method is flexible biliary endoscopy with wire basket retrieval of the calculi.¹⁷ A transcystic approach can be attempted in selected patients with stones < 6 mm in diameter, a cystic duct > 4 mm in diameter, a lateral cystic duct entrance, few stones, and stones located below the implantation of the cystic duct.^{14,17} Alternatively, a laparoscopic choledochotomy can be performed in which stones are extracted by basket or flexible choledochoscopy. LCBDE through the cystic duct or the CBD requires technical expertise, specialized instrumentation, and favorable biliary anatomy.

Successful LCBDE (58%–98% of cases) has been reported in several large series.^{14,17,26} Berthou et al²⁹ had a success rate of 97% for LCBDE by choledochotomy compared with a success rate of 69% for the transcystic approach. LCBDE by choledochotomy produces a longer hospital stay and longer operating time compared with intraoperative sphincterotomy and the transcystic approach.^{14,17,18,28} We performed transcystic

LCBDE in 9 selected patients with a success rate of 78%. We suggest that the transcystic approach can be attempted in selected patients. LCBDE by choledochotomy is an advanced technique that benefits from the resources at highly specialized academic centers. ERCP is a high-volume endoscopic procedure used in academic as well as regional hospitals.

In conclusion, this study suggests that a combined laparoendoscopic approach for the removal of CBD stone(s) is safe and effective in routine surgical practice. Clearance of ductal stone(s), morbidity, and conversion are equivalent in the 2 groups. LAS has a shorter operative time compared with LER.

REFERENCES

- Schirmer BD, Winters KL, Edlich RF. Cholelithiasis and cholecystitis. *J Long Term Eff Med Implants* 2005;15:329-38.
- Ko CW, Lee SP. Epidemiology and natural history of common bile duct stones and prediction of disease. *Gastrointest Endosc* 2002;56(6 Suppl):165-9.
- Trondsen E, Edvin B, Reiertsen O, Faerden AE, Fagurtun H, Rosseland AR. Prediction of common bile duct stones prior to cholecystectomy. A prospective validation of a discriminant analysis function. *Arch Surg* 1998;113:162-6.
- Alponat A, Kum K, Rajnakova A, Koh BC, Goh PM. Predictive factors for synchronous common bile duct stones in patients with choledocholithiasis. *Surg Endosc* 1977;11:928-32.
- Menezes N, Marson LP, de Beaux AC, Muir IM, Auld CD. Prospective scoring system to predict choledocholithiasis. *Br J Surg* 2000;87:1176-81.
- Khaira HS, Ridings PC, Gompertz RHK. Routine laparoscopic cholangiography: means of avoiding unnecessary endoscopic retrograde cholangiopancreatography. *J Laparoendosc Adv Surg Tech* 1999;9:17-22.
- Lui TH, Consorti ET, Kawashima A, Tamm EP, Kwong KL, Gill BS, et al. Patient evaluation and management with selective use of magnetic resonance cholangiography and endoscopic retrograde cholangiography before laparoscopic cholecystectomy. *Ann Surg* 2001;234:33-40.
- Loperfido S, Angelini G, Benedetti G, Chilovi F, Costan F, De Berardinis F, et al. Major early complications from diagnostic and therapeutic ERCP: a prospective multicenter study. *Gastrointest Endosc* 1998;48:1-10.
- Baillie J, Paulson EK, Vitellas KM. Biliary imaging: a review. *Gastroenterology* 2003;26:715-8.
- Tekin A, Saygılı M, Hafta A, Oztan S. Biliary stones and stenoses: diagnostic value of magnetic resonance cholangiography. *Turk J Gastroenterol* 2002;13:139-45.
- Cotton PB, Baillie G, Leung J. Correlations with post-ERCP pancreatitis. *Gastrointest Endosc* 1994;40:29.
- Freeman ML, DiSairo JA, Nelson DB, Fennerty B, Lee JG, Bjorgman DJ, et al. Risk factor for post ERCP pancreatitis: a prospective multicenter study. *Gastrointest Endosc* 2001;54:425-34.
- Iodice G, Giardiello C, Francica G, Sarrantonio G, Angelone G, Cristiano S, et al. Single-step treatment of gallbladder and bile duct stones: a combined endoscopic-laparoscopic technique. *Gastrointest Endosc* 2001;3:336-8.
- Memon MA, Hassaballa H, Memon MI. Laparoscopic common bile duct exploration: the past, the present, and the future. *Am J Surg* 2000;179:309-15.
- Tricarico A, Cione G, Sozio M, Palo D, Tricarico T, Tartaglia A, et al. Endolaparoscopic rendezvous treatment: a satisfying therapeutic choice for cholecystocholedocholithiasis. *Surg Endosc* 2004;16:711-3.
- Wright BE, Freeman ML, Cumming JK, Quickel RR, Mandal AK. Current management of common bile duct stones: is there a role for laparoscopic cholecystectomy and intraoperative endoscopic retrograde cholangiopancreatography as a single-stage procedure? *Surgery* 2002;132:729-37.
- Petelin JB. Laparoscopic common bile duct exploration. *Surg Endosc* 2003;17:1705-15.
- Morino M, Baracchi F, Miglietta C, Furlan N, Ragona R, Garbarini A. Preoperative endoscopic sphincterotomy versus laparoendoscopic rendezvous in patients with gallbladder and bile duct stones. *Ann Surg* 2006;44:889-93.
- Lui TH, Consorti ET, Kawashima A, Tamm EP, Kwong KL, Gill BS, et al. Patient's evaluation and management with selective use of magnetic resonance cholangiography and endoscopic retrograde cholangiography before laparoscopic cholecystectomy. *Ann Surg* 2001;234:33-40.
- Lai EC, Mok FP, Tan ES, Lo CM, Fan ST, You KT, et al. Endoscopic biliary drainage for severe acute cholangitis. *N Engl J Med* 1992;326:1582-6.
- ASGE guidelines for clinical application. The role of ERCP in diseases of the biliary tract and pancreas. American Society for Gastrointestinal Endoscopy. *Gastrointest Endosc* 1999;50:915-20.
- Cavina E, Franceschi M, Sidoti F, Goletti O, Buccianti P, Chiarugi M. Laparo-endoscopic "rendezvous": a new technique in the choledocholithiasis treatment. *Hepatogastroenterology* 1988;45:1430-5.
- DePaulo AL, Hashiba K, Bafutto M, Zago R, Machado MM. Laparoscopic antegrade sphincterotomy. *Surg Laparosc Endosc Percutan Tech* 1993;3:157-60.
- Curet MJ, Pitcher DE, Martin DT, Zucker KA. Laparoscopic antegrade sphincterotomy. A new technique for the management of complex choledocholithiasis. *Ann Surg* 1995;221:149-55.
- Sherman S, Ruffolo TA, Hawes RH, Lehman GA. Complications of endoscopic sphincterotomy. A prospective series with emphasis on increased risk associated with sphincter of Oddi dysfunction and nondilated bile duct. *Gastroenterology* 1991;101:1068-72.
- Vandervoort J, Soetikno RM, Tham TC, Wrong RC, Ferrari AP, Montes H, et al. Risk factors for complications after performance of ERCP. *Gastrointest Endosc* 2002;56:652-6.
- Masci E, Toti G, Mariani A, Curioni S, Lomazzi A, Dinelli M, Monili G, et al. Complications of diagnostic and therapeutic ERCP: a prospective multicenter study. *Am J Gastroenterol* 2001;96:417-23.
- Rábago LR, Vicente C, Soler F, Delgado M, Moral I, Guerra I, et al. Two-stage treatment with preoperative endoscopic retrograde cholangiopancreatography (ERCP) compared with single-stage treatment with intraoperative ERCP for patients with symptomatic cholelithiasis with possible choledocholithiasis. *Endoscopy* 2006;38:779-86.
- Berthou JC, Drouard F, Charbonneau P, Moussalier K. Evaluation of laparoscopic management of common bile duct stones in 220 patients. *Surg Endosc* 1998;12:106-18.