

# Feasibility of Therapeutic Endoscopic Retrograde Cholangiopancreatography for Bile Duct Stones in Nonagenarians: a Single Unit Audit

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## Abstract

**Background.** Little information is available on short and long-term outcome of therapeutic endoscopic retrograde colangiopancreatography (ERCP) for choledocholithiasis in nonagenarians ( $\geq 90$  years). The aim of this study was to evaluate retrospectively the feasibility of therapeutic ERCP in nonagenarians with choledocholithiasis, as compared with patients aged between 75 and 89 years. **Patients and methods.** During a 9-year period, therapeutic ERCP was performed for choledocholithiasis in 33 nonagenarian patients (group A) and 272 patients aged 75 to 89 years (group B). Clinical features, endoscopic findings, interventions, early and long-term results of therapeutic ERCP for a mean follow-up of 36 months were assessed and compared between the two groups. **Results.** Group A patients had a higher incidence of acute cholangitis, concomitant diseases and gallbladder stones, as compared to group B patients. Furthermore, they required an emergency procedure, multiple sessions, stent insertion, and needle knife fistulotomy significantly more frequently ( $p < 0.001$ ). Group B patients underwent significantly more endoscopic manipulations and had a longer procedure time than group A patients. Complete bile duct stone clearance was achieved in 24.2% of group A patients and in 90.8% of group B patients ( $p < 0.001$ ). No ERCP related deaths occurred in group A patients. Cholecystectomy was not routinely performed in Group A patients having gallbladder stones. The rate of early and late complications was not significantly different between the two age groups. **Conclusion.** Therapeutic ERCP and biliary stenting have proved to be a feasible treatment option for the management of choledocholithiasis in nonagenarians.

## Key words

Bile duct stones – nonagenarians – needle knife fistulotomy – biliary endoprosthesis.

## Introduction

It is well documented that the incidence of choledocholithiasis increases with age, and as life expectancy is rising, it is expected that the prevalence of advanced age patients with bile duct stones will correspondingly increase [1-3]. In these elderly patients, complications of choledocholithiasis carry a more substantial morbidity and mortality rate [2, 4]. Indeed, the mortality of elderly patients increases sharply, particularly when infective complications ensue or when emergency procedures are required [2-5]. Therefore, several investigators have endorsed a non-operative therapeutic approach for the management of choledocholithiasis in elderly patients with high operative risks [6, 7].

With reference to the above, therapeutic endoscopic retrograde colangiopancreatography (ERCP) and stone extraction is considered the treatment of choice for elderly or high risk patients, with biliary and pancreatic diseases [2, 8]. Notwithstanding this, little information is available about the short and long-term outcome of therapeutic ERCP, endoscopic sphincterotomy (ES) and biliary endoprosthesis (EP) insertion, in patients with choledocholithiasis aged 90 years and older [7, 8].

We have therefore retrospectively evaluated the feasibility of therapeutic ERCP in nonagenarians with choledocholithiasis, as compared with patients aged between 75 and 89 years.

## Patients and Methods

Between January 1998 and December 2006, 560 patients (235 men and 325 women) underwent ERCP for suspected choledocholithiasis. Among these, 319 were 75 years or older. A total of 14 patients with no bile duct stones or unsuccessful ES were excluded from the study. The remaining 305 patients were divided according to their

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age into the following two groups: group A: 90 years of age or older (33 patients), with a median age of 92 years, and group B: between 75 and 89 years old (272 patients) with a median age of 79 years. The age cut-off of 90 years was selected because there is little data in the literature on the role and outcome of therapeutic ERCP in patients with choledocholithiasis aged 90 years and older.

The patients' preprocedural work-up included complete blood cell count, liver function tests, serum electrolytes, coagulation studies and imaging studies (abdominal ultrasound, computed tomography and magnetic resonance cholangiopancreatography where appropriate). Before the procedure, each patient status was classified according to the physical status classification of the American Society of Anesthesiologists (ASA) [9]. Chronic concomitant diseases were classified as cardiovascular, chronic obstructive pulmonary, metabolic (diabetes mellitus), chronic renal failure, and neurological (Parkinson disease, dementia and post-stroke disorders). All patients underwent therapeutic ERCP within 24h of admission. Patients' data were obtained from our Unit's computerized disease management system, and the hospital's Ethical Committee on clinical research approved our study. Further, before the procedure, written informed consent was obtained from all patients.

During the procedure, sedation and analgesia were achieved with intravenous midazolam and fentanyl titrated to suit age and tolerance. Duodenal relaxation was achieved with intravenous hyoscine butylbromide. Patients were monitored with pulse oximetry during the procedure. The procedure was undertaken under general anaesthesia, whenever this was necessary. All patients received a single prophylactic dose of intravenous antibiotic. The same endoscopist performed all the procedures, using the same technique with a low osmolarity (diluted to half strength), nonionic contrast media (iopromide, Ultravist 370: Schering, Berlin, Germany). After selective bile duct cannulation, opacification of the biliary tree was achieved with the injection of dye under low pressure and fluoroscopic monitoring. Complete opacification of the extrahepatic and central intrahepatic bile ducts was achieved at deep cannulation. Nevertheless, in group A no additional effort was made to outline the gallbladder by contrast medium. If at this point the gallbladder was not opacified, despite adequate filling of the proximal biliary tree, the cystic duct was judged as non-patent.

After cholangiographic confirmation of choledocholithiasis, conventional ES or needle knife sphincterotomy (NKS) and deep cannulation of common bile duct (CBD) was attempted in all patients. In our unit NKS was performed by using the NK fistulotomy technique [10]. Bile duct stones were extracted with a Dormia basket and/or balloon catheter or by endoscopic mechanical lithotripsy, immediately after ES, in stable patients (mainly group B). Stone extraction was defined as difficult in the following cases: a. stone diameter  $\geq 10$  mm, b. multiple CBD lithiasis, c. presence of juxtapapillary duodenal diverticula (JDD), and d. ASA status IV or V. No insistent effort was made for CBD

clearance in group A patients, especially when this had not been achieved within 15 minutes, considering that advanced age and/or critically ill patients are at a higher risk of developing life threatening complications. In these patients an endoscopic nasobiliary drainage (ENBD) catheter or more often a 10 Fr Amsterdam type biliary EP was placed as either a temporary (mainly group A), or permanent endoscopic treatment (mainly group B) respectively. Special effort was made during stent placement so that its proximal end of the EP was positioned proximally to the stones and the distal end in the duodenum. These patients were scheduled for a further attempt of either complete clearance (mainly group B) or change of the EP (group A) in a 4-month time.

Patients having gallbladder stones were not routinely operated. We preferred the "wait and see" policy for advanced age and elective surgery for slightly younger patients. To assess long-term outcomes of therapeutic ERCP, all patients were followed-up for a mean 36 (range 8 to 48) months. All patients were hospitalized for 24 hours after therapeutic ERCP to assess the incidence of post interventional complications.

ERCP findings (CBD diameter, JDD, size and number of stones, gallbladder opacification, technique details), early outcomes (success, stone clearance, mechanical lithotripsy, permanent stent), general anesthesia, number of procedures, and early complications (within 30 days) of ES were recorded and compared between the two groups. Procedural time and intolerance rate were also recorded and compared between the two groups. Long-term outcomes of therapeutic ERCP were assessed at follow-up. Data were provided either by patients' reassessment (3 months interval) or by information that were obtained through questionnaires mailed to the referring hospitals. Phone calls were also made occasionally. When indicated, a repeat ERCP was performed.

Post-ERCP complications were defined according to published criteria [11-13]. Specifically, post-ES bleeding was classified as immediate or delayed. Immediate bleeding was defined as endoscopic venous oozing that stops spontaneously and venous oozing giving rise to a redout, which may require local injection of epinephrine for bleeding control. Delayed bleeding was defined according to published criteria [11]. Mild hemorrhage was defined as an Hb drop of  $<3$  g/dL and no need for blood transfusion; moderate was defined as transfusion of 4 units or less, with no angiographic intervention or surgery; and severe was defined as transfusion of 5 units or more or in those requiring intervention (angiographic or surgical). Post-ERCP pancreatitis was defined as a new or relapsing abdominal pain with an increase in serum amylase at least three times the upper limit of normal at more than 24h after the procedure, requiring more than one night of hospitalization. Mild pancreatitis was defined as an episode that required a hospital admission of 2-3 days, moderate 4-10 days admission and severe more than 10 days. Cholangitis was defined as jaundice, upper abdominal quadrant abdominal pain (these two symptoms/signs were not always present in the same patient) and fever of  $>38^{\circ}\text{C}$  for more than 24 h that

it was believed to have biliary causes. Mild cholangitis was defined as a hospital admission of <3 days without the need for endoscopic or percutaneous intervention, moderate as necessitating more than 3 days of hospitalization or requiring endoscopic or percutaneous intervention, and severe as septic shock or surgery. An intensive care unit admission after a procedure graded the complication as severe.

Statistical analysis compared the various parameters between the two age groups. Descriptive statistics for discrete variables are presented as frequencies and percentages. Continuous variables were summarized using medians with ranges (minimum, maximum). Differences between age groups for qualitative variables were tested using the Chi-square test or Fisher's exact test, whenever more appropriate. The median number of procedures and the median procedure time between the age groups were compared with the Mann-Whitney U test, since the dates were not normally distributed. All statistical tests were two-tailed with a significance level of 0.05. Statistical analyses were conducted in SPSS 12.0 (SPSS, Inc., Chicago, Illinois).

## Results

Patients were balanced between the two age groups in terms of gender ( $p=0.281$ , Table I). More patients experienced jaundice and pain in Group B (50%) than in Group A (36%) and patients with abnormal liver tests in Group B were over twice as many than in Group A (14% vs. 6%), but these differences were not statistically different. The frequency of acute cholangitis was significantly higher in Group A ( $p<0.001$ ). There was a trend showing that more patients had acute pancreatitis, shock or other symptoms in Group A than in Group B (Table I). The proportion of patients who had underwent previous cholecystectomy was similar in the two groups.

Gallbladder stones were significantly more frequent in patients of Group B than of patients in Group A ( $p<0.001$ ). However, there was no significant difference in the frequency of intrahepatic stones and in the proportion of patients having two or more bile duct stones between the two age groups. Worth noting is that 28 (85%) group A patients had large stones ( $\geq 10$  mm) and this proportion was significantly higher than in group B patients (39%). Patients with JDD were significantly more in group A than in group B (46% vs. 29%,  $p=0.045$ ). Over half of the patients had ASA status IV or V (58%) in Group A, while the corresponding proportion in Group B was only 18%; ( $p<0.001$ ). Patients with cardiovascular and neurological diseases were significantly more in Group A than in Group B ( $p=0.005$  and  $p<0.001$ , respectively). The other concomitant chronic diseases did not differ significantly between the two age groups (Table I).

In Group A, the majority of patients had NK fistulotomy, while in Group B the majority of patients had underwent conventional ES. This difference was statistically significant ( $p<0.001$ , Table II). Endoprosthesis was more frequently inserted in Group A than in Group B ( $p<0.001$ ). Additionally, in Group A, all patients had permanent EP (Amsterdam type

**Table I.** Clinical characteristics and concomitant chronic disease of patients

	Group A (n=33)	Group B (n=2720)	p-value
<b>Clinical characteristics</b>			
Median age in years (range)	92 (90-99)	79 (75-89)	
Gender, n (%)			0.281 <sup>a</sup>
Men	11 (33.3)	118 (43.4)	
Women	22 (66.7)	154 (56.6)	
Clinical picture, n (%)			
Jaundice/pain	12 (36.4)	125 (50.0)	0.295 <sup>a</sup>
Abnormal blood liver test	2 (6.1)	39 (14.3)	0.279 <sup>b</sup>
Acute cholangitis	9 (27.3)	14 (5.1)	<0.001 <sup>a</sup>
Acute pancreatitis	2 (6.1)	3 (1.1)	0.092 <sup>b</sup>
Shock	2 (6.1)	2 (0.8)	0.059 <sup>b</sup>
Other symptoms	6 (18.1)	24 (8.8)	0.088 <sup>a</sup>
Previous cholecystectomy, n (%)	12 (36.4)	102 (37.5)	0.899 <sup>a</sup>
JDD, n (%)	15 (45.5)	79 (29.0)	0.045 <sup>a</sup>
Gallbladder stones, n (%)	12 (36.4)	231 (84.9)	<0.001 <sup>a</sup>
Bile duct stones, n (%)			
IH stones	2 (6.1)	7 (2.6)	0.253 <sup>b</sup>
Number $\geq 2$	18 (54.5)	156 (57.3)	0.773 <sup>a</sup>
Size $\geq 10$ mm	28 (84.8)	105 (38.6)	<0.001 <sup>a</sup>
CBD diameter (>14mm)	7 (21)	14 (5)	0.008 <sup>a</sup>
<b>Concomitant diseases, n (%)</b>			
Cardiovascular	12 (36.4)	44 (16.2)	0.005 <sup>a</sup>
Pulmonary	7 (21.2)	35 (12.9)	0.189 <sup>a</sup>
Diabetes mellitus	3 (9.1)	38 (14.0)	0.593 <sup>b</sup>
Neurological	12 (36.4)	30 (11.0)	<0.001 <sup>a</sup>
Renal failure	3 (9.1)	11 (4.0)	0.184 <sup>b</sup>

<sup>a</sup>Chi-square test, <sup>b</sup>Fisher's exact test, IH - intrahepatic, CBD - common bile duct, JDD - juxtapaillary duodenal diverticula

biliary EP), while in Group B, all had temporary EP (ENBD catheter) ( $p<0.001$ ). The proportion of ENBD placement did not differ significantly between the two groups ( $p=0.339$ ). Also, there was no significant difference in the gallbladder opacification between the two groups ( $p=0.763$ ). Complete clearance of bile duct stones was achieved in the majority of patients in Group B, a rate substantially higher than that in Group A (91% vs. 24%,  $p<0.001$ ).

Multiple manipulations (basket, balloon, lithotripsy) were significantly more frequently performed in Group B than in Group A ( $p<0.001$ ). Balloon procedure was required significantly more frequently in Group B than in Group A ( $p<0.001$ ). General anesthesia was performed in only one patient in each age group. Urgent ERCP was performed in a higher proportion of patients in Group A than in Group B ( $p<0.001$ ). The median number of procedures was significantly higher in Group A than in Group B ( $p<0.001$ ), while the median procedure time was lower in Group A than in Group B (15 vs. 35 minutes,  $p<0.001$ ). The intolerance rate

**Table II.** Endoscopic sphincterotomy findings and characteristics

	Group A (n=33)	Group B (n=272)	p-value
Endoscopic sphincterotomy (ES), n (%)			<0.001 <sup>a</sup>
Needle knife	18 (54.5)	54 (19.8)	
Conventional	15 (45.5)	218 (80.2)	
Endoprosthesis, n (%)	25 (75.8)	59 (21.7)	<0.001 <sup>a</sup>
Permanent	25 (100)	0 (0)	<0.001 <sup>b</sup>
Temporary	0 (0)	59 (100)	
Contemporary (ENBD)	7 (28.0)	11 (18.6)	0.339 <sup>b</sup>
Multiple manipulations, n (%)	13 (39.4)	243 (89.3)	<0.001 <sup>a</sup>
Basket	3 (9.1)	55 (20.2)	0.134 <sup>b</sup>
Balloon	8 (24.2)	160 (58.8)	<0.001 <sup>a</sup>
Mechanical lithotripsy	2 (6.1)	28 (10.3)	0.755 <sup>b</sup>
Gallbladder opacification, n (%)	3 (9.1)	32 (11.8)	0.763 <sup>b</sup>
Complete bile duct clearance, n (%)	8 (24.2)	247 (90.8)	<0.001 <sup>a</sup>
General anesthesia, n (%)	1 (3.0)	1 (0.4)	0.205 <sup>b</sup>
Emergency ES or NKP, n (%)	13 (39.4)	19 (7.0)	<0.001 <sup>a</sup>
Median number of sessions n (range)	2 (1-4)	1 (1-5)	<0.001 <sup>c</sup>
Median procedure time in minutes (range)	15 (10-20)	35 (20-45)	<0.001 <sup>c</sup>
Intolerance, n (%)	5 (15.2)	13 (4.8)	0.017 <sup>b</sup>
Difficult extraction, n (%)	22 (66.7)	118 (43.4)	0.011 <sup>a</sup>

Group A: patients  $\geq 90$  years old, Group B: patients 75-89 years old  
<sup>a</sup>Chi-square test, <sup>b</sup>Fisher's exact test, <sup>c</sup>Mann-Whitney U test

was higher in Group A than in Group B ( $p=0.017$ ). In Group A, most patients had a difficult extraction, a rate greater than that in Group B ( $p=0.011$ ).

Early complications did not differ significantly ( $p=0.292$ ). There was also no significant difference in late complications between the two age groups (Table III). Two patients with complete or partial opacification of the gallbladder at ERCP required cholecystostomy. Of the whole number of patients evaluated, 31 remained completely asymptomatic, with neither biliary nor pancreatic symptoms. One group B patient, with advanced pulmonary failure, developed postprocedural septic complication with a fatal outcome.

## Discussion

Pancreaticobiliary surgery has significantly evolved in recent years as a result of better surgical techniques, improved intensive care, and the development of laparoscopic surgery. Complications rate has been substantially reduced, and the reported mortality rate following choledochotomy for CBD stones is less than 1% [14]. In spite of this, surgical treatment of CBD lithiasis and in particular, urgent operative intervention for its complications, continues to

**Table III.** Complications of therapeutic ERCP

Complication, n (%)	Group A (n=33)	Group B (n=2720)	p-value
<b>Early</b>			
Cholangitis	1 (3.0)	6 (2.2)	
Pancreatitis	1 (3.0)	4 (1.5)	
Bleeding	1 (3.0)	2 (0.7)	
Acute cholecystitis	1 (3.0)	5 (1.8)	
Basket impaction	0 (0)	1 (0.4)	
Death	0 (0)	1 (0.4)	
Total	4 (12.1)	19 (7.0)	0.292
<b>Late</b>			
Acute cholecystitis	1 (3.0)	7 (2.6)	
Recurrent cholangitis-jaundice	2 (6.1)	11 (4.0)	
Total	3 (9.1)	18 (6.6)	0.465

carry a high risk in the elderly population [1, 15, 16]. This is mainly attributed to the age-related natural decline in the immune status, which is the major predisposing factor contributing to increased morbidity and mortality with age [17]. Furthermore, immunosuppression caused by major abdominal surgery can further increase the incidence and/or the severity of postoperative complications in elderly patients [18].

Endoscopic retrograde colangiopancreatography and ES with stone removal is the method of choice for the treatment of CBD stones [6, 15]. Furthermore, therapeutic ERCP proved to be safe and effective for all age groups and particularly for the elderly, although advanced age patients still constitute a therapeutic challenge, because of special conditions of their biliary disease and coexistent morbidity [1, 8, 15, 19]. Nevertheless, the majority of reported series refer to patients with ages ranging from 65 to 85 years, while there is only a limited number of published series of patients 90 years of age and older, which however, include a relatively small number of patients [1, 8, 20-23].

In this study, although the rate of complete stone clearance was significantly lower in group A, the success rate of therapeutic ERCP, in terms of relieving biliary obstruction and keeping the bile duct patent, was not different between the two age groups. This fact underlines the usefulness of therapeutic ERCP, as it can prevent life threatening complications especially in very elderly patients. It is worth noting, however, that this outcome was achieved at the expense of significantly more cumbersome interventions, significant higher rates of emergency procedures, number of sessions and stent insertions, NFK and patients' intolerance.

Early complications (within 72 h after ERCP) were not different between the two groups and the overall morbidity was no different in the advanced age group. Moreover, the rate of early complications was low in both groups and similar to reported figures [19]. Other authors also found that there is no relationship between advanced age and post-

ERCP complications [12, 23]. With reference to mortality, no deaths related to ERCP were encountered in group A patients, while one group B patient, with advanced pulmonary failure developed post procedural septic complication (pneumonitis because of peri-procedural aspiration) with fatal outcome. Consequently, and in reverse to surgical therapy [15] this study showed that advanced age and poor general condition did not increase the mortality rate after therapeutic ERCP. Similar data have been reported by other investigators [15, 24].

Postoperatively, advanced age patients often develop mental deterioration (delirium and dementia) [25]. However, in this study therapeutic ERCP was not associated with mental status deterioration in either group of patients. Furthermore, in this study only one patient required emergency ventilatory support in the intensive care unit and eventually died because of severe pneumonitis and multiple system organ failure as a result of an infective inflammatory/immunological response. Furthermore, patients with JDD were significantly more in Group A than in Group B ( $p=0.045$ ). This finding is in accordance with the fact that the incidence of JDD increases with age [26]. In this study, although JDD caused in some instances technical difficulties at ERCP, it did not increase the risk of complications in either group.

Group A patients had more and larger bile duct stones than Group B patients, causing greater difficulty for stone clearance. Consequently, and in accordance to recent data [22] mechanical lithotripsy was necessary more frequently in group A patients. The rate of complete stone clearance was lower in Group A because of numerous or large stones than in Group B. Previous studies underlined the importance of the minimal diameter of the stone for spontaneous passage through the sphincterotomy [15, 19, 27]. Furthermore, in this study most of the advanced age patients had stones >14mm in diameter. This suggests that biliary stenting and nasobiliary drainage, in the majority of advanced age patients, is mandatory to protect against complications such as cholangitis. Besides, biliary stent placement has been established as a convenient and minimally invasive treatment for difficult stones [28, 29]. In this study, 76% of Group A patients required permanent stent insertion. Our policy regarding biliary stenting is that it can either be a temporary measure (Group B) to tide the patient over the crisis period, or it may serve as a more definitive therapy (Group A) in patients who are at an advanced age or otherwise at a high risk for surgery [29]. However, stent clogging may lead to serious complications such as cholangitis or recurrence of jaundice and cholestasis requiring prolonged evaluation and follow-up, and in some instances, further interventions. Nonetheless, these complications can be effectively managed endoscopically [30].

Urgent treatment is required more often for patients of advanced age than for younger patients because of the higher incidence of acute cholangitis [1]. Indeed, therapeutic ERCP was performed urgently in a higher proportion of patients in Group A than in Group B. With reference to this finding it has been reported that emergency therapeutic ERCP may

be performed safely in patients of advanced age [23]. On the other hand, it should be noted that ENBD is a less invasive and safer measure for treating acute cholangitis, particularly severe cholangitis with shock, than ES and stone extraction [1, 33].

Most of the advanced age patients (90.9%) in this study did not develop late complications during a mean follow-up of 36 months, whereas the reported late complication rate ranges from 5.8% to 24% [1, 8, 20-23]. This may be explained by the fact that these late complication rates concerned patients with a lower mean age as compared to the mean age of Group A patients of this study, since there is evidence suggesting that younger patients show a higher incidence of recurring biliary symptoms [21].

Patients with intact gallbladders have a higher incidence of late complications because of an increased risk of acute cholecystitis [30]. Of the 33 patients aged over 90 years in this study, 21 had their gallbladders in situ and only 12 had cholelithiasis. The low incidence of calculous gallbladders was considered as contributing to the low incidence of late complications. Routine cholecystectomy after ERCP and ES is not required in patients of advanced age [1, 15]. It has been reported that among patients who have undergone therapeutic ERCP for bile duct stones with their gallbladders left in situ, only about 10% will develop recurrent biliary problems over a 10 years period [31]. However, others reported a higher proportion of patients who developed recurrent biliary symptoms after a shorter follow-up period [32, 33]. The risk of acute cholecystitis after ES without a cholecystectomy ranges from 1 to 16%, and most of these cases tend to occur soon after ES in those with gall bladder stones [32]. Post-ERCP cholecystitis is usually a consequence of stones impacted in the cystic duct. Stones can be dislodged by vigorously injecting contrast material into the cystic duct or by manipulating with catheters and guidewires. We encountered a very low recurrence rate of biliary complications even over a long follow-up period (mean: 48 months). In particular, 90.8% of patients remained asymptomatic. Cholecystostomy was required only in two group A patients, because of cholecystitis. This outcome justifies a "wait-and-see" approach for advanced age patients. Other researchers have also justified this policy for advanced age patients [34, 35].

In **conclusion**, therapeutic ERCP and biliary stenting proved to be a feasible treatment option for the management of choledocholithiasis in patients aged 90 years and older.

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### Conflicts of interest

None to declare.

### References

1. Sugiyama M, Atomi Y. Endoscopic sphincterotomy for bile duct

- stones in patients 90 years of age and older. *Gastrointest Endosc* 2000; 52: 187-191.
2. Clarke GA, Jacobson BC, Hammett RJ, Carr-Locke DL. The indications, utilization and safety of gastrointestinal endoscopy in an extremely elderly patient cohort. *Endoscopy* 2001; 33: 580-584.
  3. Ross SO, Forsmark CE. Pancreatic and biliary disorders in the elderly. *Gastroenterol Clin North Am* 2001; 30:531-545.
  4. Pitt HA, Cameron JL, Postier RG, Gadacz TR. Factors affecting mortality in biliary tract surgery. *Am J Surg* 1981; 141: 66-72.
  5. Burns-Cox N, Campbell WB, van Nimmen BA, Vercaeren PM, Lucarotti M. Surgical care and outcome for patients in their nineties. *Br J Surg* 1997; 84: 496-498.
  6. Ashton CE, McNabb WR, Wilkinson ML, Lewis RR. Endoscopic retrograde cholangiopancreatography in elderly patients. *Age Ageing* 1998; 27: 683-688.
  7. Bredesen J, Jorgensen T, Andersen TF, Bronnum-Hansen H, et al. Early postoperative mortality following cholecystectomy in the entire female population of Denmark 1977-1981. *World J Surg* 1992; 16: 530-535.
  8. MacMahon M, Walsh TN, Brennan P, Osborne H, Courtney MG. Endoscopic retrograde cholangiopancreatography in the elderly: a single unit audit. *Gerontology* 1993; 39: 28-32.
  9. Owens WD, Felts JA, Spitznagel EL Jr. ASA physical status classifications: a study of consistency of ratings. *Anesthesiology* 1978; 49: 239-243.
  10. Mavrogiannis C, Liatsos C, Romanos A, Petoumenos C, Nakos A, Karvountzis G. Needle-knife fistulotomy versus needle-knife precut papillotomy for the treatment of common bile duct stones. *Gastrointest Endosc* 1999; 50: 334-339.
  11. Cotton PB. Outcomes of endoscopy procedures: struggling towards definitions. *Gastrointest Endosc* 1994; 40: 514-518.
  12. Freeman ML. Complications of endoscopic sphincterotomy: a review. *Endoscopy* 1997; 29: 288-297.
  13. Cotton PB, Lehman G, Vennes J, et al. Endoscopic sphincterotomy complications and their management: an attempt at consensus. *Gastrointest Endosc* 1991; 37: 383-393.
  14. Gonzalez JJ, Sanz L, Grana JL, Bermejo G, Navarrete F, Martinez E. Biliary lithiasis in the elderly patient: morbidity and mortality due to biliary surgery. *Hepatogastroenterology* 1997; 44: 1565-1568.
  15. Siegel JH, Kasmin FE. Biliary tract diseases in the elderly: management and outcomes. *Gut* 1997; 41: 433-435.
  16. Hacker KA, Schultz CC, Helling TS. Cholelithotomy for calculous disease in the elderly. *Am J Surg* 1990; 160: 610-612.
  17. Provinciali M, Smorlesi A. Immunoprevention and immunotherapy of cancer in ageing. *Cancer Immunol Immunother* 2005; 54: 93-106.
  18. Novitsky YW, Czerniach DR, Kaban GK, et al. Immunologic effects of hand-assisted surgery on peritoneal macrophages: comparison to open and standard laparoscopic approaches. *Surgery* 2006; 139: 39-45.
  19. 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; 2: 979-983.
  20. Rodriguez-Gonzalez FJ, Naranjo-Rodriguez A, Mata-Tapia I, et al. ERCP in patients 90 years of age and older. *Gastrointest Endosc* 2003; 58: 220-225.
  21. Hui CK, Liu CL, Lai KC, et al. Outcome of emergency ERCP for acute cholangitis in patients 90 years of age and older. *Aliment Pharmacol Ther* 2004; 19: 1153-1158.
  22. Mitchell RM, O'Connor F, Dickey W. Endoscopic retrograde cholangiopancreatography is safe and effective in patients 90 years of age and older. *J Clin Gastroenterol* 2003; 36: 72-74.
  23. Katsinelos P, Paroutoglou G, Kountouras J, Zavos C, Beltsis A, Tzovaras G. Efficacy and safety of therapeutic ERCP in patients 90 years of age and older. *Gastrointest Endosc* 2006; 63: 417-423.
  24. Winslet MC, Neoptolemos JP. The place of endoscopy in the management of gallstones. *Baillieres Clin Gastroenterol* 1991; 5: 99-129.
  25. Cohen JR, Johnson H, Eaton S, Sterman H, Wise L. Surgical procedures in patients during the tenth decade of life. *Surgery* 1988; 104: 646-651.
  26. Tham TC, Kelly M. Association of periampullary duodenal diverticula with bile duct stones and with technical success of endoscopic retrograde cholangiopancreatography. *Endoscopy* 2004; 36: 1050-1053.
  27. Gandolfi L, Rossi A, Vaira D, Tonti R, Ramini R. Endoscopic retrograde cholangiopancreatography (ERCP) in the elderly. *Acta Gastroenterol Belg* 1986; 49: 602-607.
  28. Maxton DG, Tweedle DE, Martin DF. Retained common bile duct stones after endoscopic sphincterotomy: temporary and long term treatment with biliary stenting. *Gut* 1995; 36: 446-449.
  29. Chopra KB, Peters RA, O'Toole PA, et al. Randomised study of endoscopic biliary endoprosthesis versus duct clearance for bile duct stones in high-risk patients. *Lancet* 1996; 348: 791-793.
  30. Cass O. Long-term complications of endoscopic biliary sphincterotomy for choledocholithiasis. *Gastrointest Endosc* 1998; 48: 540-542.
  31. Harness JK, Strodel WE, Talsma SE. Symptomatic biliary disease in the elderly patient. *Am Surg* 1986; 52: 442-445.
  32. Targarona EM, Ayuso RM, Bordas JM, et al. Randomised trial of endoscopic sphincterotomy with gallbladder left in situ versus open surgery for common bile duct calculi in high-risk patients. *Lancet* 1996; 347: 926-929.
  33. Hammarstrom LE, Holmin T, Stridbeck H, Ihse I. Long-term follow up of a prospective randomized study of endoscopic versus surgical treatment of bile duct calculi in patients with gallbladder in situ. *Br J Surg* 1995; 82: 1516-1521.
  34. Tanaka M, Takahata S, Konomi H, et al. Long-term consequence of endoscopic sphincterotomy for bile duct stones. *Gastrointest Endosc* 1998; 48: 465-469.
  35. Schreurs WH, Vles WJ, Stuijbergen WH, Oostvogel HJ. Endoscopic management of common bile duct stones leaving the gallbladder in situ. A cohort study with long-term follow-up. *Dig Surg* 2004; 21: 60-64.