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Gallbladder Surgery, Choice of Technique: An Overview

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1. Introduction

The first cholecystectomy was performed by Langenbuch in 1882 (1), and the surgical approach changed very little in the next century. However, in the 1980s, reports began to appear that described the removal of the gallbladder through a 3-8 cm, muscle-sparing incision (small-incision cholecystectomy, or minicholecystectomy) (2-17). A few years later, laparoscopic cholecystectomy entered the scene (18, 19). These two minimally-invasive techniques have largely replaced the traditional open cholecystectomy, which used a 10 - 20 cm incision in elective gallbladder surgery (20). In 1993, a consensus conference at the National Institute of Health concluded that the experience of small-incision surgery or mini-laparotomy cholecystectomy was limited; and that laparoscopic cholecystectomy could be performed at a treatment cost that was equal to or slightly less than that of open cholecystectomy and offered substantial cost savings to the patient and society by reducing the time off work (21). The alternative to surgical removal of the gallbladder, lithotripsy combined with chemical dissolution of gallstones is restricted to single stone disease and runs a risk of stone recurrence (22, 23). However, it has been found to be associated with good long-term quality of life in selected patients (24).

The aim of this review is to discuss factors that influence the choice between cholecystectomy techniques, taking into account the applicability and cost of each technique.

2. Methods

We conducted a literature search, including a search of the Cochrane Library and PubMed (year 2010) with the keyword "cholecystectomy" and used the principles of evidence based medicine in the presentation of the findings (25-29).

3. Results and discussion

Cholelithiasis, the magnitude of the problem

The prevalence of cholelithiasis in European population is currently 10-15%, and it increases with age and female gender (30-33). Patients with cholelithiasis may be asymptomatic or symptomatic. Biliary colic is the only symptom specific to cholelithiasis (34). It is characterised by a high intensity, long duration pain located in the right upper abdominal quadrant; it can be referred, and often appears at night (35). Cholelithiasis may be

complicated by acute cholecystitis, common bile duct stones (with pancreatitis or jaundice), or fistula (32). Gallstone disease is the most common among all abdominal diseases that lead to hospital care in the Western world (36); recently, an increase of hospital admissions for gallstone disease has been observed in England (37). This has made gallstone disease a health care problem with considerable economic consequences; moreover, this problem will most likely increase with increases in population age (38). The annual direct cost in the United States has been estimated to be approximately six billion USD (39, 40). No randomised controlled trials have favoured operative treatment of asymptomatic patients with cholelithiasis (41). A wait-and-see management approach may also be adopted for symptomatic patients with uncomplicated disease (42), particularly those with atypical symptoms (43). With the introduction of the laparoscopic technique, the cholecystectomy incidence increased substantially (15 – 80%) in Europe (38, 44, 45), Canada (46), the United States (47, 48), and Saudi-Arabia (49).

Comments on cholecystectomy techniques

Details of the laparoscopic technique (Figure 1) are readily available to any trainee and will not be discussed here. Essential equipment for small-incision cholecystectomy include



Fig. 1. Laparoscopic cholecystectomy with trainee (right). Consultant surgeon and nurse closely follow the operation.

Harrington-type retractors, headlamps, and magnification loops (Figure 2) (14). Briefly, the incision is performed over the right rectus muscle, two to three fingers below the xiphoid process (Figure 3) (10, 14). The anterior and the posterior rectus sheath are divided. The

rectus muscle is left intact, but one or two cm may be divided medially. Intra-abdominal dissection is initiated at the triangle of Calot, although in patients with inflammation, a “fundus down” dissection may be advantageous. Before wound closure, a local anaesthetic agent is administered liberally in the rectus muscle compartment as well as subcutaneously. The rectus sheaths are sutured with non-absorbable suture and the subcutaneous layer with absorbable suture. When an extension of the incision must be performed in small-incision cholecystectomy, the incision is rarely extended lateral to the rectus muscle. Conversion from laparoscopic to open cholecystectomy typically requires a traditional 10 – 20 cm subcostal incision through the rectus muscle, the oblique muscles, and the transverse muscle, with the risk of causing denervation injury and subsequent incisional hernia.



Fig. 2. Headlights and x2.5 magnification loops are necessary for performing a safe small-incision cholecystectomy.

Minimally-invasive techniques and day-case surgery

Both small-incision cholecystectomy (6, 7, 14, 17, 50-52) and laparoscopic cholecystectomy (50, 52-56) are compatible with ambulatory surgery. A Cochrane review has considered laparoscopic day-case surgery safe and effective for selected patients with symptomatic cholelithiasis (57).

Randomised controlled trials that compared open cholecystectomy, small-incision cholecystectomy, and laparoscopic cholecystectomy

Cochrane reviews demonstrate that small-incision and laparoscopic cholecystectomy should be considered equivalent with respect to complications and recovery, but the small-incision

cholecystectomy requires a shorter operation time (58). However, trials with large numbers of patients are necessary to determine potential differences in serious adverse events (59). Open cholecystectomy is associated with a longer hospital stay than the two minimally-invasive techniques (58). One randomised controlled trial concluded that small-incision cholecystectomy was also suitable for obese patients (17). Patient opinion of the cosmetic outcome of surgery did not differ significantly between small-incision and laparoscopic cholecystectomy one year after surgery (60). For both groups, the median value concerning patient views of the scar was 1 on a scale of 1 to 10, where 1= does not bother me at all, and 10=very disturbing. To judge the external validity of conclusions reached in randomised controlled trials, it is necessary to know outcomes for non-randomised patients treated at the units that participated in the trial. In one trial that compared the two minimally-invasive cholecystectomy techniques, the patients that received operations, but were excluded from the trials were older and tended to have more advanced disease (higher ASA-scores, more co-morbidities, more complications from gallstone disease) than the patients included in the trials (61).



Fig. 3. Place for small-incision cholecystectomy. The incision is 6 -7 cm long, located over the right rectus muscle, 2 - 3 fingers below the xiphoid process (to the right). The costal margins are indicated by dots.

Cholecystectomy techniques from a population based perspective

In Sweden, laparoscopy has been the predominant cholecystectomy technique since 1993 (Sandzén et al, unpublished). From 2000 through 2003, 28% of patients who underwent

cholecystectomy for benign, biliary diseases in Sweden had their operations completed as open procedures (62). Those patients showed a higher likelihood of having an acute admission and a complicated gallstone disease compared to patients that underwent laparoscopic cholecystectomy. They also had a higher mortality than expected, considering age and sex of the background population, both within 90 days of admission for cholecystectomy and 91-365 days postoperatively, indicating that these patients were sicker than the Swedish population in general. This suggested that efforts should be undertaken to reduce the surgical trauma in open biliary surgery (62). In the United States, 25% of all cholecystectomies were performed as open operations from 1998-2001, and 5-10% of laparoscopic cholecystectomies were converted to open operations (63). In Scotland, an audit reported that the open technique for gallbladder surgery was used in 11.4% of all cholecystectomies (4.0% primary and 7.4% converted laparoscopic) and concluded that also in the 2000s, open cholecystectomy is a common procedure with limited room in current trainee programs (64). Similar conclusions have been drawn from studies in the United States (65-67). Training programs for open cholecystectomy and common bile duct procedures have been considered necessary (68).

Population based studies have demonstrated that the incidence of bile duct injuries has increased after the introduction of laparoscopic cholecystectomy (69). In Sweden, there was a small to moderate long-term increase in the risk of bile duct injury after introduction of the laparoscopic technique compared to the prelaparoscopic era (70). This may be an underestimation of the real change, as the majority of bile duct injuries may be treated without reconstructive surgery today (71).

Cholecystectomy for complicated gallstone disease

The cholecystectomy technique should be chosen based on the particular type of gallstone complication in order to achieve smooth, early, definitive treatment. The complications include acute cholecystitis, common bile duct stones, and acute biliary pancreatitis.

For acute cholecystitis, an early randomised controlled trial showed that small-incision cholecystectomy was safe, reliable, and had advantages compared to traditional open cholecystectomy (72). Another randomised controlled trial found no clinically significant differences between traditional open cholecystectomy and laparoscopic cholecystectomy (73). Observational series have demonstrated that both small-incision (74) and laparoscopic cholecystectomy (75-79) are suitable for treating acute cholecystitis. According to meta-analyses, an early operation (open or laparoscopic) does not carry a higher risk of mortality or morbidity compared to delayed surgery, and therefore, should be the preferred treatment (80, 81). This is also applicable to older patients (81, 82). Laparoscopic cholecystectomy for acute cholecystitis, whether performed early or delayed, is associated with a higher conversion rate compared to elective cholecystectomy (81). In England, 40% of patients with acute gallbladder disease had an open operation (converted laparoscopic or traditional open cholecystectomy) (83). In Denmark, in 2004, 36% of cholecystectomies for acute cholecystitis were completed as open procedures (84). In Sweden, from 1995 through 1999, 68% of patients aged 70 years and older had open operations for acute cholecystitis (85).

Concomitant removal of common bile duct stones via choledochotomy can be successfully performed with open cholecystectomy (86), small-incision cholecystectomy (87), or laparoscopic cholecystectomy (88-90). According to a Cochrane review, choledochotomy is superior to endoscopic sphincterotomy for bile duct clearance in open gallbladder surgery. In contrast, laparoscopic choledochotomy and endoscopic sphincterotomy are equally

effective in the short term, although the latter alternative requires an increased number of procedures (91). In laparoscopic surgery, endoscopic sphincterotomy is the method preferred by most surgeons for common bile duct clearance (37, 66, 92). However, laparoscopic choledochotomy and transcystic common bile duct exploration (93) with concomitant cholecystectomy are achievable, effective alternatives. Long-term observational studies have shown that, following endoscopic sphincterotomy, there is a risk of infection, gallstone formation, pancreatitis (94-98), and biliary carcinoma (96). After endoscopic retrograde cholangiopancreatography (ERCP), a prerequisite for sphincterotomy, there is an increased risk for cancer in bile ducts, liver, and pancreas compared to the background population (99). A Cochrane review indicated that patients with gallbladder *in situ* should be offered a cholecystectomy following common bile duct stone removal, provided they are fit for surgery (100). An observational study recommended a cholecystectomy within one week of sphincterotomy (101). Further randomised controlled trials are necessary to assess the benefits and risks of T-tube versus primary closure after both open (102) and laparoscopic common bile duct exploration (103, 104).

In acute pancreatitis, an early etiological diagnosis (<48 h after admission) is recommended, and in mild and moderate acute pancreatitis of biliary origin, an early cholecystectomy is recommended (105-109). In acute biliary pancreatitis without cholangitis, early ERCP does not lead to a significant reduction of complications or mortality (110). Deviations from these recommendations are common (111-117). However, a recent audit demonstrated that it is possible to follow the guidelines for acute biliary pancreatitis with a low associated mortality (118). According to one randomised trial (119) and other observational studies, in acute biliary pancreatitis, an early cholecystectomy can shorten the hospital stay (120, 121) and reduce the risk for recurrent pancreatitis (122) compared to a delayed operation.

Health care costs

An early randomised controlled trial concluded that hospital costs were higher for small-incision cholecystectomy than for laparoscopic cholecystectomy (123); in one trial no significant difference was found between the two methods (124). However, in all other randomised controlled trials, health care costs were found to be lower for small-incision compared to laparoscopic cholecystectomy also when re-usable laparoscopic instruments were used (125-129). In a cost-minimising analysis, small-incision cholecystectomy appeared to be more cost-effective than laparoscopic cholecystectomy, both from hospital and societal perspectives (130). To our knowledge, no formal systematic review has compared the costs of small-incision cholecystectomy and laparoscopic cholecystectomy. However, in a recent overview of Cochrane reviews, it was concluded that small-incision cholecystectomy "seems to be less costly" (58). Observational studies have supported that view (14-16). In laparoscopic surgery, endoscopic sphincterotomy is associated with a longer hospital stay (131) and is more costly than choledochotomy (132, 133). Health care costs are ultimately determined by more factors than the surgical technique used. Factors that modify the response to surgical trauma, including the use of steroids, use of ondansetron, or liberal administration of fluid (134-141), advice to patients concerning pain medication and postoperative activity may affect convalescence, return to work, and finally, the societal cost for cholecystectomy (142). Long-term costs for cholecystectomy should include costs for repair of abdominal wall hernias following large, subcostal incisions (Figure 4). Finally, overall costs for surgical training should take into account the costs for two learning curves for laparoscopic trainees (laparoscopic cholecystectomy and open cholecystectomy in case of

conversion) versus one curve for minicholecystectomy trainees (small-incision cholecystectomy with extended incision when needed).

Medical ethics and cholecystectomy technique

Non-maleficence, beneficence, respect for autonomy, and justice are the cornerstones of principle-based medical ethics (143). Respect for autonomy involves providing evidence based information on the risks (including conversion/extended incision) and benefits of surgery in elective and emergency settings (144). Justice involves the fair distribution of resources among individuals in need of health care. External factors may affect the practice of justice (145). However, within the limits set by stakeholders, the health care system and the surgeon must always consider the cost-effectiveness of surgical care (146).



Fig. 4. Patient with a large abdominal wall hernia following subcostal incision in converted laparoscopic cholecystectomy.

4. Conclusions

Traditional open cholecystectomy is associated with a longer recovery than small-incision and laparoscopic cholecystectomy. To make a scientific evidence-based choice between small-incision cholecystectomy and laparoscopic cholecystectomy, surgeons and health care providers must scrutinize the evidence from randomised controlled trials and from defined populations, and they must consider the applicability of the techniques to their own setting. Conclusions reached may have a profound effect on costs and surgical training.

5. References

- [1] Langenbuch C. Ein Fall von Extirpation der Gallenblase wegen chronischer Cholelithiasis: Heilung. *Berliner Klin Wochenschr.* 1882;19:725-7.
- [2] Dubois F, Berthelot B. [Cholecystectomy through minimal incision (author's transl)]. *La Nouvelle presse medicale.* 1982 Apr 3;11(15):1139-41.
- [3] Goco IR, Chambers LG. "Mini-cholecystectomy" and operative cholangiography. A means of cost containment. *American Surgeon.* 1983;49:143-5.
- [4] Morton CE. Cost containment with the use of "mini-cholecystectomy" and intraoperative cholangiography. *American Surgeon.* 1985;51:168-9.
- [5] Salembier Y. [Cholecystectomy through a short transverse incision]. *Presse Med.* 1986 Feb 8;15(5):210-1.
- [6] Moss G. Discharge within 24 hours of elective cholecystectomy. The first 100 patients. *Arch Surg.* 1986 Oct;121(10):1159-61.
- [7] Ledet WP, Jr. Ambulatory cholecystectomy without disability. *Arch Surg.* 1990 Nov;125(11):1434-5.
- [8] Pelissier EP, Blum D, Meyer JM, Girard JF. Cholecystectomy by minilaparotomy without muscle section: a short-stay procedure. *Hepatogastroenterology.* 1992 Aug;39(4):294-5.
- [9] Assalia A, Schein M, Kopelman D, Hashmonai M. Minicholecystectomy vs conventional cholecystectomy: a prospective randomized trial--implications in the laparoscopic era. *World J Surg.* 1993 Nov-Dec;17(6):755-9.
- [10] Tyagi NS, Meredith MC, Lumb JC, Cacdac RG, Vanterpool CC, Rayls KR, et al. A new minimally invasive technique for cholecystectomy. Subxiphoid "minimal stress triangle": microceliotomy. *Ann Surg.* 1994 Nov;220(5):617-25.
- [11] Belli G, Romano G, D'Agostino A, Iannelli A. Minilaparotomy with rectus muscle sparing: a personal technique for cholecystectomy. *Giorn Chir.* 1996;17(5):283-4.
- [12] Daou R. [Cholecystectomy using a minilaparotomy]. *Ann Chir.* 1998;52(7):625-8.
- [13] Sharma AK, Rangan HK, Choubey RP. Mini-lap cholecystectomy: a viable alternative to laparoscopic cholecystectomy for the Third World? *The Australian and New Zealand journal of surgery.* 1998 Nov;68(11):774-7.
- [14] Seale AK, Ledet WP, Jr. Minicholecystectomy: a safe, cost-effective day surgery procedure. *Arch Surg.* 1999 Mar;134(3):308-10.
- [15] Oyogoa SO, Komenaka IK, Ilkhani R, Wise L. Mini-laparotomy cholecystectomy in the era of laparoscopic cholecystectomy: a community-based hospital perspective. *Am Surg.* 2003 Jul;69(7):604-7.
- [16] Syrakos T, Antonitsis P, Zacharakis E, Takis A, Manousari A, Bakogiannis K, et al. Small-incision (mini-laparotomy) versus laparoscopic cholecystectomy: a retrospective study in a university hospital. *Langenbecks Arch Surg.* 2004 Jun;389(3):172-7.
- [17] Harju J, Juvonen P, Eskelinen M, Miettinen P, Paakkonen M. Minilaparotomy cholecystectomy versus laparoscopic cholecystectomy: a randomized study with special reference to obesity. *Surg Endosc.* 2006 Apr;20(4):583-6.
- [18] Mühe E. Die erste Cholecystectomie durch das laparoskop. . *Langenbecks Arch Chir.* 1986;369.
- [19] Dubois F, Berthelot G, Levard H. (Cholecystectomy by coelioscopy (see comments)]. *Presse Med.* 1989;18:980-2.

- [20] Roslyn JJ, Binns GS, Hughes EF, Saunders-Kirkwood K, Zinner MJ, Cates JA. Open cholecystectomy. A contemporary analysis of 42,474 patients. *Ann Surg.* 1993 Aug;218(2):129-37.
- [21] NIH Consensus conference. Gallstones and laparoscopic cholecystectomy. *JAMA.* 1993 Feb 24;269:1018-24.
- [22] Plaisier PW, van der Hul RL, Nijs HG, den Toom R, Terpstra OT, Bruining HA. The course of biliary and gastrointestinal symptoms after treatment of uncomplicated symptomatic gallstones: results of a randomized study comparing extracorporeal shock wave lithotripsy with conventional cholecystectomy. *Am J Gastroenterol.* 1994 May;89(5):739-44.
- [23] Plaisier PW, van der Hul RL, den Toom R, Nijs HG, Terpstra OT, Bruining HA. Gallstone lithotripsy: the Rotterdam experience. *Hepatogastroenterology.* 1994 Jun;41(3):260-2.
- [24] Carrilho-Ribeiro L, Serra D, Pinto-Correia A, Velosa J, De Moura MC. Quality of life after cholecystectomy and after successful lithotripsy for gallbladder stones: a matched-pairs comparison. *Eur J Gastroenterol Hepatol.* 2002 Jul;14(7):741-4.
- [25] www.cebm.net/index.aspx?o=1025. [11 Februaury 2011].
- [26] Atkins D, Best D, Briss PA, Eccles M, Falck-Ytter Y, Flottorp S, et al. Grading quality of evidence and strength of recommendations. *Bmj.* 2004 Jun 19;328(7454):1490.
- [27] Guyatt GH, Rennie D, Meade M, Cook D. *Users' Guides to the Medical Literature: essentials of Evidence-Based Clinical Practice.* 2nd ed: McGraw-Hill. Professional, 2008; 2008.
- [28] Drummond MF, Sculpher MJ, Torrance GW, O'Brien BJ, Torrance GW. *Methods for the economic evaluation of health care programmes.* Oxford: Oxford University Press; 2005.
- [29] Maier RV. What the surgeon of tomorrow needs to know about evidence-based surgery. *Arch Surg.* 2006 Mar;141(3):317-23.
- [30] Jorgensen T. Prevalence of gallstones in a Danish population. *Am J Epidemiol.* 1987 Nov;126(5):912-21.
- [31] Attili AF, Carulli N, Roda E, Barbara B, Capocaccia L, Menotti A, et al. Epidemiology of gallstone disease in Italy: prevalence data of the Multicenter Italian Study on Cholelithiasis (M.I.COL.). *Am J Epidemiol.* 1995 Jan 15;141(2):158-65.
- [32] Jorgensen T. *Treatment of gallstone patients.* Copenhagen: National Institute of Public Health, Denmark, and Danish Institute for Health Technology Assessment; 2000.
- [33] Portincasa P, Moschetta A, Palasciano G. Cholesterol gallstone disease. *The Lancet.* 2006;368.:230-9.
- [34] Berger MY, van der Velden JJ, Lijmer JG, de Kort H, Prins A, Bohnen AM. Abdominal symptoms: do they predict gallstones? A systematic review. *Scandinavian journal of gastroenterology.* 2000 Jan;35(1):70-6.
- [35] Berhane T, Vetrhus M, Hausken T, Olafsson S, Sondena K. Pain attacks in non-complicated and complicated gallstone disease have a characteristic pattern and are accompanied by dyspepsia in most patients: the results of a prospective study. *Scandinavian journal of gastroenterology.* 2006 Jan;41(1):93-101.
- [36] Beckingham IJ, Krige JE. ABC of diseases of liver, pancreas, and biliary system: Liver and pancreatic trauma. *BMJ.* 2001 Mar 31;322(7289):783-5.

- [37] Kang JY, Ellis C, Majeed A, Hoare J, Tinto A, Williamson RC, et al. Gallstones--an increasing problem: a study of hospital admissions in England between 1989/1990 and 1999/2000. *Aliment Pharmacol Ther.* 2003 Feb 15;17(4):561-9.
- [38] Aerts R, Penninckx F. The burden of gallstone disease in Europe. *Aliment Pharmacol Ther.* 2003 Nov;18 Suppl 3:49-53.
- [39] Sandler RS, Everhart JE, Donowitz M, Adams E, Cronin K, Goodman C, et al. The burden of selected digestive diseases in the United States. *Gastroenterology.* 2002 May;122(5):1500-11.
- [40] Shaffer EA. Gallstone disease: Epidemiology of gallbladder stone disease. *Best Pract Res Clin Gastroenterol.* 2006;20(6):981-96.
- [41] Gurusamy KS, Samraj K. Cholecystectomy versus no cholecystectomy in patients with silent gallstones. *Cochrane Database Syst Rev.* 2007(1):CD006230.
- [42] Festi D, Reggiani ML, Attili AF, Loria P, Pazzi P, Scaioli E, et al. Natural history of gallstone disease: Expectant management or active treatment? Results from a population-based cohort study. *Journal of gastroenterology and hepatology.* 2010 Apr;25(4):719-24.
- [43] Halldestam I, Kullman E, Borch K. Defined indications for elective cholecystectomy for gallstone disease. *The British journal of surgery.* 2008 May;95(5):620-6.
- [44] Lam CM, Murray FE, Cuschieri A. Increased cholecystectomy rate after the introduction of laparoscopic cholecystectomy in Scotland. *Gut.* 1996;38:282-4.
- [45] Mjåland O, Adamsen S, Hjelmqvist B, Ovaska J, Buanes T. Cholecystectomy rates, gallstone prevalence, and handling of bile duct injuries in Scandinavia. *Surgical Endoscopy.* 1998;12:1386-9.
- [46] Cohen MM, Young W, Thriault ME, Hernandez R. Has laparoscopic cholecystectomy changed patterns of practice and patient outcome in Ontario? *Canadian Medical Association Journal.* 1996;154(4):491-500.
- [47] Steiner CA, Bass EB, Talamini MA, Pitt HA, Steinberg EP. Surgical rates and operative mortality for open and laparoscopic cholecystectomy in Maryland. *The New England Journal of Medicine.* 1994;330:403-8.
- [48] Legorreta AP, Silber JH, Costantino GN, Kobylinski RW, Zatz SL. Increased cholecystectomy rate after the introduction of laparoscopic cholecystectomy. *JAMA.* 1993;270(12):1429-32.
- [49] Al-Mulhim AA, Al-Ali AA, Albar AA, Bahnassy AA, Abdelhadi M, Wosornu L, et al. Increased rate of cholecystectomy after introduction of laparoscopic cholecystectomy in Saudi Arabia. *World J Surg.* 1999 May;23(5):458-62.
- [50] Saltzstein EC, Mercer LC, Peacock JB, Daugherty SH. Outpatient open cholecystectomy. *Surgery, Gynecology & Obstetrics.* 1992;174:173-5.
- [51] Amjad N, Fazal A. Mini cholecystectomy now a day stay surgery: anaesthetic management with multi modal analgesia. *J Pak Med Ass.* 2002;52:291-5.
- [52] Harju J, Kokki H, Paakkonen M, Karjalainen K, Eskelinen M. Feasibility of minilaparotomy versus laparoscopic cholecystectomy for day surgery: a prospective randomised study. *Scand J Surg.* 2010;99(3):132-6.
- [53] Arregui ME, Davis CJ, Arkush A, Nagan RF. In selected patients outpatient laparoscopic cholecystectomy is safe and significantly reduces hospitalization charges. *Surg Laparoscop Endoscop.* 1991;1:240-5.

- [54] Richardson WS, Fuhrman GS, Burch E, Bolton JS, Bowen JC. Outpatient laparoscopic cholecystectomy. Outcomes of 847 planned procedures. *Surg Endoscop.* 2001; 15: 193-5.
- [55] Vagenas K, Spyrapopoulos P, Karanikolas M, Sakelaropoulos G, Maroulis I, Karavias D. Mini-laparotomy cholecystectomy versus laparoscopic cholecystectomy: which way to go? *Surg Laparosc Endosc Percutan Tech.* 2006 Oct;16(5):321-4.
- [56] Victorzon M, Tolonen P, Vuorialho T. Day-case laparoscopic cholecystectomy: treatment of choice for selected patients? *Surg Endosc.* 2007 Jan;21(1):70-3.
- [57] Gurusamy KS, Junnarkar S, Farouk M, Davidson BR. Day-case versus overnight stay in laparoscopic cholecystectomy. *Cochrane Database Syst Rev.* 2008(1):CD006798.
- [58] Keus F, Gooszen HG, van Laarhoven CJ. Open, small-incision, or laparoscopic cholecystectomy for patients with symptomatic cholecystolithiasis. An overview of Cochrane Hepato-Biliary Group reviews. *Cochrane Database Syst Rev.* 2010(1):CD008318.
- [59] Keus F, Wetterslev J, Gluud C, Gooszen HG, van Laarhoven CJ. Trial sequential analyses of meta-analyses of complications in laparoscopic vs. small-incision cholecystectomy: more randomized patients are needed. *J Clin Epidemiol.* 2009 Dec 9.
- [60] Ros A, Nilsson E. Abdominal pain and patient overall and cosmetic satisfaction one year after cholecystectomy: outcome of a randomized trial comparing laparoscopic and minilaparotomy cholecystectomy. *Scandinavian journal of gastroenterology.* 2004 Aug;39(8):773-7.
- [61] Ros A, Carlsson P, Rahmqvist M, Backman K, Nilsson E. Non-randomised patients in a cholecystectomy trial: characteristics, procedures, and outcomes. *BMC Surg.* 2006;6:17.
- [62] Rosenmuller M, Haapamaki MM, Nordin P, Stenlund H, Nilsson E. Cholecystectomy in Sweden 2000-2003: a nationwide study on procedures, patient characteristics, and mortality. *BMC Gastroenterol.* 2007;7:35.
- [63] Livingston EH, Rege RV. A nationwide study of conversion from laparoscopic to open cholecystectomy. *Am J Surg.* 2004 Sep;188(3):205-11.
- [64] Jenkins PJ, Paterson HM, Parks RW, Garden OJ. Open cholecystectomy in the laparoscopic era. *The British journal of surgery.* 2007 Nov;94(11):1382-5.
- [65] Chung RS, Wojtasik L, Pham Q, Chari V, Chen P. The decline of training in open biliary surgery: effect on the residents' attitude toward bile duct surgery. *Surg Endosc.* 2003 Feb;17(2):338-40; discussion 41.
- [66] Livingston EH, Rege RV. Technical complications are rising as common duct exploration is becoming rare. *J Am Coll Surg.* 2005 Sep;201(3):426-33.
- [67] Chung RS, Ahmed N. The impact of minimally invasive surgery on residents' open operative experience: analysis of two decades of national data. *Ann Surg.* 2010 Feb;251(2):205-12.
- [68] Schulman CI, Levi J, Sleeman D, Dunkin B, Irvin G, Levi D, et al. Are we training our residents to perform open gall bladder and common bile duct operations? *The Journal of surgical research.* 2007 Oct;142(2):246-9.
- [69] Connor S, Garden OJ. Bile duct injury in the era of laparoscopic cholecystectomy. *British Journal of Surgery.* 2006;93:158-68.

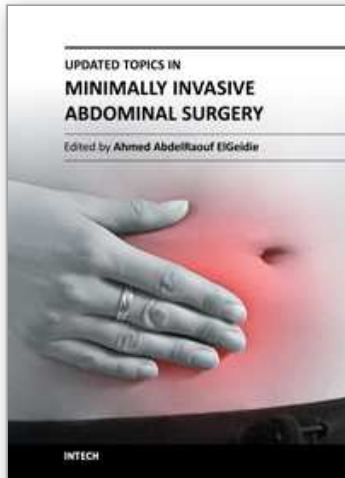
- [70] Waage A, Nilsson M. Iatrogenic bile duct injury: a population-based study of 152 776 cholecystectomies in the Swedish Inpatient Registry. *Arch Surg*. 2006 Dec;141(12):1207-13.
- [71] de Reuver PR, Grossmann I, Busch OR, Obertop H, van Gulik TM, Gouma DJ. Referral pattern and timing of repair are risk factors for complications after reconstructive surgery for bile duct injury. *Ann Surg*. 2007 May; 245 (5):763-70.
- [72] Assalia A, Kopelman D, Hashmonai M. Emergency minilaparotomy cholecystectomy for acute cholecystitis: prospective randomized trial--implications for the laparoscopic era. *World J Surg*. 1997 Jun;21(5):534-9.
- [73] Johansson M, Thune A, Nelvin L, Stiernstam M, Westman B, Lundell L. Randomized clinical trial of open versus laparoscopic cholecystectomy in the treatment of acute cholecystitis. *The British journal of surgery*. 2005 Jan;92(1):44-9.
- [74] Watanapa P. Mini-cholecystectomy: a personal series in acute and chronic cholecystitis. *HPB (Oxford)*. 2003;5(4):231-4.
- [75] Koo KP, Thirlby RC. Laparoscopic cholecystectomy in acute cholecystitis. What is the optimal timing for operation? *Arch Surg*. 1996 May;131(5):540-4; discussion 4-5.
- [76] Peng WK, Sheikh Z, Nixon SJ, Paterson-Brown S. Role of laparoscopic cholecystectomy in the early management of acute gallbladder disease. *The British journal of surgery*. 2005 May;92(5):586-91.
- [77] Wiseman JT, Sharuk MN, Singla A, Cahan M, Litwin DE, Tseng JF, et al. Surgical management of acute cholecystitis at a tertiary care center in the modern era. *Arch Surg*. 2010 May;145(5):439-44.
- [78] Young AL, Cockbain AJ, White AW, Hood A, Menon KV, Toogood GJ. Index admission laparoscopic cholecystectomy for patients with acute biliary symptoms: results from a specialist centre. *HPB (Oxford)*. 2010 May;12(4):270-6.
- [79] Sanjay P, Moore J, Saffouri E, Ogston SA, Kulli C, Polignano FM, et al. Index laparoscopic cholecystectomy for acute admissions with cholelithiasis provides excellent training opportunities in emergency general surgery. *Surgeon*. 2010 Jun;8(3):127-31.
- [80] Papi C, Catarci M, D'Ambrosio L, Gili L, Koch M, Grassi GB, et al. Timing of cholecystectomy for acute calculous cholecystitis: a meta-analysis. *Am J Gastroenterol*. 2004 Jan;99(1):147-55.
- [81] Gurusamy K, Samraj K, Gluud C, Wilson E, Davidson BR. Meta-analysis of randomized controlled trials on the safety and effectiveness of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *The British journal of surgery*. 2010 Feb;97(2):141-50.
- [82] Riall TS, Zhang D, Townsend CM, Jr., Kuo YF, Goodwin JS. Failure to perform cholecystectomy for acute cholecystitis in elderly patients is associated with increased morbidity, mortality, and cost. *J Am Coll Surg*. 2010 May;210(5):668-77, 77-9.
- [83] David GG, Al-Sarira AA, Willmott S, Deakin M, Corless DJ, Slavin JP. Management of acute gallbladder disease in England. *The British journal of surgery*. 2008 Apr;95(4):472-6.
- [84] Ainsworth AP, Adamsen S, Rosenberg J. Surgery for acute cholecystitis in Denmark. *Scandinavian journal of gastroenterology*. 2007 May;42(5):648-51.

- [85] Nilsson E, Fored CM, Granath F, Blomqvist P. Cholecystectomy in Sweden 1987-99: a nationwide study of mortality and preoperative admissions. *Scandinavian journal of gastroenterology*. 2005 Dec;40(12):1478-85.
- [86] Roukema JA, Carol EJ, Liem F, Jakimowicz JJ. A retrospective study of surgical common bile-duct exploration: ten years experience. *Neth J Surg*. 1986 Feb;38(1):11-4.
- [87] Seale AK, Ledet WP, Jr. Primary common bile duct closure. *Arch Surg*. 1999 Jan;134(1):22-4.
- [88] Martin IJ, Bailey IS, Rhodes M, O'Rourke N, Nathanson L, Fielding G. Towards T-tube free laparoscopic bile duct exploration: a methodologic evolution during 300 consecutive procedures. *Ann Surg*. 1998 Jul;228(1):29-34.
- [89] Tokumura H, Umezawa A, Cao H, Sakamoto N, Imaoka Y, Ouchi A, et al. Laparoscopic management of common bile duct stones: transcystic approach and choledochotomy. *J Hepatobiliary Pancreat Surg*. 2002;9(2):206-12.
- [90] Decker G, Borie F, Millat B, Berthou JC, Deleuze A, Drouard F, et al. One hundred laparoscopic choledochotomies with primary closure of the common bile duct. *Surg Endosc*. 2003 Jan;17(1):12-8.
- [91] Martin DJ, Vernon DR, Toouli J. Surgical versus endoscopic treatment of bile duct stones. *Cochrane Database Syst Rev*. 2006(2):CD003327.
- [92] Hüttl TP, Hrdina C, Geiger TK, Meyer G, Schildberg FW, Krämling HJ. Management of common bile duct stones - Results of a nationwide survey with analysis of 8 433 common bile duct explorations in Germany. *Zentralblatt für Chirurgie*. 2002;127:282-8.
- [93] Paganini AM, Guerrieri M, Sarnari J, De Sanctis A, D'Ambrosio G, Lezoche G, et al. Thirteen years' experience with laparoscopic transcystic common bile duct exploration for stones. Effectiveness and long-term results. *Surg Endosc*. 2007 Jan;21(1):34-40.
- [94] Bergman JJ, van der Mey S, Rauws EA, Tijssen JG, Gouma DJ, Tytgat GN, et al. Long-term follow-up after endoscopic sphincterotomy for bile duct stones in patients younger than 60 years of age. *Gastrointest Endosc*. 1996 Dec;44(6):643-9.
- [95] Sugiyama M, Atomi Y. Follow-up of more than 10 years after endoscopic sphincterotomy for choledocholithiasis in young patients. *The British journal of surgery*. 1998 Jul;85(7):917-21.
- [96] Tanaka M, Takahata S, Konomi H, Matsunaga H, Yokohata K, Takeda T, et al. Long-term consequence of endoscopic sphincterotomy for bile duct stones. *Gastrointest Endosc*. 1998 Nov;48(5):465-9.
- [97] Rolny P, Andren-Sandberg A, Falk A. Recurrent pancreatitis as a late complication of endoscopic sphincterotomy for common bile duct stones: diagnosis and therapy. *Endoscopy*. 2003 Apr;35(4):356-9.
- [98] Mandryka Y, Klimczak J, Duszewski M, Kondras M, Modzelewski B. [Bile duct infections as a late complication after endoscopic sphincterotomy]. *Pol Merkur Lekarski*. 2006 Dec;21(126):525-7.
- [99] Stromberg C, Luo J, Enochsson L, Arnelo U, Nilsson M. Endoscopic sphincterotomy and risk of malignancy in the bile ducts, liver, and pancreas. *Clin Gastroenterol Hepatol*. 2008 Sep;6(9):1049-53.
- [100] McAlister VC, Davenport E, Renouf E. Cholecystectomy deferral in patients with endoscopic sphincterotomy. *Cochrane Database Syst Rev*. 2007(4):CD006233.

- [101] Schiphorst AH, Besselink MG, Boerma D, Timmer R, Wiezer MJ, van Erpecum KJ, et al. Timing of cholecystectomy after endoscopic sphincterotomy for common bile duct stones. *Surg Endosc.* 2008 Sep;22(9):2046-50.
- [102] Gurusamy KS, Samraj K. Primary closure versus T-tube drainage after open common bile duct exploration. *Cochrane Database Syst Rev.* 2007(1):CD005640.
- [103] Gurusamy KS, Samraj K. Primary closure versus T-tube drainage after laparoscopic common bile duct stone exploration. *Cochrane Database Syst Rev.* 2007(1):CD005641.
- [104] Leida Z, Ping B, Shuguang W, Yu H. A randomized comparison of primary closure and T-tube drainage of the common bile duct after laparoscopic choledochotomy. *Surg Endosc.* 2008 Jul;22(7):1595-600.
- [105] Uhl W, Warshaw A, Imrie C, Bassi C, McKay CJ, Lankisch PG, et al. IAP Guidelines for the Surgical Management of Acute Pancreatitis. *Pancreatology.* 2002;2(6):565-73.
- [106] UK guidelines for the management of acute pancreatitis. *Gut.* 2005;54(Suppl 3):1-9.
- [107] Banks PA, Freeman ML. Practice guidelines in acute pancreatitis. *Am J Gastroenterol.* 2006 Oct; 101(10):2379-400.
- [108] Taylor E, Wong C. The optimal timing of laparoscopic cholecystectomy in mild gallstone pancreatitis. *Am Surg.* 2004 Nov;70(11):971-5.
- [109] Kimura Y, Arata S, Takada T, Hirata K, Yoshida M, Mayumi T, et al. Gallstone-induced acute pancreatitis. *J Hepatobiliary Pancreat Sci.* 2010 Jan;17(1):60-9.
- [110] Petrov MS, van Santvoort HC, Besselink MG, van der Heijden GJ, van Erpecum KJ, Gooszen HG. Early Endoscopic Retrograde Cholangiopancreatography Versus Conservative Management in Acute Biliary Pancreatitis Without Cholangitis: A Meta-Analysis of Randomized Trials. *Ann Surg.* 2008 Feb;247(2):250-7.
- [111] Toh SK, Phillips S, Johnson CD. A prospective audit against national standards of the presentation and management of acute pancreatitis in the South of England. *Gut.* 2000 Feb;46(2):239-43.
- [112] Hernandez V, Pascual I, Almela P, Anon R, Herreros B, Sanchiz V, et al. Recurrence of acute gallstone pancreatitis and relationship with cholecystectomy or endoscopic sphincterotomy. *Am J Gastroenterol.* 2004 Dec;99(12):2417-23.
- [113] Lankisch PG, Weber-Dany B, Lerch MM. Clinical perspectives in pancreatology: compliance with acute pancreatitis guidelines in Germany. *Pancreatology.* 2005;5(6):591-3.
- [114] Pezzilli R, Uomo G, Gabbrielli A, Zerbi A, Frulloni L, De Rai P, et al. A prospective multicentre survey on the treatment of acute pancreatitis in Italy. *Dig Liver Dis.* 2007 Sep;39(9):838-46.
- [115] Al-Haddad M, Raimondo M. Management of acute pancreatitis in view of the published guidelines: are we compliant enough? *Dig Liver Dis.* 2007 Sep; 39 (9): 847-8.
- [116] Sandzen B, Haapamaki MM, Nilsson E, Stenlund HC, Oman M. Cholecystectomy and sphincterotomy in patients with mild acute biliary pancreatitis in Sweden 1988 - 2003: a nationwide register study. *BMC Gastroenterol.* 2009;9:80.
- [117] Nguyen GC, Boudreau H, Jagannath SB. Hospital volume as a predictor for undergoing cholecystectomy after admission for acute biliary pancreatitis. *Pancreas.* 2010 Jan;39(1):e42-7.

- [118] Mofidi R, Madhavan KK, Garden OJ, Parks RW. An audit of the management of patients with acute pancreatitis against national standards of practice. *The British journal of surgery*. 2007 Jul;94(7):844-8.
- [119] Aboulian A, Chan T, Yaghoubian A, Kaji AH, Putnam B, Neville A, et al. Early cholecystectomy safely decreases hospital stay in patients with mild gallstone pancreatitis: a randomized prospective study. *Ann Surg*. 2010 Apr;251(4):615-9.
- [120] Alimoglu O, Ozkan OV, Sahin M, Akcakaya A, Eryilmaz R, Bas G. Timing of cholecystectomy for acute biliary pancreatitis: outcomes of cholecystectomy on first admission and after recurrent biliary pancreatitis. *World J Surg*. 2003 Mar;27(3):256-9.
- [121] Rosing DK, de Virgilio C, Yaghoubian A, Putnam BA, El Masry M, Kaji A, et al. Early cholecystectomy for mild to moderate gallstone pancreatitis shortens hospital stay. *J Am Coll Surg*. 2007 Dec;205(6):762-6.
- [122] Nebiker CA, Frey DM, Hamel CT, Oertli D, Kettelhack C. Early versus delayed cholecystectomy in patients with biliary acute pancreatitis. *Surgery*. 2009 Mar;145(3):260-4.
- [123] Barkun JS, Caro JJ, Barkun AN, Trindade E. Cost-effectiveness of laparoscopic and mini-cholecystectomy in a prospective randomized trial. *Surg Endosc*. 1995 Nov;9(11):1221-4.
- [124] McGinn FP, Miles AJ, Uglow M, Ozmen M, Terzi C, Humby M. Randomized trial of laparoscopic cholecystectomy and mini-cholecystectomy. *The British journal of surgery*. 1995 Oct;82(10):1374-7.
- [125] McMahan AJ, Russell IT, Baxter JN, Ross S, Anderson JR, Morran CG, et al. Laparoscopic versus minilaparotomy cholecystectomy: a randomised trial. *Lancet*. 1994 Jan 15;343(8890):135-8.
- [126] Calvert NW, Troy GP, Johnson AG. Laparoscopic cholecystectomy: a good buy? A cost comparison with small-incision (mini) cholecystectomy. *European Journal of Surgery*. 2000;166:782-6.
- [127] Srivastava A, Srinivas G, Misra MC, Pandav CS, Seenu V, Goyal A. Cost-effectiveness analysis of laparoscopic versus minilaparotomy cholecystectomy for gallstone disease. A randomized trial. *Int J Technol Assess Health Care*. 2001 Fall;17(4):497-502.
- [128] Secco GB, Cataletti M, Bonfante P, Baldi E, Davini MD, Biasotti B, et al. [Laparoscopic versus mini-cholecystectomy: analysis of hospital costs and social costs in a prospective randomized study]. *Chir Ital*. 2002 Sep-Oct;54(5):685-92.
- [129] Nilsson E, Ros A, Rahmqvist M, Backman K, Carlsson P. Cholecystectomy: costs and health-related quality of life: a comparison of two techniques. *Int J Qual Health Care*. 2004 Dec;16(6):473-82.
- [130] Keus F, de Jonge T, Gooszen HG, Buskens E, van Laarhoven CJ. Cost-minimization analysis in a blind randomized trial on small-incision versus laparoscopic cholecystectomy from a societal perspective: sick leave outweighs efforts in hospital savings. *Trials*. 2009;10:80.
- [131] Rogers SJ, Cello JP, Horn JK, Siperstein AE, Schecter WP, Campbell AR, et al. Prospective randomized trial of LC+LCBDE vs ERCP/S+LC for common bile duct stone disease. *Arch Surg*. 2010 Jan; 145(1):28-33.

- [132] Schroepel TJ, Lambert PJ, Mathiason MA, Kothari SN. An economic analysis of hospital charges for choledocholithiasis by different treatment strategies. *Am Surg.* 2007 May;73(5):472-7.
- [133] Topal B, Vromman K, Aerts R, Verslype C, Van Steenberghe W, Penninckx F. Hospital cost categories of one-stage versus two-stage management of common bile duct stones. *Surg Endosc.* 2010 Feb;24(2):413-6.
- [134] Holte K, Klarskov B, Christensen DS, Lund C, Nielsen KG, Bie P, et al. Liberal versus restrictive fluid administration to improve recovery after laparoscopic cholecystectomy: a randomized, double-blind study. *Ann Surg.* 2004 Nov; 240(5): 892-9.
- [135] Liberman MA, Howe S, Lane M. Ondansetron versus placebo for prophylaxis of nausea and vomiting in patients undergoing ambulatory laparoscopic cholecystectomy. *American Journal of Surgery.* 2000;179:60-2.
- [136] Bisgaard T, Klarskov B, Kehlet H, Rosenberg J. Preoperative dexamethasone improves surgical outcome after laparoscopic cholecystectomy: a randomized double-blind placebo-controlled trial. *Ann Surg.* 2003 Nov;238(5):651-60.
- [137] Feo CV, Sortini D, Ragazzi R, De Palma M, Liboni A. Randomized clinical trial of the effect of preoperative dexamethasone on nausea and vomiting after laparoscopic cholecystectomy. *The British journal of surgery.* 2006 Mar;93(3):295-9.
- [138] Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. *Ann Surg.* 2008 Aug;248(2):189-98.
- [139] Karanicolas PJ, Smith SE, Kanbur B, Davies E, Guyatt GH. The impact of prophylactic dexamethasone on nausea and vomiting after laparoscopic cholecystectomy: a systematic review and meta-analysis. *Ann Surg.* 2008 Nov;248(5):751-62.
- [140] Fujii Y, Itakura M. Reduction of postoperative nausea, vomiting, and analgesic requirement with dexamethasone for patients undergoing laparoscopic cholecystectomy. *Surg Endosc.* 2010 Mar;24(3):692-6.
- [141] Sanchez-Rodriguez PE, Fuentes-Orozco C, Gonzalez-Ojeda A. Effect of dexamethasone on postoperative symptoms in patients undergoing elective laparoscopic cholecystectomy: randomized clinical trial. *World J Surg.* 2010 May;34(5):895-900.
- [142] Keus F, de Vries J, Gooszen HG, van Laarhoven CJ. Assessing factors influencing return back to work after cholecystectomy: a qualitative research. *BMC Gastroenterol.* 2010; 10:12.
- [143] Beauchamp TL, Childress JF. *Principles of biomedical ethics.* 5 ed. Oxford: New York: Oxford University Press; 2001.
- [144] Epstein RM, Alper BS, Quill TE. Communicating evidence for participatory decision making. *JAMA.* 2004 May 19;291(19):2359-66.
- [145] Little M. Ethnomics: the ethics of the unaffordable. *Arch Surg.* 2000 Jan;135(1):17-21.
- [146] Matthews JB. Cost containment: think globally, act locally. *Arch Surg.* 2010 Dec; 145(12):1136-7.



Updated Topics in Minimally Invasive Abdominal Surgery

Edited by Prof. Ahmed Elgeidie

ISBN 978-953-307-773-4

Hard cover, 246 pages

Publisher InTech

Published online 14, November, 2011

Published in print edition November, 2011

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How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

E. Nilsson, M. Oman, M.M. Haapamäki and C.B. Sandzén (2011). Gallbladder Surgery, Choice of Technique: An Overview, Updated Topics in Minimally Invasive Abdominal Surgery, Prof. Ahmed Elgeidie (Ed.), ISBN: 978-953-307-773-4, InTech, Available from: <http://www.intechopen.com/books/updated-topics-in-minimally-invasive-abdominal-surgery/gallbladder-surgery-choice-of-technique-an-overview>

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