

General and Access-Related Complications of Laparoscopic Cholecystectomy

K. Zgraggen, M. Schilling, F. Holzinger, H. U. Baer, M. W. Büchler

Department of Visceral and Transplantation Surgery, Inselspital, University of Bern, Switzerland

Introduction

Comparison of open and laparoscopic cholecystectomy usually considers procedure-specific complications. Analysis of general complications may from a technical point of view not be very interesting, but the fact that 50% of morbidity and mortality are attributable to general complications should lead us to a careful study on general complications in laparoscopic surgery and specifically in laparoscopic cholecystectomy. The Swiss Association of Laparoscopic and Thoracoscopic Surgery (SALTS) performed a prospective multicenter study on 10,174 cases of laparoscopic cholecystectomy. The results of this study are in part presented elsewhere in this issue but form the basis of this paper.

The objective of this study was to determine if intraoperative problems and complications during laparoscopic cholecystectomy predisposed to postoperative general complications and if intraoperative complications specific for laparoscopic surgery but not specific for laparoscopic cholecystectomy, i.e. access-related complications, increased postoperative morbidity and mortality. Complications to be analyzed were grouped into general postoperative complications and into access-related intraoperative complications.

Material and Methods

SALTS conducted a prospective multicenter study on laparoscopic cholecystectomy from 1992 to 1994. Data from 10,174 cases was collected in 82 institutions and constitute the basis of the analysis. The following complications have been analyzed: (1) *general complications*: deep venous thrombosis, pulmonary embolism, and cardiopulmonary complications, and (2) *access-related complications*: needle injuries, trocar injuries, and nonprocedure-specific organ injuries.

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Urs Herzog, MD, Surgical Department, St. Claraspital, Kleinriedenstrasse 30, Postfach, CH-4016 Basel (Switzerland)

Table 2. Summary of intraoperative and postoperative complications after Veres and trocar injuries

	Veres injuries (n = 16)	Trocar injuries (n = 19)	Total (n = 35)
Intraoperative complications			
Bleeding	5	9	14
Gallbladder	3	3	6
Conversion rate	25% (4/16)	21% (4/19)	22.9% (8/35)
Postoperative complications			
Intra-abdominal/local	2	3	5
Systemic	2	2	2

Access-Related Complications

Veres Needle Injuries. Only 16 Veres needle injuries for an incidence of 0.16% have been documented in the 10,174 cases. Organs to be injured were mesenterium, omentum, small bowel, colon, stomach, blood vessels, etc., in decreasing frequency. 4/16 cases had to be converted for a conversion rate of 25%. Besides the Veres needle injuries, 8 intraoperative complications occurred (table 2). Postoperative complications were noted in 4 patients: 1 intra-abdominal abscess, 1 wound hematoma, 2 non-specifically defined systemic complications. The patient with the intra-abdominal abscess had to be reoperated. Mortality was 0.

Trocar Injuries. Nineteen trocar injuries led to a conversion rate of 21% (4/19). The incidence of intraoperative complications different than lacerations by the trocar was 63% (12/19; table 2). The postoperative complication rate was 26.3%. Reoperation was necessary in 1/19 patients. Mortality was 0.

Nonprocedure-Specific, Access-Related Organ Injuries. A total of 60 intra-abdominal nonprocedure-specific, but access-related lesions occurred during the 10,174 laparoscopic cholecystectomies at an incidence of 0.59%. Different subgroups can be divided as follows: gastrointestinal lesions, 19; vascular lesions, 14, and different intra-abdominal lesions, 27.

The group of 19 gastrointestinal lesions includes lacerations by Veres needle/trocar, instrumental perforations or thermal injuries. Including 12 liver lacerations for later comparison to the literature the distribution of organ injuries presents as follows: small bowel, 38.7%; liver, 38.7%; colon, 16.1%, and stomach, 6.5%.

Vascular lesions not specific for laparoscopic cholecystectomy occurred in 14/10,714 patients at an incidence of 0.14%. Six lesions were attributable to Veres needle/trocar injuries. Only one injury to a major retroperitoneal vascular structure (common iliac artery) was reported. The majority of lesions concerned abdominal wall vessels or mesenteric/mesocolon or omental vessels. Mortality was 0.

The group of 27 lesions different than gastrointestinal organs or vascular structures showed the following distribution in descending frequency: omentum > diaphragm > mesenterium, etc. Table 3 shows a summary of the conversion rates, postoperative complications and reoperations in patients with intraoperative lesions of gastrointestinal, vascular and 'different than the former two' structures. The rate of intraoperative complications could not be identified for valid comparison.

Table 1. General postoperative complications in relation to ASA score and emergency versus elective operation

	Deep venous thrombosis	Pulmonary embolism	Cardiopulmonary complications	n
ASA I	0.04%	0.2%	0.7%	5,621
ASA II	0.11%	0.28%	2.3%	3,581
ASA III	0.11%	0.66%	6.1%	914
ASA IV	0	0	8.6%	58
Emergency operation	0.16%	0.16%	4.4%	613
Elective operation	0.06%	0.27%	1.60%	9,541

Results

Morbidity and Mortality

Overall morbidity in the SALT study was 10.3%, 4.7% general and 5.6% local complications. Mortality was 0.2%. 50% of the mortality was related to general postoperative complications, mainly pulmonary embolisms and cardiopulmonary complications.

General Postoperative Complications

Deep Venous Thrombosis (DVT). DVT was reported in 7/10,174 (0.07%) patients. In 6/7 patients intraoperative problems such as gallbladder perforation, bleeding from cystic artery or gallbladder bed, etc. were encountered. 1/7 cases had to be converted to open cholecystectomy. Postoperative complications other than DVT occurred in 6/7 cases: 4 pulmonary embolisms, 1 intra-abdominal abscess, 1 wound infection. The reoperation rate was 1/7. One patient died due to pulmonary embolism.

Pulmonary Embolism (PE). Postoperative PE occurred in 27/10,714 cases (0.27%). The intraoperative conversion rate was 30% (8/27). In 22/27 cases different intraoperative complications were noted and the postoperative complication rate was 59% in this group. Only 1/27 cases had to be reoperated. Three patients died due to PE and to elective versus emergent indication for laparoscopic cholecystectomy are shown in table 1. A definite tendency to an increase in the high-risk population can be observed.

Cardiopulmonary Complications. A relatively high rate of cardiopulmonary complications was reported. 185/10,174 (1.8%) cases suffered a wide range of cardiopulmonary complications. Documentation of even minor complications such as supraventricular tachyarrhythmias, pneumothorax due to central venous catheter, pleural effusions, etc. was very precise. The pneumonia rate was 0.4%, major cardiac complications such as myocardial infarction, arrhythmias necessitating specialized treatment by cardiologist and/or in intensive care unit occurred in 0.6%. Different minor cardiopulmonary complications were responsible for the rest of these complications. Analysis of cardiopulmonary complications in ASA subgroups and grouped after elective and emergency procedure showed the expected increase in risk groups (ASA III/IV), emergency versus elective operation (table 1).

Table 3. Summary of intra-abdominal injuries: conversion rates, postoperative complications and reoperations

	n	Conversion rate	Postoperative complications	Reoperation rate	Mortality
Gastrointestinal lesions	19	37% (7/19)	42% (8/19)	16% (3/19)	0
Vascular lesions	14	42% (6/14)	29% (4/14)	0	0
Different intra-abdominal lesions	27	18.5% (5/27)	33% (9/27)	7.4% (2/27)	0
Total	60	30%	35%	8.3%	0

Table 4. Patients with thromboembolic complications compared to the average patient (thromboembolism is not included in the incidence of postoperative complications)

	Thromboembolism (n = 34)	The average patient (n = 10,174)
Intraoperative complications	82%	30%
Postoperative complications		
Local	23.5% (8/34)	5.6%
Systemic	41.2% (14/34)	4.7%
Total	64.7% (22/34)	10.3%
Reoperation rate	5.8% (2/34)	1.6%
Mortality	11.8% (4/34)	0.2%

Discussion

Comparing the standards of open cholecystectomy [1, 2] to the results of laparoscopic cholecystectomy, the most obvious difference is a reduction of the mortality rate. In the prospective study of the SALTs the mortality was 0.2% [see H. Wehrli, his issue] and compares favorably to a 1.53% mortality rate of a meta-analysis of more than 58,000 patients after open cholecystectomy [3-18]. Different retrospective studies on laparoscopic cholecystectomy have shown mortality rates as low as 0.04% [19, 20].

The impact on mortality of a high incidence of general complications during and in the postoperative course of laparoscopy seems obvious. In the SALTs study, 10/20 postoperative deaths, i.e. 50% of our mortality rate, were related to general postoperative complications. The rate of postoperative general complications was 4.7%.

Comparing the subgroup of patients suffering from thromboembolisms to the whole study population, differences in intraoperative and postoperative complications other than DVT and PE and differences in reoperation rates are striking (table 4). We therefore think that in terms of increasing postoperative general complications the frequently discussed negative pathophysiological effects of the pneumoperitoneum on thromboembolism and cardiopulmonary function [21-26] may just be part of the problem; intraoperative complications such as gallbladder perforation, bleeding, etc.,

may contribute substantially to morbidity and mortality as well. To analyze complications that increase the risk and their pathophysiological mechanism will be the subject of a future analysis. The relatively high incidence of cardiopulmonary complications may be an effect of the careful data collection in a prospective study design.

Compared to open cholecystectomy the laparoscopic procedure does have unique possibilities for complications. The access to the abdomen by pneumoperitoneum has its own morbidity and in most series mortality. Establishing pneumoperitoneum by Veres needle and gaining access to the abdomen by blindly inserting the first trocar is commonly practised and recommended [27].

Intraoperative general complications related to the access in laparoscopy concerned only a small group of patients. The combined incidence of Veres needle and trocar injuries of 0.34% is comparable to a published rate of 0.2-0.3% in gynecology and laparoscopic surgery [28, 29]. Mortality due to needle and trocar injuries was 0 in our study but most authors describe an increased mortality depending upon the injured organ. Major retroperitoneal vascular injuries have a mortality of approximately 6% [30] and are third leading cause of intraoperative death during laparoscopy [31]. Needle and trocar injuries did provoke an increase in postoperative complications as well but did in our study not have an impact on mortality. Open laparoscopy is an almost equally fast procedure that easily prevents these lacerations.

Long instruments, loss of tactility, use of electro-surgical instruments and the fulcrum effect lead to organ injuries which are related to laparoscopic surgery in general. The relative frequency of these organ injuries is almost identical to the series published by Scott et al. [31]. Most injuries are not caused by Veres needle or trocar but by inadvertent instrumental perforations. Difficult is the assessment of the incidence of thermal lesions and only 3 cases of gastrointestinal injuries could be reliably attributed to this mechanism.

Organ injuries are major intraoperative complications and our analysis showed that the conversion rate in this group of patients is 30%, almost 4 times higher than in the average patient. Reoperation rate and postoperative complications are increased to 8.3 and 35%, a factor of 5.2 and 3.4 compared to a reoperation rate of 1.6% and a morbidity of 10.3% in the 10,174 cases. Organ injuries did not have an impact on mortality.

Conclusions

To conclude: (1) 50% of the mortality rate after laparoscopic cholecystectomy is attributable to general complications. Patients with postoperative general complications did have an increase in intraoperative complications. Pathophysiological mechanisms during pneumoperitoneum as well as intraoperative complications may be involved in the pathogenesis of general complications. (2) Injuries to abdominal structures by needle, trocar, electro-surgery or instrumental perforations during laparoscopic cholecystectomy increased morbidity and reoperation rate but in contrast to most studies did not affect mortality. (3) Access-related injuries by Veres needle or trocar are preventable by open laparoscopy, i.e. minilaparotomy.

Laparoscopic Bile Duct Injuries: European Experience

R.C.G. Russell
London, UK

The key to the debate of whether laparoscopic cholecystectomy is the effective treatment for gallstones is bile duct injury. A bile duct injury is a disaster to the patient; such an injury can ruin a life leading to permanent disability on account of operative repair followed by stricture development leading to cholangitis, biliary cirrhosis and eventual transplantation. The costs of such a disaster are high, so altering the balance between short hospital stay and early return to work, which at present favour the laparoscopic method. Added to these medical costs can be the not inconsiderable financial burden of legal fees and compensation awards against the hospital and surgeon. Of all complications associated with this 'keyhole' operation, bile duct injury is the most important, the one to be most feared by the surgeon and the complication to be avoided by good technique. Technique is vital, and the debate related to the position of the patient (flat or Lloyd-Davies position), and the subsequent placement of the grasping forceps (fig. 1) emphasises the need to dissect out the triangle of Calot before placement of clips on the cystic duct [1, 2]. I consider that the only safe technique to avoid injury is to dissect the triangle of Calot completely with division of the branches of the cystic artery on the gallbladder, before the duct is clipped and divided. For those who do not follow these guidelines an intraoperative cholangiogram is important to avoid injury to the duct [3].

Classification of Duct Injury

One of the difficulties in determining the incidence of duct injury is the definition of a duct injury. For instance, inclusion of an incision into the main duct during an intraoperative cholangiogram is a minor injury which is easily remedied by the placement of a T-tube with few if any long-term sequelae, yet the complete transection of a duct leaves little doubt as to the major nature of the insult (fig. 2). In this survey a bile duct injury means a major transection of the bile duct which requires operative repair, while a bile leak invariably indicates peripheral damage which can be managed conservatively, often with the aid of endoscopic intervention [4]. Bile leaks can occur from the main duct, from the cystic duct (fig. 3), a gallbladder bed leak due to trauma

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K. Zgraggen, Department of Visceral and Transplantation Surgery, Inselspital, University of Bern, CH-3010 Bern (Switzerland)