Complications in Laparoscopic Surgery

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Over the last few years, laparoscopic surgery has gained widespread acceptance in surgical practice. The indications range has expanded extraordinarily in that time. Some of the practiced procedures are already considered the gold standard, while others are still on the way there. The fascinating technique and results notwithstanding, a number of risks, mistakes, and complications are possible in both the initial and the advanced states. We present our experience from 2118 laparoscopic operations performed between February 1991 to March 1995, focusing on the intraoperative complications (Tables 1, 2).

INTRAOPERATIVE COMPLICATIONS

Initial Trocar Insertion Complications

While placing the first trocar in a patient with substantial adipose tissue, we saw an injury of the anterior wall of the right common iliac vein. Due to rapid blood loss, this injury forced us immediately to convert to laparotomy and repair the vessel under direct vision.

While placing the first trocar in another patient, an injury of the mesentery of an adherent loop of small bowel was seen. In this case we could control the bleeding by applying pressure to the wound for five minutes.

Cholecystectomy Complications

Inappropriate use of the monopolar cautery resulted in 1 injury involving the common bile duct via Calot's triangle, 2 injuries resulting in cystic hemorrhaging, and 12 injuries involving iatrogenic puncture of the gallbladder during dissection from the liver bed.

In the cases of cystic hemorrhaging, one case was converted to laparotomy to control the bleeding, which was relatively minor. In the second case bleeding was controllable laparoscopically. The common bile duct injury was noticed on the second postoperative day due to an increase in serum bilirubin to 9.1 g. The ERCP demonstrated complete damage of the common bile duct (Fig. 1). In this case we performed a choledochojejunostomy via laparotomy. All injured gallbladders in this group were withdrawn from the abdomen without complication–some using a specimen retrieval bag, others not. In each of these cases, we concluded the intervention by thoroughly rinsing the abdominal cavity.

Appendectomy Complications

During laparoscopic appendectomies, we encountered two cases of hemorrhaging from the mesenteric artery. In both cases the bleeding could be controlled laparoscopically.

The following case gives an example of the potential danger in using the bipolar electrocautery in close vicinity to the cecum. In this case, severe diffuse peritonitis occurred which could only be controlled by lavage treatment. The cause of this severe complication, in a patient who suffered from a subacutely inflamed appendix with retrocecal adhesions, lay in the excessive use of electrocautery near the cecum, followed by necrosis proximal to the intact

but free-floating stump which was correctly closed using two Roeder loops.

Another example of a complication during an appendectomy was the loss of the dissected specimen in the abdominal cavity. This occurrence resulted from careless mishandling of the specimen, specifically, putting it down in the abdominal cavity without fixation. Approximately one hour of intensive laparoscopic search was required to withdraw the specimen from the pouch of Douglas. Consequently, at the same location, an abscess developed in this patient postoperatively. Under ultrasound guidance, the abscess was drained transvaginally without complication.

Transabdominal Preperitoneal (TAPP) Hernia Repair Complications

Traumatic preparation below the ileo-pubic tract near the triangle of doom has resulted in a case of minor bleeding from the base of the epigastric vessel. We could stop the bleeding laparoscopically by inserting a hemostyptic sponge near the fixated mesh.

In one case we had a postoperative infection at the site of the mesh. Consequently we performed an inguinal incision to remove the mesh, rinsing and draining the wound site and placing the patient on a systemic antibiotic treatment.

In another patient a trocar was removed accidentally and required reinsertion. A 5-mm grasping forceps was still within the trocar at the time of removal and reinsertion. In the process, this grasping forceps punctured a loop of small bowel. This injury could be repaired by suturing the lesions laparoscopically according to Lahodny.[13]

In 11 cases the patients had an "early recurrence" of the hernia. The reason involved a typical technical fault: the mesh was too small and was not fixed sufficiently in the ileo-pubic tract.

Four patients developed postoperative pain as a symptom of intraoperative injury of the lateral cutaneous nerve caused by careless stapling of the lateral margin of the mesh.

DISCUSSION

The "early generation" of laparoscopic surgeons were on their own and therefore encountered the previously described complications of the first learning stage. In contrast, their successors have had the benefit of hindsight and have indeed made use of these early experiences. The decreasing rate of severe complications in laparoscopic procedures worldwide concurs with this observation. Complications are based on the following:

1. The operating surgeon and his operative technical skills.
2. Unrefined technique and inadequate instrumentation.
3. Inexperienced operating room staff and assisting personnel.
4. Anesthesia.
5. Pre-existing conditions of the patient.

GENERAL TECHNIQUE

Surgeons were breaking new ground with the introduction of the laparoscopic method. The close three-dimensional view and the direct-tissue feeling of classic surgery were lost. Some single approaches, such as the "Rostock Hand" created by B. Helms[11] to imitate the palpatory qualities of the surgeon's hand, had value, but their use had not been widespread. Advanced technologies such as three-dimensional telescopes and computer-aided virtual reality could possibly return or provide a practical substitute for some of the lost sensation in the future.

Thus, indirect manipulation of tissue with long instruments at a two-dimensional view requires thorough training. This training can easily be achieved by participating in recommended training courses.

Just as with open surgery, the impatient, uncritical surgeon poses a very high risk for the patient. A direct puncture with the first trocar, particularly

Table 1. Laparoscopic operations from February 1991 to March 1995.

Procedure	Number of cases
Laparoscopic Cholecystectomy	1637
(Acute cholecystitis)	(195)
Laparoscopic Appendectomy	74
Laparoscopic Hernia Repair (TAPP)	263
Laparoscopic Therapy of Perforated Ulcer	19
Laparoscopic Adhesiolysis	95
Laparoscopic Resection of Large Bowel	5
Laparoscopic Gastroesphageal Reflux Repairs	4
Others	21

Table 2. Laparoscopic Cases:
Ages (average and range), mean operating time (min per side), and the number of different surgeons performing a particular operation

	Age (average)	Range (years)	Mean operating time (min per side)	Number of surgeons
Laparoscopic Cholecystectomy	46	14-93	35	8
Laparoscopic Appendectomy	24	7-81	37	3
Laparoscopic Hernia Repair (TAPP)	37	19-92	45	5

on a patient with substantial adipose tissue, can lead to injuries of bowel, bladder, and especially vessels, with the corresponding consequences, as mentioned above. The puncture with the Veress needle as well as with the first trocar should only be made when the abdominal walls are relaxed and sufficiently elevated. Gas must be infused without obstruction. Some sort of a test must be carried out to ascertain direct communication with the abdominal cavity (e.g., the "Hanging Drop" test or the test according to Semm).[23] In unclear cases (and especially in patients with scarred abdominal wall), the Hassan or mini-laparotomy technique should be used to insert the first trocar. Sigman[9,24] recommends the use of this technique in nearly all patients to avoid any possible risk. Other techniques such as those employing the "optical cannula"[21] or the "telescope trocar" are available now; however, caution is recommended with these instruments, as their use does not absolutely preclude puncture of abdominal organs. The preoperative ulrasound-guided "mapping" of the abdominal wall can be of great value in the expert's hands.[4]

Problems may arise for anesthesiologists in the delivery of the pneumoperitoneum; the increased CO_2 uptake requires a higher respiratory-minute-volume for elimination.

Uniformly distributed but higher intra-abdominal pressure can lead to cardiac and pulmonary problems which, in elderly, high-risk patients, are particularly hard to manage. Therefore, a sufficiently deep anaesthesia with corresponding extensive relaxation is essential. Also, the ideal intra-abdominal pressure needs to be maintained because if the pressure subsides, manipulation (especially sewing in the abdomen) can become difficult and dangerous. Under such circumstances, manipulation–especially intracorporeal suturing–must be undertaken with great care. With increased experience, the surgeon is able to perform routine procedures under a very low CO_2 pressure (e.g., 8 mm Hg).[14,30]

Cholecystectomy

The gravest complications occurred during dissection of the structures in Calot's triangle. Dissection further away from the gallbladder in the area of the cystic duct and common bile duct by means of electrocoagulation can lead to irremediable bile duct injury.[2,6,10,15-19,25,27] The monopolar hook can be a dangerous instrument.[5] The insulation of the point or the "hook back" is not sufficient; it quickly becomes worn and brittle. The high temperature after coagulation cannot be anticipated. Both facts lead to uncontrollable current and heat effects far from the structure to be dissected, with such possible consequences as late strictures of the common bile duct.[19]

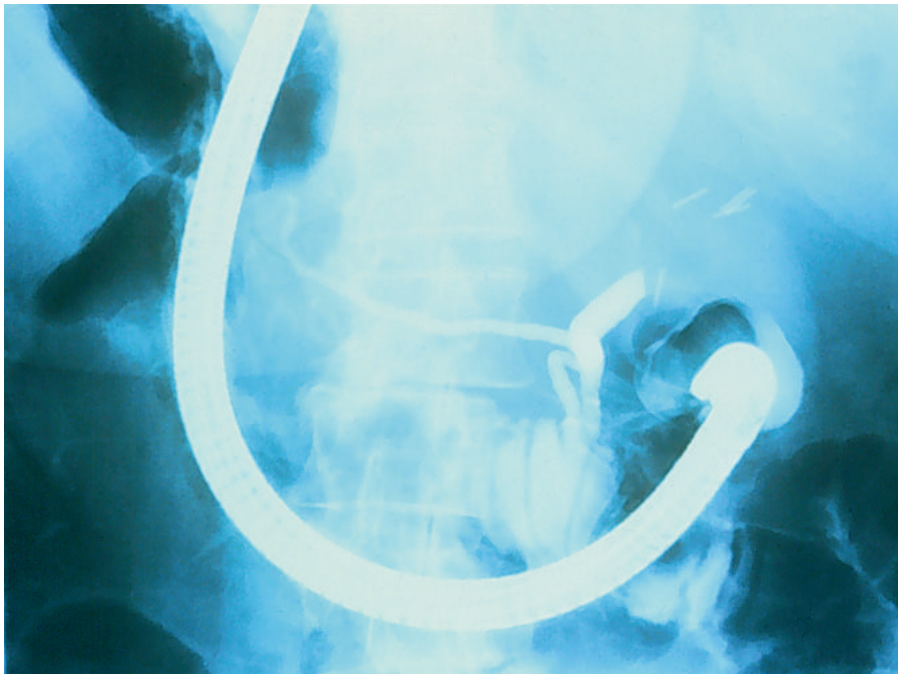

Figure 1. ERCP demonstrates complete damage of the common bile duct.

Careless dissection of the cystic artery (using the monopolar hook as well) may cause bleeding which cannot be managed laparoscopically by the beginner. This would call for laparotomy. Confusing the right hepatic artery with the cystic artery is always possible and can lead to restricted circulation of the liver.[18]

Iatrogenic piercing of the gallbladder by means of the hook or forceps forcefully "gripping" it can result in bile, abscess, or stone spillage into the abdominal cavity. In addition to an operative site which is difficult to visualize, peritonitis can arise. Thus excessive rinsing and drainage is required in those cases, and every effort is to be made to recover all spilled stones.[3]

We conclude that dissection of the structures in Calot's triangle must be started adjacent to the gallbladder. In our clinic, blunt dissection by sponge and dissector, as is performed in open surgery, has proved effective. Thus we were able to reduce the use of the monopolar hook to an absolute minimum. The cystic duct and the cystic artery must be dissected all around their circumferences; their junctions must be visualized satisfactorily and videotaped. Using all-encompassing closing clips (Absolok clip, Ethicon, Inc.) assures sufficient ligation.

Appendectomy

Hemorrhages from the appendicular artery arise from vigorous dissection of the mesoappendix with bipolar coagulation forceps and scissors. However, they can usually be treated laparoscopically.[10,18,22,25]

If the appendix is perforated, causing contamination of the abdominal cavity with fecal or abscess material, the consequences (e.g., peritonitis, Douglas abscess) should not be underestimated.

Necrosis in other intestinal areas such as the cecum by careless or defective coagulation (monopolar or even bipolar current) can be a cause of late postoperative morbidity or even mortality, since it is not recognized immediately and the consequences (peritonitis, abscesses) do not occur until after the operation.[23]

The above-mentioned septic complications after laparoscopic appendectomy (Douglas abscess and severe peritonitis) led us to abandon the method nearly totally for two years.[18] Meanwhile, new completely non-electrosurgical tech-

niques such as the use of staplers or ligation, and suturing techniques, and oversized clips became available. Thus we feel it is justified again to perform the laparoscopic appendectomy in case of special indications (e.g., chronic right lower-quadrant pain in younger women and the suspicion of appendicitis in the elderly or obese patient).

We concluded that careful gripping of the appendix and mesoappendix as well as the avoidance of excessive traction prevents rupture. Thorough rinsing of the appendiceal bed should be part of any appendectomy. Generous drainage in the Douglas pouch can prevent abscesses. The exclusive use of non-electrosurgical techniques in the area of the appendix can avoid septic complications caused by defective currents and heat effects.

TAPP Hernia Repair

The laparoscopic approach for TAPP hernia repair requires a completely different view of the inguinal anatomy than the traditional inguinal approach. Only a superb knowledge of the anatomy "from inside" can avoid bleeding from the triangle of doom (the area bordered by the inferior epigastric, spermatic, and external iliac vessels) or from the vicinity, or other severe complications in this region.[8,20]

The overall decrease in the number of clips used (especially those placed laterally) for mesh fixation avoids the described nerve injuries.

As a consequence of "early recurrences," we changed our technique. The spermatic cord and vessels are to be mobilized gently and then, in contrast to the former technique, underlayed by one portion of the mesh. Since instituting this change, we have not seen any more "early recurrences."

In the initial stage of testing new procedures, the number of surgeons and nurses performing the new methods should be strictly limited. Untrained and daily changing operating room staff present quite a significant risk to the success of the operation. In laparoscopic surgery, the most difficult task no longer rests with the scrub nurse but with the assistant nurse. She must operate the insufflator, the camera, the source of light, and video recorder and, if necessary, repair them competently. Hence if the staff is not sufficiently trained, substantial problems can result.[18]

The surgeons must be able to master possible complications (e.g., vascular interventions).

At the outset there must be good selection of case material in order to prevent disasters. Not every patient is suitable for laparoscopic surgery. Therefore, for both the less trained and experienced surgeon, the following contraindications should be respected in order not to provoke complications by patient-specific problems:

- Morbid obesity
- Acute cholecystitis
- Scleroarthrophic cholecystitis
- Previous operation in the upper abdomen (or lower abdomen in case of herniorraphy)
- Tentative diagnosis of malignant growth of the gallbladder
- Perityphlitic abscess
- Periacute appendicitis
- Perforated appendicitis
- Scrotal hernias
- Severe additional maladies

With increasing experience, the indications range can be expanded.[6,7,10,12,18] At our clinic, meanwhile, the mere suspicion of a malignant growth in the gallbladder contraindicates a laparoscopic intervention. With appendectomy, we have chosen the reverse direction. In the beginning, we were generous in the indication for laparoscopic appendectomy. Only the perityphlitic abscess and the established perforation were considered contraindications.[22,23] In a longer period (as mentioned above), after severe septic complications we nearly abandoned the laparoscopic appendectomy totally. Now we are just on the way to re-establishing this laparoscopic procedure because we are learning to use currentless techniques exclusively. If critical intraoperative situations arise, there is no disgrace in changing the procedure to a laparotomy, and indeed this suggests an appropriate sense of responsibility. Such an open-minded approach helps avoid complications.[18,27] STI

REFERENCES

1. Anteby E, Hurwitz A, Palti Z, et al. Gallstones in an ovarian dermoid cyst. New Engl J Med 1992;327:129.
2. Appel MF. Back to the basics in laparoscopic cholecystectomy. Surg Endosc 1993;7:1.
3. Birkett DH. Spilled cells, spilled clips, spilled stones [Editorial]. Surg Endosc 1995;9:269.
4. Caprini JA, Arcelus JA, Swanson J, et al. The ultrasonic localisation of abdominal wall adhesions. Surg Endosc 1995;9:283.
5. Elkus RM. Laparoscopically assisted resection of small bowel injury during laparoscopic cholecystectomy. Surg Laparoscopy Endosc 1993;3:349.
6. Feussner H, Ungeheuer A, Lehr L, et al. Technik der laparoskopischen Cholecystektomie. Langenbecks Arch Chir 1991;376:367.
7. Fitzgerald SD, Bailey PV, Liebscher GJ, et al. Laparoscopic cholecystectomy in anticoagulated patients. Surg Endosc 1991;5:166.
8. Fitzgibbons RJ Jr, Camps J, Cornet DA, et al. Laparoscopic inguinal herniorraphy. Results of a multi-center trial. Ann Surg 1995;221:3.
9. Grace PA, Leahy A, McEntee G, et al. Laparoscopic cholecystectomy in the scarred abdomen. Surg Endosc 1991;5:118.
10. Gotz F, Pier A, Schippers E, et al. Laparoskopische Chirurgie 1. Auflage. Stuttgart: Thieme; 1991.
11. Helms B, Daum W. The "Rostock-Endohand": an endoscopic palpatoring manipulator. First results of clinical use. Minimal Inv Ther 1994;3 Suppl 1:42.
12. Ko ST, Airan MC. Review of 300 consecutive laparoscopic cholecystectomies: development, evolution and results. Surg Endosc 1991;5:103.
13. Lahodny J. Ethi-Endo-Clip Naht-ein Fortschritt in der pelviskopischen Chirurgie. Gnäkol Rundschau 1991;31 Suppl 2:355.
14. Lantz PE, Smith JD. Fatal carbone dioxide embolism complicating attempted laparoscopic cholecystectomy–case report and literature review. J Forensic Sci 1994;39:1468.
15. Lepsien G, Lüdtke FE, Neufang T, et al. Treatment of iatrogenic common bile duct injury during laparoscopic cholecystectomy through the laparoscopic insertion of a T-tube stent. Surg Endosc 1991;5:119.
16. Moossa AR, Easter DW, Van Sonnenberg E, et al. Laparoscopic injuries to the bile duct. A cause for concern. Ann Surg 1992;215:203.
17. Nenner RP, Imperato PJ, Alcorn CM. Serious complications of laparoscopic cholecystectomy in New York State. NY State J Med 1992;92:179.
18. Niebuhr H, Nahrstedt U, Rückert K, et al. Laparoscopic Surgery. Mistakes and risks when the method is introduced. Surg Endosc 1993;7:412.
19. Park YH, Oskanian Z. Obstructive jaundice after laparoscopic cholecystectomy with electrocautery. Am Surg 1992;58:321.
20. Philipps EH, Rosenthal R, Carroll B, et al. Reasons for early recurrence following laparoscopic hernia repair. Surg Endosc 1995;9:140.
21. Rimbach S, Wallwiener D, Bastert G. Die optische Veress Nadel. Entwicklung und erste Anwendung im experimentellen Modell. Minimal Invasive Medizin 1994;5:166.
22. Rückert K, Niebuhr H, Nahrstedt U. Laparoskopische Cholecystektomie und Appendektomie. Hamb Ärzteblatt 1992; 46:47.
23. Semm K. Operationslehre für endoskopische Abdominal-Chirurgie. 1. Auflage.

Stuttgart: Schattauer; 1984.
24. Sigman HH, Fried GM, Garzon J, et al. Risks of blind versus open approach to celotomy for laparoscopic surgery. Surg Laparoscopy Endosc 1993;3:296.
25. Stahlschmidt M, Lotz M, Moergel K. Endoskopische Appendektomie und Cholecystektomie. Aerzteblatt Rheinland-Pfalz 1990;43:309.
26. Storms P, Stuyven G, Vanhemelen G, et al. Incarcerated trocar-wound hernia after hysterectomy. Is the closure of large trocar fascia defects after laparoscopy necessary? Surg Endosc 1994;8:901.
27. Troidl H, Spangenberger W, Dietrich A, et al. Die laparoskopische Cholecystektomie. Chirurg 1991;62:257.
28. Ungeheuer A, Feussner H, Böttcher K, et al. Laparoskopische Cholezystektomie-Welche preoperative Diagnostik sollte Standard sein? Minimal Invasive Chirurgie 1993;2 Suppl 1:29.
29. Unger SW, Scott JS, Unger HM, et al. Laparoscopic approach to gallstones in the morbidly obese patient. Surg Endosc 1991;5:116.
30. Wurst H, Finsterer U. CO2 Emphysem bei laparoskopischer Chirurgie. Veränderungen der pulmonalen CO2-Elimination. Anästhesist 1994;43:466.