



## The use of laparoscopy in abdominal emergencies

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### Abstract

**Background:** The purpose of this article is to describe our experience using laparoscopy in the management of emergent and acute abdominal conditions.

**Methods:** Between March 1997 and November 2001, 277 consecutive minimally invasive procedures were performed for various nontrauma surgical emergencies. The indications for operation were nonspecific abdominal pain in 129 cases (46%), peritonitis in 64 cases (23%), small bowel obstruction in 52 cases (19%), complications after previous surgery or invasive procedures in 24 cases (9%), and sepsis of unknown origin in 8 cases (3%).

**Results:** Laparoscopy obtained a correct diagnosis in 98.6% of the cases. In 207 patients (75%), the procedure was completed laparoscopically. An additional 35 patients (12.5%) required a target incision. The remaining 35 patients (12.5%) underwent formal laparotomy. The morbidity rate was 5.8%. No laparoscopy-related mortality was observed.

**Conclusions:** For patients with abdominal emergencies, the laparoscopic approach provides diagnostic accuracy and therapeutic options, avoids extensive preoperative studies, averts delays in operative intervention, and appears to reduce morbidity.

**Key words:** Diagnostic laparoscopy — Minimally invasive surgery — Abdominal emergencies — Acute abdomen

The growing experience with minimally invasive surgery has enabled an increasing number of laparoscopic and video-assisted operations. In the emergency setting, the exact diagnosis often is in doubt, so a laparoscopic approach is particularly attractive because it can provide

the diagnosis and avoid a large abdominal incision [2, 4, 13].

Many surgeons now routinely perform laparoscopic cholecystectomy for acute cholecystitis and its complications [15, 23]. It is clear that laparoscopy is safe and effective in patients with this condition.

In the trauma setting, laparoscopy was found to be inaccurate in diagnosing hollow viscus injuries, but as good as sonography in determining the need for open exploration [6, 20]. Therefore, most trauma surgeons use laparoscopy only in highly selected cases.

In other emergency surgical situations, the role of laparoscopy is not as well defined. Although a number of studies [1, 4, 14] have described laparoscopic surgery used in nontrauma emergencies other than acute cholecystitis, it is clear that more experience and collective data are needed.

In this article, we present a series of 277 patients with nontrauma emergency surgical conditions for whom laparoscopy was the initial operative approach. The pathology, outcomes, conversion rates, morbidity, and mortality rate are discussed.

### Materials and methods

Between March 1997 and November 2001, we performed 277 consecutive minimally invasive procedures for various nontrauma surgical emergencies. The patients included 192 women and 85 men ages 18 to 91 years. All the procedures were performed at the Soroka University Medical Center, a 1,100-bed tertiary teaching hospital, which is the main teaching facility of the Ben Gurion University Medical School. Laparoscopic cholecystectomies for acute cholecystitis were excluded from this study.

All the procedures were performed by themselves or under the guidance of one among the five attending surgeons in our group. The surgical resident on call worked up the patients, and the decision to operate was based on standard indications. Initial diagnostic laparoscopy was considered for patients with abdominal pain and localized tenderness; patients with an unclear diagnosis, obscure diffuse peritonitis, free air in the peritoneal cavity, intestinal obstruction, postoperative complications, or a suspected mesenteric event; and patients critically ill with sepsis of unknown origin.

Whenever possible, informed consent was obtained. In obtaining informed consent, the innovative nature of the minimally invasive

approach was emphasized, and it was made clear that conversion might be necessary. In the rare instances wherein the patient could not give consent and the procedure could not be delayed, the explanation was given to the next of kin.

Either the Hasson technique or the Veress needle was used to establish pneumoperitoneum according to individual surgeon preference. The location usually was periumbilical, but in patients with previous scars, a different location was chosen as far as possible from previous scars, particularly when the Veress needle was used. Pressures were kept between 10 and 15 mmHg. The lower pressures were used with sicker patients. A 45° 10-mm telescope usually was preferred.

After thorough examination of the peritoneal cavity and at all times during the procedure, the surgeon decided whether to proceed laparoscopically, to convert the procedure immediately, or to terminate the procedure. If the surgeon decided to proceed laparoscopically, additional 5- or 10-mm ports were inserted under direct vision, as required. If it was necessary to resect a viscus, a small target transverse incision was made, and anastomosis was performed outside the abdominal cavity. If the rest of the procedure was performed laparoscopically, we did not count this as a conversion.

In cases of intestinal obstruction, the surgeon attempted to identify the point of transition from dilated to collapsed bowel. Failure to identify this point clearly was an indication for conversion.

The following outcome measures were used to assess the results: diagnostic accuracy, duration of operation, morbidity, mortality, and length of hospital stay.

## Results

Overall, the operation was completed by minimally invasive methods in 240 of the 277 patients (87%) in this series. In the remaining 66 patients, it was necessary to convert the procedure, either immediately or as the procedure developed. As detailed later, the rate of conversion was lowest for patients with abdominal pain and localized tenderness, and highest for intestinal obstruction.

The distribution of the patients according to indication for emergency operation is summarized in Table 1.

### *Obscure abdominal pain and generalized peritonitis*

Of the 129 patients with acute abdominal pain and localized tenderness, 61 (47%) had acute appendicitis. It should be emphasized that this was a selected group. The patient with obvious signs of appendicitis underwent a conventional operation. Other findings for this group are summarized in Table 2. Initially, most of the surgeons in the group routinely removed a normal appendix, even if the diagnosis was clearly a gynecologic problem or the laparoscopy was negative. As we gained confidence, removal of normal appendices became less prevalent, particularly in women of reproductive age. In this group, laparoscopy involved one diagnostic error: One woman with a negative laparoscopy was found to have a disseminated retroperitoneal sarcoma 5 months later.

Table 3 lists the findings for the patients who had diffuse peritonitis, with or without free air. Laparoscopy was attempted in 61 patients. Among these patients, 21 had a perforated duodenal ulcer and 2 had a perforated gastric ulcer. Consequently, 22 (96%) of these patients underwent laparoscopic suturing and omentopexy. One patient had a posterior gastric ulcer that could not be

**Table 1.** Indications for laparoscopy

Preoperative presentation	<i>n</i>
Acute abdominal pain	129
Generalized peritonitis	64
Small bowel obstruction	52
Complications after invasive procedures and operations	24
Sepsis of unknown origin	8
Total	277

visualized laparoscopically, and conversion was necessary.

In this group a single death occurred. A 77-year-old morbidly obese woman with multiple chronic conditions had a perforated gastric ulcer. She died of severe congestive heart failure 3 days after the operation.

Another patient complicated with a subhepatic abscess required percutaneous drainage. He was uneventfully discharged after 15 days. The remaining patients had an uneventful course. Overall, the median hospital stay was 5 days. All the patients were placed on triple therapy for ulcer.

Eleven patients ages 53 to 81 years, had a colon perforation. In six of these patients, there was overt obvious carcinoma. For all six the procedure was converted. In four of the patients with perforated diverticulitis, the sigmoid colon was mobilized laparoscopically, and resection was performed via a left gridiron incision. Because these patients had generalized peritonitis, they all underwent a colostomy. The procedure for one patient was converted to a Hartman procedure. Of the 11 patients with perforated colon, 3 died of sepsis. Excluding these, the median postoperative stay was 6 days.

There was one case of sigmoid volvulus involving a debilitated bedridden 67-year-old woman. The diagnosis was missed preoperatively because the plain abdominal radiographs were read as showing free air. The volvulus was successfully derotated laparoscopically, and the patient underwent an uneventful sigmoidectomy at a later date.

In 14 patients, we found a small bowel source for their generalized peritonitis. Six of these patients had a mesenteric event. In two patients, the process was extensive, and they received only supportive measures. The remaining four had limited resections via target incisions. In all of these patients, a 10-mm port was left for a planned second look after 24 h. One of these patients died of sepsis resulting from an anastomotic leak.

There were two foreign body perforations, one perforated lymphoma, and one perforated Crohn's disease. All four of these patients had a late presentation, and all their procedures had to be converted. One of the patients with a foreign body perforation died. The patient with perforated Crohn's disease had an anastomotic leak and required a second operation with an ileostomy. All had a prolonged postoperative course.

One 90-year-old woman had a perinephric abscess that ruptured into the abdomen. We could not identify the source of pus by laparoscopy, and the diagnosis was

**Table 2.** Management of patients with nonspecific abdominal pain after diagnostic laparoscopy

Diagnosis	<i>n</i>	Laparoscopic appendectomy <i>n</i> (%)	Laparoscopic treatment <i>n</i> (%)	Target minilaparotomy <i>n</i> (%)
Acute appendicitis	61	61		
Gynecologic problems	24	9	2	
Acute diverticulitis	5	1		
Mesenteric ischemia	2			1
Ruptured hepatoma	1			
Terminal ileitis	1	1		
Torsion of the omentum	1		1	
Mesenteric lymphadenitis	1	1		
Normal	33	22		
Total	129	95 (74)	3 (2)	1 (1)

**Table 3.** Pathology diagnosed and treated in patients admitted with peritonitis

	<i>n</i>	Laparoscopic treatment <i>n</i> (%)	Target minilaparotomy <i>n</i> (%)	Formal laparotomy <i>n</i> (%)
Gastroduodenal pathology				
Perforated duodenal ulcer	21	21		
Perforated gastric ulcer	2	1		1
Colonic pathology				
Perforated diverticulitis	5		4	1
Perforated colonic carcinoma	6			6
Sigmoid volvulus	1	1		
Small bowel pathology				
Perforated lymphoma	1			1
Mesenteric hemorrhage	1			1
Volvulus	1	1		
Enteritis	1			
Foreign body perforation	2			2
Crohn's disease	2	1		1
Pancreatobiliary pathology				
Infected liver cyst	1			1
Acute pancreatitis	1			
Perforated gallbladder	1			1
Destructive appendicitis	4	1	3	
Mesenteric ischemia	9		5	
Ovarian tumor	1		1	
Retroperitoneal abscess	1			1
Normal	3			
Total	64	26 (41)	13 (20)	16 (25)

made after conversion of the procedure. Predictably, this patient died.

There were four cases of perforated appendix with generalized peritonitis. In only one of these cases was the appendix removed laparoscopically. In the remaining cases, the procedure was converted, but because the pathology was known, a standard gridiron incision could be used for resection, and a midline incision was avoided. All four patients recovered well.

There was one case of portal vein thrombosis that was missed by laparoscopy. The patient continued to have abdominal pain after the negative laparoscopy, and the diagnosis was established on a computed tomography scan. He recovered after treatment with anticoagulants.

### Intestinal obstruction

Intestinal obstruction was found in 52 patients. Adhesions were the most common cause, occurring in 35 of the patients. All the patients with adhesion either failed

to resolve their obstruction with conservative treatment or experienced unrelenting pain. The adhesions in 21 (60%) of the patients were released laparoscopically. Laparoscopy was most successful when there was a single band and a clear transition zone. All laparoscopically treated patients recovered well. The postoperative hospital stay was 1 to 7 days (median, 4 days).

Procedure conversion was required for 14 patients, including 3 patients with iatrogenic perforation of the small bowel, 4 patients requiring resection of a severely ischemic small bowel, segment and 7 patients with dense adhesions that were too difficult to lyse laparoscopically. In four of these patients, it was possible to perform a small target incision, including one patient in whom the site of the obstruction was mobile, although densely stuck. Other causes of intestinal obstruction are listed in Table 4. In 13 patients, the correct laparoscopic diagnosis was made. All required conversion of procedure, although a target incision was possible in five patients.

One patient had a kinked loop of bowel adherent to an inflamed distal ileum. The adhesion was lysed laparoscopically, and Crohn's disease was diagnosed oper-

**Table 4.** Intraabdominal findings and treatment possibilities for patients with small bowel obstruction

Diagnosis	<i>n</i>	Laparoscopic treatment <i>n</i> (%)	Target minilaparotomy <i>n</i> (%)	Formal laparotomy <i>n</i> (%)
Adhesions	35	21	8	6
Incarcerated hernia				
Inguinal	2		2	
Internal	1		1	
Bezoar	3			3
Small bowel tumor	2		2	
Complicated appendicitis	2			2
Intususception	2			2
Cecal carcinoma	1			1
Crohn's disease	1			
Pseudoobstruction	2			2
Normal	1			
Total	52	21 (40)	13 (25)	16 (31)

**Table 5.** Postoperative and postinvasive complications of procedures treated laparoscopically

Complications	<i>n</i>	Diagnosis by laparoscopy <i>n</i> (%)	Laparoscopic treatment <i>n</i> (%)	Target minilaparotomy <i>n</i> (%)	Formal laparotomy <i>n</i> (%)
After laparoscopic cholecystectomy					
Bile leak	5	5	3		2
Pain	4	4			
Small bowel perforation	2	2	1	1	
Bleeding	2	2	2		
Subphrenic abscess	2	2	2		
After laparoscopic appendectomy	4	4	2	2	
After laparoscopic incisional hernia repair	1	1	1		
After right colectomy	1	1		1	
After PEG tube insertion	2	2	1	1	
After colonoscopy	1	1		1	
Total	24	24 (100)	12 (50)	6 (25)	2 (8)

PEG, percutaneous endoscopic gastrostomy

actively. She had a rapid recovery, but came back with recurrent obstruction 2 months later. At that time, she had an open exploration with resection of the diseased segment. Surprisingly, the pathology report showed adenocarcinoma of the distal ileum.

In one patient, the bowel was dilated throughout, and the procedure was terminated. Further evaluation during the same hospitalization discovered carcinoma of the ascending colon. The patient underwent a successful right hemicolectomy.

The procedure for two patients with similar findings was converted. They were chronically ill patients with paralytic ileus whose condition had been misdiagnosed preoperatively as mechanical obstruction.

There was one death in the intestinal obstruction group. The patient who died had undergone forward-milking of a bezoar after conversion of her procedure. Peritonitis had developed, perforating the small bowel at the site where the bezoar was stuck.

#### *Diagnostic laparoscopy after operations or invasive procedures*

A diagnostic laparoscopy was performed for 15 patients who had complications of laparoscopic cholecystectomy (Table 5). The most common indication for relaparos-

copy was extraordinary postoperative pain. Five patients had bile leaks: one from an accessory duct and four from the cystic duct stump. In three of these patients, we were able to fix the problem laparoscopically, and the procedures for two of the patients had to be converted. One of the latter two patients, a human immunodeficiency virus carrier, died of sepsis.

Three patients had a bleeding site. All of these sites were controlled laparoscopically. There were two cases of bowel perforations. The first patient had a small hole in the second part of the duodenum, which was closed laparoscopically with omentopexy. The other patient had a small bowel perforation. The loop was dragged out to the Hasson port site, and the hole sewn. Both patients recovered well postoperatively.

One subphrenic abscess was drained laparoscopically. Four patients had a negative relaparoscopy. All the patients treated laparoscopically recovered well, except one patient with a rectus sheath hematoma who required a long time to recover.

Four patients were scoped after laparoscopic appendectomy. The findings showed one with a perforated cecum, one with a perforated small bowel, one with an abscess in the right gutter, and one with negative examination results.

Three patients had complications of endoscopic procedures. One had sustained a 7-cm-long sigmoid

**Table 6.** Morbidity

Complication	<i>n</i>
Intraoperative	
Small bowel laceration	2
Uterus laceration	1
Postoperative	
Intraabdominal sepsis	6
Small bowel fistula	2
Anastomotic leak	2
Subphrenic abscess	1
Paralytic ileus	1
CHF	1
ARDS	1
Respiratory failure	1
Total	18

CHF, congestive heart failure; ARDS, acute respiratory distress syndrome

perforation during colonoscopy, and two patients had leaks after percutaneous endoscopic gastrostomy tube placement. The sigmoid was repaired primarily via a left gridiron incision. One of the gastrostomy tube placements was converted. In the other case, the gastrostomy tube was removed. The hole was oversewn laparoscopically, and a laparoscopically assisted feeding jejunostomy was performed.

#### *Sepsis of unknown origin*

Diagnostic laparoscopy was performed in eight intensive care unit patients with sepsis of unknown origin. One had acute acalculous cholecystitis, which was treated by laparoscopic cholecystectomy. No intraabdominal pathology was found in the remaining patients. The overall morbidity rate in our series was 5.8%. The complications are summarized in Table 6. The mortality rate was 6.9% (Table 7). No death was related to the use of laparoscopy for diagnosis or treatment of the emergency condition.

## Discussion

Diagnostic laparoscopy was introduced to surgical practice in the beginning of the 20th century, but had a limited use for about 80 years. In the past decade, the advent of new video systems, improved laparoscopic instruments, and increasing surgical experience all have enabled laparoscopic surgeons to venture into new areas. Laparoscopy provides adequate visualization of the entire abdominal cavity as well as accurate diagnosis and localization of intraabdominal pathology. Determination of the fluid type; aspiration of pus, blood, bile and intestinal content; and irrigation of the peritoneal cavity under pressure are much more precise with laparoscopy [9]. In cases of acute diverticulitis, pancreatitis, extensive mesenteric ischemia, or negative laparoscopy, an unnecessary laparotomy can be avoided.

Other authors [1–4, 8, 10, 14] have reported a high diagnostic yield (89% and 100%) with diagnostic laparoscopy in acute abdomen. In the current series of 277

**Table 7.** Mortality

Cause of death	<i>n</i>
Mesenteric vascular event	6
Continuation of preoperative sepsis	6
Postoperative intraabdominal sepsis	5
CHF	1
ARDS	1
Total	19

CHF, congestive heart failure; ARDS, acute respiratory distress syndrome

patients, laparoscopy obtained a correct diagnosis in 98.6% of the cases.

Two of the diagnostic errors occurred two patients with intestinal obstruction in a virgin abdomen whose procedures were not converted. In one of these patients, carcinoma of the distal ileum was misdiagnosed as Crohn's terminal ileitis. This error could occur also in open surgery, and in fact was found by the pathologist only after resection a few months later. Nevertheless, the procedure for patients with intestinal obstruction in a virgin abdomen probably should be converted, at least to a target incision. If the procedure is not converted, further investigations should be conducted to make sure no significant pathology was missed.

With current laparoscopic devices, the retroperitoneum, pancreas, and posterior gastric wall are not well visualized. If pathology in these areas is suspected, conversion of procedure or initial formal laparotomy is the best approach.

In 33 of our cases (12%), we were able to treat the pathology via a small target incision. This was possible for small bowel resection, formation of stomas, and adhesiolysis. Often, the target incision was a simple enlargement of a port site. The advantage of making a small target incision is not merely cosmetic. It reduces postoperative pain and discomfort, and lowers the risk of wound complications such as infection or a subsequent incisional hernia.

In our study, only 37 patients (13%) underwent formal laparotomy. Overall, 75% of the patients brought to the operating theater were treated exclusively by laparoscopy.

A possible criticism of laparoscopy use in septic patients is that it may lead to intraabdominal abscess formation. In our study, we had only one patient with postoperative abscess. We found that vacuuming out pus and cleaning the abdominal cavity were much more accurate under laparoscopic guidance. We could avoid the copious use of saline to wash out the abdominal cavity, a practice that at least theoretically has some disadvantages [18].

We found that in patients with intraabdominal sepsis and peritonitis, the role of laparoscopy is mainly diagnostic. Unless the diagnosis was appendicitis, perforated ulcer, or a mesenteric event, the procedure had to be converted. However, because the diagnosis had been established, a small incision often could be used.

Diagnostic laparoscopy for acute abdominal pain clearly is beneficial for women of childbearing age be-

cause it allows careful evaluation of the tubes, ovaries, and uterus [11]. In our study, 73% of such patients had gynecologic pathology. In a recent randomized study, Olsen et al. [16] showed that diagnostic laparoscopy in women suspected of acute appendicitis could avoid an unnecessary appendectomy in 30% of the cases.

Like others [7, 17], we too found that the minimally invasive approach is particularly advantageous in obese patients, those with a known ectopic appendix, and patients with suspected peritonitis.

Our results support the efficacy of laparoscopic omentopexy for perforated gastric and duodenal ulcers. Because we currently can treat more than 90% of patients with peptic ulcer using eradication of *Helicobacter pylori* and proton pump inhibitors, an acid-reducing procedure rarely is required. A recent report, comparing omentopexy alone to omentopexy with vagotomy and drainage found no difference in outcome between the two procedures [5, 22]. We could not compare our results to historical cases, because in the past, all but the sickest patients underwent a vagotomy. Nevertheless, our results compare favorably with reported cases [19]. With experience, the average operating time currently is approximately 30 min, and most patients are discharged within 4 days. All patients require eradication of *H. pylori* and treatment with proton pump inhibitors postoperatively.

A potential disadvantage of laparoscopically treated perforated gastric ulcer is that a biopsy is not performed. It is reasonable to obtain a biopsy, even with laparoscopy, but this enlarges the hole and makes closure more technically challenging. We believe that it is better to obtain the biopsy by gastroscopy after the patient recovers, and to consider a gastrectomy in a more stable patient.

An acid-reducing operation still may be necessary for patients using chronic nonsteroidal drugs because an ulcer can develop in these patients without *H. pylori* infection. There were no such patients in the current study. It is possible that for such patients, the surgeon should consider conversion to a Cox II inhibitor agent or an alternative surgical approach.

We did not perform laparoscopy for bleeding peptic ulcers, although a laparoscopic approach to bleeding ulcers has been described [12]. Currently, most bleeding ulcers can be controlled endoscopically [21]. The few patients who still require operative control usually are sick and hemodynamically unstable. Consequently, we believe that in such patients, prolonged juggling with the laparoscopic instruments is ill advised.

For small bowel obstruction, laparoscopy was most useful when there was a clear demarcation between distended and collapsed loops of small bowel. In these cases, it is possible to follow the loops of bowel to the transition point, which often is a single band that can be divided easily. Manipulation of the small bowel should be done carefully using atraumatic graspers. If possible, it is preferable to manipulate collapsed loops first. Conversion should be considered if multiple adhesions are found, or if manipulation of grossly distended loops is required. The risk of tearing the thin-walled friable, dilated bowel is high, and a tear in the distended loop

will lead to gross contamination of the peritoneal cavity. When the adhesions are deep in the pelvis, conversion also may be necessary because of poor visualization.

To undertake emergency laparoscopic operations, the surgeon must be well trained and experienced in advanced laparoscopic surgery. Mastery of two-handed dissection and laparoscopic suturing techniques is an absolute requirement. Good judgment is needed for a timely decision to convert the procedure. Prolonged attempts to complete the operation laparoscopically are ill advised and may lead to serious complications, including death.

The training of surgical residents in these procedures is important. Initially, senior faculty members performed all the emergency procedures in this series. Later, senior residents and junior staff under the supervision of a more experienced surgeon performed them.

We conclude that in many emergency abdominal conditions, initial laparoscopy is always an excellent and even a preferred diagnostic tool. After the diagnosis is established, the problem often can be solved without opening the abdomen.

## References

1. Agresta F, Michelet I, Coluci G, Bedin N (2000) Emergency laparoscopy: a community hospital experience. *Surg Endosc* 14: 484–487
2. Chung RS, Diaz JJ, Chari V (1998) Efficacy of routine laparoscopy for the acute abdomen. *Surg Endosc* 12: 219–222
3. Cuesta MA, Borgstein PJ, Meijer S (1993) Laparoscopy in the diagnosis and treatment of acute abdominal conditions: clinical review. *Eur J Surg* 159: 455–456
4. Cuesta MA, Eijsbouts QA, Gordijn RV, Borgstein PJ, de Jong D (1998) Diagnostic laparoscopy in patients with an acute abdomen of uncertain etiology. *Surg Endosc* 12: 915–917
5. Druart ML, Van Hee R, Etienne J, Cadiere GB, Gigot JF, Legrand M, Limbosch JM, Navez B, Tugilimana M, Van Vyve E, Vereecken L, Wibin E, Yvergneaux JP (1997) Laparoscopic repair of perforated duodenal ulcer: a prospective multicenter clinical trial. *Surg Endosc* 11: 1017–1020
6. Elliott DC, Rodriguez A, Moncure M, Myers RA, Shillinglaw W, Davis F, Goldberg A, Mitchell K, McRitchie D (1998) The accuracy of diagnostic laparoscopy in trauma patients: a prospective, controlled study. *Int Surg* 83: 294–298
7. Enochsson L, Hellberg A, Rudberg C, Fenyo G, Gudbjartson T, Kullman E, Ringqvist I, Sorensen S, Wenner J (2001) Laparoscopic vs open appendectomy in overweight patients. *Surg Endosc* 15: 387–392
8. Fahel E, Amaral PC, Filho EM, Ettinger JE, Souza EL, Fortes MF, Alcantara RS, Regis AB, Neto MP, Sousa MM, Fogagnoli WG, Cunha AG, Castro MM, Santana PA Jr (1999) Nontraumatic acute abdomen: videolaparoscopic approach. *J Soc Laparoendosc Surgeons* 3: 187–192
9. Geis WP, Kim HC (1995) Use of laparoscopy in the diagnosis and treatment of patients with surgical abdominal sepsis. *Surg Endosc* 9: 178–182
10. Henry C, Smadja C, Vons C, Bobocescu E, Mariette D, Tahrat M, Franco D (1998) Results of laparoscopic treatment of abdominal emergencies. *Ann Chir* 52: 223–228
11. Larsson PG, Henriksson G, Olsson M, Boris J, Stroberg P, Tronstad SE, Skullman S (2001) Laparoscopy reduces unnecessary appendectomies and improves diagnosis in fertile women: a randomized study. *Surg Endosc* 15: 200–202
12. Martin I, O'Rourke N, Bailey I, Branicki F, Nathanson L, Fielding G (1998) Laparoscopic underrunning of bleeding duodenal ulceration: a minimalist approach to therapy. *Aust N Z J Surg* 68: 213–215

13. Memon MA, Fitzgibbons RJ Jr (1997) The role of minimal access surgery in the acute abdomen. *Surg Clin North Am* 77: 1333–1353
14. Navez B, d'Udekem Y, Cambier E, Richir C, de Pierpont B, Guiot P (1995) Laparoscopy for management of nontraumatic acute abdomen. *World J Surg* 19: 382–386
15. Navez B, Mutter D, Russier Y, Vix M, Jamali F, Lipski D, Cambier E, Guiot P, Leroy J, Marescaux J (2001) Safety of laparoscopic approach for acute cholecystitis: retrospective study of 609 cases. *World J Surg* 25: 1352–1356
16. Olsen JB, Myren CJ, Haahr PE (1993) Randomized study of the value of laparoscopy before appendectomy. *Br J Surg* 80: 922–923
17. Pedersen AG, Petersen OB, Wara P, Ronning H, Qvist N, Laurberg S (2001) Randomized clinical trial of laparoscopic versus open appendectomy. *Br J Surg* 88: 200–205
18. Pross M, Mantke R, Kunz D, Reinheckel T, Halangk W, Lippert H, Schulz HU (2002) Reduced neutrophil sequestration in lung tissue after laparoscopic lavage in a rat peritonitis model. *World J Surg* 26: 49–53
19. Robles R, Parrilla P, Lujan JA, Torralba JA, Cifuentes J, Liron R, Pinero A (1995) Long-term follow-up of bilateral truncal vagotomy and pyloroplasty for perforated duodenal ulcer. *Br J Surg* 82: 665
20. Rossi P, Mullins D, Thal E (1993) Role of laparoscopy in the evaluation of abdominal trauma. *Am J Surg* 166: 707–710
21. Seewald S, Seitz U, Thonke F, Sriram PV, He XK, Soehendra N (2001) Interventional endoscopic treatment of upper gastrointestinal bleeding: when, how, and how often. *Langenbecks Arch Surg* 386: 88–97
22. So JB, Kum CK, Fernandes ML, Goh P (1996) Comparison between laparoscopic and conventional omental patch repair for perforated duodenal ulcer. *Surg Endosc* 10: 1060–1063
23. Suter M, Meyer A (2001) A 10-year experience with the use of laparoscopic cholecystectomy for acute cholecystitis: is it safe? *Surg Endosc* 15: 1187–1192