

SAGES guideline for laparoscopic appendectomy

James R. Korndorffer Jr. · Erika Fellinger ·
William Reed

Received: 15 May 2009 / Accepted: 24 June 2009 / Published online: 29 September 2009
© Springer Science+Business Media, LLC 2009

Preamble

The laparoscopic approach to appendectomy has gained wide acceptance over the last 15 years as a means of improved diagnostic accuracy and wound complication rate over the open procedure. Despite a breadth of data and widespread adoption of the technique, there continues to be controversy regarding the advantages of this approach in hastening postoperative recovery, as well as its use in the management of complicated appendicitis. The following guidelines provide recommendations to surgeons for the laparoscopic management of patients with both simple and complicated appendicitis.

Disclaimer

Guidelines for clinical practice are intended to indicate preferable approaches to medical problems as established by experts in the field. These recommendations will be based on existing data or a consensus of expert opinion when little or no data are available. Guidelines are applicable to all physicians who address the clinical problem(s)

without regard to specialty training or interests, and are intended to indicate the preferable, but not necessarily the only acceptable approaches. Guidelines are intended to be flexible. Given the wide range of specifics in any health care problem, the surgeon must always choose the course best suited to the individual patient and the variables in existence at the moment of decision.

Guidelines are developed under the auspices of the Society of American Gastrointestinal Endoscopic Surgeons and its various committees, and approved by the Board of Governors. Each clinical practice guideline has been systematically researched, reviewed, and revised by the guidelines committee, and reviewed by an appropriate multidisciplinary team. The recommendations are therefore considered valid at the time of their production based on the data available. Each guideline is scheduled for periodic review to allow incorporation of pertinent new developments in medical research knowledge, and practice.

Definitions

See SAGES [1].

Utilization of laparoscopy for appendicitis

Guideline: The indications for appendectomy are identical whether performed laparoscopically or open (level III, grade A).

For the purpose of this guideline, it is recognized that the clinician has determined that operative intervention for presumed appendicitis is indicated. When the clinician is evaluating a patient with possible appendicitis, the risk and benefit of each diagnostic test and evaluation should be

J. R. Korndorffer Jr. (✉)
Department of Surgery, Tulane University School of Medicine,
New Orleans, LA, USA
e-mail: Korndorffer@tulane.edu; jkorndo@tulane.edu

E. Fellinger
Department of Surgery, Cambridge Health Alliance, Cambridge,
MA, USA

W. Reed
Department of Surgery, Winthrop University Hospital, Mineola,
NY, USA

taken into account during the workup. The use of laparoscopy to establish the diagnosis of appendicitis is addressed in [2].

General considerations when deciding to proceed laparoscopically include availability of trained staff and equipment, ability and training of surgeon, and the patient's ability to tolerate general anesthesia and pneumoperitoneum. Previous laparotomy is not an absolute contraindication to a laparoscopic approach.

Patient selection

Uncomplicated appendicitis

Guideline: Laparoscopic appendectomy is a safe and effective method for treatment of uncomplicated appendicitis and may be used as an alternative to standard open appendectomy (level I, grade A).

Length of operation, postoperative pain, and return to work

Multiple randomized controlled studies have demonstrated the safety and efficiency of laparoscopic appendectomy compared with open appendectomy for the treatment of acute appendicitis. Generally, these studies involve 200 patients or less [3] but some larger experiences have also been reported [4, 5]. Although the differences between the two approaches have been small, most studies show that the laparoscopic operation is longer but associated with a shorter hospital stay and possibly with a more rapid return to work. A meta-analysis of 28 trials available by 1998 [6] found that the laparoscopic approach took about 16 min longer but resulted in less postoperative pain on day 1, shorter hospital stays (15 h), and quicker return to full activities (5–9 days sooner). Complication rates were comparable, except that wound infections were slightly lower after laparoscopic appendectomy. More recent updates by these authors [7, 8], analyzing 45 and 54 studies, confirm that the open procedure is shorter (12 min) but results in more pain and longer stays. Wound infections occurred about half as often with the laparoscopic approach, but deep pelvic abscesses were twice as frequent.

Because of the lack of clarity of results from clinical trials, population-based studies of up to 150,000 cases looking at the results by International Classification of Diseases (ICD)-9 codes for laparoscopic and open appendectomy have been analyzed to sample a broader range of patients [9, 10]. These studies have again shown shorter stays, higher rates of routine discharge, and lower morbidity and mortality rates for the laparoscopic group. In particular, mortality rates for laparoscopic appendectomy

were only one-fifth of the rates of open appendectomy for patients older than 65 years.

Complications and conversions

In earlier population studies, complication rates were comparable between the two approaches, except for a higher wound infection rate for the open approach and a higher intraabdominal abscess rate for the laparoscopic procedure. Recent studies [5, 11] show little difference in complications, suggesting that with added experience surgeons can reduce the rate of abscess formation.

Recurrent appendicitis has been seen in patients whose appendix was incompletely removed at the original operation [12, 13]. This is a problem seen with open appendectomies as well [14], but stresses the need for careful laparoscopic dissection and identification of landmarks prior to appendiceal division. Fortunately, the tip of the appendix usually lies free in the peritoneal cavity [15] rather than being behind the cecum, minimizing this risk.

Conversion rates vary from 0 to 27% [3]. Conversion to open appendectomy should be done according to surgeon judgement, experience, and ability to treat the operative findings safely.

Cost

Initial studies of laparoscopic appendectomy (LA) suggested higher costs because of the expense for equipment and the longer operative times [16]. As surgeons and centers have gained experience, it is no longer clear that there is a higher cost with laparoscopy. The small differences in operative costs are offset by gains attributable to shorter hospital stay and quicker return to work [17, 18]. These factors are not entirely addressed by current studies. See the technical section for further discussion.

Perforated appendicitis

Guideline: Laparoscopic appendectomy may be performed safely in patients with perforated appendicitis (level II, grade B) [10, 19] and is possibly the preferred approach (level III, grade C).

There have been no randomized controlled trials comparing open and laparoscopic treatment of perforated appendicitis, but multiple studies have established the feasibility and safety of LA. There is significant variability in complication rates, specifically infection rates, reported in the literature. Level I evidence indicates that LA has a lower wound infection rate, and a large population-based study also identified LA to be associated with a lower infection rate [10]. The population studies showed shorter stays, and lower morbidity and mortality rates for the

laparoscopic group. These findings were the same for all age groups, regardless of whether perforations had occurred or abscesses developed. Earlier studies showed a possible increased risk of intra-abdominal abscess (IAA) formation after LA for perforated appendicitis, however more recent studies show no difference [19]. Others have shown that, with specialized laparoscopic teams, the IAA rate can be diminished [20].

Women of childbearing age

Guideline: Laparoscopic approach for fertile women with presumed appendicitis should be the preferred method of treatment (level 1, grade A).

With improved visualization of the entire abdomen, laparoscopy for the treatment of appendicitis improves the diagnostic accuracy and can identify the definitive pathology more often than the open approach [21–24].

Elderly patients

Guideline: Laparoscopic approach may be the preferred method of treatment (level II, grade B) [10, 25].

Population-based studies have shown a lower rate of complications and death, especially in the elderly (2.4 vs. 0.5%) [10] for open versus laparoscopic appendectomy in patients aged over 65 years. This supports the primary use of laparoscopic appendectomy for uncomplicated appendicitis in those centers possessing the requisite skills and equipment.

Pediatric patients

Guideline: Laparoscopic appendectomy may be safely performed in pediatric patients. For specific recommendations, reference may be made to International Pediatric Endosurgery Group (IPEG) guidelines.

Pregnancy

Guideline: Laparoscopic appendectomy may be performed safely in pregnant patients with suspicion of appendicitis (level II, grade B).

Laparoscopic appendectomy can be performed safely in any trimester and is considered by many to be the standard of care for gravid patients with suspected appendicitis [26–29]. See [30] for more complete discussion.

Obesity

Guideline: Laparoscopic appendectomy is safe and effective in obese patients (level II, grade B) and may be the preferred approach (level III, grade C).

The laparoscopic approach may convey some advantages over the open approach in access to the appendix, visualization, and decrease in wound complications. In the morbidly obese, longer trocars and instruments may be needed [31].

Special considerations

Treatment of normal appendix on laparoscopy for appendicitis

Guideline: If no other pathology is identified, the decision to remove the appendix should be considered but based on the individual clinical scenario (level III, grade A).

Macroscopically normal appendixes may have abnormal histopathology. Several studies have shown a 19–40% rate of pathologically abnormal appendix in the setting of no visual abnormalities [32]. Therefore, the risk of leaving a potentially abnormal appendix must be weighed against the risk of appendectomy in each individual scenario. Cases of postoperative symptoms requiring reoperation for appendectomy have been described in patients whose normal appendix was left in place at the time of the original procedure.

Technical aspects

Guideline: Developing a consistent operative method decreases costs, operating room (OR) time, and complications (level II, grade B).

Historical context

Laparoscopic appendectomy has been simplified by the development of electrocoagulating bipolar instruments, ultrasonic dissectors, and endoscopic staplers as well as improved camera optics. Experience has brought about a reduction in the size and number of ports. Mastery of the learning curve and proficiency in advanced laparoscopic techniques has decreased OR times.

There is very little level I evidence comparing particular techniques, however some level II and III evidence suggests that developing a consistent method decreases costs and OR time and decreases complications [20, 33]. This applies to laparoscopic appendectomy performed in a training program. One study involved the creation of a minimally invasive service.

The use of standardized techniques, including peritoneal lavage following removal of the appendix, has been shown to reduce the intraabdominal abscess rate [20] after a learning curve of 20 cases.

Technical approaches

Positioning: Supine position with Trendelenburg, left arm tucked with both surgeon and camera operator on patient's left side. Foley placement, or voiding preoperatively in uncomplicated appendicitis, provides decompression of bladder which may help with exposure and avoid injury.

Trocar placement: Basic principles of triangulation in trocar placement apply. All studies describe placement of the initial (usually a 10-mm camera) port at the umbilicus. One study [34] found that using all 5-mm ports was feasible, although 35% needed conversion to a 10-mm trocar due to a fatty mesoappendix. While port placement is at the discretion of the operating surgeon, the secondary port placements reported in the literature were:

- i. LLQ and RUQ or R mid-abdomen.
- ii. LLQ and RLQ directly above appendix for retraction. This location provides a means for "fingeroscopy" [20] to break up adhesions. One study found that fingeroscopy may allow more efficient and full lysis of inflammatory adhesions and loculations and prevent incomplete appendectomy.
- iii. RLQ and suprapubic.
- iv. LLQ and suprapubic.
- v. Considerations: Having two working ports in adjacent quadrants (i.e., LLQ and suprapubic positions) allows the surgeon to work two-handed, rather than relying on an assistant to provide retraction while the surgeon dissects. Surgeons should consider the experience level of their assistant as well as the goals of a training program if they work in one.

Appendiceal retraction: Methods reported include simple retraction with a grasper via a 5-mm port, a 5-mm port placed directly above the appendix, an endotie around the end of the appendix to retract up, or a straight needle placed through the abdominal wall.

Appendix

This document was prepared and revised by the SAGES Guidelines Committee:

James R, Korndorffer, Jr., MD
 Erika Fellinger, MD
 William Reed, MD
 Keith Apelgren, MD
 Stephen Haggerty, MD
 Geoffrey Kohn, MD
 Raymond Price, MD
 J. Salameh, MD
 Dimitrios Stefanidis, MD
 Limaris Barrios, MD

Keenan Berghoff, MD

Simon Bergman, MD

David Earle, MD

Timothy Farrell, MD

Jeffrey Hazey, MD

Steven Heneghan, MD

Thom Lobe, MD

Sumeet Mittal, MD

Jonathan Myers, MD

Wayne Overby, MD

Patrick Reardon, MD

Matthew Ritter, MD

Alan Saber, MD

Kevin Wasco, MD

William Richardson, MD, Co-Chair

Robert Fanelli, MD, Chair

It was reviewed and approved by the Board of Governors of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), April 2009.

Requests for prints should be sent to:

Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)

11300 West Olympic Blvd., Suite 600

Los Angeles, CA 90064

Phone: (310) 437-0544

Fax: (310) 437 0585

E-mail: sagesweb@sages.org

www.sages.org

This is a revision of a SAGES publication, which was printed 10/92.

References

1. Society of Gastrointestinal and Endoscopic Surgeons. www.sages.org/publication/id/DEF/. Accessed 14 Sept 2009
2. Guidelines Committee of SAGES (2008) SAGES guidelines for diagnostic laparoscopy. *Surg Endosc* 22:1353–1383
3. Fingerut A, Millat B, Borrie F (1999) Laparoscopic versus open appendectomy: time to decide. *World J Surg* 23:835–845
4. Hellberg A, Rudberg C, Kullman E, Enochsson L, Fenyo G, Graffner H et al (1999) Prospective randomized multicentre study of laparoscopic versus open appendectomy. *Br J Surg* 86:48–53
5. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R (2005) Laparoscopic versus open appendectomy, a prospective randomized double-blind study. *Ann Surg* 242:439–449
6. Sauerland S, Lefering R, Holthausen U, Neugebauer EAM (1998) Laparoscopic vs conventional appendectomy: meta-analysis of randomized controlled trials. *Langenbeck's Arch Surg* 383:289–295
7. Eypasch E, Sauerland S, Lofering R, Neugebauer EAM (2002) Laparoscopic versus open appendectomy: between evidence and common sense. *Dig Surg* 19:518–522
8. Sauerland S, Lefering R, Neugebauer EAM. Laparoscopic versus open surgery for suspected appendicitis. *Cochrane Database of Systematic Reviews* 2004, Issue 4. Art. No.: CD001546
9. Guller U, Hervey S, Purves H, Muhlbauer LH, Peterson ED, Eubanks S et al (2004) Laparoscopic versus open appendectomy:

- outcomes comparison based on a large administrative database. *Ann Surg* 239:43–52
10. Guller U, Jain N, Peterson ED, Muhlbaier LH, Eubanks S, Pietrobono R (2004) Laparoscopic appendectomy in the elderly. *Surgery* 135:479–488
 11. Frizelle FA, Hanna GB (1996) Pelvic abscess following laparoscopic appendectomy. *Surg Endosc* 10:947–948
 12. Walsh DCA, Roediger WEW (1997) Stump appendicitis: a potential problem after laparoscopic appendectomy. *Surg Laparosc Endosc* 7:357–358
 13. Marcoen S, Ongena T, vanLoon C, Vereecken L (2003) Residual appendicitis following incomplete laparoscopic appendectomy. *Acta Chir Belg* 103:517–518
 14. Watkins BP, Kothari SN, Landercasper J (2004) Stump appendicitis: case report and review. *Surg Laparosc Endosc Percutan Tech* 14:167–171
 15. O'Connor CE, Reed WP (1994) In vivo location of the human veriform appendix. *Clin Anat* 7:139–142
 16. McCahill LE, Pellegrini CA, Wiggins T, Helton WS (1996) A clinical outcome and cost analysis of laparoscopic versus open appendectomy. *Am J Surg* 171:533–537
 17. Martin L, Puente I, Sosa J, Bassin A, Breslaw R, McKenney M, Ginzburg E, Sleeman D (1995) Open versus laparoscopic appendectomy: a prospective randomized comparison. *Ann Surg* 222:256–262
 18. Long KH, Bannon MP, Zietlow SP, Helgeson ER, Harmsen WS, Smith CD et al (2001) A prospective randomized comparison of laparoscopic appendectomy with open appendectomy: clinical and economic analysis. *Surgery* 129:390–400
 19. Kouwenhoven EA, Repelaer van Driel OJ, van Erp WFM (2005) Fear for the intraabdominal abscess after laparoscopic appendectomy. *Surg Endosc* 19:923–926
 20. Kathouda N, Friedlander MH, Grant SW, Achanta KK, Essani R, Paik P et al (2000) Intraabdominal abscess rate after laparoscopic appendectomy. *Am J Surg* 180(6):456–461
 21. Laine S, Rantala A, Gullichsen R, Ovaska J (1997) Laparoscopic appendectomy—is it worthwhile? A prospective, randomized study in young women. *Surg Endosc* 11:95–97
 22. Fogli L, Brulatti M, Boschi S, Domenico M, Papa V, Patrizi P et al (2002) Laparoscopic appendectomy for acute and recurrent appendicitis: retrospective analysis of a single-group 5-year experience. *J Laparoendosc Adv Surg Tech* 12(2):107–110
 23. Bruwer F, Coetzer M, Warren BL (2003) Laparoscopic versus open surgical exploration in premenopausal women with suspected acute appendicitis. *S Afr J Surg* 41(4):82–85
 24. Zaninotto G, Rossi M, Anselmino M, Costantini M, Piannalto S, Baldan N, Pizzato D, Ancona E (1995) Laparoscopic versus conventional surgery for suspected appendicitis in women. *Surg Endosc* 9:337–340
 25. Hui TT, Major KM, Avital I, Hiatt JR, Margulies DR (2002) Outcome of elderly patients with appendicitis. *Arch Surg* 137:995–1000
 26. Affleck DG, Handrahan DL, Egger MJ, Price RR (1999) The laparoscopic management of appendicitis and cholelithiasis during pregnancy. *Am J Surg* 178:523–529
 27. Barnes SL, Shane MD, Schoemann MB, Bernard AC, Boulanger BR (2004) Laparoscopic appendectomy after 30 weeks pregnancy: report of two cases and description of technique. *Am Surg* 70:733–736
 28. Suttie SA, Seth S, Driver CP, Mahomed AA (2004) Outcome after intra- and extra-corporeal laparoscopic appendectomy techniques. *Surg Endosc* 18:1123–1125
 29. Carver TW, Antevil J, Egan JC, Brown CVR (2005) Appendectomy during early pregnancy: what is the preferred surgical approach? *Am Surg* 71:809–812
 30. Guidelines Committee of SAGES (2008) SAGES guidelines for diagnosis, treatment, and use of laparoscopy for surgical problems during pregnancy. *Surg Endosc* 22:849–861
 31. Enochsson L, Hellberg A, Rudberg C, Fenyo G, Gudbjartson T, Kullman E et al (2001) Laparoscopic vs open appendectomy in overweight patients. *Surg Endosc* 15:387–392
 32. Chiarugi M, Buccianti P, Decanini L, Balestri R, Lorenzetti L, Franceschi M et al (2001) “What you see is not what you get” a plea to remove a “normal” appendix during diagnostic laparoscopy. *Acta Chir Belg* 101:243–245
 33. Ng WT, Lee YK, Hui SK, Sze YS, Chan J, Zeng AGY, Wong CH, Wong WH (2004) An optimal, cost-effective laparoscopic appendectomy technique for our surgical residents. *Surg Laparosc Endosc Percutan Tech* 14:125–129
 34. El-Dhuwaib Y, Hamade AM, Issa ME, Balbisi BM, Abid G, Ammori BJ (2004) An “all 5-mm ports” selective approach to laparoscopic cholecystectomy, appendectomy, and anti-reflux surgery. *Surg Laparosc Endosc Percutan Tech* 14:141–143