Advantages and Problems with Endoscopic Surgery

JMAJ 52(5): 330–334, 2009

Nobuhiko TANIGAWA*1

Abstract

Endoscopic surgery, developed in response to the increased demand for less-invasive treatment, is now rapidly expanding its applications. This article explains the advantages and problems of endoscopic surgery compared with conventional surgical treatment based on peer-reviewed papers providing Level I or II evidence. We describe the safety, less-invasiveness and postoperative outcomes of endoscopic surgery, focusing on laparoscopic surgery for gallstone disease, gastric cancer, colorectal cancer, appendicitis, and gastroesophageal reflux, where this technology has been actively applied. Although it is clear that this approach involves several problems specific to diseases in particular organ systems, clinical results show that laparoscopic surgery is a new surgical approach offering the benefits of less-invasiveness and achieving long-term postoperative outcomes comparable to those of conventional open surgery.

To ensure the safe and secure use of this new surgical approach, it has been pointed out that the establishment of proper systems for education and training of endoscopic surgeries is important. It is demonstrated here that there is a need for clinical experience and training in a certain number of cases ("learning curve") to acquire the necessary surgical skills by showing our clinical experiences of laparoscopic gastrectomy. In addition, it is also stressed that a Web-based textbook "WebSurg," one of the e-learning systems, is useful in the field of endoscopic surgeon education.

Key words Comparative clinical study, Less-invasiveness, Endoscopic surgery education, WebSurg

Introduction

Endoscopic surgery, developed in response to the increasing demand for less-invasive treatment, is now rapidly expanding its applications not only in gastroenterological surgery and general surgery but also in urology, obstetrics/gynecology, respiratory surgery, endocrine surgery, pediatric surgery, orthopedic surgery, anesthesiology, and all other fields of surgical treatment. Endoscopically-guided cholecystectomy, which was first performed in 1986 in France, has been practiced at many medical institutions in Japan since about 1990. The history of medicine offers many examples of situations in which the development of a new therapeutic modality was thwarted by the frequent occurrence of complications due to a lack of experience in the initial stage of clinical introduction. For this reason, it is required to clearly define the advantages of a new therapy and its benefits for patients, as well as to address any related clinical problems.

This article points out the advantages and problems of endoscopic surgery in an objective and concrete manner. Discussion is based on reports of clinical studies comparing endoscopic surgery and conventional surgical treatment, focusing on representative peer-reviewed papers providing Level I or II evidence. We describe the safety, less invasiveness, postoperative outcomes, and prognosis of endoscopic surgery, focusing on laparoscopic surgery for cholecystolithiasis, gastric cancer, colorectal cancer, appendicitis, and

*1 Professor, Department of General and Gastroenterological Surgery, Osaka Medical College, Takatsuki, Japan (sur001@poh.osaka-med.ac.jp).
This article is a revised English version of a paper originally published in the Journal of the Japan Medical Association (Vol.137, No.9, 2008, pages 1833–1837).

gastroesophageal reflux, where this technology has been actively applied.

What Are the "Advantages" and "Problems" of Endoscopic Surgery?—Based on the reports of comparative clinical studies

What are the advantages of endoscopic surgery? Although during the relatively short 10-year history of this procedure little evidence has been accumulated demonstrating the advantages and problems of endoscopic surgery relative to those of conventional surgical treatment, there are some clinical studies comparing endoscopic surgery with conventional surgical treatment for diseases of particular organ systems.

Here, we focus on laparoscopic surgery, which is a representative form of endoscopic surgery, and discuss the comparative results of laparoscopic surgery and open surgery for cholecystolithiasis, appendicitis, colorectal cancer, gastric cancer, and gastroesophageal reflux based on reports providing Level I or II evidence.

Laparoscopic and open surgery for cholecystolithiasis

Scandinavian countries have been leading in the comparative study of laparoscopic cholecystectomy and open cholecystectomy.[1,2] These two studies come to similar conclusions, stating that laparoscopic surgery significantly contributed to the decrease in postoperative pain, the decrease in respiratory insufficiency, and the shortening in hospital stay and work-off periods as compared with open surgery, while there were no changes in the indicators of surgical invasion such as blood CRP, IL6, urine adrenalin, and cortisol levels.

Laparoscopic and open surgery for appendicitis

While laparoscopic surgery for appendicitis takes longer than open surgery, the occurrence of complications is comparable, and many reports agree on the benefits of less invasiveness of laparoscopic surgery, such as the decrease in wound infection, the decrease in postoperative pain, shorter hospital stay, and earlier rehabilitation.[3,4]

Laparoscopic and open surgery for colorectal cancer

The results of randomized studies comparing laparoscopic and open surgery for colorectal cancer have been reported from the NCI trial[5] in the U.S., the CLASSIC trial in the U.K., the COLOR trial in Europe, a study in Hong Kong,[6] etc. during the past several years. Studies agree that there is no difference in remote outcome in terms of 2- to 3-year short-term prognosis. While laparoscopic surgery significantly shortened postoperative hospital stay and the duration of analgesic use, and one report found no difference in the total cost of care and the QOL at 1 year after operation.[7]

Laparoscopic and open surgery for gastric cancer

No randomized comparative study has examined laparoscopic gastrectomy and open surgery using a sufficiently large number of cases. The interim analysis of one randomized comparative study regarding distal gastrectomy for early-stage gastric cancer, albeit small in sample size, demonstrated that laparoscopic surgery was a less-invasive therapy that was as curative as open surgery.[8,9] Other randomized comparative studies and case-control studies generally detected no difference in the occurrence of complications between open and laparoscopic surgery. The results of randomized comparative studies showed that laparoscopic distal gastrectomy was associated with lower occurrence of postoperative respiratory insufficiency[9] and respiratory complications,[10] and further evaluations of these findings are awaited. The occurrence of ileus has been reported to be lower after laparoscopic surgery than after open surgery.

Many reports available at the present suggest the usefulness of laparoscopic surgery, although this has not been supported by high-level evidence yet. Considering the small sample size in most of these studies, it is necessary to conduct multicenter randomized comparative studies that can provide high-level evidence supporting statistical demonstration of usefulness. As of August 2008, a phase-2 clinical trial covering the stages up to T2, N1 is planned by the Gastric Surgery Group of the Japan Clinical Oncology Group (JCOG), to be followed by a phase-3 comparative study in the future.

Laparoscopic and open surgery for gastroesophageal reflux

An active study to compare laparoscopic surgery

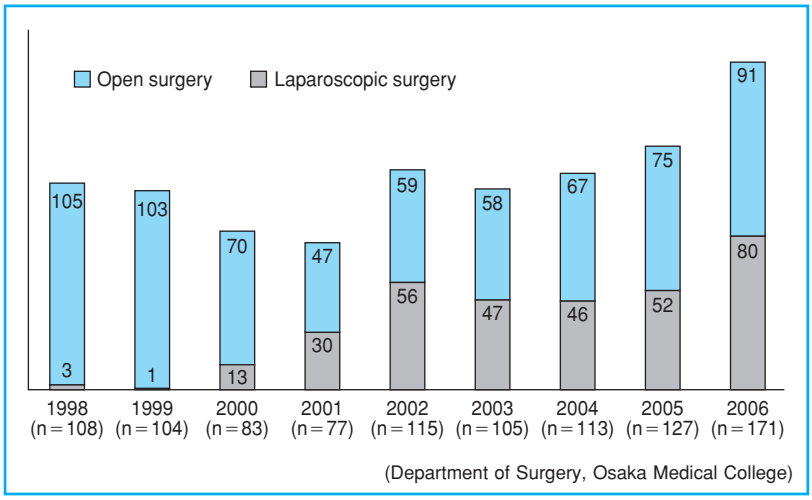

Fig. 1 Number of cases of open vs. laparoscopic surgery for primary gastric cancer

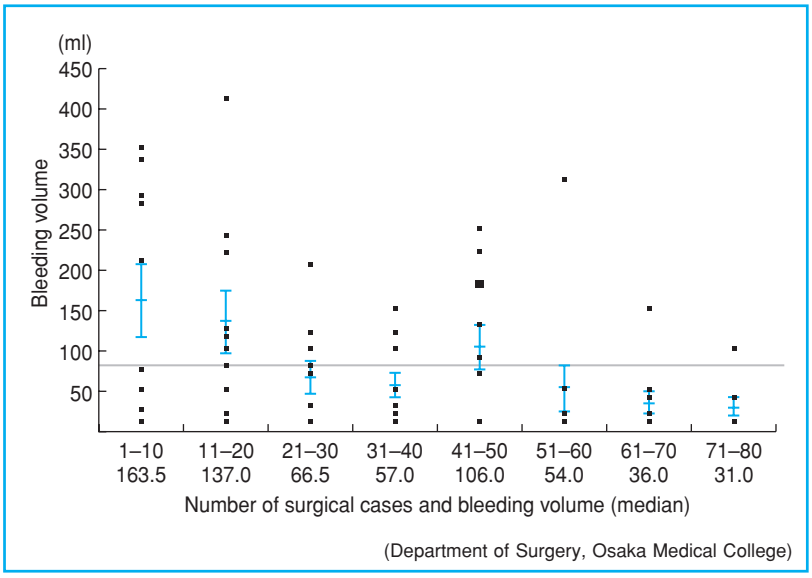

Fig. 2 The learning curve regarding intraoperative bleeding volume—laparoscopy-assisted pylorus-preserving gastrectomy (n=80)

and conventional open surgery for gastroesophageal reflux has been conducted. Reports have found no difference in subjective and objective comparison at 6 months,[11] 2 years,[12] and 5 years[13] postoperatively. The superiority of laparoscopic surgery has been demonstrated in terms of lower occurrence of postoperative wound infection, pulmonary complications, and epigastric bloating.[14] On the other hand, there are reports of higher occurrence of swallowing difficulty at 1 and 3 months after laparoscopic surgery as compared with open surgery.[15,16] Whether this difference is attributable to the difference in surgical procedures should be determined in future evaluation.

As discussed above, clinical results show that laparoscopic surgery is a new surgical approach offering the benefits of less invasiveness and achieving long-term postoperative outcomes

comparable to those of conventional open surgery. On the other hand, it is also clear that this approach involves several problems specific to diseases in particular organ systems.

Overcoming the Problems of Endoscopic Surgery

To ensure the safe and secure use of this new surgical approach, sufficient education and training, as well as clinical experience, are required. The necessary surgical skills may not be acquired quickly as there is a need for clinical experience and training on a certain number of cases, and there is a "learning curve."

Our experience regarding the "learning curve"—trends in the number of surgical cases and intraoperative bleeding volume

Figure 1 shows the trends in the annual number of surgical cases treated for primary gastric cancer at the Department of General and Gastroenterological Surgery, Osaka Medical College. After the introduction of laparoscopic surgery 9 years ago, the number of cases treated with laparoscopic surgery continued to increase year by year. The breakdown of the 328 cases of laparoscopic surgery for gastric cancer during this period mainly consists of distal gastrectomy. Focusing on laparocscopy-assisted pylorus-preserving gastrectomy, **Fig. 2** shows how intraoperative bleeding volume decreases with the number of cases each surgeon has experienced. The bleeding volume decreases to 100 mL or lower after the experience of 20 cases, and stabilizes at a level below 50 mL after 50 cases. These results demonstrate a typical "learning curve."[17]

Education using a Web-based textbook "WebSurg"

Because of the fundamental difference from the conventional approach of open surgery, endoscopic surgery involves many problems such as the inability to perform palpation, the small field of view, the difficulty in grasping the situation in its entirety, and the poor sense of depth on a 2-dimensional monitor. Various methods for teaching operating skills in endoscopic surgery have been attempted, including training with animal labs and virtual reality systems and showing videos of surgical operations performed by experts at academic meetings and workshops.[18] The use of Internet-based learning materials is showing great progress, and is widely accepted with high regard. In particular, the effectiveness of WebSurg (http://www.websurg.com) (**Fig. 3**) specializing in endoscopic surgery is remarkable. This web site allows the visitor to view surgical videos of internationally esteemed endoscopic surgeons, as well as explanations of operations and relevant specialist opinions, covering over 150 procedures.

(http://www.websurg.com)

Fig. 3 The top page of WebSurg, a web-based textbook on endoscopic surgery

Since its launch by IRCAD (Institute de Recherche contre les Cancers de l'Appareil Digestif)/EITS (European Institute of Telesurgery) (President: Prof. Jacques Marecaux) in Strasbourg (France) in January 2001,[19] the author and colleagues have been developing the Japanese version of WebSurg. While working in daily practice, surgeons can access this site via the Internet and receive various training ranging from the basics of endoscopic surgery to the practical aspects of the most up-to-date procedures. In 2007, WebSurg was accessed 1.06 million times from 207 countries worldwide. There were 35,992 accesses from Japan, with a mean connection time of 6 min 30 sec.[20] In this way, WebSurg is making a great contribution to international society including Japan in the field of endoscopic surgeon education.

References

1. Berggren U, Gordh T, Grama D, et al. Laparoscopic versus open cholecystectomy: hospitalization, sick leave, analgesia and trauma responses. Br J Surg. 1994;81:1362–1365.
2. Hendolin HI, Pääkönen ME, Alhava EM, et al. Laparoscopic or open cholecystectomy: a prospective randomised trial to compare postoperative pain, pulmonary function, and stress response. Eur J Surg. 2000;166:394–399.
3. Golub R, Siddiqui F, Pohl D. Laparoscopic versus open appendectomy: a metaanalysis. J Am Coll Surg .1998;186:545–553.
4. Hellberg A, Rudberg C, Kullman E, et al. Prospective randomized multicentre study of laparoscopic versus open appendicectomy. Br J Surg. 1999;86:48–53.
5. Clinical Outcomes of Surgical Therapy Study Group. A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med. 2004;350:2050–2059.
6. Leung KL, Kwok SP, Lam SC, et al. Laparoscopic resection of rectosigmoid carcinoma: prospective randomised trial. Lancet. 2004;363:1187–1192.
7. Janson M, Björholt I, Carlsson P, et al. Randomized clinical trial of the costs of open and laparoscopic surgery for colonic cancer. Br J Surg. 2004;91:409–417.
8. Huscher CG, Mingoli A, Sgarzini G, et al. Laparoscopic versus open subtotal gastrectomy for distal gastric cancer: five-year results of a randomized prospective trial. Ann Surg. 2005;241: 232–237.
9. Kitano S, Shiraishi N, Fujii K, et al. A randomized controlled trial comparing open vs laparoscopy-assisted distal gastrectomy for the treatment of early gastric cancer: an interim report. Surgery. 2002;131 (1 Suppl):S306–S311.
10. Lee JH, Han HS, Lee JH. A prospective randomized study comparing open vs laparoscopy-assisted distal gastrectomy in early gastric cancer: early results. Surg Endosc. 2005;19:168–173.
11. Wenner J, Nilsson G, Oberg S, et al. Short-term outcome after laparoscopic and open 360 degrees fundoplication. A prospective randomized trial. Surg Endosc. 2001;15:1124–1128.
12. Heikkinen TJ, Haukipuro K, Bringman S, et al. Comparison of laparoscopic and open Nissen fundoplication 2 years after operation. A prospective randomized trial. Surg Endosc. 2000; 14:1019–1023.
13. Nilsson G, Wenner J, Larsson S, et al. Randomized clinical trial of laparoscopic versus open fundoplication for gastro-oesophageal reflux. Br J Surg. 2004;91:552–559.
14. Chrysos E, Tsiaoussis J, Athanasakis E, et al. Laparoscopic vs open approach for Nissen fundoplication. A comparative study. Surg Endosc. 2002;16:1679–1684.
15. Luostarinen M, Virtanen J, Koskinen M, et al. Dysphagia and oesophageal clearance after laparoscopic versus open Nissen fundoplication. A randomized, prospective trial. Scand J Gastroenterol. 2001;36:565–571.
16. Heikkinen TJ, Haukipuro K, Sorasto A, et al. Short-term symptomatic outcome and quality of life after laparoscopic versus open Nissen fundoplication: a prospective randomized trial. Int J Surg Investig. 2000;2:33–39.
17. Zhang X, Tanigawa N. Learning curve of laparoscopic surgery for gastric cancer, a laparoscopic distal gastrectomy-based analysis. Surg Endosc Published online; 2008 Sep.
18. Tanigawa N, Okuda J. Construction of an endoscopic surgery training system utilizing animal labs, virtual reality, the Internet, etc. Journal of Japan Society for Endoscopic Surgery. 2004; 9:284–287. (in Japanese)
19. Marescaux J, Soler L, Mutter D, et al. Virtual university applied to telesurgery: from teleeducation to telemanipulation. Stud Health Technol Inform. 2000;70:195–201.
20. Keitaro Tanaka, Maisonneuve H, Dutson E, et al. Present state of the introduction of Internet-based textbooks in endoscopically-guided less-invasive surgery. Journal of Japan Society for Endoscopic Surgery. 2003;8:361–366. (in Japanese)