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Laparoscopy-assisted Total Gastrectomy: A Simplified Approach

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Laparoscopy-assisted total gastrectomy (LATG), esophagojejunostomy is an effective but difficult procedure to perform. We describe a simple modification that substantially facilitates insertion of the anvil into the esophagus and avoids oral injuries and complications. After mobilization of the stomach and esophagus, a semicircumferential esophagotomy is made at the anterior esophageal wall. An OrVil anvil (Orvil, Covidien, Norwalk, CT, USA) is delivered laparoscopically and secured with a POLYSORB (Covidien) suture to the esophagus. The suture is advanced anteriorly so that the center rod penetrates the esophageal wall. The esophagus is transected with the stapler at this point. A circular-stapled esophagojejunostomy is then performed using the hemidouble stapling technique. Laparoscopy-assisted total gastrectomies were performed for 40 patients with gastric cancers (T1N0M0). All procedures were completed laparoscopically without any complications. The time required to place the anvil averaged 5 min compared with 9 min reported by others. There were no major complications or mortality in this series. The major advantage of this technique is that circular stapling is much easier than linear stapling, allowing surgeons without advanced surgical skills in LATG to perform the procedure effectively and safely.

Key words: Anvil – Esophagojejunostomy – Gastrectomy – Gastric cancer – Laparoscopy

The Japan Cancer Surveillance Research Group reported this year that at the end of 2006 in Japan, gastric cancer was the leading site of cancer in men and the fourth leading site in women.[1] In a recent review, Etoh *et al* stated that the only potential curative therapy for patients with gastric cancer is surgical resection.[2] Kitano introduced laparoscopy-assisted distal gastrectomy (LADG) in 1994,[3] but it

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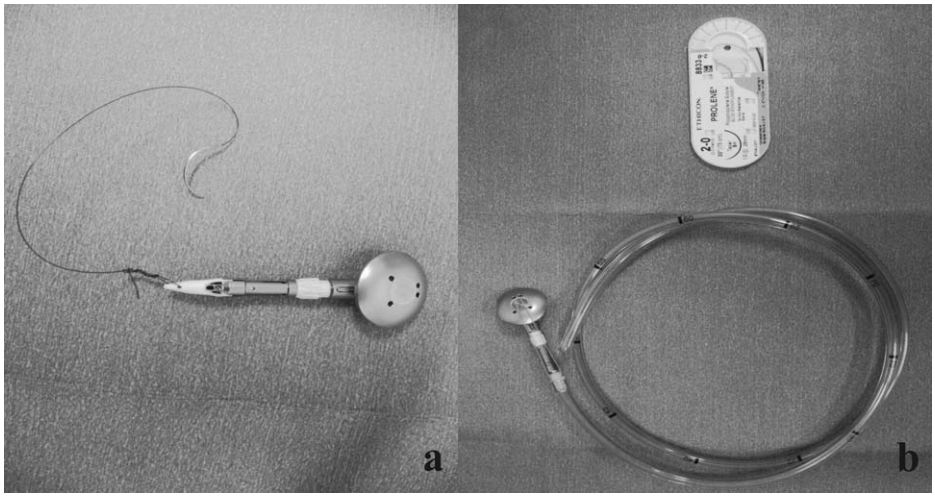

Fig. 1 Anvil characteristics. (a) An anvil with a center rod secured with 2-0 POLYSORB at the hole of the tip. (b) A pre-tilted anvil (OrVil, Covidien).

was adopted only slowly by Japanese surgeons, because the associated technical difficulties compromised safety.[4] In fact, it has been pointed out that most surgeons in Japan have no experience with LADG,[5] and even now the procedure performed most effectively by highly experienced surgeons who have received extensive training.[5] Some prospective trials have shown that LADG combined with lymphadenectomy to treat gastric cancer is less invasive and compares favorably with conventional distal gastrectomy.[3,6,7] Similarly, laparoscopy-assisted total gastrectomy (LATG) for gastric cancer localized in the upper portion of the stomach is now feasible.[8–11]

Surgeons frequently employ the Roux-en-Y method to perform esophagojejunostomy in LATG, because it is relatively simple to perform, restores alimentary function, and may provide relatively good perioperative results.[12] Esophagojejunostomy using a circular stapling device is considered preferable in LATG, because it has been applied frequently to conventional open approaches. However, the placement of the anvil of a circular stapling device can be technically difficult, mainly because of the complicated procedures involved in performing a purse-string suture to secure it to the esophageal stump. To address this problem, Omori *et al* (2009) devised an apparently safe and simple technique for esophagojejunostomy employing a circular stapler.[13] Further improvements for performing esophagojejunostomy after LATG were reported by Jeong and Park (2009) using the OrVil anvil[14] (Orvil, Covidien, Norwalk, CT, USA) and more recently by Kunisaki *et al* (2011).[12] In the latter study of 335 patients with

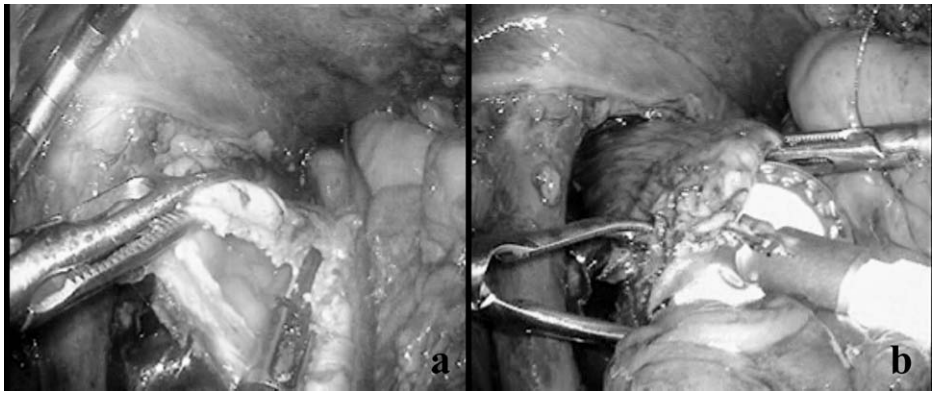

Fig. 2 Esophagectomy and anvil insertion. (a) Semi-circumferential esophagectomy is performed at the anterior esophageal wall. (b) The anvil with POLYSORB suture is inserted into esophageal cavity through the opened hole.

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Fig. 3 Securing the anvil. The accompanying needle is penetrated through the anterior esophageal wall 1–2 cm from the oral side of the opened line.

early gastric cancer, operation times were shorter and blood loss and wound pain were reduced, because the OrVil system (Covidien) requires only a small skin incision. Further, postoperative morbidity was equivalent to that reported by Jeong and Park (2009).[14]

Although these two studies represent significant advances, LATG for upper gastric cancer, for example, is technically demanding and incurs a higher rate of postoperative complications than LADG.[2] It is important to note that only 44.6% of surgeons who applied for Board Certification in laparoscopic techniques from the Japan Society of Endoscopic Surgery from 2004 to 2009 passed the examination.[15,16]

Here, we report a technique using the OrVil anvil system, which allows the anvil to be inserted in much less time and significantly reduces postoperative complications.

Materials and Methods

Patients

This study included 32 consecutive patients (24 men; 8 women) who underwent surgery for gastric cancer during the period from July 2009 to September 2012. Median age was 67 years (range, 38–82 years) for the men and 66.5 years (range, 53–81 years) for the women, and median body mass index was 22.5 kg/m^2 (range, 14.4–29.4 kg/m^2) for men and 21.7 kg/m^2 (range, 15.7–24.0 kg/m^2) for women. All of the patients were staged as T1N0M0. LATG with Roux-en-Y reconstruction was performed after receipt of written informed consent.

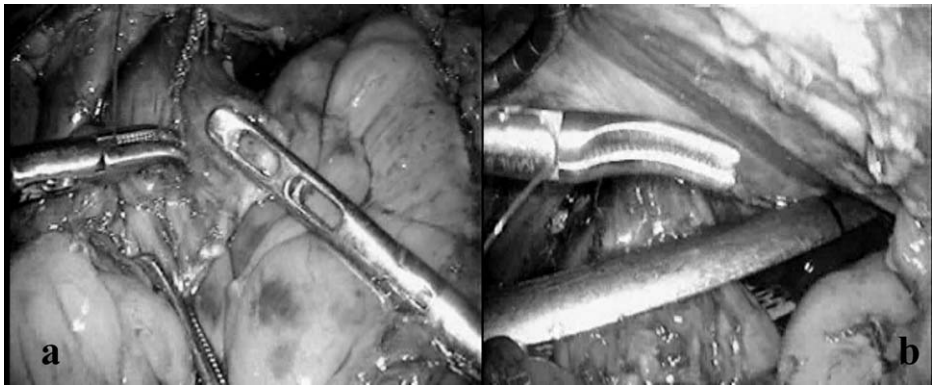

Fig. 4 Securing the esophagus. (a) The POLYSORB suture with a center rod is pulled completely out of the esophagus. (b) The esophagus is fixed using a linear stapler (Endo GIA Ultra Universal Stapler, Covidien Surgical, Mansfield, MA, USA) with a disposal GI cartridge (EGIA60AVM).

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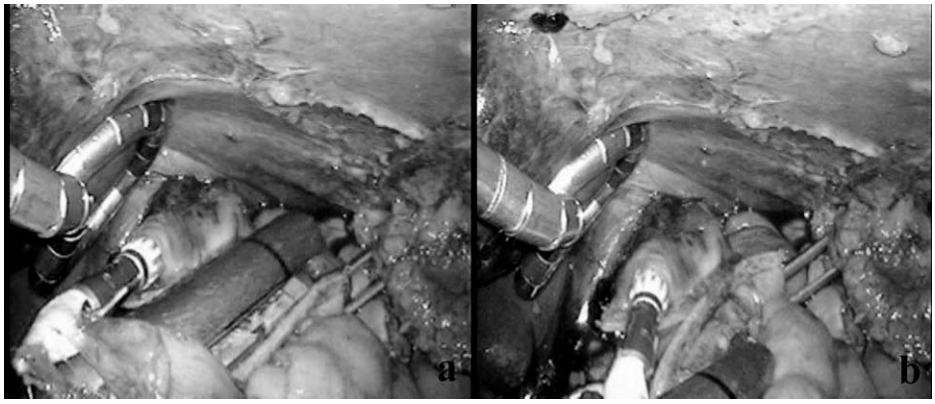

Fig. 5 Transecting the esophagus. (a) The POLYSORB suture is pulled out completely, and then the center rod is penetrating into the esophageal wall. (b) The esophagus is transected and the anvil head is simultaneously secured in the esophageal cavity.

Technique

The techniques described here are identical to those described by Omori *et al*[13] except with regard to the use of an OrVil anvil (Orvil, Covidien, Norwalk, CT, USA). We placed the patient in the supine position and spread the legs. We next clipped and divided the gastric arteries laparoscopically and divided them by performing an adequate lymphadenectomy using a 5-port technique. After mobilizing of the duodenum, it is transected and stapled using a 60-mm endoscopic linear stapler (Endo GIA Ultra Universal Stapler, Covidien Surgical, Mansfield, MA, USA) with a disposable GI cartridge (EGIA60AVM, Covidien). We then performed a pararectal laparotomy (4–5 cm) in the left upper quadrant of the abdomen after mobilization of the stomach and esophagus and then retraction using a wound-sealing device (Alexis Wound Retractor; Applied Medical, Rancho Santa Margarita, CA, USA). We next prepared the anvil head of a circular stapling device (DST- EEA2535, Covidien Surgical, Mansfield, MA, USA) for connecting to the trocar attached to the center rod. The joint was secured using a needle with a 2-0 multifilament suture (POLYSORB, Covidien), which was bound at the hole of the tip.

We used the OrVil anvil (OrVil 25 mm, Covidien) with the anvil head secured in the tilted position. This is a ready-to-use anvil delivery device designed for transoral insertion of the anvil into the abdominal esophagus in a manner similar to that used for an orogastric tube (Fig. 1). In the OrVil system, the orogastric tube is connected to the center rod of the anvil. The tilted anvil head of the Orvil system facilitates the passage of the anvil through the mouth and upper esophagus and automatically untilts for parallel closure of an anastomosis when using a stapler. After inserting the anvil head, we performed an intracorporeal hemidouble-stapling esophagojejunostomy using a circular stapler (DST-EEA2535, Covidien).

The anvil was placed into the peritoneal cavity, and a wound retractor was covered by a surgical glove to establish pneumoperitoneum. The esophagus was clamped and held with detachable forceps at the esophagogastric junction [Minimally Invasive Surgery (MIS) intestinal clamp, jaw length, 70 mm; Aesculap AG, Tuttlingen, Germany]. Next, we performed a semicircumferential esophagotomy (Fig. 2a) at the anterior esophageal wall just proximal to the forceps. The anvil with the POLYSORB suture (Covidien) was then inserted into the esophageal cavity through the esophagotomy (Fig. 2b), and the needle attached to the center rod of the anvil was advanced through the anterior esophageal wall 1–2 cm from the oral side of the opened line (Fig. 3). The POLYSORB suture (Covidien) connected to the center rod was pulled completely out of the esophagus (Fig. 4a). Next, the esophagus was fixed using a linear stapler with a disposable GI cartridge (EGIA60AVM, Covidien) (Fig. 4b), and the POLYSORB suture (Covidien) was pulled completely out with the center rod penetrating the esophageal wall (Fig. 5a). The esophagus was then transected simultaneously to secure the anvil head in the esophageal cavity (Fig. 5b). Esophagojejunostomy was performed under pneumoperitoneum using a hemidouble stapling technique that was monitored laparoscopically (Fig. 6). The procedure is summarized diagrammatically in Fig. 7.

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Fig. 6 Esophagojejunostomy. Under pneumoperitoneum, the esophagojejunostomy is performed using a hemidouble stapling technique and laparoscopic monitoring.

Results

Thirty-two LATGs have been performed using our technique. In all cases, intact anastomotic doughnuts were obtained. The operations were completed laparoscopically without any serious perioperative complications. The median operative time was 318 minutes (range 244–387 min), including 5 minutes for placement of the anvil on the esophageal stump. Estimated median blood loss was 127 mL (range 20–280 mL).

Although a surplus esophageal margin was necessary, an anvil could be placed very smoothly on the stump in the same fashion using our methods. Clear liquids were resumed on the third postoperative day, and a soft diet was offered on the fourth postoperative day. There were no major complications, such as anastomotic leakage, stenosis, pancreatitis, or abdominal abscess. The postoperative hospital stay was 16.8 days on average (10–29 days). There was no mortality in this series.

Discussion

Gastric cancer is the most common site in Japanese men and fourth worldwide (following prostate, lung, and colorectum) and ranks among the top 8 sites worldwide for women.[17] Early gastric cancer is highly curable,[5] and the continuing improvements in LADG since its advent in 1994[3] have contributed to treatment and postoperative survival and quality of life.[5] However, to reach its full potential, esophagojejunostomy techniques require simplification to enable more surgeons to perform them.

Here, we describe just such a technique based exactly on the procedure described by Omori *et al* (2009),[13] except that we used the Orvil anvil instead of the ECS 25 (Ethicon Endo-Surgery). We found that the Orvil anvil is much easier to use such that surgeons with relatively little experience in gastric laparoscopy should be able to conduct the operation described here and avoid complications. The median operative time was 318 min (range, 244–387 min), including 5 minutes for placement of the anvil on the esophageal stump. Estimated blood loss was 127 mL in median (range 20–280 mL). The postoperative hospital stay was 16.8 days on average (10–29 days). There was no mortality in this series or even significant complications in our series of patients with gastric cancer (T1N0M0). Before we implemented the present method (without the OrVil anvil), we used purse-string suturing. In 3 of 15 (20%) of these cases, anastomosis was insufficient. No such complications have been encountered using the improved procedure described in our present report. Further, Omori *et al*, 2009[13] (see next paragraph) describe the disadvantages of purse-string suturing related to anastomosis.

Moreover, using a linear stapling method requires dense intraperitoneal suturing to close the entry incision. This method requires advanced surgical skills. Using a circular stapling method does not require dense suturing and therefore can be performed effectively and safely by surgeons with relatively little experience in this type of surgery. This is the other main advantage of our technique and will allow more patients to be treated at a greater number of surgical facilities.

The challenges that esophagojejunostomy present surgeons are described in great detail by Omori *et al* (2009).[13] In particular, they point out that the procedures for manipulating the anvil include two steps that make the procedure complicated. The first involves inserting the anvil to the esophageal

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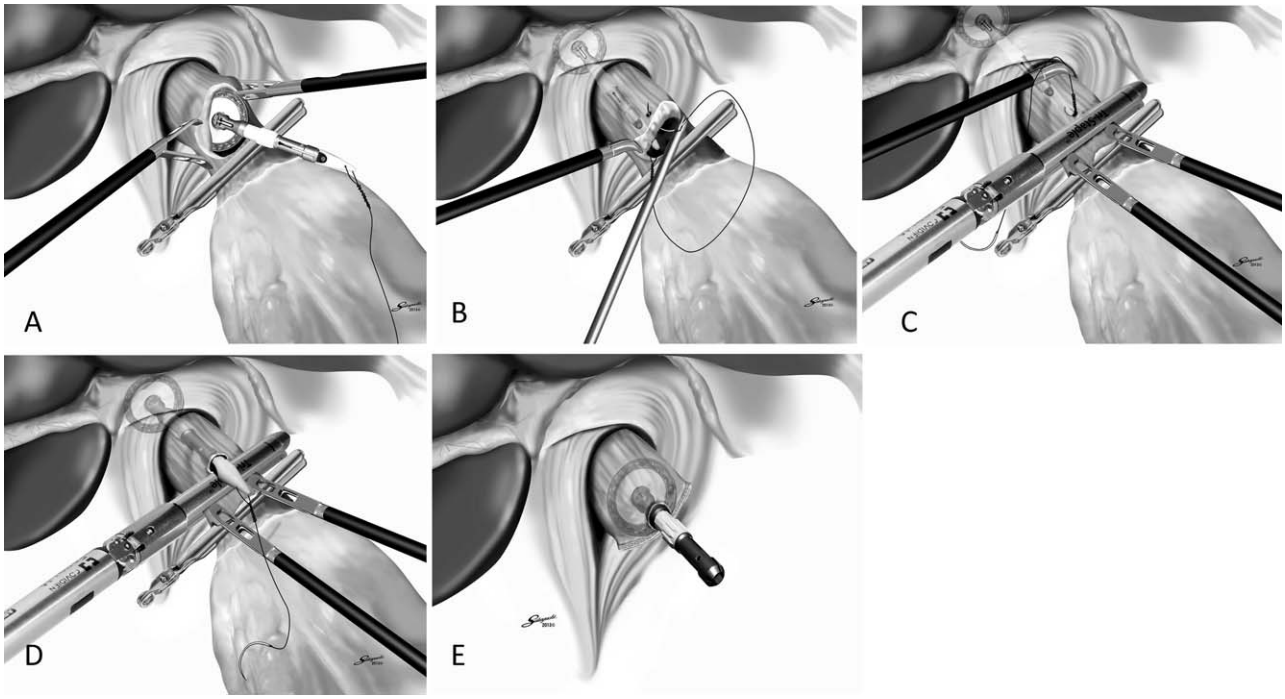

Fig. 7 Critical surgical steps. (A) The anvil with the prolene suture is inserted into esophageal cavity through the opened hole. (B) The accompanying needle is penetrated through the anterior esophageal wall 1–2 cm from the oral side of the opened line. (C) The prolene suture connected to the center rod is pulled completely out of the esophagus. The esophagus is fixed using a linear stapler with a disposal GI cartridge. (D) After removing the prolene suture, the center rod now penetrates the esophageal wall. (E) The esophagus is transected and the anvil head is simultaneously secured in the esophageal cavity.

stump after completely transecting the esophagus. This makes it difficult to stabilize the stump. The second is placing a purse-string suture to fix the anvil to the esophagus, which requires advanced skills in laparoscopic suturing. These difficulties were circumvented in our present study. Other advantages of the technique described here are also described in detail by Omori *et al* (2009).[13] The use of the OrVil anvil should be considered applicable to potential new modalities for minimally invasive surgery for gastric cancer, such as robot-assisted gastrectomy,[18–21] natural orifice transluminal endoscopic surgery (NOTES)[22,23] and laparoendoscopic single-site surgery (LESS).[24,25]

We consider that this technique using the OrVil anvil in esophagojejunostomy in LAG represents a significant advance in the surgical treatment of gastric cancer and other conditions in which gastrectomy is indicated.

References

1. Matsuda T, Marugame T, Kamo K, Katanoda K, Ajiki W, Sobue T *et al*. Cancer incidence and incidence rates in Japan in 2006: based on data from 15 population-based cancer registries in the monitoring of cancer incidence in Japan (MCIJ) project. *Jpn J Clin Oncol* 2012;**42**(2):139–147
2. Etoh T, Inomata M, Shiraishi N, Kitano S. Minimally invasive approaches for gastric cancer-Japanese experiences. *J Surg Oncol* 2012;**107**(3):282–288
3. Kitano S, Iso Y, Moriyama M, Sugimachi K. Laparoscopy-assisted Billroth I gastrectomy. *Surg Laparosc Endosc* 1994;**4**(2): 146–148
4. Fujiwara M, Kodera Y, Kasai Y, Kanyama Y, Hibi K, Ito K *et al*. Laparoscopy-assisted distal gastrectomy with systemic lymph node dissection for early gastric carcinoma: a review of 43 cases. *J Am Coll Surg* 2003;**196**(1):75–81
5. Yoshikawa T, Cho H, Rino Y, Yamamoto Y, Kimura M, Fukunaga T *et al*. A prospective feasibility and safety study of laparoscopy-assisted distal gastrectomy for clinical stage I gastric cancer initiated by surgeons with much experience of open gastrectomy and laparoscopic surgery. *Gastric Cancer* 2012;**16**(2):126–132
6. Pugliese R, Maggioni D, Sansonna F, Scandroglio I, Ferrari GC, Di Lernia S *et al*. Total and subtotal laparoscopic gastrectomy for adenocarcinoma. *Surg Endosc* 2007;**21**(1):21–27
7. Kitano S, Shiraishi N, Uyama I, Sugihara K, Tanigawa N, Japanese Laparoscopic Surgery Study Group. A multicenter

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study on oncologic outcome of laparoscopic gastrectomy for early cancer in Japan. *Ann Surg* 2007;**245**(1):68–72
8. Mochiki E, Kamimura H, Haga N, Asao T, Kuwano H. The technique of laparoscopically assisted total gastrectomy with jejunal interposition for early gastric cancer. *Surg Endosc* 2002; **16**(3):540–544
9. Usui S, Inoue H, Yoshida T, Fukami N, Kudo SE, Iwai T. Hand-assisted laparoscopic total gastrectomy for early gastric cancer. *Surg Laparosc Endosc Percutan Tech* 2003;**13**(5):304–307
10. Omori T, Nakajima K, Endo S, Takahashi T, Hasegawa J, Nishida T. Laparoscopically assisted total gastrectomy with jejunal pouch interposition. *Surg Endosc* 2006;**20**(9):1497–1500
11. Uyama I, Sugioka A, Fujita J, Komori Y, Matsui H, Hasumi A. Laparoscopic side-to-side esophagogastrostomy using a linear stapler after proximal gastrectomy. *Gastric Cancer* 1999;2230–2234
12. Kunisaki C, Makino H, Oshima T, Fujii S, Kimura J, Takagawa R *et al*. Application of the transorally inserted anvil (OrVil) after laparoscopy-assisted total gastrectomy. *Surg Endosc* 2011; **25**(4):1300–1305
13. Omori T, Oyama T, Mizutani S, Tori M, Nakajima K, Akamatsu H *et al*. A simple and safe technique for esophagojejunostomy using the hemidouble stapling technique in laparoscopy-assisted total gastrectomy. *Am J Surg* 2009;**197**(1):e13–17
14. Jeong O, Park YK. Intracorporeal circular stapling esophagojejunostomy using the transorally inserted anvil (OrVil) after laparoscopic total gastrectomy. *Surg Endosc* 2009;**23**(11):2624–2630
15. Mori T, Kimura T, Kitajima M. Skill accreditation system for laparoscopic gastroenterologic surgeons in Japan. *Minim Invasive Ther Allied Technol* 2010;**19**(1):18–23
16. Tanigawa N, Lee S, Kimura T, Mori T, Uyama I, Nomura E *et al*. The Endoscopic Surgical Skill Qualification System for gastric surgery in Japan. *Asian J Endosc Surg* 2011;**4**(3):112–115
17. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin* 2011;**61**(2):69–90
18. Song J, Oh SJ, Kang WH, Hyung WJ, Choi SH, Noh SH. Robot-assisted gastrectomy with lymph node dissection for gastric cancer: lessons learned from an initial 100 consecutive procedures. *Ann Surg* 2009, Jun;249(6):927–932
19. Kim MC, Heo GU, Jung GJ. Robotic gastrectomy for gastric cancer: surgical techniques and clinical merits. *Surg Endosc* 2010;**24**(3):610–615
20. Yoon HM, Kim YW, Lee JH, Ryu KW, Eom BW, Park JY *et al*. Robot-assisted total gastrectomy is comparable with laparoscopically assisted total gastrectomy for early gastric cancer. *Surg Endosc* 2012;**26**(5):1377–1381
21. Woo Y, Hyung WJ, Pak KH, Inaba K, Obama K, Choi SH *et al*. Robotic gastrectomy as an oncologically sound alternative to laparoscopic resections for the treatment of early-stage gastric cancers. *Arch Surg* 2011;146(9):1086–1092
22. Wang J, Zhang L, Wu W. Current progress on natural orifice transluminal endoscopic surgery (NOTES). *Front Med* 2012; **6**(2):187–194
23. Moreira-Pinto J, Ferreira A, Rolanda C, Correia-Pinto J. Natural orifice transesophageal endoscopic surgery: state of the art. *Minim Invasive Surg* 2012;2012896952.
24. Verit A, Rizkala E, Autorino R, Stein RJ. Robotic laparoendoscopic single-site surgery: from present to future. *Indian J Urol* 2012;**28**(1):76–81
25. Graversen JA, Lusch A, Landman J. Is LESS really more? *Indian J Urol* 2012;**28**(1):82–88

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