Safe, simple & efficient totally laparoscopic Billroth II gastrectomy by only stapling devices

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Submitted May 08, 2013. Accepted for publication May 28, 2013.
doi: 10.3978/j.issn.2224-4778.2013.05.28
Scan to your mobile device or view this article at: http://www.amepc.org/tgc/article/view/2081/2870

Gastric cancer is the fourth most common cancer diagnosis worldwide in men with an expected incidence of 640,000 cases and the fifth most common in women with an expected incidence of 350,000 cases in 2011 (1). Approximately, 8% of total cases and 10% of annual cancer deaths worldwide are attributed to this dreaded disease. Surgical resection offers the only durable cure from gastric cancer (2). Since the introduction of Billroth's procedure of gastrectomy and reconstruction in 1881, surgical techniques in gastric surgery has progressed gradually. Since Azagra *et al*. performed the first laparoscopic distal gastrectomy with Billroth II reconstruction for gastric cancer in the early 90's, laparoscopic approach has become a promising method of surgical treatment for patients with gastric cancer proving to own several advantages over open surgery (3,4).

Most surgeons prefer laparoscopy-assisted gastrectomy rather than totally laparoscopic procedures due to the technical difficulties associated with intracorporeal anastomosis. However, recent advancement in surgical stapling technology enables an entirely laparoscopic approach in the treatment of gastric cancer (5). Compared to laparoscopy-assisted gastrectomy, this approach appears to have several advantages which include shorter incision, less pain, and earlier recovery (6). Studies have also suggested the feasibility, safety and efficiency of totally laparoscopic gastrectomy when performed by high volume laparoscopic surgeons, albeit with a relatively prolonged operating time (7,8).

Intracorporeal gastrojejunostomy (GJ) anatomosis following Billroth II gastrectomy can be performed by either hand-sewn technique, using stapler devices or a combination of both. Du J *et al*. reported their experience of intracorporeal gastrojejunal anastomosis using a two layer hand-sewn technique (9), whereas Ruiz *et al*. described a 4-layer closure using continuous absorbable sutures (10). Hand-sewn anastomosis requires advanced laparoscopic skills and is considered to be time-consuming, but has the advantage of avoiding the risk of wound infection and hernias, which occur as a result of manipulation by a circular stapler. It also has a lower risk of gastrointestinal bleeding at the GJ site and lower operating costs (11). However, totally hand-sewn GJ anastomosis is technically demanding, with a steep learning curve. Experience at the beginning can be discouraging, even for surgeons with extensive training in advanced laparoscopic surgery. Though it will lengthen the operating time during the initial learning period, constant training develops the surgeon's skills and will significantly shorten the operating time as experience accumulates (9-11).

Nevertheless, totally hand-sewn anastomosis has been considered extremely difficult and has been avoided by most laparoscopic surgeons. Authors have reported intracorporeal reconstruction of the digestive tract following gastrectomy using linear stapler devices combined with a hand-sewn technique (12,13). Lee *et al*. performed an end-to-side GJ with an endo GIA stapler and closure of the stoma with intracorporeal hand-sewn technique in 2 layers (12). It is important to ensure that both gastrotomy and enterotomy are small, just large enough to accommodate the jaws of the stapler so that subsequent suture closure of the hole is not time consuming.

In a comparison study with open Bill Roth II gastrectomy, the operating time was significantly longer

and this was attributed to performing the intracorporeal anastomosis. However, over time they were able to improve their technique and perform the surgery faster (12). Although more technically demanding compared to open distal gastrectomy, Wong *et al*. reported that the combined laparoscopic procedure with stapled and hand sewn anastomosis had less blood loss, fewer inflammatory reactions, rapid return of gastrointestinal function, and shorter hospital stay without compromising operative curability (13).

Circular staplers are also widely used for reconstruction following Billroth II gastrectomy for gastric cancer. Seo *et al*. compared the hand-sewn method to the circular stapling method for anastomosis in patients who underwent laparoscopy assisted distal gastrectomy (LADG) (14). No significant differences were observed in the clinicopathologic parameters and post operative outcomes. However, the operating time and anastomosis time were significantly shorter in the stapler group (14). Therefore, the circular stapling method could be applied safely and efficiently for GJ anastomosis in LADG.

Recently, Du *et al.* described a novel method for performing Billroth II gastrectomy by only using circular and linear stapling devices without any hand sewn anastomosis (15). Most surgeons avoided linear staplers in favour of hand-sewn anastomosis for closure of the enterotomy that was used to introduce the shaft of the circular stapler. A stapled enterotomy closure here was believed to cause postoperative intestinal stricture (16). However, Du *et al*. were able to prevent stricture formation by an additional side-to-side anastomosis using a linear stapler at the site of enterotomy to enlarge the lumen. In a comparative study of patients undergoing laparoscopic Billroth II distal gastrectomy with only hand-sewn anastomosis and stapling device anastomosis, Du's method seemed also safe and feasible while associated with decreased operative time and may be associated with shorter learning curve (15).

Intracorporeal GJ anastomosis could also be performed using a two linear stapler technique (17-19). When using linear staplers, care must be taken to avoid stricturing of the efferent loop of the jejunum, when the entry hole is closed with a stapler. Ahn *et al.* reported that in experienced hands, the complication rate following intracorporeal reconstruction using linear staplers was significantly lower than that of the extracorporeal group (17). They also concluded that intracorporeal reconstruction after laparoscopic distal gastrectomy was feasible and safe after a learning curve of 20 cases, if the surgeon had already sufficient experience in extracorporeal reconstruction. In a study by Lee *et al*., the mean operating time and post operative hospital stay was statistically shorter in the laparoscopic distal gastrectomy group using linear staplers compared to LADG group (18). Anastomosis related complications were not significantly different in both groups. However, bleeding from the anastomosis site in the intra-corporeal procedure tended to be higher than that of the extra-corporeal method (18).

In intracorporeal anastomosis, a linear stapler has some advantages over a circular stapler. In order to use a 25 mm circular stapler intraabdominally, a 33 mm trocar is needed or the incision has to be extended and this requirement could jeopardize the merit of a minimally invasive procedure. Moreover, it may be tedious and complicated to perform an intracorporeal purse-string suture and anvil placement (19). In contrast, a linear stapler only requires a 12 mm trocar for introduction, thereby resulting in better cosmetic outcome. Furthermore it is much easier to handle a linear stapler intraabdominally (18,19).

In spite of the obvious benefits, laparoscopic gastrectomy has not yet met with widespread acceptance and it still is limited to only a few centers. This slow acceptance is not only related to the major concern about the difficulty of intracorporeal reconstruction. In addition, operative cost is obviously higher because of the additional laparoscopic instruments and stapling devices (13,20). In a cost analysis study by Song *et al*., operation related costs and total costs were greater in the laparoscopic distal gastrectomy group compared to open and LADG groups (21). These differences resulted mainly from the cost of materials that were used in the operation theatre. Some surgeons have attempted to lower the cost spent on staplers, by closing the entry hole of the stapler in GJ anastomosis using an intracorporeal hand-sewn technique (19,21). Others have reduced the expenses further by performing a totally hand-sewn anastomosis (11).

Another important factor that could increase the operative cost is prolonged hospital stay due to complications. In the Eight Nationwide survey of endoscopic surgery [2006] in Japan, the rate for the postoperative complications after laparoscopic distal gastrectomies was 9.2%, and more than half of those complications were related to the anastomosis (54.0%) including leakage, stenosis and obstruction of the anastomotic site (20). In a recent meta-analysis of published trials, laparoscopic distal gastrectomy was associated with significantly lower overall complications, estimated blood loss and hospital stay despite having longer operative times (22).

Similarly, a study comparing LADG and laparoscopic Billroth II distal gastrectomy showed the latter to be a more feasible procedure that could be safely performed in less time producing better cosmetic results (18). Therefore as the surgical technique matures without significant complications, which could lengthen the hospital stay, totally laparoscopic distal gastrectomy is believed to be apparently a cost-effective approach (13).

Reports of laparoscopic techniques for treating patients with early gastric cancer in the world literature have shown oncologic equivalency to that of open technique, with much benefits of minimally invasive approach, including less pain, earlier recovery, shorter hospital stay, and better quality of life (23). In advanced gastric cancer, Shuang *et al*. performed D2 lymph node dissection in both LADG and open gastrectomy groups. There was no significant difference between the two groups in the number of resected lymph nodes, yielding similar oncologic outcomes (3). In a case-controlled study of 30 patients undergoing laparoscopic subtotal gastrectomy with 30 matched open gastrectomy patients for gastric cancer, Strong *et al*. reported on the technical feasibility and equivalent short-term recurrence-free survival of laparoscopic subtotal gastrectomy when compared with the open procedure (24).

In conclusion, intracorporeal Billroth II anastomosis using stapling devices has been shown to be safe, feasible and efficient. Using this approach, surgeons embarking in laparoscopic distal gastrectomy may have a shorter learning curve with better outcomes. However cost remains a major factor in its widespread utilization.

Acknowledgements

Disclosure: The authors declare no conflict of interest.

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Cite this article as: Malapan K, Huang CK. Safe, simple & efficient totally laparoscopic Billroth II gastrectomy by only stapling devices. Transl Gastrointest Cancer 2013;2(S1):98-101. doi: 10.3978/j.issn.2224-4778.2013.05.28

