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An Effective New Intestinal Anastomosis Method

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Data Interpretation D
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Background: This study aimed to establish an easy, safe, and cost-saving intestinal anastomotic method.

Material/Methods: Between January 2014 and February 2016, a total of 150 patients with gastric cancer who underwent surgery in the Department of General Surgery of Xuzhou Medical University Affiliated Hospital were divided into 2 groups: the treatment group (80) using new hand-sewn anastomoses, and the control group (70) using stapled anastomoses. Briefly, a new hand-sewn anastomosis of continuous suture without inversion was performed, with the first layer encompassing the entire layer of the intestinal wall. The edge was about 5 mm, and the stitch spacing was about 6 mm. Continuous suturing was performed only in the seromuscular layer of intestinal wall for the second layer, with the same edge and stitch spacing as the first layer. All 70 patients in the control group underwent intestinal stapled anastomoses. Surgical anastomotic time and cost, postoperative anastomotic bleeding, leakage, and stricture were recorded and analyzed.

Results: The surgical anastomotic time using the new method was relatively short compared with the control group (8±1.6 min *vs.* 9±2.8 min), and the cost of anastomosis using the new method was significantly lower compared to the control group ($30±6.8 *vs.* $1000±106.2). The new method exhibited lower anastomotic bleeding (0/80 *vs.* 2/70) and anastomotic leakage (0/80 *vs.* 1/70), but similar anastomotic stricture (0/80 *vs.* 0/70).

Conclusions: Our results suggest the new hand-sewn intestinal anastomosis is a safe, easy-to-learn, cost-saving, and time-saving method that also avoids some of the drawbacks of the stapled anastomoses.

MeSH Keywords: Hand • Intestinal Absorption • Stomach Neoplasms • Sutures

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Background

Intestinal anastomosis is a very important procedure to a general surgeon in clinical practice, and it has been carried out using a variety of techniques and suture materials for over 100 years [1]. Generally, these were divided into 2 categories, stapled anastomosis and hand-sewn anastomosis, which include interrupted or running sutures and single- or 2-layer sutures [2,3]. Both procedures have advantages and shortcomings [4–7].

In recent years, we have used a special running 2-layer method to perform intestinal anastomosis (Roux-en-Y) in gastric cancer patients. This method showed some advantages when compared to stapled anastomosis. The aim of this retrospective study was to introduce this new intestinal anastomotic skill and compare our hand-sewn anastomosis with stapled anastomosis by analyzing intraoperative anastomotic time, cost, and occurrence of postoperative complications in order to make an objective access of the 2 anastomotic methods.

Material and Methods

The present study was conducted in the Department of General Surgery of the Affiliated Hospital of Xuzhou Medical University, Jiangsu, China. We retrospectively analyzed a total of 150 patients with gastric cancer who underwent radical distal or total gastrectomy between January 2014 and February 2016. All patients received jejunum Roux-en-Y anastomosis (Figure 1). The patients were divided into 2 groups according to the different method of jejunum Roux-en-Y anastomosis (stapled or our new hand-sewn anastomosis). Informed written consent was obtained from all patients. There were 93 men and 57 women, with a mean age of 52.9±12.6 years (range 28–84 years). Patients' demographic information and perioperative data of the 2 groups were recorded and analyzed (Table 1).

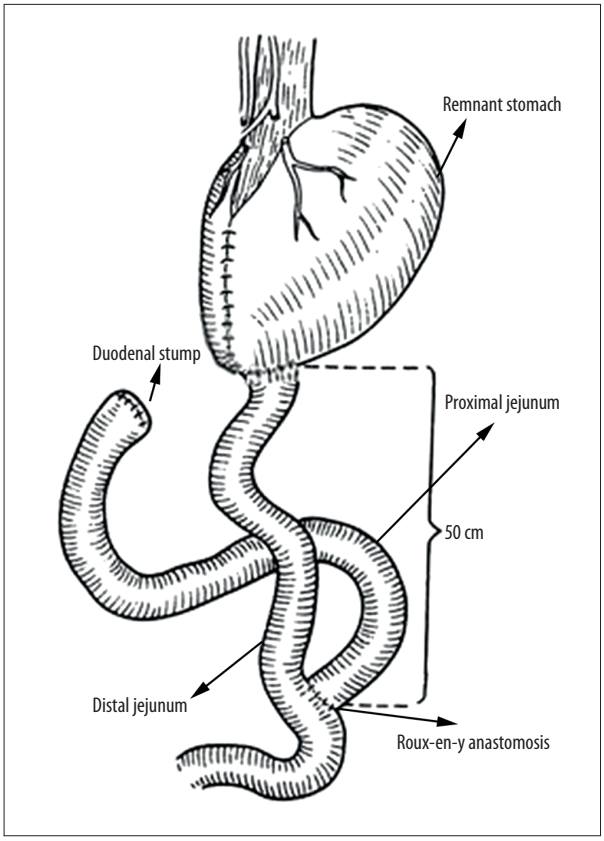

Figure 1. Illustration of Roux-en-Y anastomosis.

Table 1. Patients' demographic information and perioperative data of the two groups.

Variable	Hand-sewn (n=80)	Stapled (n=70)	*p*-value
Age	52±13.2	54±15.3	0.391
Sex (Male/Female)	49/31	44/26	0.840
BMI	22.3±2.2	21.8±2.8	0.223
Ischemic cardiopathy	12/80	14/70	0.420
COPD	8/80	10/70	0.420
Hypertension	24/80	19/70	0.699
Diabetes	16/80	12/70	0.654
Hypoalbuminemia	26/80	27/70	0.438
Anemia	32/80	28/70	1.000
Types of operation (distal/total gastrectomy)	57/80	46/70	0.466
Assisted laparoscopy	36/80	31/70	0.930
Intraoperative blood loss (ml)	546.36±298.63	626.82±232.85	0.071
Operation time (min)	242±52.32	233±48.66	0.279

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Technique

All the anastomoses were performed by the same consultant surgeon. The affected segment of bowel was resected as per the standard technique. The bowel ends were cleaned with 2.5% povidone iodine swabs.

Stapled anastomosis

After a total or partial gastrectomy and specimen removal, the jejunum was divided about 20 cm distal to the Treitz ligament. The distal end of the jejunum was then joined to the stomach remnant or lower esophagus (in total gastrectomy) using a stapler. A circular stapler was inserted in the lumen of lower jejunum (through a small incision) about 50 cm from the gastrointestinal anastomosis and fixed using a purse string suture. The anastomosis was then finished in a Roux-en-Y fashion between the proximal and distal jejunum. Finally, a non-cutting linear stapler was then used to close the defect at the end of the proximal jejunum. A 4-0 polyglactin suture was then used to reinforce every stapler line in a continuous full-layer fashion.

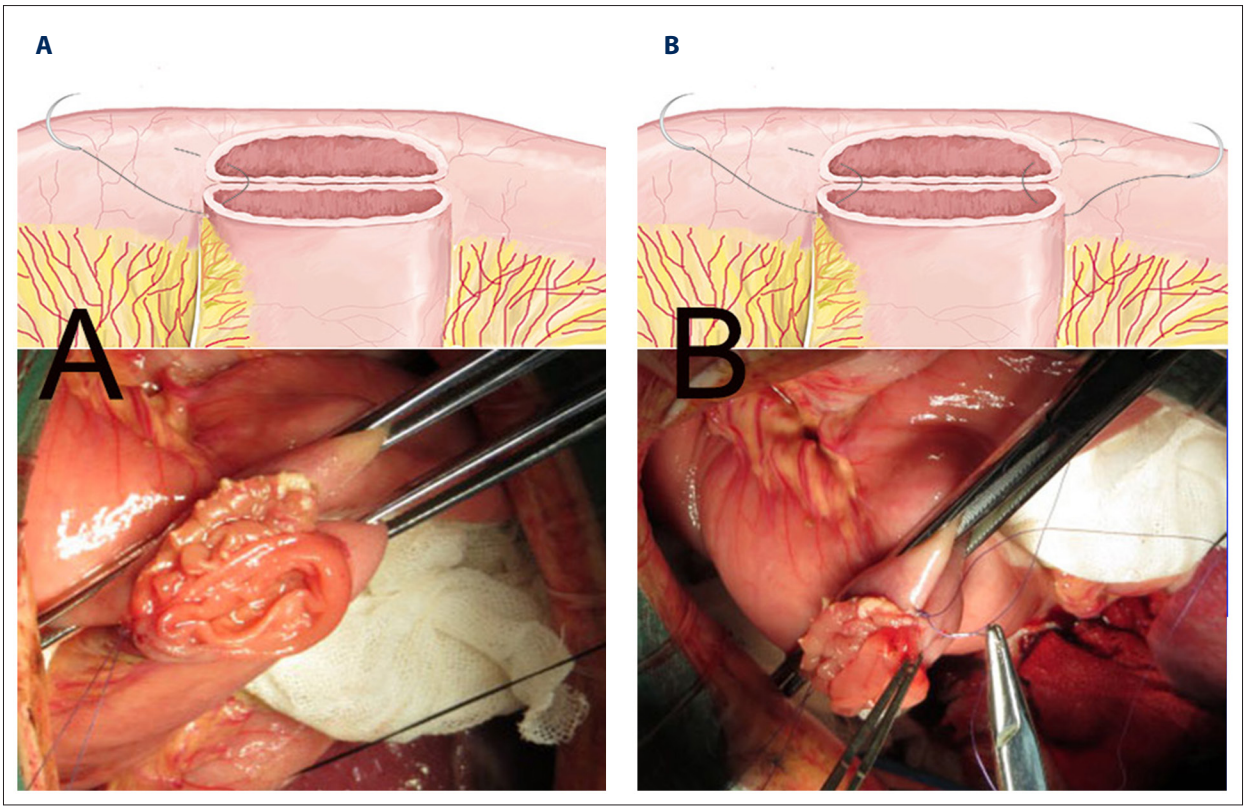
Our new hand-sewn anastomosis

All the anastomoses were constructed in an end-to-side fashion. The jejunal transection and gastrectomy were performed as described above and the specimen was removed. After the gastrointestinal anastomosis was performed, a small incision approximately the diameter of the proximal jejunum was made parallel along the length of the distal jejunum, about 50 cm distal to the gastrointestinal anastomosis.

The intestinal (jejuno-jejunum) anastomosis was performed in the following steps:

1. Approximation and fixation of the bowel openings

The proximal cut end of the jejunum was approximated to the opening of the incision made distally on the jejunum and held in place by bowel clamps. Care was taken to ensure proper alignment of the mesentery. In preparation for suturing, two 4-0 pyloric sutures were used to fix the 2 corners of the aligned bowels. Starting from either end, the stitch was passed carefully from an out-in direction through the distal jejunum, with a margin of approximately 5 mm. The stitch was then continued through the adjacent proximal jejunum in the opposite direction (in and then out), and then a knot was made. This process ensures that the subsequent knot made will fall outside the lumen of the bowel. The same process was repeated on the other corner of the aligned edges of the bowel. The length of both sutures was preserved so that they could be used in the next step, which is the continuous suturing and closure of the bowel (Figure 2A, 2B).



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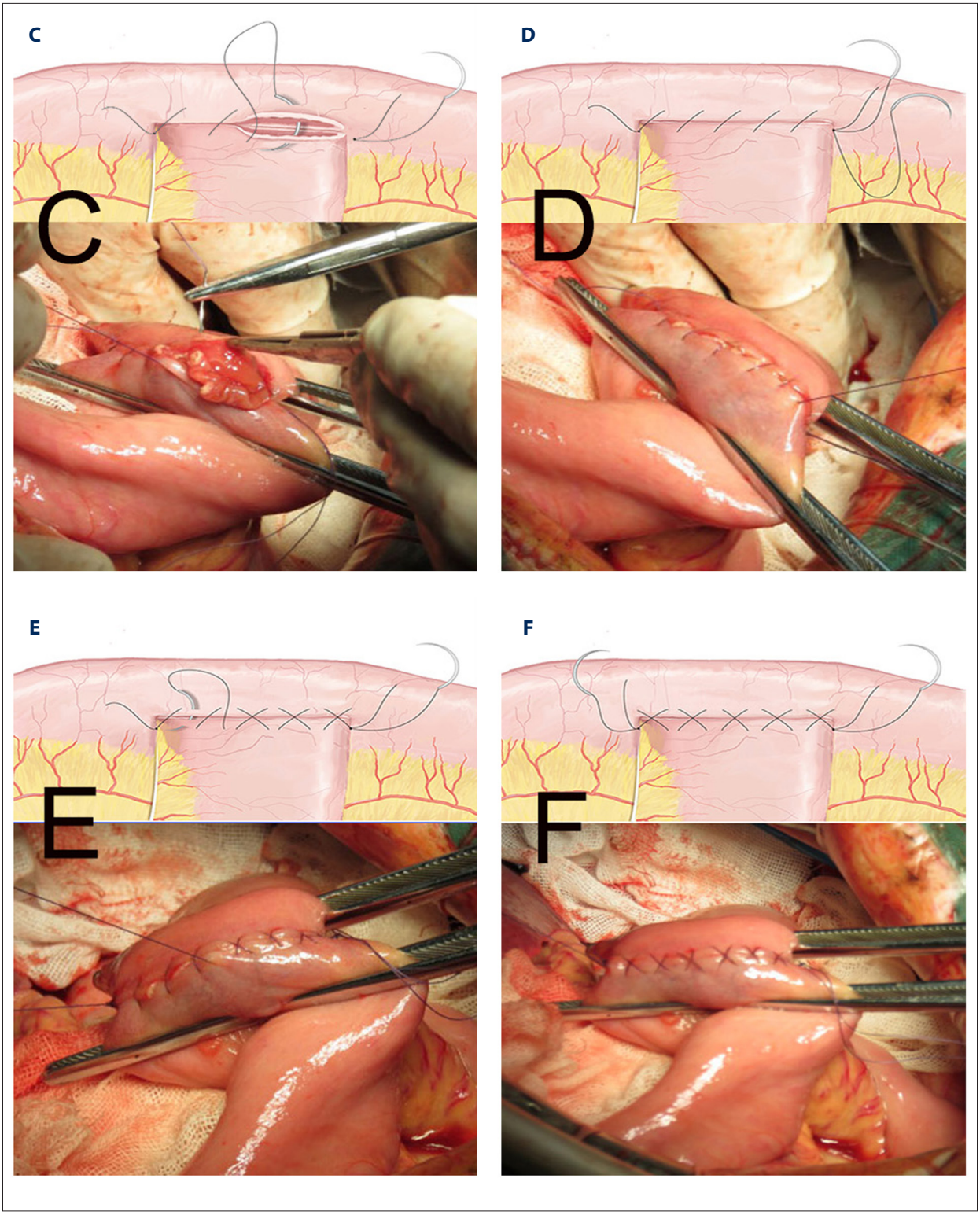

Figure 2. (**A, B**) Two 4-0 pyloric sutures were used to fix the 2 cut edges of the intestines. (**C, D**) One of the pyloric sutures was used to perform continuous non-varus manual suturing through the whole layer of the intestine. The edge was about 5 mm, and the stitch spacing was about 6 mm. (**E, F**) Another pyloric suture was then used for continuous suturing only through the seromuscular layer of the intestine to complete the second layer of suturing. The edge and the stitch spacing were the same as in the first layer (the posterior edges of intestine were finished using the same suturing method).

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2. Continuous suturing and closure of the bowel

This step is crucial to our technique. Beginning at either corner, the preserved suture is picked up, and the stitch begins about 5 mm from the cut edge of the bowel through the seromuscular layer only, then the mucosal layer is added only 1 mm before exiting the bowel wall. It is important to ensure that the mucosal layer is included approximately 1 mm from the cut edge so as to ensure proper alignment, since this is a non-varus technique. The same process is repeated on the opposite side but in a reverse fashion (1-mm mucosal layer and 5-mm seromuscular layer) to complete a full stitch. The process is then continued, ensuring an approximately 6-mm inter-stitch interval until the sutures arrive at the other corner of the bowel, and a knot is made to complete the placement of the first layer of suturing. The excess length of thread (if available) is kept in place to be used on the underside of the bowel (Figure 2C, 2D).

3. Placement of the second layer of suture

The preserved thread at the other end is then picked up, and the suturing is done in a reverse direction (toward the beginning of the first suturing). This time the sutures are only continued through the seromuscular layer, maintaining the distances mentioned in the first layer (stitch to bowel cut edge and inter-stitch distances), thereby appearing as a cross or figure-eight in relations to the first layer of suture. A knot is then made and the excess length of thread is kept in place to be used later on the underside of the bowel (Figure 2E ,2F).

4. Suturing of the underside of the bowel and completing the anastomosis

The bowel is then flipped over, exposing the underside. Repeating the same procedure described in steps 2 and 3, the suturing of the exposed underside is finished and the anastomosis is checked for bleeding and proper alignment of the bowel. The edges of the mesentery are closed to prevent any internal herniation. The patency of the anastomosed segment is confirmed by gently palpating the anastomosis between the thumb and index finger.

Anastomotic costs, time, and relative postoperative complications (including anastomotic bleeding, leakage, and anastomotic stricture) were recorded and analyzed. Drainage tubes were removed once the output was less than 10 ml. Patients were advised of necessary treatment at the time of discharge.

Statistics

Continuous data are expressed as means ± standard deviation (SD). Differences between the groups were assessed by use of the *t* test and the Mann-Whitney test. Categorical data were analyzed using the Fisher exact test and the Pearson chi-square test. A significant difference was assumed when P was less than 0.05. Statistical analyses were performed using SPSS version 18.0, statistical software (SPSS Inc, Chicago, IL).

Results

Comparisons of demographic information and perioperative data of the 2 groups

Eighty patients received a new hand-sewn Roux-en-Y anastomosis, and 70 patients received a stapled Roux-en-Y anastomosis. Demographic information and perioperative data of the 2 groups are shown in Table 1. Anemia was defined as Hb ≤120 g/L (male) and Hb ≤110 g/L (female), and hypoalbuminemia was defined as ALB ≤35 g/L. Patients in both groups were evenly matched by age; sex, body mass index (BMI); type of operation; assisted laparoscopy; operation time; intraoperative blood loss; presence of diabetes, hypertension, ischemic cardiopathy, or chronic obstructive pulmonary disease (COPD); and perioperative data such as hypoalbuminemia and anemia. There were no significant differences between the 2 groups (Table 1).

Anastomotic time

The time required for construction of the Roux-en-Y anastomosis was recorded, beginning with the placement of the first stitch and continuing until the excess material was cut from the last stitch. The mean time required for a new hand-sewn anastomosis was 8±1.6 min, and that of stapled anastomosis was 9±2.8 min. No significant difference was observed between the 2 groups (Figure 3).

Anastomotic costs

The mean amount of suture materials used in the construction of our new hand-sewn anastomosis was a 2-pack of 4–0 polypropylene, whereas in stapled construction it was 1 linear stapler and 1 circular stapler. The expenditure was approximately $30±6.8 in the new hand-sewn anastomosis group and approximately $1000±106.2 in the stapled anastomosis group. The average cost of Roux-en-Y anastomoses using the new hand-sewn method was significantly lower than that using the stapled anastomoses (Figure 4).

Postoperative complications associated with Roux-en-Y anastomosis

Both groups had a mean hospital stay of 12 days. The postoperative complication rates associated with Roux-en-Y

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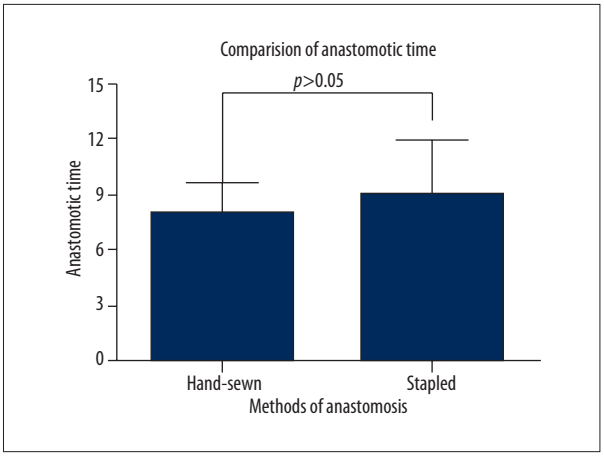

Figure 3. The surgical anastomotic time using the hand-sewn method was relatively shorter than in the stapled group (8±1.6 min *vs.* 9±2.8 min).

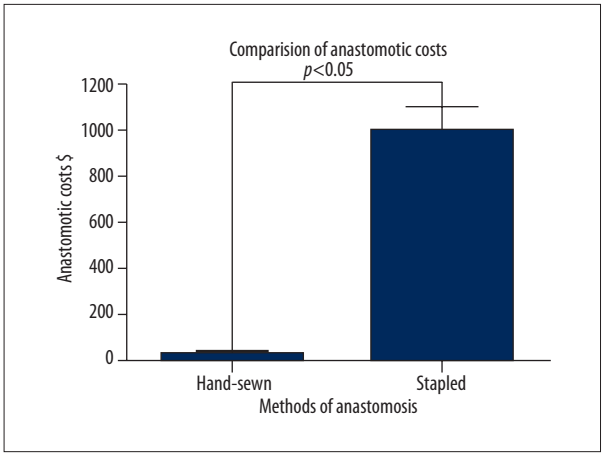

Figure 4. The cost of anastomosis using the hand-sewn method was significantly lower compared to the control group ($30±6.8 *vs.* $1000±106.2).

Table 2. The comparison of relative postoperative complications of the two methods.

Relative postoperative complications	Hand-sewn	Stapled	*p* value
Anastomotic bleeding	0/80	2/70	0.216
Anastomotic leakage	0/80	1/70	0.467
Anastomotic stricture	0/80	0/70	>0.90

anastomoses, including anastomotic bleeding, leakage, and stricture, were not significantly different between the 2 groups (Table 2). Anastomotic bleeding, confirmed by relaparotomy, occurred in 2 patients in the stapled group. Both patients showed hemorrhagic shock at postoperative 8 h and 16 h, respectively, and recovered uneventfully through reoperation. One patient in the stapled group experienced anastomotic leakage due to severe abdominal infection on postoperative day 8, which was confirmed by the examination of upper-gastrointestinal radiography using 60% compound meglumine diatrizoate. No anastomotic stricture was observed in either group.

Discussion

Hand-sewn anastomosis and stapled anastomosis are both widely used in digestive tract reconstruction [2]. Hand-sewn anastomoses have a history of over 100 years of successful use. Double-layered intestinal anastomosis was first performed in the early 19th century and the single-layered interrupted anastomosis was first described by Hautefeuille in 1976 [8]. Surgical stapling devices did not gain popularity for some time because the early instruments were cumbersome and unreliable. However, stapled anastomoses are used more and more often in clinical applications with the dramatic improvements of staplers in the last 3 decades [9]. This technique shows unique advantages in some anastomoses with difficult locations, such as low rectal anastomosis [10].

The present study assessed the efficacy and safety of our new hand-sewn anastomosis against the stapled anastomosis after cutting the jejunum in Roux-en-Y construction in terms of anastomotic leakage, bleeding, stricture, time required to construct the anastomosis, and cost incurred. The mean time required in the 2 methods has no significant difference. Thus, our new method does not increase the anastomotic time compared with stapled anastomosis, which is probably due to the use of full-layer running reinforced sutures after stapled anastomoses in our study. However, the most significant finding was the considerable difference in the required cost of anastomoses. The total number of suture packs required in our hand-sewn anastomosis was a 2-pack of 4–0 polyglactin sutures, for a total cost of $30±6.8. Stapled anastomoses required a circular stapler and a non-cutting linear stapler, with a total cost of $1000±106.2, which was over 30 times more than that of our hand-sewn anastomosis and this difference was highly significant.

Many randomized studies have been done to evaluate stapling methods in elective and emergency surgery and have not demonstrated any significant difference in the incidence of relative complications between stapled and hand-sewn anastomoses.

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Failure of an anastomosis with leakage of intestinal contents is one of the most significant surgical complications reported, with failure rates ranging from 1% to 24% [11–13]. We applied our new hand-sewn anastomosis in 80 patients, and no related complications occurred. In contrast, anastomotic leakage and bleeding occurred in 2 cases and 1 case, respectively, in the stapled anastomotic group, although there was no significant difference between the 2 groups. This confirms that our new hand-sewn anastomosis is safe and feasible. In fact, we also used this method in gastrointestinal, ileum-colon, and colon-colon anastomosis in several patients, without any complications such as anastomotic bleeding, leakage, or stricture. This approach is a better choice than stapled anastomosis, especially when the intestinal wall was edematous, because use of staplers can easily damage the intestinal wall, resulting in postoperative anastomotic leakage.

In this study, we introduced a new hand-sewn intestinal anastomosis method. Due to the ease of this technique, it can be safely introduced into a surgical training program without a difficult learning curve, making it easier for beginners to master than the traditional continuous running suture or interrupted suture (single- or double-layered anastomosis). Hand-sewn anastomoses have been reported as more time-consuming and difficult to learn than stapled anastomoses during surgery [14,15]. However, our results showed no significant difference in anastomotic time between the 2 groups. Moreover, our new hand-sewn anastomosis was more cost-effective and presented no obvious relative postoperative complications compared to stapled anastomosis. This technique also eliminated some of the drawbacks of the stapled anastomoses. However, further multicenter and randomized controlled trials are needed to confirm the safety and validity of our new hand-sewn anastomosis method due to the limited number of cases in our study.

Conclusions

Therefore, we submit that our new hand-sewn anastomosis method is reliable, cost-saving, and is recommended for gastrointestinal or intestinal anastomosis during general surgery.

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