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Papers presented

Robotic assistance provides excellent outcomes during the learning curve for laparoscopic Roux-en-Y gastric bypass: results from 100 robotic-assisted gastric bypasses

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Abstract

Background: Laparoscopic Roux-en-Y gastric bypass (LRYGB) has a reported learning curve of 100 cases. Robotic-assisted surgery decreases the learning curve in complex laparoscopic surgeries. We hypothesize that robotic-assisted, hand-sewn gastrojejunostomy during a LRYGB will improve results during the initial 100 cases when compared with the literature.
Methods: Our first 100 robotic-assisted gastrojejunostomies performed during LRYGB were reviewed from a prospective database. Patient demographics, operative times, length of stay, reoperations, anastomotic leak, pulmonary embolus, and death were all evaluated.
Results: The mean age and body mass index were 42 and 50, respectively. Operative times ranged from 148 minutes to 437 minutes (mean = 254). There were no leaks or deaths. Four patients had complications, including reoperation (1), incisional hernia (1), pulmonary embolus (1), and recurrent umbilical hernia (1).
Conclusions: Robotic-assisted LRYGB is feasible and safe, as evidenced by the excellent outcomes from this series during the initial learning curve for LRYGB.

Keywords: Robotic surgery; Gastric bypass; Learning curve; Outcomes

Because obesity continues to become a more recognized health epidemic in the United States, the focus on bariatric surgery has grown. Bariatric surgery is the most effective treatment available for morbid obesity and its associated comorbidities [1]. Never before has a surgeon had the ability to improve or cure medical conditions, such as non–insulin-dependent diabetes mellitus [2]. Laparoscopic Roux-en-Y gastric bypass (LRYGB) has become the most frequently performed bariatric procedure in the United States [1], and the demand for it continues to grow. The technical challenges in performing an LRYGB are numerous and require advanced laparoscopic skills that are often not used by general surgeons for other laparoscopic cases. Advanced techniques required during an LRYGB include 2-handed manipulation of the bowel, stapling, suturing, and intracorporeal knot tying. These skills are difficult to master because of the limitations of laparoscopy, such as a 2-dimensional view and a limited range of motion of the instruments. As with the introduction of other advanced laparoscopic procedures, a learning curve for this procedure exists, during which time complication rates and operative times are increased. The learning curve for LRYGB has been reported to be 100 cases [3].

The introduction of the da Vinci Surgical System (Intuitive Surgical Inc, Sunnyvale, CA) in 2000 allowed surgeons to overcome many of the limitations of standard laparoscopic surgery. From a remote console, a surgeon has a 3-dimensional view with magnification of the operating field and instruments with 2 additional degrees of freedom over laparoscopy (up-down and left-right). Additional benefits of the robotic system include adjustable motion scaling and filtering of tremor to allow for fine manipulation and precise suturing [4]. In bariatric surgery, the da Vinci system improves surgeon ergonomics by not just allowing one to sit at the console but also by alleviating surgeon fatigue caused by the torque created on the instruments and trocars

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by a thick abdominal wall [4]. The bariatric surgery experience with the da Vinci system has been limited in the literature. The results from the available studies have shown that robotic Roux-en-Y gastric bypass is feasible and possibly beneficial over standard LRYGB [5,6]. One of these study groups showed no gastrointestinal leaks when using the robotic system [5]. The most common application of the da Vinci system in bariatrics is in creating a hand-sewn anastomosis because of the precision it provides when operating in a confined space. This is advantageous in LRYGB because large amounts of intra-abdominal fat and a large left lobe of the liver significantly limit the operating area at the gastrojejunostomy.

The advantages of the da Vinci system would appear to be most useful in improving the outcomes during the learning curve of an advanced laparoscopic procedure, which has been shown in robotic radical prostatectomy [7]. Being a tertiary referral center, we see a super obese population (body mass index [BMI] >50), with some having had prior gastric surgery. Robotic assistance seems very beneficial in this situation, especially when early in one's experience. During the initial learning curve for a LRYGB by a single surgeon (EBW), the da Vinci system was used to perform the 2-layer, hand-sewn gastrojejunostomy. Before adapting this technique, he had only performed 12 LRYGBs without robotic assistance. We present the results from the first 100 robotic-assisted LRYGB cases performed during the gastric bypass learning curve.

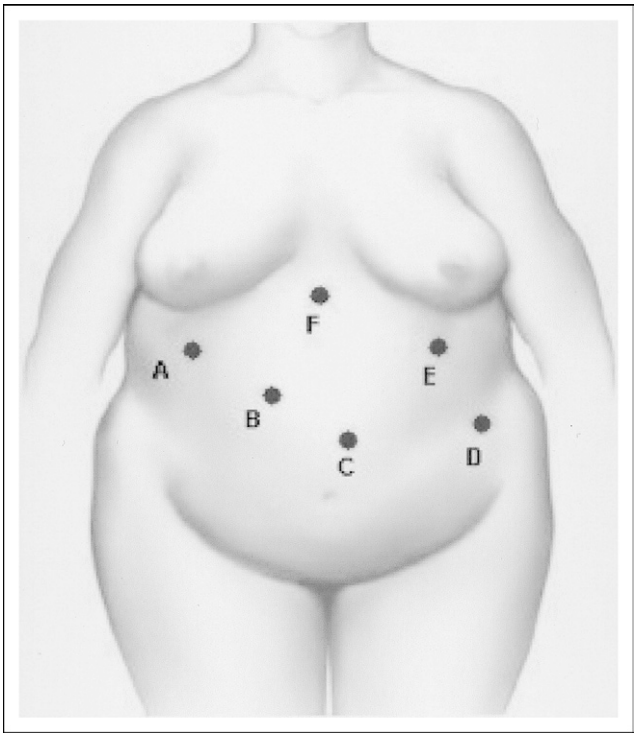

Fig. 1. Port placement. (A) 5 mm (robot), (B) 12 mm, (C) 12 mm (camera), (D*) 5 mm, (E) 5 mm (robot), and (F) liver retractor. *Currently used for fourth arm of the robot.

Materials and Methods

Between May 2003 and August 2005, we reviewed our first 100 consecutive robotic-assisted LRYGB from a prospectively collected database. Patient demographics, operative times, length of stay, reoperations, anastomotic leak, pulmonary embolus, and death were all evaluated. Patients were followed up at routine intervals of 1 week, 6 weeks, 3 months, 6 months, 1 year, and yearly after that. All patients in this series had at least a 6 month follow-up. Cases were considered robotic assisted if the 2-layer, hand-sewn gastrojejunostomy was performed by using the da Vinci system. All cases involved 1 attending surgeon (EBW) and at least 1 assistant, whose experience ranged from a laparoscopic fellow to a medical student.

As the experience with the robotic-assisted gastrojejunostomy increased, the fellows became more involved with the robotic portion of the procedure. For the last 15 cases, the fourth arm of the da Vinci system was used to assist in performing both the gastrojejunostomy and the closure of the enterotomy at the jejunojejunostomy.

The operative technique for the gastric bypass is a modification of the Higa et al technique [8]. Port placement is as shown in Figure 1 and consists of two 11-/12-mm ports and three 5-mm ports in which 2 will later be changed to 8-mm cannulas for the robot. Of note, when the 5-mm instruments became available for the da Vinci, we began using all 5-mm cannulas. Beginning laparoscopically, we create a 20-mL gastric pouch over a sizing balloon with linear staplers and Seamguard (Gore, Scottsdale, AZ) staple line reinforcement. Next, a stapled side-to-side jejunojejunostomy is made with a 50-cm biliopancreatic limb and a 100-cm Roux limb for BMI <50 or a 150-cm Roux limb for BMI ≥50. For the first 85 cases, we laparoscopically closed the subsequent enterotomy with a single-layer hand-sewn vicryl suture and the mesenteric defect with a running silk suture. For the last 15 cases, we devised a technique to close both the enterotomy and mesenteric defect by using the da Vinci system without having to redock for the gastrojejunostomy because of the addition of the fourth arm for the robot. At this point, sutures were placed into the abdomen via the 12-mm working port, and the 5-mm trocars were changed to the da Vinci cannulas. The robot was then docked. By using an antecolic, antegastric Roux limb, a 1.5-cm, 2-layer hand-sewn anastomosis was fashioned. Intraoperative endoscopy was performed to check for leaks after the robot was undocked.

All patients attended an informational meeting during their workup for a gastric bypass. During this meeting, the use of robotic assistance in performing their surgery was discussed. In addition, written informed consent was obtained from all patients before surgery. This prospectively collected database has been approved by the Institutional Review Board for the University of Texas Health Science Center Houston, Houston, TX.

Results

The average age of our patients was 42 years old (range 23–63) with a mean BMI of 50 (range, 35–88). Seventeen percent of these patients were male, and 43 were super obese. Four patients underwent revisions of prior bariatric procedures, and 24 patients underwent additional procedures at the time of their LRYGB (Table 1). Muscle biop-

Table 1
Additional procedures performed in 24 patients

Lysis of adhesions	10
Muscle biopsy	10
Hernia repair	7
Revision of prior bariatric surgery	4
Cholecystectomy	2
Revision of Nissen	1
Sebaceous cyst excision	1

Table 2
Postoperative complications

Anastomotic stricture	2%
Reoperation	2%
Trocar hernia	1%
Pulmonary embolus	1%
Anastomotic leak	0%
Death	0%

sies were performed in 10 patients as part of another study being currently performed in bariatric patients at our institution. Operative time was determined from the start of the first incision until closure of all incisions was performed. The mean operative time was 254 minutes, with a range of 148 to 437 minutes. When cases with concurrent procedures were removed, including revisions, the mean operative time decreased to 238 minutes. When operative times are averaged for groups of 20 patients, the operative times decreased throughout the series (Fig. 2). The last 20 cases performed had a mean operative time less than the average of all 100 cases. All cases were completed without conversion to an open technique and with robotic assistance as planned. Patients routinely underwent an upper-gastrointestinal gastrografin swallow on postoperative day 1 and were started on clear liquids if that study did not show a leak or an obstruction. Patients were discharged at a mean of 3 days after surgery (range, 1–13).

Postoperative complications are shown in Table 2. There were no leaks or deaths in this series of 100 patients. Two patients were reoperated on. One patient was taken back to surgery during her initial hospitalization because of clinical concern for a leak. No leak was detected at laparoscopy. The other reoperation was for a trocar-site hernia that was repaired laparoscopically. During the follow-up period, 2 patients presented with anastomotic strictures and underwent successful endoscopic balloon dilation. One patient had a pulmonary embolus detected and was treated with anticoagulation.

Comments

Robotic-assisted gastric bypass is a safe and effective procedure for morbid obesity. During the initial learning curve for LRYGB, the use of robotic assistance in creating a hand-sewn gastrojejunostomy has resulted in no leaks and no deaths. The gastrojejunostomy is one of the most technically challenging portions of a LRYGB. It requires the use of advanced laparoscopic skills, such as intracorporeal knot tying and suturing. A morbidly obese abdomen makes these tasks even more difficult. A large left lobe of the liver decreases the operating space around the gastric pouch, while a thick abdominal wall results in increased abdominal wall torque and surgeon fatigue. These factors can all affect the precision in which a laparoscopic hand-sewn anastomosis can be completed. The articulating instruments, mechanical advantage, and 3-dimensional view of the da Vinci robotic system help overcome these difficulties. These advantages may also significantly shorten the learning curve for a LRYGB [6]. Even after the learning curve for this procedure, a surgeon can still use these advantages of the robot, especially in the larger patient population. The ability to more easily and precisely perform a 2-layer hand-sewn anastomosis with the robotic system allows more surgeons a choice on how to create the gastrojejunostomy. The circular stapler can be avoided, eliminating the difficulties and risks in introducing the anvil and decreasing stricture rates and lowering wound infection rates [9].

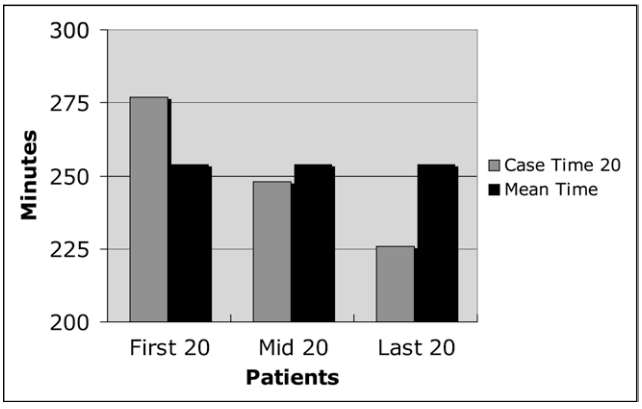

Fig. 2. Operative times averaged by groups of 20 patients compared with the average of the entire series of 100 patients.

Higher complications are expected during a surgeon's learning curve for LRYGB, especially in terms of anastomotic leaks. In 1 series, the leak rate was 7% during their initial 100 LRYGB [3]. We have had no leaks in our series. In addition, our stricture rate was 2%, which compares favorably with a 5% stricture rate in larger series on hand-sewn anastomosis [8]. However, larger series directly comparing robotic assisted versus laparoscopic hand-sewn gastrojejunostomy in a prospective, randomized fashion are still needed to verify the apparent favorable outcomes present in our series.

Operative times in our series ranged from 148 to 437 minutes, with a mean of 254 minutes. As the main surgeon's experience grew with this procedure, the amount of console time by the fellows increased and more difficult patients were operated on, which blurs the possible improvement in operative times that may have been seen. Despite that fact, the average operative time for the last 20 cases in this series was still less than the overall average of the series. Another factor is that for the last 15 patients, we additionally closed the enterotomy and the mesenteric defect at the jejunojejunostomy with the da Vinci. Furthermore, being a tertiary referral center, we operate on a more obese patient population in which the benefits of the robot may be more pronounced. Regardless, our mean operative times are similar to those reported by Schauer et al [3] group during their first 100 LRYGB cases, which was 269 minutes. The follow-

ing 50 patients in that study had a mean operative time of 237 minutes, and 1 reason that it remained high was that they started operating on heavier and higher-risk patients as their comfort level with the surgery increased. This is similar to our experience with our patient group. Other groups have reported operative times averaging 189 minutes during their learning curve [10], but we believe the outcomes from this series, especially with no leaks or deaths, justify these longer operative times.

Our results support the feasibility and safety of robotic assistance in LRYGB. During the learning curve for LRYGB, we have been able to maintain a low complication rate with no deaths. Robotic-assisted LRYGB should be considered by surgeons during their learning curve for laparoscopic Roux-en-Y gastric bypass.

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