Totally Robotic Roux-en-Y Gastric Bypass: Technique

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Abstract The da VinciTM robotic system (Intuitive Surgical, Inc, Sunnyvale, CA) has been used frequently for urological procedures including radical prostatectomy and pyeloplasty. Its use in bariatric surgery is limited to few high volume centres in the western world. The advantages of robotic assistance are three-dimensional vision, ergonomic advantage and improved precision. We report our experience of using this advanced technology to perform a robotic Roux-en-Y gastric bypass in a 55-year-old obese diabetic patient. We were able to reproduce our standard laparoscopic technique and all the steps of the surgical procedure were done using robotic assistance.

Keywords Robotic · Gastric bypass · Bariatric surgery

Introduction

Robots have been used for a variety of surgical procedures but are most useful in procedures where complex reconstruction is required. Use of robotic system for Roux-en-Y gastric bypass (RYGB) was first described by Horgan and Vanuno in year 2001 [1]. Since then, many centres in the western countries have incorporated its use in their programme and reported their experience [2, 3]. We report our experience of using the da VinciTM robotic system to perform a RYGB in an obese diabetic female patient.

Case Presentation

The patient was a 55-years-old female with a body mass index of 37.7 kg/m². She was suffering from type 2 diabetes

mellitus for the past 10 years and was on oral hypoglycaemic medicines. Her other co-morbidities included hypertension, dyslipidemia and osteoarthritis. The patient was evaluated as per the standard protocol and her co-morbidities were optimised prior to surgery. She was started on very low calorie diet for a period of 10 days. She was counselled about the advantages and possible drawbacks of robotic surgery. Being a public funded hospital, the procedure was free of charge for the patient.

Surgical Technique

Detailed preoperative planning was done regarding the approach, port positions and the steps of surgery. The operating room setup is depicted in Fig. 1. The robot was placed over patient's left shoulder and docked from this position. With the patient in supine position, the ports were inserted (Fig. 2) after creating pneumoperitoneum using a Veress needle. Five ports were used as in the standard laparoscopic RYGB. A 12-mm port was inserted in the supraumbilical position and the robotic telescope was inserted through this port. Subsequently, two 8-mm ports were inserted for the robotic arms. A 12-mm port was inserted on the right side for the stapling device and a 5-mm port was inserted for assistant. Nathanson liver retractor (Cook Medical Inc) was inserted through a small incision in the epigastrium. Dissection was started close to the gastric wall, about 5–6 cm from gastro-oesophageal junction. This was done using robotic assistance. A small gastric pouch was created using the Echelon 60 endostapler (Ethicon Endosurg, Cincinnati Ohio) using blue cartridges. The proximal biliopancreatic limb was measured at 50 cm and the loop of jejunum is brought up in antecolic fashion at this point and hitched to the gastric pouch using stay sutures using robotic assistance. Jejunum was divided using a white cartridge just proximal to left stay suture. The alimentary limb was measured at 100 cm and approximated to the biliopancreatic limb using a stay suture taken with robotic assistance. The jejuno-jejunal anastomosis was created in a side to side manner using a single firing of a 60-mm linear stapler. The resultant enterotomy was closed with stapler after taking three stay

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Fig. 1 Operating room setup for performing robotic Roux-en-Y gastric bypass

sutures using robotic assistance. A two-layered gastro-jejunal anastomosis of about 2 cm was fashioned using 3–0 polyglactin and 3–0 silk sutures using robotic arms (Fig. 3). Intraoperative leak test was done by air insufflation test which was negative. A drain was placed subsequently.

The total operative time was 186 min. The post-operative period was uneventful. Patient was allowed orally on the second post-operative day after a normal Gastrografin study. Drain was taken out on the third post-operative day and the patient was discharged. At 6 months of follow-up, the patient has lost 24 kg of weight and is off any anti-diabetic medications.

Discussion

Laparoscopic RYGB has remained a technically demanding surgery requiring advanced laparoscopic skills such as dissection in various abdominal compartments, intracorporeal suturing and knot tying, increased abdominal torque causing

surgeon's fatigue [2, 3]. Moreover, it has limitations inherent to any laparoscopic procedure, viz, the two-dimensional view, the counterintuitive movement of instruments and limited degree of freedom [2, 3].

The da Vinci™ robotic system has been designed to overcome these problems of laparoscopy. The surgeon's console is away from the patient and provides a comfortable sitting position. Three-dimensional view, endo-wrist instruments with 7 *df*, the computer-controlled tremor filters and motion sensors add to the sensorial and physical ergonomics. It was initially introduced in the gastric bypass procedure for performing only the gastro-jejunal anastomosis, which is the most technically demanding step. With increasing experience, it was found to be feasible for the entire procedure and each step of the surgery has been reproduced with similar or even better precision compared to standard laparoscopy [2, 3]. The learning curve for gastric bypass has been estimated to be 100 procedures for standard laparoscopy [4] but only 35 with robotic assistance [2]. This has important implications for resident training in teaching centres.

Operative time for the procedure in our patient was 186 min, which was longer than the time taken for laparoscopic RYGB in our hands (120–160 min). However, the duration of surgery can be reduced with increasing experience. Kim and Buffington

Fig. 2 Port placement for robotic Roux-en-Y gastric bypass. O—port for robotic telescopic; R1, R2—ports for robotic arms; A1, A2—assistant ports; N—Nathanson self-retaining liver retractor

Fig. 3 Operative photograph showing completed gastro-jejuno-stomy using the da Vinci™ robotic system

almost halved their mean operative time from 183 min in first 10 cases to 95 min in last 10 cases [3]. We found the use of the robot to be more surgeon friendly for performing RYGB as compared to conventional laparoscopy. For a surgeon working in a high volume centre, use of robotic assistance leads to higher precision and lesser fatigue. From the patient's perspective, the robotic surgery retains the advantages of a minimally invasive surgery including decreased post-operative pain, faster recovery and decreased hospital stay. Snyder et al. compared their series of 320 robotic gastric bypass procedures with 356 cases of the laparoscopic RYGB and found lower morbidity and mortality in the robotic group [5].

The main technical limitations are loss of force feedback and haptic sense, which may lead to increased tearing of intestinal tissue during manipulation. Other limitations include system failure, multi-quadrant surgery and limited instrumentation. Moreover, the instruments can be used only for a limited number of cases, resulting in higher cost per procedure. With advances in technology, these limitations are likely to be reduced in the future. The number of ports as well as their placement during robotic surgery is essentially similar to the one used during standard laparoscopic gastric bypass; the difference being only in the size of the ports. For robotic surgery, the two 8-mm ports replace the 5-mm ports used in laparoscopic bypass. Another issue is the use of staplers during robotic surgery. The standard staplers can

be introduced only through the 12-mm ports. One option is to place a 12-mm port for the stapler as was used in our patient. Double cannulation of 8-mm robotic ports has been described to provide retraction of robotic arms and insertion of the standard staplers through same ports [2].

Although bariatric surgery is getting popular in Asia, robotic gastric bypass has not been reported. We report our first experience with using the da VinciTM robotic system for performing laparoscopic Roux-en-Y gastric bypass in a morbidly obese patient with diabetes.

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