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Original article

Resident education in robotic-assisted vertical sleeve gastrectomy: outcomes and cost-analysis of 411 consecutive cases

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Abstract

Background: Robotic technology is increasingly prevalent in bariatric surgery, yet there are national deficiencies in exposure of surgical residents to robotic techniques.
Objectives: The purpose of this study is to accurately characterize the perioperative outcomes of a resident teaching model using the robotic-assisted sleeve gastrectomy.
Setting: University Hospital.
Methods: We identified 411 consecutive patients who underwent robotic sleeve gastrectomy at our institution from a prospectively maintained administrative database. Perioperative morbidity, operative time, and supply cost of the procedure were analyzed.
Results: Mean operative time was 96.4 ± 24.9 minutes; mean robot usage time was 63.9 minutes (range 30.0–122.0 min). Ninety-day morbidities included reoperation (0.72%), major bleeding complications (0.48%), staple line leak (0.24%), stricture (0.97%), need for blood transfusion (3.86%), surgical site infection (1.69%), deep vein thrombosis (0.48%), and pulmonary embolism (0.48%). Mortality was nil. The resident cohort achieved operative time plateaus after five consecutive cases. Subset analysis for fiscal year 2014 demonstrated significantly increased supply cost for robotic sleeve gastrectomy compared with its laparoscopic equivalent.
Conclusion: Robotic-assisted sleeve gastrectomy can be instituted as a model for resident robotic education with rates of morbidity and operative times equivalent to historical laparoscopic controls. The robot's enhanced ergonomics and its opportunity for resident education must be weighed against its increased supply cost. (Surg Obes Relat Dis 2015;▮:00–00.)

Keywords: Sleeve gastrectomy; Robotic surgery; Bariatric Surgery; Morbid Obesity; Surgical education

Robotic technology is increasingly prevalent in bariatric surgery, as the field has trended from open to minimally invasive techniques. Robotic computer-assisted platforms provide tremor stabilization, improved optics, and greater range of motion for enhanced ergonomics. The robotic interface has been applied for use in minimally invasive gastric banding, sleeve gastrectomy, and Roux-en-Y gastric bypass. Of these, the sleeve gastrectomy has quickly gained popularity, given the absence of a gastrointestinal anastamosis, mesenteric defect, or foreign body, while permitting routine accessibility of the gastric sleeve by endoscopy in the post-operative setting. Yet critics point to the increased cost associated with a robotic system and the increased operative times needed for robot docking [1–3]. Moreover, there are few published outcome analyses of robotic sleeve gastrectomy to date, resulting in an insufficient quantity of data to properly assess the safety of this novel technique [4–6].

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Additionally, there is increasing patient preference for minimally invasive techniques and, in response, a growing importance to training the next generation of surgical residents in the skills of laparoscopic and robotic surgery. Yet a recent survey of contemporary surgical residents revealed that while the majority of residents had participated in a robotic case during their training, fewer than 10% had experience operating the robotic console [7]. As such, we sought to evaluate the experience of our high-volume bariatric practice, where the surgical resident exclusively operates the robot console during the robotic-assisted sleeve gastrectomy. We present the largest case series of robotic-assisted sleeve gastrectomies to accurately characterize its feasibility as a teaching model for surgical residents and the outcomes of this process.

Methods

Following approval by the Institutional Review Board, all patients who underwent robotic sleeve gastrectomy at our tertiary care center between September 1, 2011, and April 30, 2014, were identified from a prospectively maintained administrative database. Inclusion criteria included age $\geq$18 years, body mass index (BMI) of $\geq$35–39 kg/m^2 with one obesity-associated co-morbidity or BMI $\geq$40 kg/m^2. Before surgery, patients completed a standardized psychological and physical assessment.

Surgical technique

One bariatric attending surgeon performed all surgeries in one single institution and was assisted by a surgical resident of clinical year 3 or 5. Residents completed a simulation training using the *da Vinci Si* Surgical System (Intuitive Surgical, Sunnyvale, CA) before the surgical rotation, which extended for 4 to 8 consecutive weeks. The rotation marked the first exposure of all surgical residents included in the study to the robotic interface. The surgical resident was the sole console surgeon, whereas the bariatric attending surgeon was the scrubbed table surgeon.

The patient cart is positioned by dedicated surgical nurses trained in the robotic platform. The patient is positioned supine, with arms extended laterally and legs belted with footplate in position. A nasogastric tube and foley catheter are placed, and the patient is placed in steep reverse Trendelenburg position.

Access port placement is illustrated in Fig. 1. A supra-umbilical Veress needle technique is used to gain initial peritoneal access and is upgraded to a 12-mm port, which functions as the camera port. The left liver lobe is retracted with a Nathanson liver retractor. Two right-sided and 2 left-sided ports (all 12-mm) are placed; the left lateral and the right medial ports are used for the robotic arms, and the left medial and right lateral ports provide access for a laparoscopic stapling device and vessel sealer, which are handled by the bedside attending surgeon. Hence, the attending surgeon is responsible for stapling and energy application, and the surgical resident manipulates the robotic instruments that help expose tissues. The *da Vinci* robot is docked from the patient's left.

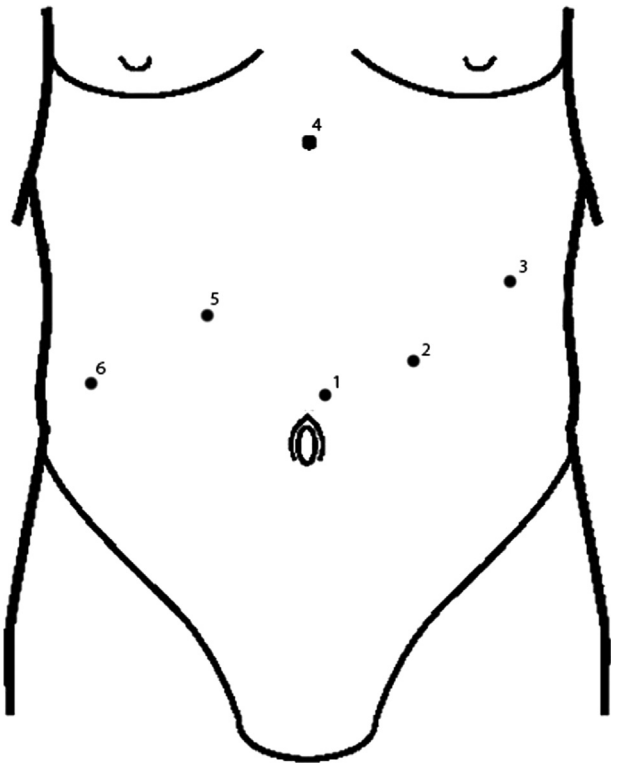

Fig. 1. Key: Camera port (1), 12-mm Instrument port (2), 12-mm Robot Arm (3), 5-mm Liver Retractor (4), 12-mm Robot Arm (5), 12-mm Instrument port (6)

The first step is the division of the greater omentum from the greater curvature in the prepyloric region, advancing the dissection along the greater curvature through the short gastric to the angle of His. The stapling is started 5 cm from the pylorus toward the angle of His with a 38 Bougie as a guide. A Covidien Endo GIA Medium-Thick (Purple) or Extra-Thick (Black) load with Tri-Staple Technology is used to divide the stomach. We prefer the improved ergonomics of the *da Vinci* robot—compared with traditional laparoscopy—to facilitate visualization of the gastroesophageal junction. Additionally, we prefer to use the robot for the super-obese patients, who constitute a large proportion of sleeve gastrectomy cases, as this group is often deemed too high risk for the more involved Roux-en-Y gastric bypass.

The excised stomach is removed via the left lateral port. No method for staple line reinforcement is employed. We typically test for leak using indigo blue and place a 10 Jackson-Pratt drain adjacent to the gastric staple line. The left lateral port used for specimen extraction is closed with a laparoscopic suture passer.

Estimated blood loss was obtained from the anesthesia case record. Robot usage time for each case was obtained