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Original Research

Two years of experience with robot-assisted anti-reflux surgery: A retrospective cohort study

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HIGHLIGHTS

- Robot-assisted anti-reflux surgery was compared to laparoscopy.
- All patients over a study period of two years was included.
- Robot-assisted anti-reflux surgery had longer duration of surgery.
- There was no significant advantages to robot-assisted surgery.
- There was no significant learning curve for an experienced surgeon.

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ABSTRACT

Background and aims: Robot-assisted anti-reflux surgery (RAAS) is an alternative to conventional laparoscopic anti-reflux surgery (CLAS). The purpose of this study was to evaluate initial Danish experiences with robot-assisted anti-reflux surgery compared to conventional laparoscopic anti-reflux surgery incorporating follow-up and evaluation of possible learning curve.

Material and methods: Patients undergoing primary RAAS or CLAS at The Department of Surgery A, Odense University Hospital and The Department of General Surgery, Kolding Hospital from April 2013 to April 2015 was included. Demographic data, comorbidity, docking time, length of procedure, type of fundic wrap as well as perioperative complications and postoperative complications, need for reoperation or any upper gastrointestinal endoscopy from surgery to final follow-up was retrospectively extracted from patient records.

Results: 103 patients were included in this study. 39 patients underwent RAAS and 64 patients underwent CLAS. There were no statistically significant differences in demographic data or comorbidities except distribution of heart disease (RAAS: 5.1% vs. CLAS: 18.8%, $p = 0.05$) and previous abdominal surgery (RAAS: 28.2% vs. CLAS: 48.4%, $p = 0.04$). Duration of surgery was significantly increased in patients undergoing RAAS (RAAS: 135 ± 27 min vs. CLAS: 86 ± 19 min, $p < 0.01$). There was no statistical significant difference in intraoperative complications ($p = 0.20$), 30-day postoperative complication rate ($p = 0.20$) or mortality ($p = 1.00$).

At follow-up in April 2016, there were no statistically significant differences in patients having undergone upper endoscopy postoperatively ($p = 0.92$), the use of anti-secretory drugs ($p = 0.46$) or patients having undergone reoperation ($p = 0.60$).

Reasons for reoperation were significantly dependent on type of fundic wrap with reoperation of Nissen fundoplication being dysphagia and reoperation of Toupet being recurrent reflux ($p = 0.008$). There was no clearly determined learning curve.

Conclusions: RAAS was safe, feasible and with equal efficacy to CLAS. There were however no particular advantages to performing antireflux surgery as robot-assisted procedures neither intra-operatively nor at follow-up.

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1. Introduction

Conventional laparoscopic anti-reflux surgery (CLAS) is the gold standard for surgical treatment of gastroesophageal reflux disease with high patient satisfaction and excellent results compared to medical treatment [1]. The development of anti-reflux surgery from open to a minimal invasive laparoscopic approach has resulted in reduced postoperative pain and shorter procedure-related length of stay without compromising patient satisfaction [2].

Robotic surgical platforms have been introduced and applied for a variety of surgical procedures. In the United States, 31.867 procedures, approximately 4.3% of all general surgery operations, were performed with robotic assistance in 2009 [3]. Robotic technology offers technical improvements to conventional laparoscopy by integrating 3D visualization, offering increased maneuverability of applied instruments and improving ergonomic comfort for the surgeon [4].

Robot-assisted anti-reflux surgery (RAAS) has been performed and evaluated with six randomized clinical trials and subsequent meta-analysis [5,6], demonstrating longer operating time and non-superiority compared to the conventional laparoscopic approach, but the included studies are small, heterogeneous, include only short-term follow-up and lack focus on the possible differences between complete and partial fundoplication.

The purpose of this study was to evaluate initial Danish experiences with robot-assisted anti-reflux surgery, comparing the technique to conventional laparoscopic anti-reflux surgery incorporating operative parameters as well as follow-up of complications and possible reoperation. Furthermore the purpose was to investigate whether a learning curve was present when introducing the robot-assisted procedure to experienced laparoscopic surgeons.

2. Methods and materials

2.1. Patient selection and preoperative evaluation

Included in this retrospective cohort study were all consecutive patients undergoing primary anti-reflux surgery as either laparoscopic or robot-assisted procedure at The Department of Surgery A, Odense University Hospital and The Department of General Surgery, Kolding Hospital for a two year period (April 2013–April 2015). Patients with a hiatal hernia larger than 5 cm were excluded from the study as was patients undergoing cholecystectomy and fundoplication as a combined procedure. Doing the study period, no patients were selected for primary open surgery.

All patients had been evaluated preoperatively with upper gastrointestinal endoscopy, 24-h pH measurement and esophageal manometry as recommended before anti-reflux surgery [7]. All included patients had pathological gastroesophageal reflux disease verified by pH-measurement and inadequate effect of medical treatment with split-dose proton-pump inhibitors.

Demographic data on age, sex and body mass index (BMI) was registered preoperatively. Comorbidity in the form of American Society of Anastesiologists (ASA)-score, diabetes, heart disease, cerebrovascular disease, lung disease, hypertension, hypercholesterolemia, history of smoking and/or alcohol abuse (defined as consumption of >21 units of 12 g of alcohol per week for men and >14 units of 12 g of alcohol per week for women) and previous abdominal surgery, was also registered preoperatively.

2.2. Surgical technique

Pneumoperitoneum was established and trocars placed. If the surgery was performed as a robot-assisted procedure, the robotic platform (Da Vinci SI, Intuitive Surgical, Sunnyvale, California, USA) was docked.

Using a bipolar vessel sealer and divider (laparoscopy: Ligasure, Covidien, Copenhagen, Denmark. Robotic platform: Vessel Sealer, Intuitive Surgical, Sunnyvale, California, USA) the gastrohepatic ligament was divided along the lesser curvature, exposing the right crus (Picture 1). The short gastric vessels (Picture 2) and gastrosplenic ligament were divided to the angle of His and the left crus exposed. If a hiatal hernia was present, the hernia sac was completely reduced with careful attention not to harm the pleura, esophagus and vagus nerves. The esophagus was mobilized to allow for at least 3 cm of tension-free intraabdominal esophagus. No Collis gastroplasty was performed in any of the cases.

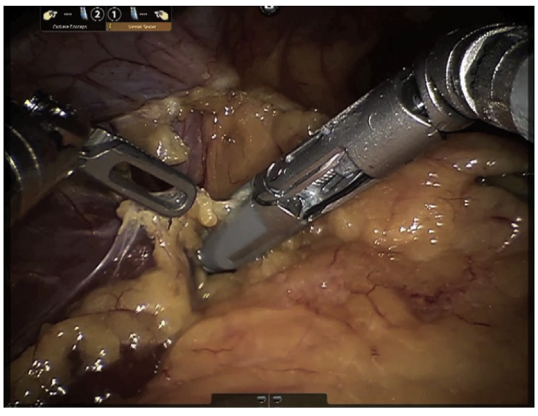
Cruraplasty was now performed with sutured closure using figure-eight non-absorbable multifilament sutures (TiCron, Covidien, Copenhagen, Denmark) (Picture 3). Mesh was not used to reinforce the crural closure as tension-free adequate closure was possible in all cases Hereafter fundoplication was performed, either as 360° Nissen procedure or if manometry had demonstrated reduced esophageal motility, using the 270° posterior Toupet procedure. Toupet procedure was also performed if a sufficiently floppy wrap could not be achieved during Nissen fundoplication. Routinely, a 56Fr Bougie was used to calibrate the fundic wrap. Both procedures were performed using nonabsorbable multifilament sutures (TiCron, Covidien, Copenhagen, Denmark) and anchored with single sutures at the most lateral parts of the wrap, to the right and left crus respectively (Picture 4). Finally all trocars were removed under direct vision and at 12 mm trocar sites the fascia was closed, before the skin-incisions were sutured.

Docking time, length of procedure, type of fundic wrap and intraoperative complications defined as lesion or perforation of pleura, stomach, esophagus, liver or spleen, aspiration or myocardial infarction during anesthesia, conversion to open or laparoscopic surgery and blood loss above 100 ml, was registered immediately postoperatively.

Patients were treated with paracetamol/acetaminophen and ibuprofen for pain relief postoperatively. All proton pump inhibitors and other anti-secretory drugs were discontinued immediately after surgery. Patients were discharged as soon as postoperative pain was sufficiently managed and they were able to ingest liquids orally.

2.3. Follow-up

Postoperative complications within 30 days, defined as complications with a score of 2 or more according to the Clavien-Dindo



Picture 1. Opening of the gastrohepatic ligament.

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