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Case Report

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Anesthesia in an Oncology Patient Undergoing Minimally Invasive Robotic Ivor Lewis Gastroesophagectomy Case Report

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Introduction

Cancer is the main public health problem in the world, being one of the main causes of death and, consequently, one of the main barriers to increasing life expectancy worldwide. In Brazil, the estimate for the three-year period from 2023 to 2025 indicates that there will be 704 thousand new cases of cancer [1]. The estimated number of esophageal cancer cases for each year of the three-year period from 2023 to 2025 is 10,990 cases, corresponding to an estimated risk of 5.07 per 100,000 inhabitants, with 8,200 cases in men and 2,790 cases in women [1].

Although also performed for benign diseases, esophageal cancer represents the most common indication for esophagectomy, the first being transthoracic esophagectomy was performed in 1913 [2]. Transthoracic esophageal resection with gastric conduit reconstruction represents a widely adopted approach for the treatment of junctional and thoracic esophageal cancer. The Ivor Lewis technique was described in 1946 and consists of an abdominal phase including a D2 level lymphadenectomy followed by the preparation of a gastric conduit and the thoracic phase involving esophageal resection, the mediastinal lymphadenectomy, and esophagogastric anastomosis [3].

The initial descriptions of a Minimally Invasive Esophagectomy (MIE) was started in the 1990s, and the addition of robotic-assistance is the latest evolution of minimally invasive esophageal resection and reconstruction [4]. The procedure can nowadays be performed using a laparoscopic-thoracoscopic approach to fully minimally invasive esophagectomy, with superior short-term outcomes and equivalent oncologic results compared to the conventional open approach. A randomized trial comparing the minimally invasive technique with open surgery for esophagectomy showed excellent outcomes, including short hospital stay and lower frequency of respiratory complications and supporting the routine use of minimally invasive surgery [5]. The robot-assisted minimally invasive thoraco-laparoscopic esophagectomy has recently been developed to overcome the technical complexity of MIE [6].

Patient with clinical diagnosis of adenocarcinoma of the cardia affecting the esophagus cranially distal and inferior to the lesser gastric curvature undergoing chemotherapy. We present a case of combined robotic laparoscopic and thoracoscopic resection of the distal third esophagus with an intrathoracic esophagogastric reconstruction for esophageal carcinoma, with the first stage via the dorsal decubitus route and the second stage via the ventral decubitus route.

Case Report

After registration in the Brazil Platform (CAAE: 91445725.5.0000.5274), approval by the Ethics Research Committee (Number: 7.792.282) and signing of the informed consent. A female patient, 72 years old, 78 kg, 170 cm, with hypertension, T2DM, obesity, ex-smoker long time ago (45 packs/year), with chest X-ray and auscultation compatible with Chronic Obstructive Pulmonary Disease (COPD), but without declaration of previous clinical treatment without allergies. She has a surgical history of conventional cholecystectomy 30 years ago, tubal ligation, perineoplasty approximately 40 years ago, and total thyroidectomy with bilateral dissection, due to medullary thyroid carcinoma.

After an upper digestive endoscopy examination that showed an ulcerated and circumferential lesion at the esophageal-gastric junction, extending towards the cardia and lesser curvature for 6 cm, and histopathological diagnosis of poorly differentiated carcinoma,

with neoadjuvant treatment with FLOT (Fluorouracil, Leucovorin, Oxaliplatin and Docetaxel) for 8 cycles. After 6 months, a new endoscopy was performed showing a partial reduction of more than 50% of the lesion, and then total gastrectomy was indicated.

During the surgical procedure for total gastrectomy, it was evident that there would be no possibility of surgical resection of the lesion with satisfactory oncological margins, so the procedure was suspended and after discussion at this time, Ivor-Lewis Gastroesophagectomy (ILG) was indicated via robotic approach on another day to be scheduled. Preoperative laboratory tests showed hematocrit of 32.8%, hemoglobin 10.5 mg/dL, platelets of 291,000 k/µL, urea 21 mg/dL, creatinine 0.77 mg/dL, active thromboplastin time 25.4 s, INR 0.91, sodium 142 mmol/L, potassium 4.4 mmol/L.

After 16 days of surgery being suspended due to impossibility of safe resection, the patient was transferred to the Operating Room (OR), monitored with cardioscope, non-invasive blood pressure, and pulse oximetry. In prior venoclysis in the left cubital fossa (22G), dexmedetomidine infusion was started via pump (0.4 µg/kg/h), magnesium sulfate 1 g, midazolam 1.5 mg and fentanyl 50 µg were injected intravenously to perform an epidural block. After asepsis and antisepsis with alcoholic chlorhexidine and local anesthesia with 1% lidocaine, an epidural puncture was performed between T7-T8 with passage of a catheter in the cephalad direction, and administration of ropivacaine 0.3% was started throughout the surgery with a total of 17 ml.

After confirmation of catheter placement (analgesia in the corresponding dermatome by pin-prick), preoxygenation was performed under a mask with 6 l/min and intravenous induction with fentanyl 100 µg, lidocaine 120 mg, propofol 50 mg and rocuronium 80 mg for passage of a left double-lumen orotracheal tube number 37 under direct laryngoscopy with positioning checked by bronchoscopy and pulmonary auscultation and initiation of balanced general anesthesia.

After stabilizing the patient, the right internal jugular vein was punctured with passage of a triple-lumen catheter and the left radial artery for invasive blood pressure, both procedures performed using an aseptic technique, using the Seldinger technique, guided by ultrasound and without complications.

Before the robot docking procedure, rocuronium was started via pump (0.3 mg/kg/h) to maintain adequate muscle blockade for robotic surgery. The first surgical procedure was performed in the supine position with bi-lung ventilation (VCP-VG: VC=450 ml, RR=14 irpm, PEEP=7cm/H_2O, Peak=25cm/H_2O) to perform subtotal gastrectomy, D2 lymphadenectomy and creation of the gastric tube. The procedure followed without surgical complications for a period of approximately 7 hours, requiring the use of norepinephrine via pump (0.03-0.09 µg/kg/min), dexmedetomidine infusion pause in the 5th hour of surgery with serial arterial blood gas analysis indicating mild uncompensated respiratory acidosis, pH=7.28, pCO2=50.7 mmHg, pO_2=111 mmHg, P/F=277, $satO_2$=96.9%, standard bicarbonate 21.9 mmol/L and lactate 0.6 mmol/L.

The second part of the surgery consisted of transaction of the mid-esophagus, end-to-end esophageal-gastric anastomosis and bilateral thoracic drainage, was performed in the prone position through robotic approach to the esophageal lesion, intrathoracic anastomosis of the esophagus to the preserved part of the stomach and under protective single-lung ventilation with following parameters PCV-VG, VC=300ml, RR=15 irpm, PEE= 5cm/H_2O, Peak=23cm/H_2O. When placing the patient in the prone position, it was necessary to increase the dose of norepinephrine, with progression to 0.15 µg/kg/min, marked worsening of respiratory acidosis in arterial blood gas analysis in single-lung ventilation with the following parameters pH=7.09, pCO_2=80 mmHg, pO_2=76.2 mmHg, P/F=127, $satO_2$=88.5%, standard bicarbonate=19.6 mmol/L and lactate 1.0 mmol/L.

After optimization of single-lung ventilation with VCP-VG parameters, VC=425 ml, RR=19 irpm, PEEP=5 cm/H2O, Ppeak=31 cm/H_2O and request for use of low pressures of carbon dioxide for chest insufflation, there was a significant clinical improvement, with a gradual reduction in the dose of norepinephrine to 0.07 mcg/kg/min and arterial blood gas analysis pH=7.22 pCO_2=52.8 mmHg, pO_2=67.2 mmHg, P/F=112, $satO_2$=90.3%, standard bicarbonate=9.6 mmol/L and lactate=1.1 mmol/L.

After the end of the thoracic time, which lasted 5 hours and 30 minutes, and consequently the end of the ILG, the patient was ventilated again in both lungs and returned to the supine position. The decision was made, together with the surgical team, to perform the immediate postoperative period of the patient in an ICU under orotracheal intubation and mechanical ventilation due to the long operating room time of 14 hours and 30 minutes, use of intraoperative amines and large surgical size. For this purpose, fentanyl 100 µg IV was administered, and the double-lumen tube was exchanged for an orotracheal tube number 7.5 under direct laryngoscopy without complications.

Before transfer to the ICU, new arterial blood gas analysis was collected: pH=7.28, pCO_2=46.9 mmHg, pO_2=453 mmHg, P/F=453, $satO_2$=99.2%, standard bicarbonate=20.6 mmol/L and lactate=2.0 mmol/L. Midazolam 3 mg and rocuronium 50 mg IV were administered and the patient was transferred to the ICU, sedated, blocked, intubated and connected to mechanical ventilation, hemodynamically unstable at the expense of norepinephrine 0.05 µg/kg/min, without infusion in epidural catheter, and without complications. During the entire surgical time, a restrictive fluid therapy strategy was chosen, using 5 liters of Ringer's Lactate and Human Albumin 20% 50ml, without the need for blood transfusion. The patient was catheterized at the beginning of the procedure with a total urinary output of 455 ml. The patient was monitored with a thermometer, and a thermal blanket was placed throughout the procedure.

In the ICU, ventilatory weaning was performed 20 hours postoperatively and infusion of 0.2% ropivacaine and 1 µg/ml fentanyl with a flow rate of 6 ml/h through the epidural catheter was performed to control pain. After extubation, the patient remained stable, with adequate analgesia with pain on a visual numerical scale during active mobilization in bed of 3/10 and at rest 0/10, and regular dipyrone 1 g 4/4h only, without the need for rescue with intravenous opioid. The epidural catheter was removed on the 5th postoperative day without complications. The patient was discharged from the ICU on the 6th day after surgery. The postoperative period was uneventful related to the surgery and anastomoses she was fed on the 8th day post-operatively with satisfactory progression of diet over the following days. However, the patient developed a worsening of the coughing pattern and secretion associated with wheezing during her stay in the ward bed, which was successfully treated with antibiotic therapy, corticosteroids and bronchodilators and she was discharged from the hospital 18 days after the definitive surgery.

The pathology report revealed poorly differentiated squamous cell carcinoma with free proximal and distal surgical boundaries and one of eight lymph nodes involved. The pathological staging was pT3 N1, and immunohistochemical analysis revealed positive p63, CK5/6, and CK19 (Figure 1).

Figure 1: Surgical Specimen Consists of Terminal Esophagus (12cm) and Proximal Gastric Segment in the Greater Curvature (18cm) and in the Lesser Curvature (12cm)

Discussion

The robotic approach offers the advantages of the magnified three-dimensional vision and the use of intracorporeally articulated instruments, thus facilitating the technically demanding dissection phase required during esophagectomy.

Anesthesia for robotic surgery involves comprehensive review of the latest advances, indications, contraindications, perioperative management, and pain relief techniques. Robot-assisted operations involve numerous challenges resulting from the surgical technique. The most important problems during anesthesia include changes in physiology resulting from the development of pneumoperitoneum and a steep Trendelenburg position [7]. In robotic surgery, it is necessary to establish pneumoperitoneum with carbon dioxide. Gas insufflation elevates intra-abdominal pressure above physiological levels, which particularly affects the circulatory and respiratory systems during the procedure [7]. In both Ivor Lewis technique procedures, single-lung ventilation was performed, but when placing the patient in the prone position, it was necessary to reduce the CO2 pressure to improve the ventilatory parameters.

Intraoperative desaturation is an undesirable complication of one-lung ventilation. In 360 patients undergoing selective left intubation with a double-lumen tube, it was shown that patients with a left main bronchus length of less than 40 mm had a significantly higher incidence of desaturation [8]. When placing patients in the prone position, it was necessary to increase the dose of norepinephrine, decrease CO2 pressure and improve respiratory acidosis.

The choice of anesthetic technique is a decision made by the anesthesiologist and is governed by his/her knowledge of the patient's clinical condition. Deep neuromuscular blockade or even continuous infusion of a muscle relaxant are recommended, since coughing and movement of the patient can have serious consequences when the robot is in operation [9]. In the present case, continuous infusion of the muscle blocker (rocuronium) was used, so that the patient would not start breathing again and increase in intra-abdominal pressure.

Epidural anesthesia is recommended for robotic surgery in the thoracic region. It is combined with general anesthesia and has been found to lower peak inspiratory airway pressure, enhance dynamic compliance, allow better oxygenation, and lower concentrations of lactate through more profound muscle block [10]. In the present case, continuous epidural block using ropivacaine was associated with excellent analgesic results and the catheter was only removed on the 5th postoperative day without complications.

Robot-assisted thoracic surgery is most often performed for the resection of lung, mediastinal or esophageal tumors, and provide unique advantages over traditional video-assisted thoracoscopic surgery by providing a three-dimensional view of the surgical field [11]. The use of a surgical robot facilitates navigation and surgery in hard-to-reach spaces such as the mediastinum. Despite the duration of 14 hours and 30 minutes, the patient was admitted to the ICU for better monitoring.

The preferred monitoring method during robotic surgery is standard monitoring: ECG, SpO2, EtCO2, blood pressure, and assessment of depth of anesthesia and neuromuscular blockade. All these monitoring methods were used in the present case, in addition to urinary output. Robot-assisted surgery typically takes longer than the same procedures performed laparoscopically patients run a greater risk of developing hypothermia, having been used heating devices, thermometer and a thermal blanket was placed throughout the procedure.

Conclusion

When compared to open esophagectomy, robotic-assisted minimally invasive esophagectomy has demonstrated intraoperative benefits including less blood loss and more complete lymphadenectomy, despite its longer operative time [12]. Robotic-assisted minimally invasive esophagectomy showed faster convalescence with a shorter length of stay, decreased pain, decreased ICU admissions, and fewer infectious and cardiopulmonary complications [12]. In this case, robotic surgery for ILG required first access in the supine position that lasted 7 hours and second access in the prone position lasting 5:30 hours with the need to correct intra-abdominal pressure and single-lung ventilation to correct respiratory acidosis. The patient was discharged from the hospital to her home 18 days after surgery.

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