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Robot-assisted Laparoscopic Inferior Vena Cava Thrombectomy: Different Sides Require Different Techniques

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Abstract

Background: The safety and feasibility of robot-assisted laparoscopic inferior vena cava (IVC) thrombectomy (RAL-IVCTE) have been investigated in limited reports.
Objective: To share our initial experience with RAL-IVCTE, as well as describe respectively the detailed techniques for RAL-IVCTE for left or right renal cell carcinoma (RCC).
Design, setting, and participants: From May 2013 to July 2014, 17 patients with RCC involving IVC tumor thrombus were admitted to our hospital.
Surgical procedure: For right RCC, the caudal IVC, left renal vein, and cephalic IVC were sequentially clamped. The IVC wall was cut, and the thrombus was removed. For left RCC, the left renal vein, which included the thrombus, was ligated with Endo-GIA. The caudal IVC, right renal artery, right renal vein, and cephalic IVC were sequentially clamped.
Measurements: The detailed techniques for RAL-IVCTE for different sides were described and the perioperative outcomes recorded.
Results and limitations: The operations were successfully performed without open conversion. Median operation time was 131 min (100–150 min) and 250 min (190–275 min) for the right and left RCC, respectively. Median estimated blood loss was 240 ml (145–320 ml). Median IVC blocking time was 17 min (12–25 min). For left RCC, median warm ischemia time for the right kidney was 18 min (14–22 min). A grade IV complication—bleeding from tributaries of the IVC—developed in one case and was successfully resolved with intraoperative endoscopic suture.
Conclusions: RAL-IVCTE is safe and feasible. For left RCC involving IVC thrombus, right renal warm ischemia time is necessary during the procedure, requiring a more advanced technical skill. The therapeutic effect and overall survival rate require further investigation with a larger sample size and longer follow-up.
Patient summary: Robot-assisted laparoscopic inferior vena cava thrombectomy is technically challenging but safe and feasible. The therapeutic effect needs further investigation.

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1. Introduction

Renal cell carcinoma (RCC) exhibits a natural tendency to extend from the kidney into the inferior vena cava (IVC) in about 4–10% of cases [1]. In 1972, Skinner et al [2] first reported radical nephrectomy (RN) with IVC thrombectomy (IVCTE). Open IVCTE is the current standard modality for RCC with IVC thrombus [3]. Nevertheless, potentially fatal complications caused by bleeding or embolism may occur during IVCTE [4].

Fergany et al [5] developed a laparoscopic technique for IVCTE, using a porcine model. Sundaram et al [6] described a hand-assisted laparoscopic technique with a Satinsky clamp for short IVC thrombus. With the development of laparoscopy and robotic technology in later years, several centers have reported a successful experience with laparoscopic IVCTE [7–14]. The safety and feasibility of robot-assisted laparoscopic IVCTE (RAL-IVCTE) have been investigated in limited reports [15,16].

In the present study, we report our initial series of pure RAL-IVCTE. In addition, detailed techniques for RAL-IVCTE of different sides (left or right RCC) are compared and described.

2. Patients and methods

2.1. Patients

We retrospectively evaluated the records of 17 patients with RCC involving IVC tumor thrombus who underwent a RAL-IVCTE and robot-assisted laparoscopic RN (RAL-RN) at our hospital from May 2013 to July 2014. Patient characteristics (age, sex, body mass index, clinical stage, size of renal tumor, IVC thrombus classification, and thrombus length) were assessed. Thirteen cases had RCC on the right side and four on the left. Color Doppler ultrasound and computed tomography (CT) were used preoperatively to define tumor location and vascular extension in all patients, and 12 of them received a further magnetic resonance imaging (MRI) examination. One patient with distant metastases in the lung was administered preoperative neo-adjuvant targeted therapy for 3 mo. Lymph node involvement was suspicious in two cases. The RCC was classified according to the American Joint Committee on Cancer 2010 TNM staging criteria [17].

The exclusion criterion was if, based on CT or MRI, the IVC thrombus was suspected to be infiltrating the IVC wall. The IVC thrombus was classified according to the Mayo classification [18].

Perioperative data (median operative time, estimated blood loss, IVC clamping time, blood transfusion, preoperative and postoperative serum creatinine, blood urea nitrogen and hemoglobin, and perioperative complications) were assessed. Complications were graded according to Clavien system [19].

The study was approved by the ethics committee of the Chinese PLA General Hospital. All patients signed written consent to allow the use of their data. All procedures were performed by a single surgeon (X. Zhang) with advanced robot-assisted laparoscopic skills.

2.2. Preoperative preparation

General preoperative preparation included preoperative skin preparation, fasting, water enema, and placement of an indwelling gastric tube. Oral antibiotics for resisting bowel anaerobic bacteria and gram-negative bacilli were taken for 1 d before surgery. These antibiotics, for example, metronidazole and norfloxacin, are used for bowel preparation and for intraoperative suturing an intestinal "rupture"—an unexpected complication. Special preoperative preparation included renal artery embolization on the related side 1–2 h before operation.

2.3. Surgical technique

A pure RAL-IVCTE and RAL-RN were performed in all cases. For right RCC, seven of 13 patients underwent a preoperative right renal artery embolization. After general anesthesia and Foley catheter placement, patients were positioned in a modified left lateral decubitus position with a 70° bump (Fig. 1A). With this position, RAL-IVCTE and RAL-RN can be both completed.

A 12-mm port was placed at about 2–3 cm to the upper right of the umbilicus for the camera (Fig. 1A). Three 8-mm robotic ports for the first, second, and third robot arm were placed at about 3 cm medial to the right midclavicular line under the costal margin (Fig. 1A), at about 3 cm lateral to the right midclavicular line near McBurney's point (Fig. 1A), and at 6–8 cm lateral to the second robot port (Fig. 1A), separately.

Three assistant ports were used. One was placed about 6 cm above the umbilical (Fig. 1A) for the aspirator. The second was placed near the umbilical (Fig. 1A) for Hem-o-lok clips, and the third was placed near the xiphoid under the costal margin for the retraction of liver (Fig. 1A).

The cart was pushed in towards the camera port along the middle line of the 120° angle, which was composed of points 1, 2, and C (Fig. 1B).

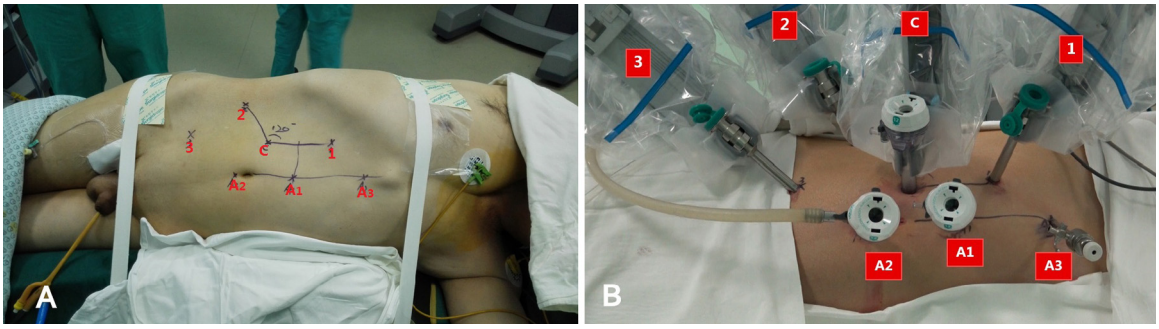

Fig. 1 – Port placement and docking for robot-assisted laparoscopic inferior vena cava thrombectomy. (A and B) Point C: the 12-mm port for the robot camera, at about 2–3 cm to the upper right of the umbilicus. Point 1: the 8-mm port for the first robot arm, at about 3 cm medial to the right midclavicular line under the costal margin. Point 2: the 8-mm port for the second robot arm, about 3 cm lateral to the right midclavicular line near McBurney's point. Point 3: the 8-mm port for the third robot arm, at 6–8 cm lateral to the second robot arm. Point A1: the 12-mm port for the aspirator, about 6 cm above the umbilical; point A2: the 12-mm port for Hem-o-lok clips, near the umbilical. Point A3: the 5-mm port for the retraction of the liver, near the xiphoid under the costal margin. (B) The camera arm and the first, second, and third robot arms were docked with ports, which were placed at points C, 1, 2, and 3, respectively.

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