How-to-do-it

Robot-assisted resection of pulmonary sequestrations

Franca M.A. Melfi, Andrea Viti*, Federico Davini, Alfredo Mussi

Thoracic Surgery, Cardiac and Thoracic Department, University of Pisa, Pisa, Italy

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Abstract

Pulmonary sequestration is a rare congenital malformation and may cause recurrent infections and hemoptysis. Although video-assisted thoracic surgery (VATS) is feasible, some drawbacks remain, mainly dealing the managing of anomalous vessels. We describe the use of a robotic system (da Vinci Robotic System, Surgical Intuitive, Mountain View, CA, USA) in the treatment of four consecutive cases of pulmonary sequestration.

Keywords: Pulmonary sequestration; Robot-assisted thoracic surgery; Vascular clips

1. Introduction

Pulmonary sequestration is a rare congenital malformation (0.15—6.4%) with systemic arterial supply arising from the descending thoracic or abdominal aorta [1]. Two kinds of pulmonary sequestration are recognized: intralobar sequestration (75%) (abnormal region within the normal parenchyma without pleural covering) and extralobar sequestration (25%) (with an own pleural covering). Surgery is the treatment of choice, usually performed through a posterolateral thoracotomy [2], and more recently by video-assisted thoracic surgery (VATS) [3]. Robot-assisted resection of an extralobar sequestration has been described as a case report [4].

Robots have been introduced into surgical procedures in an attempt to facilitate surgical performance. The three-dimensional view with depth perception is a marked improvement over the conventional thoracoscopic camera view. All of this creates images with increased resolution that, combined with the increased degrees of freedom and enhanced dexterity, could enhance the dissection of anomalous vessels [5].

2. Our series

Between 2005 and 2009, four consecutive patients with pulmonary sequestration underwent robotic pulmonary resection. In the previous years, sequestrations were approached with a standard posterolateral thoracotomy. In this initial experience, we employed the robotic approach for lesions smaller than 5 cm, in patients in good clinical status. Two patients were females, and the mean age was 51 years (range: 46—62). The diagnosis, including the localization of the anomalous vessel, was made by computed tomography (CT) scan with three-dimensional (3D) spatial reconstruction. An intralobar sequestration of the left lower lobe was showed in all cases.

Like other thoracic procedures, a single-lung ventilation is achieved. Patients are prepared and draped for a posterior lateral thoracotomy, and placed in a maximally flexed lateral decubitus position. A CO2 inflation is applied (6—8 mmHg).

The port layout was the following (Fig. 1(A)):

- 1st incision (Camera Arm): 4th intercostal space (ICS) at the middle or posterior axillary line;
- 2nd incision (Arm 1): 5th ICS, anterior-middle axillary line; and
- 3rd incision (Arm 2): 5th ICS, auscultatory triangle.

Once the incisions have been made, the surgical cart is placed at the patient’s feet, slightly posterior, to obtain a cranio—caudal arms direction (Fig. 1(B)). A 30° angled-down scope is introduced through a 12-mm trocar and secured to the camera arm. The positioning of the instruments is accomplished under direct vision.

Few robotic instruments are used during this procedure. To handle the lung parenchyma an a-traumatic grasp is used (Cadiere forceps). Dissection of structures is performed with a combination of electrocautery Hook and Debakey forceps. A fourth access (12 mm) was provided on the 6th ICS beneath the anterior axillary line, for suction, gauze, and stapler placement.

In all cases, only one aberrant vessel was present, always arising from the thoracic descending aorta. The vessels had a...
mean diameter of 9 mm (range 5—12 mm). Dissection along the vessel was performed for at least 1 cm, and a sling was placed around it.

In two cases, we used a stapling vascular device, while in the others we used four vascular clips (Hem-o-lok™ Weck Surgical Instrument, Teleflex Medical, Durham, NC, USA). The mean operative time was 130 min (range: 100—150 min). The placement of vascular clips is safer and requires less time than the stapler (Fig. 2). The tip of the robotic clip applier could rotate around the vessel, a motion not possible in VATS. Suture on the parenchyma was performed with an endostapler. All the surgical steps were completed with this minimally invasive approach, no conversion into open thoracotomy was needed. At the end of the procedure, two chest tubes were placed in the pleural cavity, through the anterior robotic ports. There was no mortality or perioperative morbidity. The patients were discharged from hospital on third postoperative day.

3. Discussion

Surgery is the treatment of choice for pulmonary sequestration. The traditional approach by thoracotomy could be successfully replaced by VATS [3]. The first step is the localization of the aberrant artery, which is often localized within the pulmonary ligament, being partially hidden by the dome-shaped profile of the diaphragm. Furthermore, dissection is often difficult because of the presence of scar tissue and adhesions. The localization of the anomalous vessel and its origin could be simplified thanks to the CO2 inflation, which flattens the diaphragm. Another important aspect is represented by the tridimensional vision and the camera magnification. The dissection of the pulmonary ligament and manipulation, isolation, and resection of anomalous vessels is simplified by the special robot instruments whose tips can rotate 360°, improving maneuverability around anatomic structures. The length of dissection along the vessel (1 cm or more) up to its origin and the placement of a sling around it allow proper vessel manipulation and suture and avoid undue traction on it, thereby limiting the risk of inadvertent lacerations.

Bleeding during preparation of the anomalous vessel in VATS has been described, leading to conversion to open thoracotomy [6]. The use of clips for vascular ligation (Hem-o-lok™) simplifies the procedure by avoiding the difficulties related with stapler positioning. We recommend the use of stapling devices when the vessel diameter is greater than 10 mm. The improved instrument dexterity, proper eye—hand coordination, ergonomic position, and fine human-tremor filtering overcome some of the traditional burdens of thoracoscopic surgery.

References