INTRODUCTION

Several reports have demonstrated that robotic technology allows to perform delicate surgical maneuvers in narrow and difficult-to-reach anatomic regions with vital structures as anterior mediastinum, thanks to dexterous robotic arms with 7 degrees of freedom providing hand-like articulation, tremor filtration and high-resolution image acquisition [1,2]. Despite these technical characteristics have allowed to overcome limitations of traditional thoracoscopy in the mediastinal surgery such as rigid instruments and suboptimal vision, nowadays there is no consensus among surgeons regarding the use of minimally invasive techniques for excision of large mediastinal masses due to a more challenging manipulation during tissue dissection [3]. In recent years we have performed fully endoscopic excisions of large anterior mediastinal masses by the da Vinci robotic surgical system with a final enlargement non-rib spreading of camera port or arm port to remove the specimen: this procedure, proposed as an alternative approach to either open surgery or video-assisted thoracoscopic surgery in the management of large mediastinal masses, allows a minimally invasive surgical resection, exploiting advantages of robotic technology, and avoids, at the same time, the postoperative discomfort following thoracotomy or sternotomy approach.

PATIENTS AND METHODS

Between December 2012 and October 2018, 85 cases of anterior mediastinal mass underwent surgical resection with a curative intent using the da Vinci robotic system: of these, 13 patients (7 men, 6 women) were enrolled for excision of large anterior mediastinal masses (Table 1). A mediastinal lesion was defined as large if it had a maximum diameter > 5 cm on computed tomography (CT) scan. In all patients preoperative evaluation, including routine laboratory tests, assessment of cardiac and pulmonary function, was within normal limits. Preoperative radiological work-up included contrast-enhanced CT scan and, in selected cases, fluorodeoxyglucose positron emission tomography (18F-FDG-PET), magnetic resonance imaging (MRI) and thyroid scintigraphy. The criteria for inclusion of patients were: unilateral mass predominance; distinct fat plane between the mass and vital organs; absence of diffuse pleural thickening; solid mass heterogeneity. In all cases, under general anesthesia,
a single-lung ventilation was provided with a double-lumen endobronchial tube. The patients, supported with a roll under the shoulder and with the omolateral arm brought down below the level of ribcage, were placed in semi-sit-up position. They all underwent excision of large anterior mediastinal mass through a three-port endoscopic approach, with the camera port inserted in the fifth or sixth intercostal space in the anterior axillary line for exploration of the pleural cavity using initially a 30° scope angled up. Two additional ports were placed under direct thoracoscopic vision and with CO2 insufflation at pressure of 6-8 mmHg and a flow rate of 2L/min to gain a better exposure: right arm port in the sixth or seventh intercostal space along the midclavicular line and left arm port in the third intercostal space at the anterior axillary line or midclavicular line (Fig. 1a). The instruments were adapted to the patients but in general, Cadire forceps (Intuitive Surgical Inc, Sunnyvale, CA, USA) were preferred in the robotic right arm (Intuitive Surgical Inc, Sunnyvale, CA, USA). In three patients with anteromediastinal retrosternal goiter, a hemithyroidectomy was performed through a cervical incision before robotic mediastinal dissection. We used three robotic arms from the right side in eight patients (61.5%). At the end of the procedure, once the specimen was completely resected, one of the port-sites was extended to remove the mass with a retrieval bag but without ribs spreading (Fig. 1b). A single pleural drainage tube (28 Fr) was routinely placed through a port-site after the operation and the thoracic incisions were closed and dressed after lung re-inflation under direct vision.

RESULTS

Minimally invasive mediastinal surgery was completed with robotic approach in 12 patients (92.3%). One patient required elective conversion to standard median sternotomy in order to prevent hemorrhagic complications due to severe adhesions between mediastinal goiter and left innominate vein. The overall duration of chest tube drainage was 3.30 ± 1.25 days and the overall postoperative stay was 3.92 ± 1.32 days. No mortality or morbidity occurred in any of the patients. Pathological examination of specimens showed: Masaoka stage I thymoma (30.8%), multinodular goiter (23.1%), teratoma (15.3%), Masaoka stage II thymoma (7.7%); timolipoma (7.7%), omental adipose tissue (7.7%), solitary fibrous tumor (7.7%). Any sign of recurrence was found during the follow-up period of 17.5 months.

DISCUSSION

Most authors advise surgeons who are just starting robotic mediastinal surgery to treat small mediastinal masses, recommending lesions less than 5 cm in maximum diameter for proceeding with robot-assisted thoracoscopic surgery due to a more challenging manipulation [4]. However, our experience suggests that the development of robotic surgical skills can also allow, in selected cases, to perform the excision of large mediastinal masses, optimizing all the advantages of robotic technology as enhanced dexterity and visualization. In our personal experience, during surgical procedure, we didn’t grasp the large mediastinal lesions with instruments but, using the powerful robotic arms, we lifted the mass and created a dissection plane developing a tunnel-like passageway (Fig.2a,b). This technique avoids overmanipulations of the mediastinal mass and, moreover, allows to perform precise maneuvers of dissection with excellent visualization of adjacent abnormally feeding vessels which may cause bleeding complications during surgical resection [5] (Fig.2c,d). It is obvious that, in such instances, invasion of adjacent structures and bilateral extension of the mediastinal mass could be a limit to gain a complete resection. To overcome the difficulty encountered in extruding the large masses, we enlarge a port-site incision, without rib spreading, at the end of a fully endoscopic surgical procedure performed with the aid of the robotic system, as described in our single case reports. [6-8].
our experience, absence of diffuse pleural thickening, secondary to empyema, pleurodesis, collagen vascular disease, etc, and presence of heterogeneous content in the mediastinal mass are the essential conditions to gain a port-site extension without rib spreading, avoiding painful sequelae of thoracotomy.

CONCLUSION

In selected cases, robotic thoracic surgery is feasible for excision of large anterior mediastinal masses: the fully endoscopic procedure allows precise maneuvers of dissection in the anterior mediastinum via minimally invasive surgical accesses and, through an extension of a port-site incision, avoids the postoperative discomfort following open surgery. The increased experience in mediastinal surgery with powerful robotic arms and the tips reported as non-grasping dissection, tunnelling technique, careful identification of feeding vessels, can help to avoid overmanipulation of the large mediastinal masses during surgical resection, potential seeding of the mediastinum and potential intraoperative complications.

Acknowledgments: None

Conflicts of Interest: The authors have no conflicts of interest to declare

Contributions

Conception and design: C Curcio, D Amore; Administrative support: D Amore, C Curcio; Provision of study materials or patients: C Curcio, D Amore, P Imitazione, C Bergaminelli, A Izzo; Collection and assembly of data: D Amore, D Casazza, U Caterino, A Saglia; Data analysis and interpretation: D Amore, D Casazza, P Imitazione, A Izzo, M Rispoli; Manuscript writing: All authors; Final approval of manuscript: All authors.

References


How to cite this article:

********