



Robotic approach for mediastinal lesions: the surgery of extreme locations

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In the recent issue of *Neurosurgical Focus*, Pacchiarotti *et al.* described their experience with robotic resection of paravertebral tumors, particularly focusing on the extreme locations into the thorax, as the superior and the inferior sulci (1).

The mediastinal space still remains a challenging anatomical district for surgeons, being a delicate and difficult to reach region, with vulnerable structures as great vessels and nerves.

Surgical planning for both benign or malignant diseases of the mediastinum should carefully evaluate several aspects such as resectability, radicality, and finally the choice of the surgical access.

Median sternotomy has been considered the preferable approach for most cases involving the anterior mediastinum, whereas thoracotomy and posterior approaches are indicated for the lesions arising from the middle and posterior mediastinum.

Since the introduction of thoracoscopic approach, great debate has raised over the possibility to apply this technique to mediastinal surgery. Minimally invasive techniques have showed clear advantages in terms of reduction of postoperative morbidity, mortality and length of hospital stay (2). While the advantages minimally invasive approach over the open one, particularly for benign lesions, are clearly recognized, leading to a great diffusion and acceptance both by patients and surgeons, the main issue remains whether robotic surgery confers any advantages compared to standard thoracoscopy [video-assisted thoracoscopic surgery (VATS)].

Robotic system may be considered an evolution of VATS,

born with the purpose to overcome their intrinsic technical and technological limitations. Anyway, to date, there are no clear data that support a technique over the other in the field of thoracic surgery. Therefore, only general statements are made about the preference towards one approach or the other, based on impressions and personal feeling (3,4). Indeed, standard thoracoscopy has all the advantages of minimally invasive techniques, without the costs of the robotic approach.

So, which could be the role and the real field of robotic surgery? The article of Pacchiarotti *et al.* can help to give an answer to this question, highlighting how, differently from other surgical sites, the particular characteristics of the mediastinum make clear the advantages of robotic techniques over the standard thoracoscopy.

The middle and posterior mediastinum represents a challenging anatomical area for surgeons because of the delicate structures that pass through this narrow space, particularly towards the upper thoracic inlet. In this region any accidental lesion could have dramatic consequences, particularly vascular lesion to the great vessels or also lesions to the nervous structures, as the phrenic and the vagus nerves and the ganglia of the sympathetic nervous system, with consequent diaphragmatic palsy, hoarseness or Horner's syndrome.

When operating in the mediastinal region, VATS has some relative limitations as the less than ideal range of motion of the long thoracoscopic instruments placed through fixed entry points, thus creating a fulcrum effect, the transfer of the surgeon's tremor, the 2-D visualization

and the steep learning curve. For all of these reasons, the technique has not been widely practiced and its use is limited to specialized centers.

When the lesion is surrounded by great vessels and delicate nervous structures, is on the surgeon's interest to be able to perform operation in the safest and comfortable possible way. Indeed, the 3-D view, the articulated instruments with 360-degree rotation, the 7 degrees of freedom and the tremor filtering make the robotic instrumentation ideal and advantageous compared with standard VATS. When the lesion involves extreme location in the pleural cavity or in the mediastinum, the technical advantages of the robotic system become clear, allowing surgeons to perform precise dissection from extreme angles within a narrow space, elsewhere challenging with standard VATS.

Different authors described their experience regarding removal of posterior mediastinal lesions through the robotic approach, all stressing the precise isolation of the anatomic structures and the safe manipulation of the tissues obtained with the robotic system (5-8).

On the contrary, there are no particular advantages for schwannomas in the mid-thoracic region. The wide space of maneuvering, the high experience and the ability to vary the number of accesses, from the triportal to the uniportal technique, make VATS advantageous in these cases.

Another point that should be always been considered is the procedural cost. Robotic operations are more expensive compared to VATS, not only because of the initial cost of the robotic system and the annual maintenance, but also considering the disposable robotic instruments, which can be reused only a certain number of times (9). In conclusion, surgeons should prefer the robotic approach to VATS when the technical advantages of former approach clearly overcome the economic advantages of the latter.

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