

## Review Article

# Indications of Hemi-Clamshell Approach: About 3 Cases and Literature Review

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## Abstract

Hemi-clamshell approach is defined by a median sternotomy associated with an anterolateral thoracotomy with possibility of a supraclavicular incision. It is an open surgery which allows an excellent surgical exposure. We present three cases all approached by hemi-clamshell way. The first patient had a thymoma B1 benefiting of surgery after three sessions of chemotherapy. The second case had a huge solitary fibrous tumor of pleura, and the third had a hydatid cyst of the cervicothoracic region. We conclude that hemi-clamshell approach presents a wide exposure which allows a complete resection especially in tumors of challenging localizations.

**Keywords:** Hemi-clamshell approach; Sulcus tumor; Cervicothoracic region

## Introduction

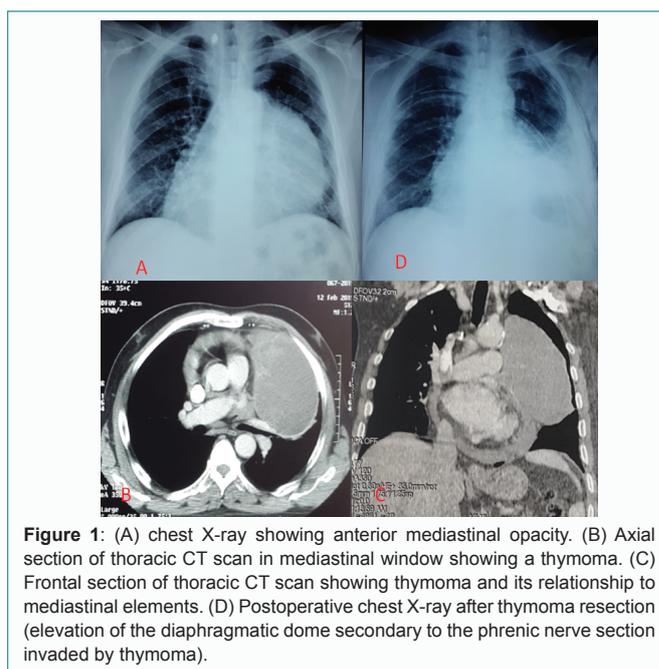
Open thoracotomy surgery remains the basic approach in thoracic surgery, despite the progressive development of the VATS since the 1990s. However, some giant mediastinal tumor tumors of the cervicothoracic region are not well managed satisfactorily by thoracotomy alone, and the use of an approach that provides adequate exposure for complete resection remains necessary. For example, Darteville and colleagues described an anterior approach to superior sulcus tumors, but with resection of the internal half of the clavicle [B]. This approach was modified by Grunenwald who described a transmanubrial incision instead of resection of the clavicle. This approach known as "Cormier-Darteville-Grunenwald" approach. The disadvantage of this approach that it doesn't allow the exposure of the pulmonary hilum, the diaphragm and the rest of the basal pleural cavity. For that, we describe in this manuscript three cases that were operated by hemi-clamshell approach. It consists on a median sternotomy associated to an anterior or anterolateral thoracotomy, with possibility of supraclavicular incision [AA]. Our objective is to specify indications of the hemi-clamshell approach in these cases and discuss them with the help of the literature review.

## Case Presentation

### Observation 1

This is Mr. M T, 65-years-old, a chronic smoker who has had a chronic dry cough for 8 months. The patient had a chest X-ray showing mediastinal opacity whose internal limit was confused with the mediastinum, convex external limit, and deletion of the left border of the heart (Figure 1A) associated with left homolateral pleural

effusion. The patient received a percutaneous pleural biopsy returned in favor of a thymoma B1 according to the classification of thymics epithelial tumors done by World Health Organization. The patient was discussed in a multidisciplinary consultation meeting after he has benefited of a thoracic CT scan completed by imagery staging. The radiological interpretation was in favor of a mediastinal tumor which invades the anatomical structures of the mediastinum with presence of ipsilateral left pleural effusion without other associated metastasis (Figure 1B and C). The decision was to do three sessions of chemotherapy for the patient. Thoracic CT after chemotherapy showed a mediastinal process of 133 mm × 160 mm × 90 mm, which appears resectable, and the surgical procedure was retained. The patient was approached by a sternotomy followed by a left anterolateral thoracotomy (Figure 2). Complete resection of the thymoma enlarged to the rest of the thymus and mediastinal fat, with sacrifice of the left phrenic nerve running inside the tumor. The postoperative follow-up was favorable (Figure 1D).



**Figure 1:** (A) chest X-ray showing anterior mediastinal opacity. (B) Axial section of thoracic CT scan in mediastinal window showing a thymoma. (C) Frontal section of thoracic CT scan showing thymoma and its relationship to mediastinal elements. (D) Postoperative chest X-ray after thymoma resection (elevation of the diaphragmatic dome secondary to the phrenic nerve section invaded by thymoma).

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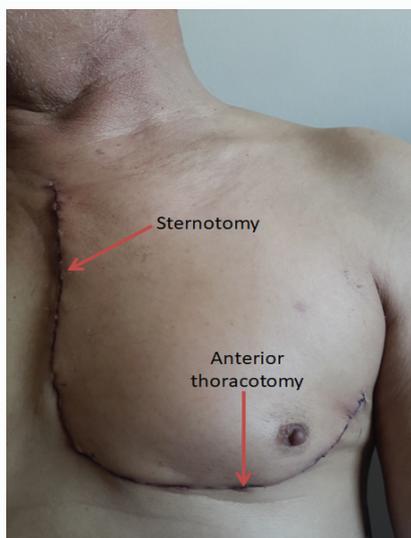
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## Observation 2

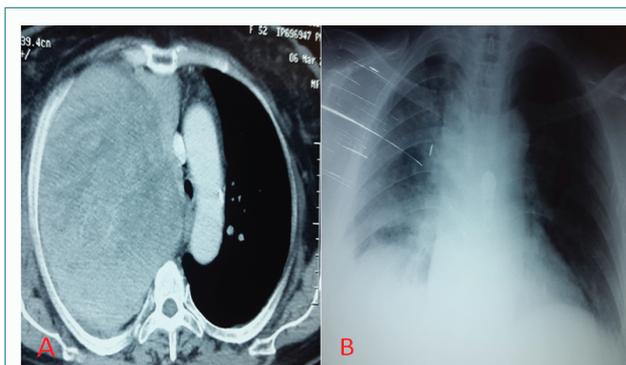
A 52-years-old woman, diabetic and having high blood pressure, who consulted for a dyspnea with right chest pain. The patient had a chest X-ray showing a white right hemithorax. Thoracic CT showed a huge tumoral process of the right hemithorax, with 180 mm × 140 mm × 170 mm in size, and a compression effect on the lung, trachea, and superior vena cava. The patient underwent bronchial fibroscopy, which showed stenosis of the upper lobe bronchus and stenosis of segmental bronchi of the middle and lower lobe bronchus. The bronchial biopsy was inconclusive. The patient subsequently benefited from a biopsy under a thoracic CT scan returning in favor of a solitary fibrous tumor of the pleura (Figure 3A). Patient benefited of a right anterolateral thoracotomy passing through of the 4<sup>th</sup> rib, enlarged towards the sternum. The exploration found a huge tumor plating the right lung against the mediastinum and keeping a cleavage plane relative to the lung, wall and diaphragm, and complete tumor resection was performed. Postoperative follow-up was satisfactory (Figure 3B).

## Observation 3

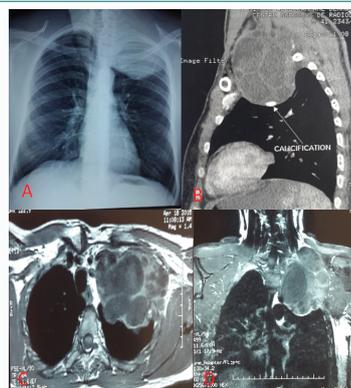
A 40-year-old patient has never smoked, who consulted for a left-sided supraclavicular swelling, gradually increasing in size, with a paresthesia of the left upper limb. Physical examination finds a supraclavicular mass fixed in relation to the deep and superficial plane, without inflammatory signs. Chest X-ray showed left apical opacity (Figure 4A). Cervicothoracic CT scan revealed a large left apical mass containing calcification with cervical extension (Figure 4B). As the patient presented with neurological signs, magnetic resonance imaging showed a left apical cervicothoracic mass with a large diameter of 10 cm, containing cystic stalls, including the brachial plexus without infiltration, and subclavian artery without invasion (Figure 4C and D). The patient had benefited of a sternotomy with a left anterior thoracotomy associated with a left supraclavicular approach. The intervention consisted on a dissection of the brachial plexus, the phrenic nerve, the left carotid artery and subclavian artery. A puncture of the mass was done bringing back clear liquid, and after opening of the mass and aspiration of a multivesicular hydatid cyst presumably starting at a vertebral cervical point, and Resection of the pericyst. The postoperative follow-up was favorable.



**Figure 2:** Hemi-clamshell approach (median sternotomy associated to anterolateral thoracotomy) performed for the first patient (thymoma B1).



**Figure 3:** (A) thoracic CT scan in the mediastinal window showing solitary fibrous tumor of the pleura occupying all the right hemithorax. (B) Chest X-ray thirty days after surgical resection of the tumor.



**Figure 4:** (A) Chest X-ray showing left apical opacity. (B) Cervicothoracic CT scan in sagittal section showing a cervicothoracic mass. (C, D) Magnetic resonance imaging showing a 10 cm mass of large diameter, with cystic stalls inside.

## Discussion

Table 1 summarizes the clinical, paraclinical and surgical characteristics of patients. The indications for surgery in these 3 cases were a thymic epithelial tumor, a solitary fibrous tumor of the pleura, and a hydatid cyst in a particular localization in the cervicothoracic region. These tumors require a surgical approach that allows a wide exposure and secure surgical procedure leading to complete resection. The hemi-clamshell approach is an anterolateral thoracotomy passing through the fourth or fifth intercostal space associated with a vertical median sternotomy, with the possibility of collar incision [2]. This approach has the disadvantage of sacrificing the internal thoracic pedicle, but leads to an excellent exposure to the pulmonary hilum, the thoracic cavity, and the cervicothoracic region.

Mediastinal pathology includes a wide variety of lesions that can be infectious, inflammatory, acquired or congenital tumors [3]. In thymic epithelial tumors which represent 50% of the tumors of anterior mediastinum, the reference approach remains sternotomy, which was first performed by Blalock in 1936 [4]. In our case (Observation 1), hemi-clamshell approach was necessary since the thymic tumor was adherent to the pulmonary hilum, especially that the patient has already benefited from chemotherapy. Ayako Fujiwara and colleagues, in their recent study published in 2018, they reported 14 patients who benefited from a hemi-clamshell approach for advanced thymic malignancy with pulmonary hilar invasion [5]. They performed seven lobectomy, one bilobectomy, and five wedge resection. This approach also makes it possible to practice diaphragmatic plication in the case

**Table 1:** Characteristics of the patients.

	Observation 1	Observation 2	Observation 3
Age	65	52	40
Sex	Man	Woman	Man
Functional signs	Chronic dry cough	Dyspnea + chest pain	Supraclavicular swelling
Chest X-ray	Ediastinal opacity	White right hemithorax	Left apical opacity
Thoracic CT	Mediastinal tumor	Tumor of right hemithorax	large left apical mass
Magnetic resonance imagery			Cervicothoracic mass containing cystic stalls
Final diagnosis	Thymoma B1	Solitary fibrous tumor of the pleura	Hydatid cyst
Approach	Sterno-thoracotomy	Sterno-thoracotomy	Sterno-thoracotomy + supraclavicular incision

of resection of the phrenic nerve which is invaded by the thymic tumor [5].

The solitary fibrous tumor of the pleura is a rare tumor of fibroblastic origin, most often localized and benign, representing less than 5% of all pleural tumors [6] in the series of Pierre Magdeleinata and colleagues of 60 patients had a solitary fibrous tumor of the pleura, no approach by hemi-clamshell was made [7]. In our case (observation 2), this approach was necessary because of the size of the tumor that occupies the entire hemithorax, and for a good exploration in order to find the base of implantation of the tumor allowing a complete resection.

Superior sulcus tumors are a rare subset of lung carcinomas which occur with an incidence less than 5% of all lung cancers [8]. Their location at the cervicothoracic region can lead to invasion within an area that is anatomically rich in nerve, bone, muscle and vascular structures [9]. Our case (observation 3) was particular since it was a hydatid cyst revealed by Pancoast Tobias syndrome. Ohta and colleagues reported a series of 24 patients who were operated only by hemi-clamshell approach for advanced primary lung cancer. Of these 24 patients, 5 patients had a Pancoast tumor. They conclude that hemi-clamshell is an excellent approach in case of advanced lung cancer since it allows a complete resection and complete lymph node dissection with reconstructions in case of mediastinal invasion.

## Conclusion

Despite the evolution of minimally invasive surgery, the hemi-clamshell approach has an important place that allows a large surgical exposure on the mediastinum, the thoracic cavity and the cervicothoracic region, allowing respecting the rules of oncological surgery and therefore having a complete resection.

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