

Hybrid treatment of T3 chest wall lung cancer lobectomy

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Abstract: Nowadays the treatment of patients with non-small cell lung cancer (NSCLC) that invades the chest wall is still questioned. The classic approach is a lobectomy that requires chest wall resection through thoracotomy, but thanks to the progress in the field of thoracoscopic surgery, this procedure can be performed by video-assisted thoracoscopic surgery (VATS). Major advances have been made in recent years both in the surgical technique associated with thoracoscopy and in the instrumentation available today. This has allowed the use of thoracoscopic technique even in advanced disease. To choose to perform complex surgery in assisted video surgery, considerable experience is needed to avoid making mistakes and giving up a better approach for the patient only for any technical difficulties. Thoracoscopy is not currently the preferred intervention for patients with chest wall invasion because there are insufficient studies on the feasibility of lobectomy with thoracoscopic wall resection, although the thoracoscopic approach has reduced mortality and morbidity in lung cancer cases not in advanced stage. We discuss our experience in three patients using hybrid approach with assisted video thoracoscopic lobectomy and a chest wall *en-block* resection with an alternative method of estimating thoracic wall resection that uses assisted video surgery and hypodermic needles (minimally invasive posterior approach).

Keywords: Video-assisted thoracoscopic surgery (VATS); thoracoscopy; lung cancer; chest wall; minimally invasive surgery

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Introduction

The video-assisted thoracoscopic surgery (VATS) has been used since the early 1990s. Over the years, the choice of VATS over thoracotomy in pulmonary resection depends on the personal choice of the surgeon, his experience and the availability of the technical instrument. Non-small cell lung cancer (NSCLC) is now widely treated in VATS, considered in selected cases as a gold standard, though not limited to this type of tumor. In selected patients, 5-year survival without lymph node invasion reaches 40–50% after tumor and chest wall resection, although this procedure may have a higher morbidity with mortality of up to 9%, higher than the simple lobectomy (1-5,6). Unfortunately, in

aggressive cases with wall invasion, surgery often involves a potentially disruptive resection, long hospitalization, and a long and painful period of recovery. Several reports have shown that thoracoscopic lobectomy is safe and effective for operable tumors, with overlapping oncological findings and minor complications compared to thoracotomy (5,7-9). Thoracoscopy is not currently the preferred surgery for chest wall invasion because there is not enough studies on the feasibility of lobectomy with wall resection with thoracoscopic hybrid technique.

The purpose of this study was to test a hybrid approach using thoracoscopic lobectomy combined with thoracic wall resection where avoiding rib spreading and scapular

Table 1 Patients who underwent *en bloc* pulmonary and chest wall resection for lung cancer

Gender	Age (years)	Lung resection	Ribs excised	Histology	Staging	Complications	Drain removal	Discharge	Follow up
Female	68	Right upper lobectomy	3 (III-IV-V)	Adenocarcinoma	T3N0M0	None	5 th day post-op	6 th day post-op	33 months—no evidence of recurrence of disease at follow-up CT
Male	76	Right upper lobectomy	3 (II-III-IV)	Adenocarcinoma	T3N0M0	None	5 th day post-op	6 th day post-op	12 months—no evidence of recurrence of disease at follow-up CT
Male	61	Right upper lobectomy	3 (III-IV-V)	Poorly differentiated carcinoma	T3N0M0	pain, bronchial pressure, atelectasis with pleural effusion	10 th day post-op	12 th day post-op	60 days CT control: no evidence of recurrence of disease at follow-up CT

CT, computed tomography.

mobilization. The best choice in locally advanced disease involving the wall is full lung resection with chest wall to ensure long-term survival. The choice of type of treatment for patients with NSCLC invading the chest wall is under discussion today (10,11-15). The traditional technique used at present is thoracotomy, with wall resection before lobectomy. The parietal resection is done after an exploratory thoracotomy with palpation, which provides a measure of the extent of the disease on the chest wall. This, however, involves an approximation in wall resection. VATS is increasingly gaining ground thanks to many studies in Literature, so the guidelines for its use are being expanded. Our little case shows that using a hybrid approach allows us to engrave the affected area with a precise excision of the chest wall without the need for extensive thoracotomy without rib spreading. Experienced surgeons in VATS demonstrate in Literature the feasibility of the thoracoscopic approach in patients with advanced stage tumor with wall invasion (16).

Patient selection and workup

We selected 3 patients: 2 males and 1 female, smokers, that came to our attention with history of cough and persistent right sided interscapular chest pain (Table 1).

Computed tomography (CT) and positron emission tomography-CT (PET-CT) scans demonstrated a 6.4 cm mass in the right upper lobe invading the segment VI and abutting the pleural surface in the first case, 6 cm same position for the second, 9.4 cm for the third case same position, without hilar adenopathy, CT fine needle biopsy revealing a squamous cell cancer in the first case, a transbronchial biopsy revealed an adenocarcinoma for the

second case and a CT fine needle biopsy revealed a poorly differentiated carcinoma in the third case (Figures 1-3).

Pre-operative preparation

Each patient was subjected to induction chemotherapy and two of them concurrent radiotherapy. The induction treatment showed a decrease the T parameter in all patient: to 4.4 cm in the first one, to 2.2 cm in the second and to 6.8 cm in the third (Figures 1-3). All 3 patients were subjected to functional and oncological extended re-evaluation preoperatively after induction treatment [total body contrast CT, PET/CT, brain magnetic resonance imaging (MRI)] and staging standard mediastinoscopy has been performed few days before the major procedure always sampling station 4 L, 7 and 4 R.

Procedure

Patients under general anaesthesia undergo double lumen intubation for one lung ventilation. The patients are harvested with arterial and central versus lines, monitored with capnography, pulse oximetry, ECG and invasive arterial pressure. The patient placed in the lateral decubitus position and homolateral arm in the foreword position but free to be moved in the pending position, three-port anterior VATS approach is performed. This allows for macroscopic staging of the disease and also facilitates location and extension of the chest wall involvement. A right upper lobectomy with complete lobe specific lymph node dissection is performed via conventional anterior 3/5 cm utility VATS incision in the anterior axillary line at the 5th intercostal space. The exact extension of chest wall involvement is assessed under VATS

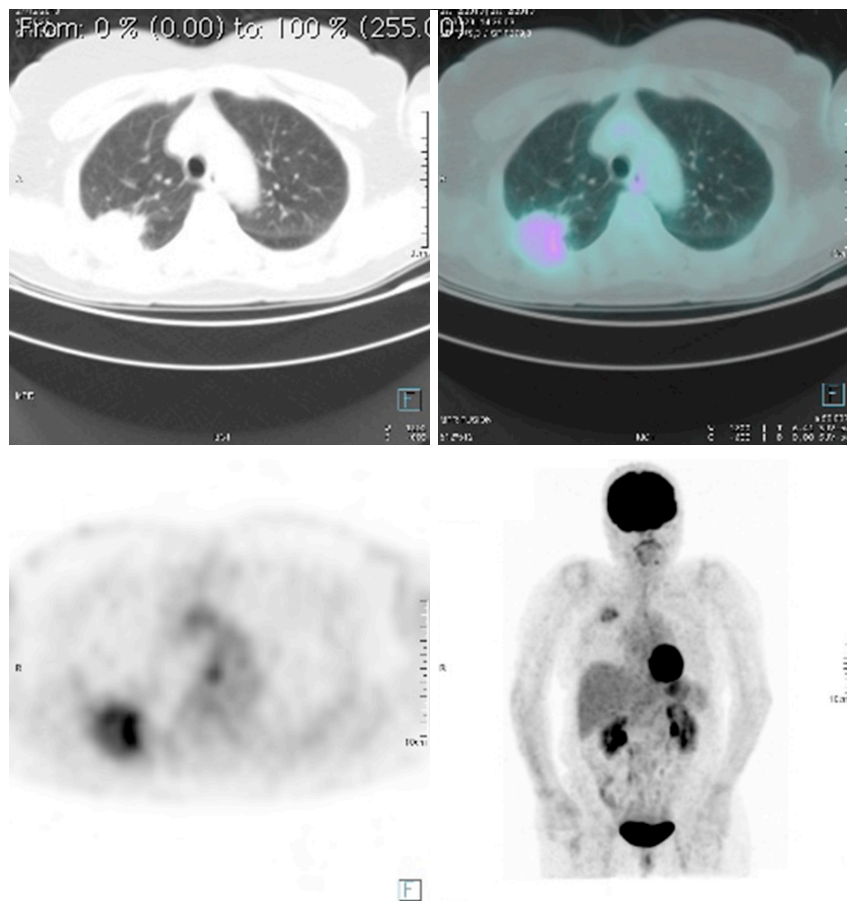


Figure 1 PET/CT after induction CHT first patient. PET, positron emission tomography; CT, computed tomography; CHT, chemotherapy.

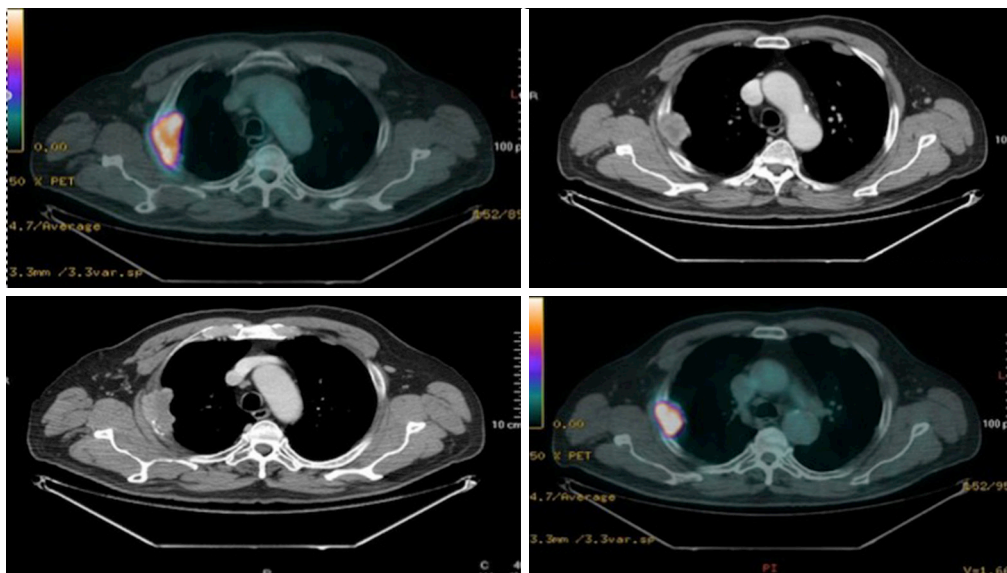


Figure 2 PET/CT before CHT/RT treatment, second patient. PET, positron emission tomography; CT, computed tomography; CHT, chemotherapy; RT, radiotherapy.

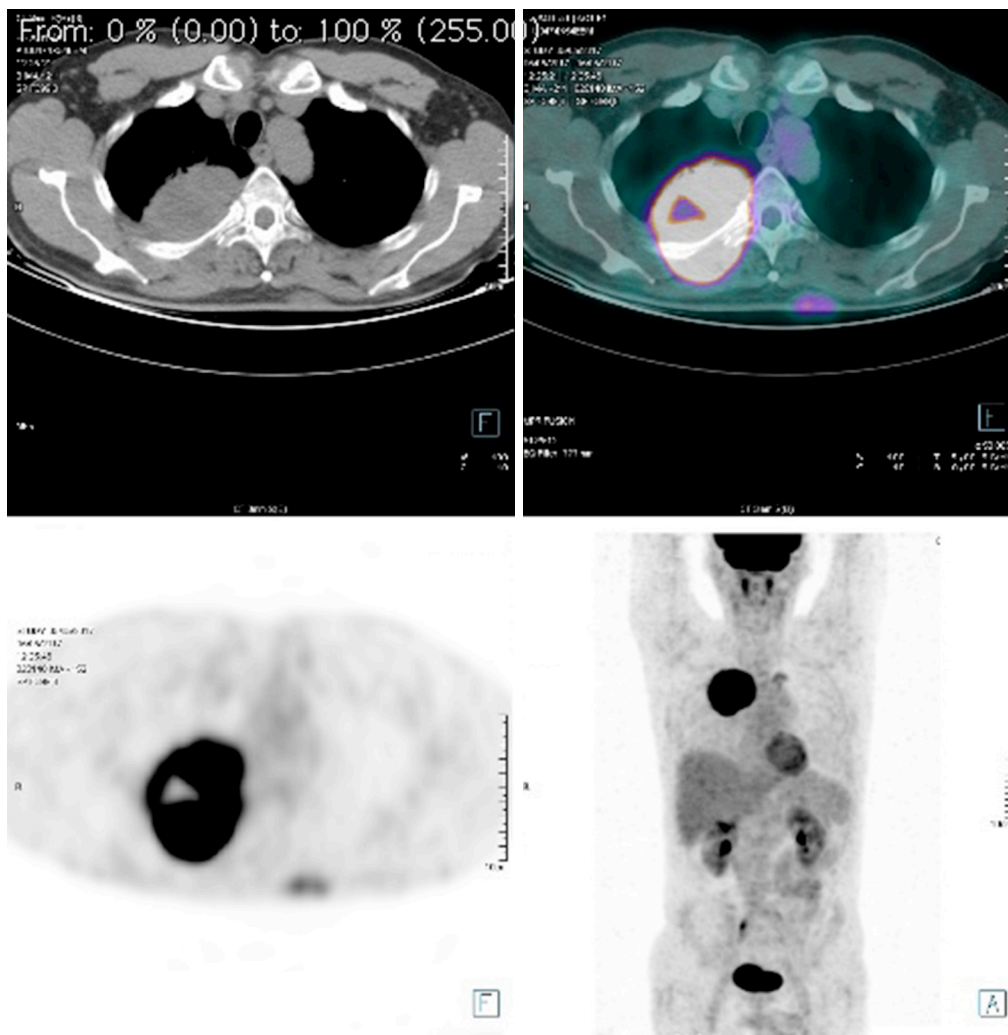


Figure 3 PET/CT before CHT/RT treatment, third patient. PET, positron emission tomography; CT, computed tomography; CHT, chemotherapy; RT, radiotherapy.



Figure 4 Technical surgical procedure for hybrid treatment of T3 chest wall lung cancer lobectomy (17).

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guidance, and the limits of chest wall resection required to achieve adequate clear margins are defined. The patient arm is moved from the foreword position to the pending position to permit the mobilization of the scapula anteriorly and on endoscopic control we can precisely identify the extent of wall resection with the help of peridural needles. Needles are pinned into the chest wall from outside under VATS guidance to mark the extent of chest wall resection. Normally we include at least a 2 cm margin around the tumour for histologic clearance. A needle targeted 10–12 cm posterior incision is performed to allow resection of posterior arches of the ribs, transverse processes and related intercostal musculature without the need of an additional thoracotomy and without rib spreading. The chest wall defect did not

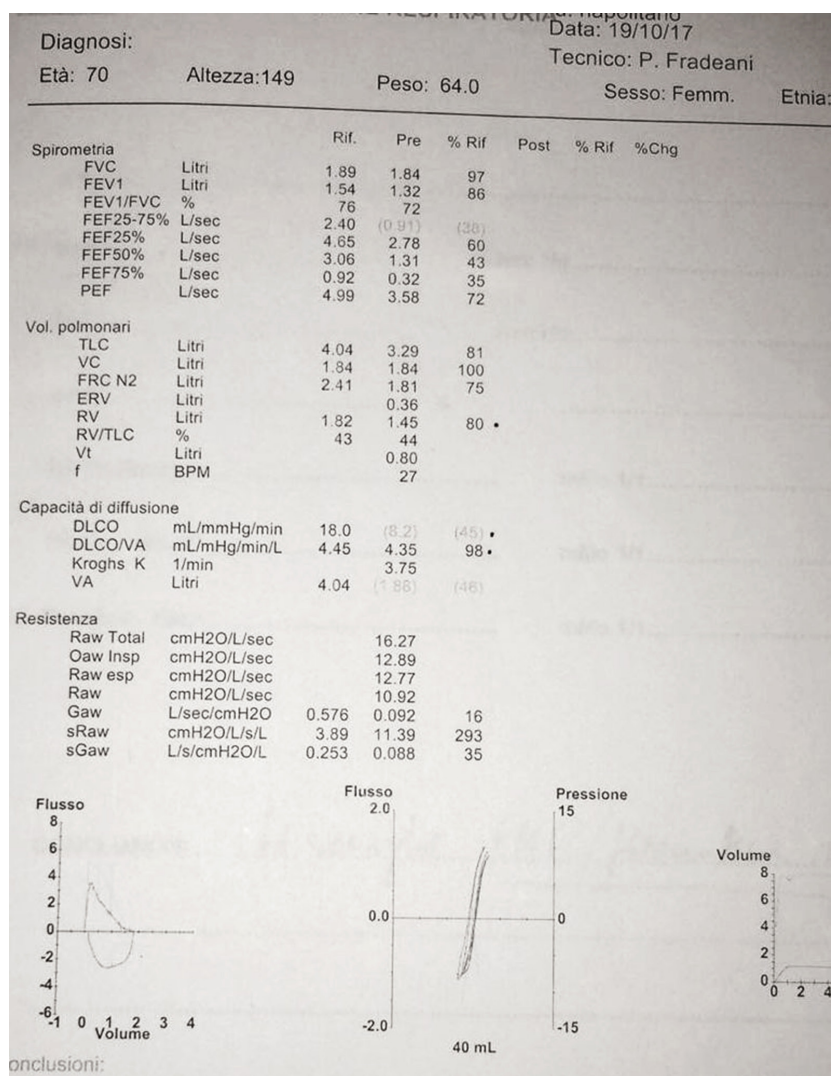


Figure 5 Spirometry at 33 months taking in consideration that she also had LUL due to metachronous T1a adenocarcinoma, first patient.

need reconstruction in any case. Two intercostal drains are inserted via each VATS port incision and the wound is closed by layers. This approach was used in the three patients (Figure 4). The demographics are described in Table 1.

Role of team members

Each case has been discussed in a multidisciplinary meeting dedicated to lung cancer.

Post-operative management

The postoperative outcome is significantly better than the standard surgical procedure. It is mandatory the optimum

pain treatment, early mobilization of the patient, respiratory physiotherapy, and last but not least nutrition. In our series the first two patients had no complications at all; the drain removal was in the post-operative 5th day after a chest X-ray. During all the hospitalization all the patients were entrusted to the physiotherapist, so early mobilization was achieved. The discharge was without any problem in the 6th day post-surgery. As for the third case, he had pain, bronchial retention (which required fibrotic bronchoscopy), atelectasis with pleural effusion after the surgery, but in the 12th post-operative day, we were able to remove the drainage after the chest X-ray showed a good recovery of the pulmonary panel. We follow the patients with a CT scan after 60 days, and we discharge every patient with a programme as

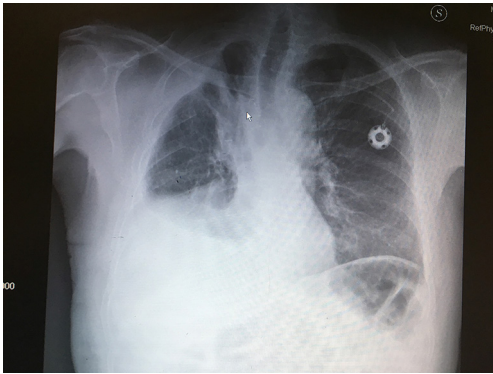


Figure 6 Chest X-Ray at discharge in 12th day post-operative.

for the pulmonary physiotherapy and for the diagnostic exams (Figures 5,6).

Tips, tricks and pitfalls

We agree that is vital:

- (I) Before approaching the wall resection create a tunnel on the posterior mediastinal pre-esophageal plane and superficially to the Azygos vein, interposing a gauze to protect these structures;
- (II) Intraoperative mobilization of the homolateral arm in a sloping position to anteriorize the scapula to achieve the fullest possible expulsion of the back arches of the affected ribs without the need to raise the bail;
- (III) Use high-energy devices both for dissection and soft wall tissue and to control intercostal arteries;
- (IV) Keep the thoracoscope in place for the rest of the procedure to see what happens in the pleural cord;
- (V) At the end of the wall resection, mobilize the homolateral arm to verify that the scapula does not enter the pleural cord;
- (VI) In the case of extension to the VI segment, perform the parenchymal section after the wall resection;
- (VII) Perform the 4th and 7th linfectomy from the back access at the end of the demolition.

Conclusions

In Literature there are not enough clinical studies that highlight the feasibility of chest wall resection in VATS. The hybrid technique, which includes a VATS lobectomy with chest wall resection, becomes viable and suitable in selected patients.

The mini-invasive technique is certainly applicable to extensive lobectomy to wall resection and can also be reproduced by surgeons with a meaningful experience in the field, as this little series demonstrates. The postoperative outcome is significantly better than the standard surgical procedure. It is mandatory the optimum pain treatment, early mobilization of the patient, respiratory physiotherapy, and last but not least nutrition. The use of more and more specific instrumentation will help reducing the size of the interscope-vertebral access. As this little series, we did not have the need to rebuild the wall defect or to resect the scapula (3,5,18).

There is the need of more studies and experience to accurately determine if using this approach can effectively offer advantages over the classic approach and improve the end result. Selecting the patient with precision is mandatory, considering the size of the tumor, the presence of lymphadenopathy, the possible neo-adjuvant chemotherapy or radiotherapy as in our series, which could entail more technical difficulties by addressing the VATS intervention. Obviously, a mini-invasive approach involves minor alterations of the wall muscles and the ribcage and less nervous trauma than thoracotomy, reducing post-operative pain and improving patient outcome and quality of life (QoL) (1,4,9). In our case, we can't demonstrate a real advantage of the hybrid approach to the classical one, but only its usefulness and viability, in well-selected patients, which correspond to particular surgical feasibility criteria. Our aim is to propose an approach that could be inspirational for other studies on cancer patients with chest wall invasion and could push to choice this type of treatment only after gaining considerable experience in VATS. The purpose of this type of study should always be to improve the QoL of patients. VATS in patients with lung cancer invading the wall allows for complete resection, less hospitalization and rapid healing. The use of hypodermic needles to delineate the wall resection limits in VATS has allowed us to reschedule the exact amount of chest wall avoiding thoracotomy with optimal neuromuscular and respiratory recovery. This simple approach is repeatable in any case of invasion of the chest wall in selected patients.

In our experience it has been successfully used according to the previous experience described by D'Amico (5). A major diffusion of this technique is necessary in order to better point out its advantages. An optimal learning curve looks inevitable so to bring the surgeon to obtain an adequate experience to complete this type of surgical approach.

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Footnote

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

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