Extrapleural Pneumonectomy for Malignant Pleural Mesothelioma
A Novel Mini-Invasive Technique

Francesco Paolo Caronia, MD, Alfonso Fiorelli, MD, PhD,† Mario Santini, MD,† and Ettore Arrigo, MD**

Abstract: We report a novel less-invasive extrapleural pneumonectomy for early-stage malignant pleural mesothelioma without rib spreading. Our approach is unique and differed from the previously reported cases, because we used one skin incision and two small intercostal incisions with videothoracoscopic viewing without rib spreading. The pleural dissection and approach to the hilum for pneumonectomy were performed through a 4- to 5-cm port incision in the sixth intercostal space. Another 4- to 5-cm port was made in the eight intercostal space through the same skin incision and was used for diaphragm resection and reconstruction. At the end of the surgery, the skin incision was enlarged to 8 cm; through which and the first port in the sixth intercostal space, the resected specimen was retrieved. Three cycles of adjuvant chemotherapy followed by radiation therapy were administered. Eleven-month follow-up showed no recurrence.

Key Words: Video-assisted thoracoscopy, Extrapleural pneumonectomy, Malignant pleural mesothelioma.

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Surgical management for malignant pleural mesothelioma (MPM) remains controversial, but because of the limitations of radiation and chemotherapy in this disease, surgery is still an important part of treatment for these patients. Curative intent operations for MPM include extrapleural pneumonectomy (EPP) and extended pleurectomy/decortication (P/D), both aiming to obtain a macroscopic R0 resection.[1,2] However, standard EPP remains one of the most invasive and painful thoracic surgery procedure with significant morbidity and mortality compared with P/D.[3] Thus, to reduce the surgical trauma, herein, we proposed a less-invasive EPP for early-stage MPM using one skin incision and two small intercostal incisions with videothoracoscopic viewing without rib spreading.

Video clip is available online.

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From the *Thoracic Surgery Unit, Istituto Oncologico del Mediterraneo, Catania, Italy; and †Thoracic Surgery Unit, Second University of Naples, Naples, Italy.

Francesco Paolo Caronia, MD, and Alfonso Fiorelli, MD, PhD, contributed equally to prepare this article.

A video clip is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.innovjournal.com).

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Address correspondence and reprint requests to Alfonso Fiorelli, MD, PhD, Thoracic Surgery Unit, Second University of Naples, Piazza Miraglia, 2, I-80138 Naples, Italy. E-mail: alfonso.fiorelli@unina2.it.

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CASE REPORT

A 51-year-old man was referred for the management of left-sided epithelioid MPM diagnosed at another hospital through a surgical biopsy. He underwent two cycles of induction cisplatin/pemetrexed chemotherapy. Computed tomography and positron emission tomography scan (http://links.lww.com/INNOV/A90) showed no local or distant diseases (Fig. 1); thus, mediastinal invasive staging was not performed. The good performance status of the patient due to young age and the lack of comorbidities, the normal body mass index (body mass index = 23 kg/m^2), and the early stage of the tumor supported the feasibility of EPP. Patient was aware of pros and cons of our approach and gave a specific written informed consent.

Under general anesthesia with selective intubation, the patient was placed in lateral decubitus as for left thoracotomy. A 5-cm posterolateral incision through the left sixth intercostal space was performed without rib spreading (Fig. 2). The parietal pleura was dissected in a blind fashion with fingers placed outside the parietal pleura to create a space for inserting thoracoscope. The dissection continued with videothoracoscopic viewing. The parietal pleura was dissected from the endothoracic fascia up to apex of the chest, then anteriorly to pericardium, posteriorly to spine, and down the diaphragm. During dissection, the hemostasis was performed with Harmonic scalpel (Ultracision Harmonic; Johnson&Johnson, Somerville, NJ USA). The tumor was mobilized away from the underlying mediastinal structures exposing the hilum (http://links.lww.com/INNOV/A91). The subcarinal lymph node was resected to show the main left bronchus. Using the same skin incision, a second 4- to 5-cm incision was performed at level of the eight intercostal space to approach diaphragm. The main left bronchus and pulmonary artery, in that order, were divided using staplers. The pericardium was circumferentially opened to encompass the tumor. The superior and inferior pulmonary veins were stapled intrapericardially (http://links.lww.com/INNOV/A92). The diaphragm was disconnected circumferentially from the chest wall, and a sponge stick technique was used to separate the peritoneum from the inferior diaphragmatic surface. The peritoneum was dissected off bluntly

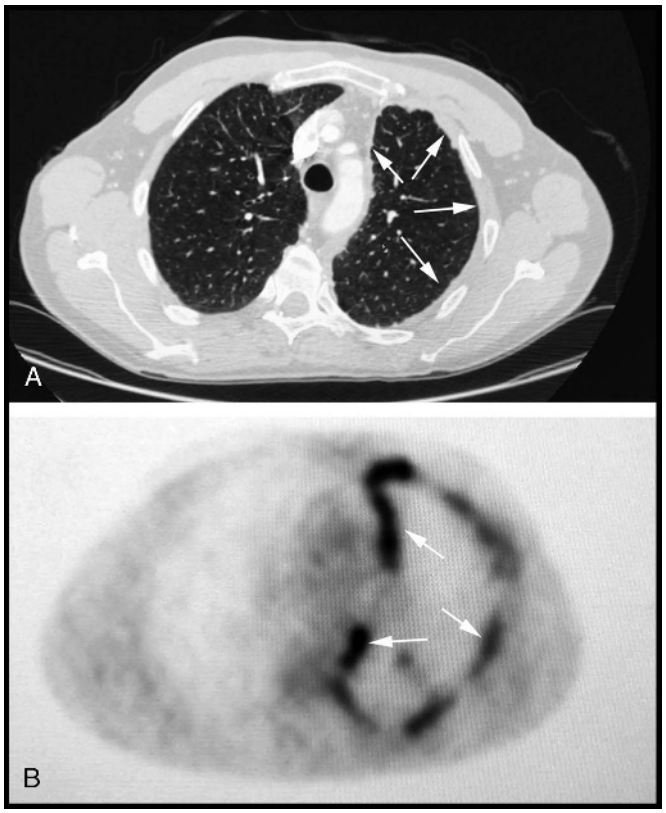

FIGURE 1. Axial contrast-enhanced computed tomography scan (A) showed circumferential left-sided pleural thickening (arrows). Positron emission tomography scan (B) showed diffusely increased fluoro-deoxy-glucose uptake in the pleura of the left hemithorax (arrows) without other abnormalities.

and left intact. The specimen was removed en block through the sixth intercostal space access enlarged to 8 cm without rib spreading (http://links.lww.com/INNOV/A93). After the lung specimen was removed, all mediastinal lymph nodes including stations number 5, 6, 8, and 9 were resected. Left hemidiaphragm was replaced with a 20 × 30-cm 2-mm Gore-Tex prosthetic patch (http://links.lww.com/INNOV/A94). The pericardium was resected and not reconstructed. A single chest tube was inserted through the incision. The operation was summarized in Figure 3 and Video 1.

The overall surgical time was 450 minutes and estimate blood lost was 500 mL. Epidural analgesia was used for control pain, and pain intensity score was less than 4 (0–10 visual analogue scale) for the entire postoperative course. No intraoperative or postoperative complications occurred, and the patient was discharged 11 days later. Pathological examination revealed an epithelioid-type mesothelioma without mediastinal and hilar lymph node involvement (pT2N0M0). Three cycles of adjuvant chemotherapy, followed by radiation therapy, were administered. Eleven-month follow-up showed no recurrence.

DISCUSSION

The standard of care for patients with MPM has not been established. Extrapleural pneumonectomy has been performed as a treatment option. Despite a heightened interest in EPP for the past decade, concerns about the morbidity (range, 2.5%–48%) and mortality (range, 0%–11.8%) of this surgical procedure and its efficacy have delayed a consensus in its practice.[3,4] Standard EPP is one of the most invasive and painful thoracic surgery procedures, and recently, less-invasive procedures have been proposed to minimize surgical trauma. Suda et al[5] and Demmy et al[6] performed EPP using a three- to fourth-port video-assisted thoracoscopic surgery (VATS) approach with a utility incision without rib spreading. In line with this strategy, we proposed a less-invasive EPP for early-stage MPM. Our technique was unique and differed from the previously reported cases[5,6] because we used one skin incision and two small intercostal incisions with videothoracoscopic viewing without rib spreading. The pleural dissection and approach to the hilum for pneumonectomy were performed through a 4- to 5-cm port incision in the sixth intercostal space. Another 4- to 5-cm port was made in the eight intercostal space through the same skin incision and was used for diaphragm resection and reconstruction. At the end of the surgery, the skin incision was enlarged to 8 cm, through which and the first port in the sixth intercostal space, the resected specimen was retrieved.

The preoperative evaluation is crucial for the success of our procedure. It aims to determine whether the patient has

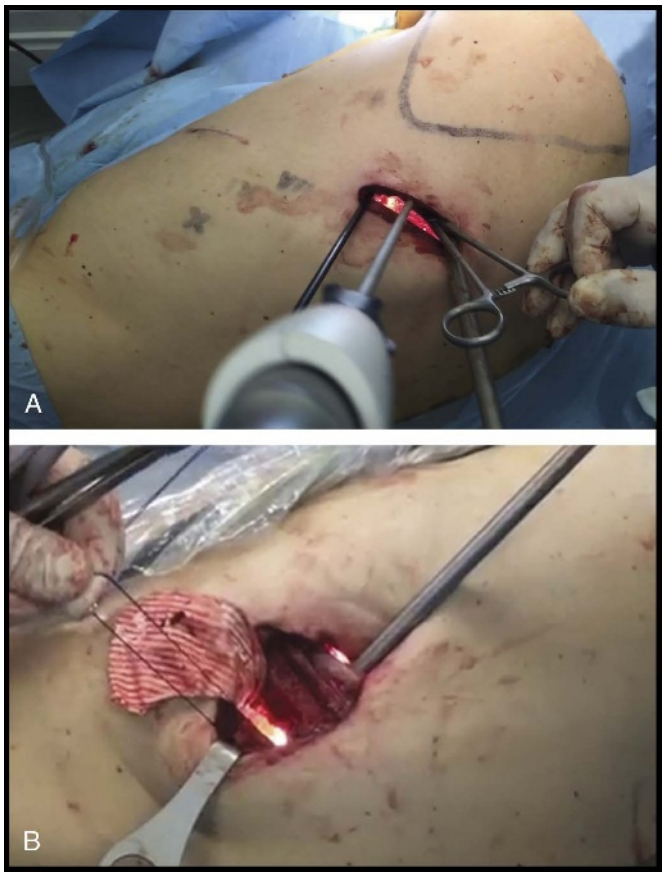

FIGURE 2. A 5-cm posterolateral incision through the left sixth intercostal space was performed without spreading the ribs (A). Widening the skin incision, a second 4- to 5-cm incision was performed inferiorly at level of eight intercostal space to approach the diaphragm (B).

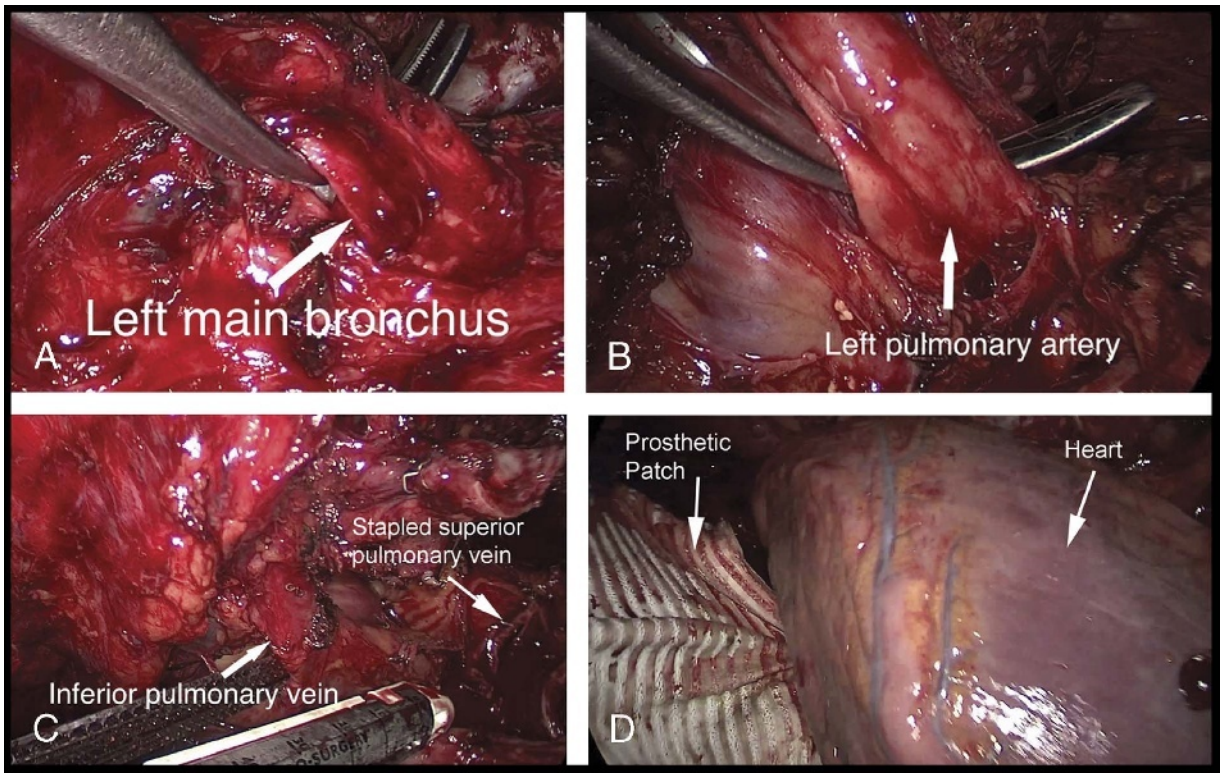

FIGURE 3. The main left bronchus (A) and the main pulmonary artery (B), in that order, were extrapericardially isolated and divided using staplers. The superior and inferior pulmonary veins were stapled intrapericardially (C). The left hemidiaphragm was replaced with prosthetic patch, whereas the pericardium was not reconstructed (D).

potentially resectable tumor and sufficient cardiopulmonary reserve to undergo the planned operation. The radiological identification of metastatic diseases in the peritoneum or in the contralateral lung and pleura precluded the feasibility of our procedure. In addition, the poor respiratory reserve and/or underlying cardiovascular disease excluded using this approach also if the tumor was potentially resectable, because EPP places patients at high risk for respiratory failure due to resection of the entire lung and for myocardial ischemia because of intraoperative blood loss and postoperative fluid shifts. In these cases, other approaches as P/D should be advocated over EPP. From a technical point of view, previous talc pleurodesis is an absolute contraindication for our technique because the tenacious pleural adhesions could make unfeasible the extrapleural dissection, whereas a body mass index more than 30 is a relative contraindication. Obtaining access for mediastinal dissection can be difficult in patients with significant subcutaneous obesity or mediastinal adipose tissue. Thus, in this case, the use of longer ports and of a wound protector can provide easier access into the chest.[7]

The "tips and pitfalls" of this technique are (1) the correct identification of the plane between the tumor and the other mediastinal structures as the aorta and the esophagus during pleurectomy, (2) the injury of the peritoneum that could favor tumor implants during diaphragm resection, and (3) the anchoring of the patch to the lateral chestwall during diaphragm reconstruction because of the difficult angle. Obviously, there are reasonable concerns regarding some aspects of our approach. (1) The decision to not reconstruct the pericardium was a hazard because of potential life-threatening complications. Pericardial reconstruction is always indicated after EPP for MPM. Right-sided pericardioplasty is performed to prevent cardiac dislocation. Left-sided pericardial defects that result after EPP are large, and there is no risk of cardiac strangulation, but reconstruction is recommended to prevent constrictive epicarditis.[8] Furthermore, reconstruction of large pericardial defect also after EPP for MPM by minimally invasive means is previously reported.[5,6] Thus, we will take care to reconstruct the diaphragm in future similar cases. (2) Despite that an 8-cm skin incision was required for retrieving the specimen, we did not start with the bigger skin incision. This choice was mainly due to the fact that we did not know whether we might have to convert. In addition, enlarging port incision only at the end of the procedure could concur to minimize the thoracic parietal trauma and reduce postoperative pain.[9]

In agreement with the well-defined advantages of VATS compared with standard thoracotomy in surgical treatment of lung diseases, the minimal incisions and the lack of rib spreading of our approach would help reduce pain, morbidity, accelerate convalescence for adjuvant therapies, and minimize wound surface area with possible tumor contamination. Unfortunately, our speculations cannot be demonstrated because of lack of control group, but other authors[5,6] also expected similar advantages after VATS EPP. Finally, despite not all readers necessarily agree with adopting EPP for MPM and with all aspects of our approach, some of the technical suggestions listed in our video

might prove useful for management of other pleural pathologies with more favorable tumor biology than MPM. Obviously, more data from future experiences are needed before any conclusion can be drawn.

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