Perforation of the Right Ventricle*

A Complication of Blind Placement of a Chest Tube Into the Postpneumonectomy Space

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We were asked to review a case from an outside hospital in which there was inadvertent perforation of the right ventricle during the percutaneous placement of a chest tube. We present the case in the hopes that by doing so, others will avoid such a complication in the future. After reviewing the case, it appeared that the complication occurred because the physician was not knowledgeable about the anatomy of the postpneumonectomy space and the physician failed to use the safest procedure in placing the tube.

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Key words: chest tube; complication; perforation; pneumonectomy; right ventricle; tube thoracostomy

Knowledge of the location of vital thoracic and abdominal organs after pneumonectomy is paramount if a physician is to access the postpneumonectomy space without complication. Strict adherence to the safe chest tube insertion procedure is mandatory.

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Procedures have been well described for percutaneously placing a chest tube into the pleural space successfully and safely.1–3 Chest radiograph and/or CT scan need careful interpretation prior to chest tube insertion. To minimize the chance of inadvertently inserting the chest tube into the lung or other vital structures, it is recommended that the initial incision be made and then deepened with a clamp. The clamp is used to separate the musculature and bluntly dissect the soft tissue to the parietal pleura. Next the parietal pleura is carefully pierced with the clamp. Last, before inserting the chest tube, an exploratory finger is inserted into the pleural space to make certain that the tube can be safely placed and most advantageously positioned.

The anatomic changes that occur in the thorax after pneumonectomy were first described by Rienhoff4 in 1936. It is now well known that after pneumonectomy, there is some degree of hyperinflation of the remaining lung, elevation of the hemidiaphragm on the side the pneumonectomy occurred, and displacement of the esophagus and heart toward the postpneumonectomy space. Biondetti et al5 described the CT changes that occur in the postpneumonectomy space, reporting the

![Figure 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21845/ on 03/31/2017)
amount of lung herniation, elevation in the hemidiaphragm, and rotation and shifting of the mediastinal structures in 22 patients after pneumonectomy.

We were asked to review a case from an outside hospital in which the right ventricle was inadvertently perforated during the percutaneous placement of a chest tube, and present the case in the hopes that by doing so, others will avoid such a complication in the future. After reviewing the case, it appeared that the complication occurred because the physician was not knowledgeable of the anatomy of the postpneumonectomy space and the physician failed to use the safest procedure in placing the tube.

CASE REPORT

A 64-year-old woman was admitted to an outside hospital for a left pneumonectomy for severe bronchiectasis. Prior to surgery, a chest CT scan revealed a left lung completely destroyed by bronchiectasis, marked shift in the patient's mediastinum toward the diseased lung, and the right ventricle abutting the chest wall (Fig 1). The patient's immediate postoperative course was complicated by hemorrhage into the postpneumonectomy space that did not require surgical reexploration for the bleeding. She was discharged home from the hospital 14 days after the surgery.

The patient did well until approximately 17 months after her pneumonectomy, when fever, chills, and worsening dyspnea developed. She was admitted to her local hospital where a chest radiograph revealed a new air-fluid level in the left pneumonectomy space (Fig 2). A bronchoscopy was performed that confirmed the presence of a small bronchopleural fistula in the left bronchial stump. The patient was initially treated with IV antibiotics, and she was discharged home from the hospital with instructions to follow up with her thoracic surgeon. During follow-up with her surgeon 1 week later, it was recommended that the patient be readmitted to the hospital and undergo drainage of the postpneumonectomy space.

After the patient consented to the percutaneous placement of a chest tube, she was placed in the right lateral decubitus position. The physician inserted a 23-gauge needle into her left postpneumonectomy space via the left fifth intercostal space in the midaxillary line. After a small amount of dark, bloody fluid was removed, the physician inserted a 32F chest tube at the same location. Upon placement of the chest tube, approximately 500 mL of dark blood was immediately drained. Suddenly, the patient became severely hypotensive and suffered a cardiopulmonary arrest. Despite aggressive resuscitation, the patient died. At autopsy, it was shown that the chest tube had been placed into the patient's right ventricle. The patient's heart was noted to be rotated to the left, and directly abutting the left lateral chest wall where dense pericardial adhesions were found adhering the heart to the lateral chest wall.

DISCUSSION

This case report documents a fatal complication that can arise when the proper procedure for the placement of a chest tube is not observed. It also exemplifies a risk of placing a chest tube into the postpneumonectomy space without complete understanding of the anatomic changes that can occur after removal of one lung.

![Figure 2](http://example.com/figure2.jpg)  
*Figure 2. The patient's posteroanterior (left) and lateral (right) chest radiographs 17 months following left pneumonectomy demonstrate a new air-fluid level consistent with the diagnosis of a bronchopleural fistula.*
If the correct procedure for inserting a chest tube, especially regarding finger exploration of the pleural space, had been performed properly, the physician would have felt the patient’s beating heart immediately abutting the chest wall, and thus been warned not to place the chest tube in that location. Finger exploration of the pleural space is a very important step in the placement of a chest tube. This step helps confirm that the pleural space has indeed been entered, it allows for lysis of any adhesions in the pleural space at the tube site, and it helps locate any vital organs, usually the lung, to assure that they are not injured when inserting the tube. When placing a chest tube into the pleural space, it is important never to deviate from the standard procedure. Ipsilateral narrowing of the intercostal spaces is commonly seen after pneumonectomy; these anatomic changes may prevent full finger insertion into the pleural space. Image guided placement of the chest tube needs to be performed in these instances. Injury to vital organs in the thorax at the time of chest tube placement has been described previously. We are aware of two other potentially avoidable cases in the literature describing injury to vital thoracic structures after blind placement of a chest tube into patients with anatomic alterations in the thoracic cage. Meisel et al7 reported the perforation of the right atrium during chest tube placement in a patient with severe kyphoscoliosis, while Van Kralingen et al7 described the placement of a chest tube into the pulmonary artery of a patient who had undergone a prior pneumonectomy.

The case we report herein, and the work of Biondetti et al6 sparked our interest in further delineating the locations of vital organs in the thorax after pneumonectomy. Consequently, we retrospectively reviewed the CT scans of 20 patients at our institution after pneumonectomy (see page 000 in this issue). We found that nine patients had changes in location of vital organs such that blind placement of a needle or chest tube into the postpneumonectomy space at the fifth or sixth intercostal space in the midaxillary line would risk injuring them. In seven of these cases, either the liver or spleen was elevated above the fifth intercostal space and abutting the lateral chest wall. In the remaining two cases, the heart had rotated and shifted, and was abutting the lateral chest wall. These changes could not have been predicted by routine chest radiographs because of opacification of the postpneumonectomy space.

It is often difficult to detect the precise location of vital organs in the thorax after pneumonectomy by chest radiograph. Because the chest radiograph is often unreliable, and the amount of shifting of thoracic structures after pneumonectomy is unpredictable, we recommend that any attempts to drain the postpneumonectomy space should be done by an experienced physician under direct visual guidance with ultrasonography or CT. These studies will provide the physician with a clear picture of the anatomy of the postpneumonectomy space and aid in the proper placement of a needle or chest tube without harming vital structures.

References


Unilateral Segmental Hyperhidrosis Associated With Pulmonary Adenocarcinoma

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This is the report of a 38-year-old man with unilateral dermalomal hyperhidrosis documented by a starch-iodine technique; a subsequent diagnosis was made of a generalized pulmonary adenocarcinoma. The association of unilateral hyperhidrosis and a malignant tumor is reviewed.

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Key words: hyperhidrosis; malignancy; paraneoplastic disorders

Several dermatologic syndromes including palmar hyperkeratosis, reactive erythema, and acanthosis nigricans have been reported in association with pulmonary neoplasms.1 The majority of cases of localized or unilateral hyperhidrosis have been reported in association with organic nervous system disease including vascular cerebral disease, spinal cord disease, and peripheral neuropathy.2 In addition, there have been reports of multisegmental hyperhidrosis associated with involvement of the sympathetic trunk or postganglionic sympathetic fibers by thoracic malignant tumors, especially mesothelioma.2,4 This is

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