

## Mediastinal Shift toward the Remaining Lung: A Report of Six Cases

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**Key words:** postpneumonectomy, cancer, lung, mediastinum, shift

*IMAJ 2007;9:885–886*

Deviation of the mediastinum towards the remaining lung after pneumonectomy may produce symptomatic airway obstruction by lung compression, thereby impairing venous return. This is a rare post-pneumonectomy complication and may occur not only in the early postoperative period but also at a later stage after surgery. A late (more than 1–2 weeks after surgery) shift of the mediastinum towards the opposite lung after pneumonectomy may produce compression of mediastinal structures and airway compromise, leading to dyspnea on minimal exertion and low cardiac output. If the mediastinum has not yet been stabilized, decompression of the post-pneumonectomy cavity may be sufficient to relieve the symptoms. Therefore, early diagnosis and management are essential.

### Patient Descriptions

Six patients with a shift of the mediastinum towards the remaining lung after pneumonectomy were treated in our department between 1998 and 2004 (these patients comprised 6.5% of the 92 pneumonectomies performed during this period). There were four males and two females, with a mean age at pneumonectomy of 67.2 (range 54–80 years). The reasons for pneumonectomy were non-small cell lung carcinoma in five cases and atypical carcinoid in one.

After pneumonectomy a 32 French size trocar catheter (Tyco Healthcare UK Ltd, Gosport, UK) chest tube connected to a high capacity chest drainage system (Thorametrix, Biometrix, Jerusalem, Israel) was inserted in all the patients and removed 24 hours later. The position of the mediastinum was controlled by daily chest X-rays. At the time of patient discharge, 5–7 days following surgery, the mediasti-

num was in the midline with air filling the post-pneumonectomy cavity.

The six patients complained of disabling dyspnea and onset weakness 1 to 2 weeks after surgery. They all underwent extensive evaluation to rule out other causes of dyspnea, such as pulmonary hypertension, pulmonary edema, air leak, chronic obstructive pulmonary disease exacerbation, pneumonia and myocardial infarction. The tests included physical examination, chest X-rays, electrocardiographic monitoring, blood gas analyses, a central venous catheter, a Foley catheter, an arterial line and a bedside echocardiogram. All six patients received 100% oxygen through a face mask and were hemodynamically stabilized by fluids or blood products as needed. They were fully monitored and continuously evaluated by means of blood saturation analyses and thermometer measurements. Chest X-rays showed complete or nearly complete opacification of the post-pneumonectomy cavity and a shift of the mediastinum towards the remaining lung. Blood gas analyses revealed low partial pressure of oxygen in blood content (ranging from 55 to 68), ECG monitoring showed sinus tachycardia (> 100 beats/min), urinary output was reduced (< 30 ml/hour), and central venous pressure was elevated (> 12–14 mmHg). Trans-thoracic echocardiography ruled out pulmonary hypertension or cardiac dysfunction as causes of the dyspnea. Due to the absence of other possible causes, the shift of the mediastinum was suspected to be the cause of the symptoms.

A chest tube was inserted into the post-pneumonectomy cavity under local anesthesia with 30–40 ml of 1% lidocaine. The maximum volume of pleural fluid

removed was 1300 ml (mean 900 ml). Clinical improvement was immediate upon chest tube insertion, and a reshift of the mediastinum towards the empty cavity was confirmed by repeat chest X-ray.

The patients stabilized over the next 24 hours with an increase in urine output, an elevated level of pO<sub>2</sub> (ranging from 62 to 78), elevated blood pressure, and a reduction in heart rate and central venous pressure. The monitors were disconnected and the patients were discharged home in good health 48 hours after chest tube removal. Follow-up did not reveal any abnormalities during the ensuing 12 months.

### Comment

Pneumonectomy continues to be associated with high rates of morbidity and mortality (7–11%) [1]. Following complete pneumonectomy, the pleural space is reduced due to increased expansion of the remaining lung and a shift of the mediastinum and diaphragm towards the newly created space. The fluid that fills the space increases until the postoperative pneumothorax is obliterated, a process that takes 2 weeks on average, at which time the mediastinum is stabilized in the midline of the chest cavity [2].

Proper positioning of the mediastinum is critical in the immediate postoperative period and is usually achieved by indwelling thoracic catheters or needle aspiration of air (thoracentesis) from the empty chest cavity. Improper positioning of the mediastinum may contribute to a shift of the mediastinum towards the contralateral side following post-pneumonectomy, resulting in many devastating complications,

pO<sub>2</sub> = partial pressure of oxygen in the blood

such as arrhythmias, pulmonary edema, or sudden death. Conversely, accumulated fluid or retained air in the empty space shifts the mediastinum towards the remaining lung with compromise of pulmonary function and severe cardio-respiratory failure. Early post-pneumonectomy complications, induced by deviation of the mediastinum towards the remaining lung, significantly increase postoperative morbidity and mortality in the first days after surgery and may be controlled by various methods [2,3].

Late complications of pneumonectomy induced by a shift and rotation of the mediastinum towards the post-pneumonectomy side have also been described (post-pneumonectomy syndrome) [4], but the late (> 1–2 weeks) shift of the mediastinum towards the remaining lung and symptoms induced by this shift have not yet been completely reviewed. Improper positioning of the mediastinum 1–2 weeks after surgery could be due to any of the follow-

ing factors: inadequate management of the post-pneumonectomy pleural space after surgery, hemorrhage, new-onset broncho-pleural fistula, and microscopic pleural metastasis that may not have been seen during surgery [5] and can be the cause of a massive early pleural effusion.

Mediastinal shift should be suspected in patients presenting with dyspnea one or more weeks after pneumonectomy. We consider the timing of the diagnosis – a late shift of the mediastinum towards the remaining lung – to be critical in the management of these patients because of the respiratory and possible cardiac compromises that could jeopardize their lives, as seen in the six cases treated in our department. In addition, mediastinal repositioning in the relatively late postoperative period is very difficult. Chest tube insertion provides symptomatic relief and clinical improvement, but simple thoracotomy may also be helpful in the initial management.

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