Management of Chest Drains After Thoracic Resections

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KEYWORDS

• Pleura • Pleural fluid • Chest drain • Pulmonary resection • Postoperative course

KEY POINTS

- Immediately after lung resection, air tends to collect in the retrosternal part of the chest wall (in supine position), and fluids in its lower part (costodiaphragmatic sinus).
- Several general thoracic surgery textbooks currently recommend the placement of 2 chest tubes after major pulmonary resections, one anteriorly, to remove air, and another into the posterior and basilar region, to drain fluids.
- Recently, several authors advocated the placement of a single chest tube. In terms of air and fluid drainage, this technique demonstrated to be as effective as the conventional one after wedge resection or uncomplicated lobectomy.
- A single chest tube is less painful than 2 and, therefore, patients are able to perform postoperative respiratory physiotherapy adequately; this reflects on a better lung expansion, decreasing the risk of possible respiratory complications.

PLEURAL PHYSIOLOGY PILLS

The pleural space is a perfect biological system capable of accomplishing at least 2 fundamental functions: (1) to maintain the lung perfectly expanded in the chest, and (2) to preserve a perfect sliding between visceral and parietal pleura, with a very low coefficient of friction. Pleural fluid is kept in a subatmospheric range, which results by balancing its filtration and drainage.[1]

From an anatomic point of view, the pleural space is delimited by the visceral pleura, which wraps the entire lung and the fissures, and the parietal one, which covers the rib cage along with the diaphragmatic surface. Also, the parietal pleura is rich in lymphatics, that directly opens on the mesothelial surface trough the lymphatic stomata.[2,3] On the other hand, visceral pleura's lymphatics do not connect directly with the pleural space and therefore are not involved in the drainage of the pleural fluid.

The pleural fluid is hypo-oncotic (~1 g/dL protein),[4] explaining the low permeability of the parietal pleura to water and proteins. The overall pleural fluid turnover is estimated to be ~0.15 mL/kg/h.[4] In physiologic conditions, the pleural liquid pressure (P_{liq}) is more subatmospheric, while increasing the height in the pleural cavity, being about 0 at the bottom and ~10 cm H_2O at the midheart level. The role of pleural lymphatics is therefore paramount to (1) set a P_{liq} capable to maintain lung and chest wall together; (2) act as a regulator of pleural fluid volume, balancing its drainage and filtration. Whenever the lymphatic drainage becomes inefficient, pleural

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fluid starts to accumulate in the pleural cavity, determining lung collapse.

As a consequence of pulmonary resections, the mechanical and pleural characteristics alter, even after the chest closure. The immediate problem after a thoracic operation is the correct evacuation of air from the cavity, accumulated as a consequence of the surgical maneuvers. Furthermore, a smaller lung must fill up the pleural cavity, which previously hosted a larger one: the compliance of the remaining part of the lung parenchyma appears to be decreased, correlated to the amount of the resected lung as well as to the intrinsic lung tissue characteristics. The remaining lung re-expansion requires a considerable lower subatmospheric P_{liq} along with a deformation of its natural shape. Furthermore, removing air from the chest wall results in the overdistension of unresected lung alveoli, which may favor persistent air leak and may be the cause of possible pulmonary edema.[5] A severe perturbation of the lung-water balance is also a major cause of developing other postresectional complications, such as atelectasis, acute lung injury, and acute respiratory distress syndrome.[6,7]

Immediately after lung resection, air tends to collect in the retrosternal part of the chest wall (in supine position), whereas fluids are located in its lower part (costodiaphragmatic sinus).[8,9] This condition explains why some surgeons use 2 drains after pulmonary resections, whereas some others prefer a single chest tube, to drain both air and fluids.

Air and fluid drainage may be increased by the use of an active suction, but the most innovative technique in chest drainage management is the adoption of a "controlled drainage," capable of avoiding an immediate lung overdistension, which may represent one of the major causes of postoperative development of complications.

NUMBER, TYPE, AND SIZE OF CHEST TUBES

Management of chest tubes after lung resection is still determined by the surgeons' habit and personal experience rather than valid scientific evidence. Moreover, chest tube duration is one of the most important factors influencing the overall hospital length of stay, hospitalization costs, as well as morbidity in general. Many textbooks recommend that, after a lobectomy, the pleural space should be drained by 2 chest tubes placed at the end of the surgical procedure: one in the anterior region, to remove air, and another in the posterior and basilar region, to drain fluids[10] (Fig. 1). Furthermore, according to a recent survey of thoracic surgery practice in the United Kingdom, more than 90% of thoracic surgeons leave 2 drains after both anatomic and nonanatomic lung resections.[11]

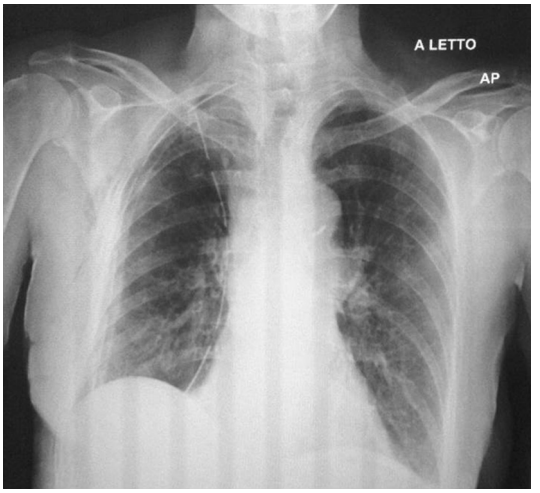

Fig. 1. Day 1 postoperative chest radiograph after right upper sleeve lobectomy: 2 chest drains (one anterior, another posterior) have been placed at the end of the intervention. The lung is correctly re-expanded.

An inadequate residual lung re-expansion (Fig. 2) may also result in possible severe complications, such as atelectasis, hemothorax, or persistent air leak. From the mere physics point of view, the chest drain's effectiveness mostly depends on its diameter, and therefore, a large-bore chest tube (24 Fr–32 Fr) is advocated. However, small-bore drains have been recently used for the drainage of spontaneous pneumothorax or malignant pleural effusions,[12,13] but actually, to date, no scientific evidence related to their

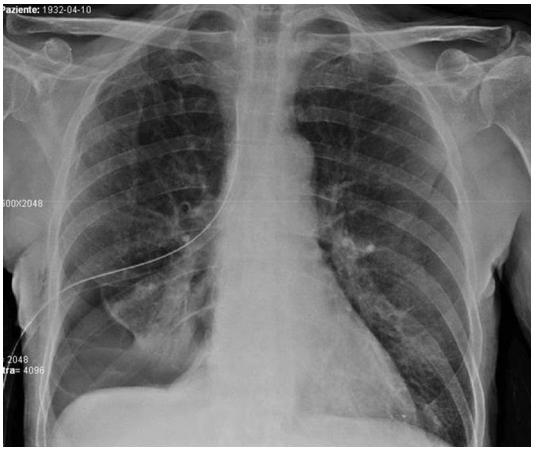

Fig. 2. Inadequate residual lung re-expansion after right lower lobectomy.