THE MANAGEMENT OF CHEST TUBES AFTER PULMONARY RESECTION

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FREQUENTLY ASKED QUESTIONS ABOUT CHEST TUBES

- Are they always necessary for every lung resection?
- How many chest tubes?
- Suction or no suction?
- Milking or not?
- Electronic or conventional drainage system?
- Why is important to remove them ASAP?
- Timing of chest tube removal?
- Most appropriate technique of chest drain removal?
- Management in prolonged air leak?
The Society for Translational Medicine: clinical practice guidelines for the postoperative management of chest tube for patients undergoing lobectomy.

J Thorac Dis 2017;9(9):3255-3264
ARE CHEST TUBES ALWAYS NECESSARY FOR EVERY LUNG RESECTION?

It is safe and feasible to omit the chest tube postoperatively for selected patients receiving thoracoscopic pulmonary resection: a meta-analysis.

Patients without chest tube were found to have:

- similar 30-day morbidity.
- shorter postoperative length of stay.
- less pain postoperatively.
- patients should be carefully selected to meet specific criteria:
  - The absence of air leaks during an intraoperative sealing test,
  - the absence of bullous or emphysematous changes in the lung,
  - the absence of dense pleural adhesions

Pengfei Li, et al, J Thorac Dis 2018;10(5):2712-2721
Is it safe not to drain the pneumonectomy space (PPS)?

Karim Morcos, Kasra Shaikhrezai and Alan J.B. Kirk

- The rate of post-pneumonectomy complications that might be prevented or monitored by pneumonectomy space drainage is very low.
- Omit chest tube reduces the risk of infection as well as other chest drain related complications.
- There is no consensus on the PPS drainage
- The strategy of pneumonectomy space management is fundamentally driven by the pros and cons of drainage versus no drainage in individual patients.
- For instance, a patient on antiplatelet therapy with a high risk of postoperative bleeding is a favourable candidate for drain insertion at the conclusion of pneumonectomy
HOW MANY CHEST TUBES SHOULD BE INSERTED?

- 1 for lobectomy
- 2 for bilobectomy,

Unless if we have a major intraoperative bleeding...or space problem insert 2.

Recommendation

- One chest tube is adequate following pulmonary lobectomy (2A).

*J Thorac Dis 2017;9(9):3255-3264*
Suction or not suction (water seal)?

- Suction improves apposition of the visceral pleura to the parietal pleura.
- By the other hand suction can maintain the airflow through an alveolar pleural fistula.
SUGGESTIONS FOR ROUTINE POSTOPERATIVE CHEST TUBE SUCTION MANAGEMENT

- In patients with severe emphysema (forced expiratory volume in 1 second <40% predicted; patients undergoing lung volume reduction surgery), the traditional algorithm of -20 cm of suction until cessation of air leak is likely counterproductive. “Straight” water seal is likely optimal in these patients, and when suction is necessary, the minimum amount of suction that achieves the desired effect should be used. (Level of evidence C)

- In patients without severe emphysema, either “reduced suction” and “early water seal” algorithms or the traditional -20 cm suction are reasonable. Early water seal and reduced suction algorithms likely reduce the duration of air leak, but they may increase complications if the patients are not carefully monitored. As in previously listed item, any early water seal strategy must require that a chest roentgenogram be performed after placement to water seal in the setting of an ongoing air leak. (Level of evidence B)

- Water seal is not indicated in patients who have a large air leak (>4/7) or more than a small pneumothorax (25% or 8 cm) associated with air leak. (Level of evidence B)

- Water seal strategies are not indicated in patients who have moderate to severe restrictive lung disease or those in whom there is more than the usual low risk of postoperative bleeding. (Level of evidence C)

### Randomized, Prospective Trials Evaluating “Water Seal” Algorithms

<table>
<thead>
<tr>
<th>Author [Ref No.]</th>
<th>Algorithm Evaluated</th>
<th>No. of Patients</th>
<th>Resections Included</th>
<th>CXRs Obtained to R/O PTX</th>
<th>Benefit to “Water Seal”</th>
<th>Significant Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerfolio and colleagues</td>
<td>Water seal on POD 2 after ≤20 cm</td>
<td>33</td>
<td>Lobectomy and sublobar</td>
<td>Yes</td>
<td>Yes</td>
<td>Greater air leak sealing by POD 3</td>
</tr>
<tr>
<td>Marshall and colleagues</td>
<td>Water seal after ≤20 cm only while in OR</td>
<td>68</td>
<td>Lobectomy and sublobar</td>
<td>Yes</td>
<td>Yes</td>
<td>Reduced air leak duration</td>
</tr>
<tr>
<td>Brunelli and colleagues</td>
<td>Water seal on POD 1 after ≤20 cm</td>
<td>145</td>
<td>Lobectomy</td>
<td>No</td>
<td>No</td>
<td>Do not recommend water seal because trend to increased complications</td>
</tr>
<tr>
<td>Brunelli and colleagues</td>
<td>Alternating –10 cm (night) and water seal (day) on POD 1 versus full-time water seal after ≤10 cm</td>
<td>94</td>
<td>Lobectomy</td>
<td>No</td>
<td>Yes (to alternating suction/water seal)</td>
<td>Shorter tube duration, LOS, less PALs versus full-time water seal</td>
</tr>
<tr>
<td>Alphonso and colleagues</td>
<td>Immediate water seal</td>
<td>239</td>
<td>Lobectomy and sublobar</td>
<td>No</td>
<td>Yes</td>
<td>Recommend water seal because no differences found and water seal promotes mobilization</td>
</tr>
</tbody>
</table>

CXR = chest roentgenograms; LOS = length of stay; OR = operating room; PAL = prolonged air leaks; POD = postoperative day; PTX = pneumothorax; R/O = rule out.
Recommendations *J Thorac Dis* 2017;9(9):3255-3264

- Routine chest tube suction offers no advantage for patients undergoing lobectomy, and may only be indicated in case of progressive subcutaneous emphysema (2A).

- Regulated seal is as effective as regulated suction (−11 to −20 cmH2O, depending on the type of lobectomy) when an electronic drainage system to maintain preset intrathoracic pressure is used after lobectomy by thoracotomy (2B).
**Recommendation**

- Chest tube clearance by milking and stripping offers no advantages in patients after lobectomy (2B).

ELECTRONIC OR CONVENTIONAL DRAINAGE SYSTEM?

- Digital chest drainage is better than traditional chest drainage following pulmonary surgery: a meta-analysis.

Digital chest drainage reduced:
- the duration of chest tube placement
- length of hospital stay
- air leak duration
- and postoperative cost.
- However, the effect differences between the 2 groups were not significant for the duration of a prolonged air leak and the percentage of patients discharged home on a device.

Electronic drainage systems
- provides more accurate information about air leak.
- Reduce chest drain duration.
- Reduce chest drain reinsertion.
- Reduce length of hospital stay.

Recommendation
- Electronic drainage systems are recommended in the management of chest tube in patients undergoing elective lobectomy, as it helps reducing the clinical variability of its management (1B)
WRIGHT TIMING TO REMOVE CHEST DRAINS

- When daily pleural fluid is <450ml and is non hematic and non chylous
- When there is no air leak monitoring for the last 12-24h

**Recommendations**

- Chest tubes can be removed safely with daily pleural fluid of up to 450 (non-hematic, non-chylous), which may reduce chest tube duration and hospital length of stay (2B).
- Use of **pleural fluid-to-blood protein ratio** PrRP/B <0.5 to determine removal of chest tube might be beneficial (2B).

*J Thorac Dis 2017;9(9):3255-3264*
WHY IS IMPORTANT TO REMOVE CHEST TUBES ASAP?

Early chest drain removal:
- Reduces postoperative pain.
- Improves postoperative ventilatory function.

Comparison of pre- and post removal pain and FEV1

<table>
<thead>
<tr>
<th>Variables</th>
<th>Pre-removal</th>
<th>Post-removal</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static pain</td>
<td>2.6 (2)</td>
<td>1.5 (1.5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Dynamic pain</td>
<td>4.1 (2.1)</td>
<td>2.4 (1.9)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>FEV1 (l/s)</td>
<td>1.5 (0.8)</td>
<td>1.7 (0.9)</td>
<td>0.0004</td>
</tr>
<tr>
<td>FEV1%</td>
<td>53 (24.7)</td>
<td>60.2 (30.8)</td>
<td>0.0004</td>
</tr>
</tbody>
</table>

MOST APPROPRIATE TECHNIQUE OF CHEST DRAIN REMOVAL?

- On full inspiration? (intrathoracic pressure -8 cmH₂O) or
- On full expiration? (intrathoracic pressure 0 cmH₂O)

**Recommendation**

- There is no clear evidence indicating when during the respiratory cycle the chest tube should be removed (2A).

*J Thorac Dis 2017;9(9):3255-3264*
**PROLONGED AIR LEAK (PAL)**

- **Definition:** air leak for >5 days. Bubbles in a chest drainage system, progressive subcutaneous emphysema, or expanding pneumothorax.
- **Occurring in approximately 10 to 15% of patients after lobectomy.**

**Clinical entities**

- Alveolar air leak (peripheral lesion)
- Bronchopleural fistula (from bronchial structures)
- Early bronchoscopy
GRADES OF AIR LEAK

grade 1: forced expiratory only
grade 2: expiratory only
grade 3: inspiratory only
grade 4: continuous

CONSEQUENCES OF PROLONGED AIR LEAK

- prolonged chest tube drainage causes prolonged pain
- restricted ventilation leads to increased risk of pneumonia
- decreased mobility through chest tubes and related pain
- decreased mobility results in increased risk of thromboembolism
- necessity of pleurodesis, mechanical ventilation, and reoperation
- higher readmission rate to intensive care units • prolonged hospital stay and related higher
- overall costs
PATHOPHYSIOLOGICAL MECHANISM OF POST-LOBECTOMY AIR LEAKS.

AARON R. CASHA, ET ALL, J THORAC DIS 2018;10(6):3689-3700

Pleural stress showing an eighty-fold variation in pleural stress that is maximal towards the apex and within the furrows produced by the first rib and lowest at the base.

Diagram indicating the location of high and low pleural stress zones in the lung and how these are related to the degree of air leak post lobectomy. Diagram of lung adapted from.
Because the vast majority of prolonged alveolar air leaks will resolve in time with tube drainage alone, a trial of a few weeks of watchful waiting is a reasonable option in patients with no more than a small, stable, asymptomatic pneumothorax on water seal. (Level of evidence B)

Watchful waiting can be conducted in most cases in an outpatient setting with a Heimlich valve (or other portable, valved, one way egress device). Close follow-up is an important part of this approach; office visits should be carried out at least weekly. (Level of evidence B)

An oral antibiotic covering skin flora may be appropriate when discharging a patient with a Heimlich valve, particularly if there is a residual space present. (Level of evidence C)

It is reasonable, in patients with an “air leak” beyond 10 days postoperatively that is present on cough but not during normal tidal breathing, to clamp the tube for several hours and remove it if no increasing pneumothorax or progressive subcutaneous air develops (“provocative clamping”). (Level of evidence B)

In patients with prolonged air leaks that persist beyond a several-week waiting period, it is reasonable to attempt pleurodesis, either with autologous blood patch or chemical agent. (Levels of evidence B, C)

In patients with prolonged air leaks that persist after a several-week waiting period and have not responded to nonsurgical measures, reoperation is generally required. Either thoracoscopy or thoracotomy is reasonable, and multiple methods of closing the site of leak and creating pleurodesis have been described and are reasonable. (Level of evidence C)
THANK YOU