



# Lung decortication for pleural empyema

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**Abstract:** In this chapter we give an overview of the pathogenesis of empyema, explore the different stages and the different treatments available. An in-depth description of the surgical technique is also provided.

**Keywords:** Empyema; decortication; thoracotomy

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## Empyema definition, etiology, pathogenesis

Thoracic empyema is an accumulation of infected fluid within the pleural space. The most common cause in the western world is parapneumonic followed by complications of surgery. Patients with advanced age, multiple comorbidities such as chronic obstructive pulmonary disease (COPD), diabetes and immunodeficiency are more likely to develop empyemas.

Empyemas are classified in three evolving stages:

- (I) Exudative: accumulation of sterile fluid into the pleural space as the result of the initial inflammatory process, usually during the first week;
- (II) Fibrinopurulent: the fluid tends to be colonized by bacteria migrating from the lung parenchyma;
- (III) Organized: if the fluid is not evacuated at this stage, the activation of fibroblasts produces a thick cortex over the surface of the lung. Whilst this process has a role in limiting the spread of the infection, on the other hand restricts lung expansion.

Pleural aspiration, often under ultrasound guidance to assess the presence of locations and drain pockets of fluid, is mandatory in the management of empyemas. The gold standard to assess the need for open surgical intervention remains CT scan of the chest. The thickness of the cortex is often a reliable sign that the patient will require an open procedure.

## Empyema treatment by stages

The treatment of empyemas varies according to the stages, but the main goal is twofold: (I) drainage of the fluid; (II) re-expansion of the lung.

In our experience and according to the most up to date guidelines, medical treatment with culture-targeted antibiotics is effective in stage one. In stage two we opt for uniportal video-assisted thoracoscopic surgery and finally we reserve open decortication to the more advanced cases.

Decortication is a surgical procedure aimed to remove a restrictive layer of fibrous membrane overlying the lung parenchyma, diaphragm, and chest wall. The ultimate goal is to allow parenchymal re-expansion. Most patients present to surgeons with fibrothorax, which is a production of fibrous tissue that pulls the ribs together and inhibits the re-expansion of the lung.

In order for a patient to be candidate for open surgery it is expected for him to have evidence of trapped lung that failed to respond to medical treatment and is not amenable of minimally invasive intervention. We do not believe there are absolute contraindications to surgery as the infective process is not going to resolve on his own. Ideally the patients should be medically optimized and then operated on promptly. It is surprising how very sick patients recover very rapidly once the infective process is resolved and adequate support (especially nutritional) is instituted.

Of course the patient must be able to tolerate single lung ventilation, therefore large bilateral lung consolidations precludes immediate surgery.

In our experience, in the presence of thick cortex on CT scan, we prefer an open approach to adequately clear the pleural space and expand the lung. We start with a posterolateral thoracotomy and the chest is entered in the bed of the sixth rib. This is because, almost always, the largest amount of adhesions and cortex is at the bottom. In cases of severe loss of volume in the hemithorax due to rib crowding, we remove a segment of the sixth rib. This avoids to force open the ribs avoiding traumatic fractures. If the cortex is particularly thick, we dissect extra-pleurally for about 2–3 cm cranially and caudally in order to insert the branches of the spreader without tearing the underlying lung. Particular care must be paid, at the beginning of the operation, to identify correctly the different layers. Sometime it is easy to get confused and start stripping entirely the parietal pleura with potential for iatrogenic injuries to the surrounding structures or bleeding from small peri-spinal veins. We recommend to start the dissection with the lung inflated. Such approach allows easier visualisation of the anatomical planes. It is important to dissect on top of the lung and inside the parietal pleura. To identify the lung we incise the cortex with a number 11 blade until the lung start to become evident. At that point we use sharp dissection to define the correct plane. Most of the dissection is done with the lung inflated with a combination of sharp and blunt dissection. We recommend to swipe along the lung horizontally, rather than pushing the lung down. In this way it is easier to avoid injuring the lung. We also strongly recommend to identify the fissures. The reader as to image each lobe like a cubical structure in three-dimension. If the cube (lobe) is expanded only on one side it is impossible for the lung to fill the space. If accidental injury of the lung occurs, then we recommend to choose a different spot and start again. Usually it is easier to identify the plane toward the upper part of the lung (the least affected part) then move caudally. It is also suggested to remove partially the parietal pleura to avoid a restrictive movement of the chest. We routinely leave an area of 4–5 cm just above the spine to insert a paravertebral catheter for analgesia. One or two drains are inserted and the chest closed in routine fashion. If we remove a segment of the rib, we bring together the intercostal muscles to avoid surgical emphysema. If there is a bothersome air leak with loss of capnography, the patient should not be closed and further manoeuvres must be done to reduce it, otherwise the patient will lose all the tidal volume down the drain and it won't be

possible to ventilate him.

### Tips and tricks

- ❖ Start the dissection from the least involve part of the lung, usually that is the top. It is possible to appreciate, in most of the cases, a transition area between relatively normal lung and the cortex. That is a useful area to gauge the depth of the cortex and to avoid to get too deep into the lung.
- ❖ Resist the temptation to rip everything apart with fingers. The only result you will achieve for sure is to cause a lot of bleeding and damage to the lung.
- ❖ Reassess anatomy continuously. The biggest mistake is to confuse the parietal pleura for the cortex and land into the oesophagus or rip small vessels perispinally or, worse, the hemiazygos vein. If that last eventuality occurs, the best way to control the bleeding is to push a sponge stick on the bleeding point and isolate the vessel proximally and distally. Do not try to repair the vessel directly as it is likely to tear more.
- ❖ Pay attention to always be intrapleurally at the top as there is a risk of damaging the subclavian vessels.
- ❖ Small patients, especially if emaciated because of chronic infection, might have a very thin diaphragm. That could be much thinner than the cortex. Pay attention to that to avoid entering into the abdomen. The best way to prevent this is to follow the contour of the lung with the lung inflated.
- ❖ If a lung abscess is encountered, then it should be drained and the raw area potentially treated with capitonage.
- ❖ Be careful of the oesophagus. A good trick is to insert a large nasogastric tube to guide digital exploration of the area.
- ❖ Always re-expand all lobes removing the cortex. In very rare occasions, the underlying lung is so fragile that it is impossible to remove the cortex without significant iatrogenic injury. In that case a good re-expansion can be achieved by incising the cortex with a number 11 blade in a criss-cross fashion.
- ❖ Always perform a bronchoscopy before and after surgery. Before to avoid surgery problems with lung expansion during surgery and poor oxygenation due to mucous plugs. Moreover, occasionally, empyema and pneumonia can be caused by inhaled foreign-bodies. Preoperative bronchoscopy is a great way to ensure that is not the case and to retrieve them in case. The authors removed pills, vegetables and buttons from the airways. The presence of foreign body can be suspected in case

of a prevalent lobar distribution of the pneumonic process. Endobronchial cancer can also cause empyema.

- ❖ Immediately after surgery to remove any phlegm in order to give the patients the best chances of keeping the lung expanded without the need for positive pressure ventilation.
- ❖ Analgesia is essential. There is no reason not to insert a paravertebral catheter in these patients for the fear of infection.
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