

## Peer Review File

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### Review Comments

#### Reviewer A

Thank you for the chance of reviewing this interesting narrative review article regarding chest wall reconstruction after open window thoracotomy. Because this review is well written and summarize the literatures, it will be instructive for thoracic surgeons.

**Comment 1:** Empyema is generally divided into two groups: empyema with or without bronchopleural fistula. It would be better if the authors could concisely mention the treatment of empyema with fistula, how to close the fistula.

**Reply 1:** Thank you for your feedback. We have modified our text as advised, by including the definition of a bronchopleural fistula in the introduction. Furthermore, a concise overview of options of how to close a fistula has been included.

**Changes in the text:** The following text was added to the introduction: '*Empyema may also occur in association with bronchopleural fistula. The morbidity associated with bronchopleural fistula varies between 25% and 71%. Treatment often involves primary closure with the use of flaps. Additionally, the use of airway stents, coils and fibrin glue have been described (8-10).*' (page 3, lines 63-67).

#### Reviewer B

**Comment 2:** I think that it is not so appropriate to use free flap for the reconstructive surgery of the thoracic empyema. Thoracoplasty may be put together for the reconstruction after OWT for the treatment of the thoracic empyema, but how is your knowledge about it?

**Reply 2:** As mentioned in this review, pedicled and free flaps can be used as a last option for soft tissue reconstruction after thoracic empyema has subsided; not so much for treating thoracic empyema itself. However, it may be applied where there is concomitant bronchopleural fistula. Furthermore, we concur with the observation that thoracoplasty could be considered as a treatment option for thoracic empyema.

Nevertheless, it is important to note that this review was specifically focused on providing an overview of soft tissue reconstruction options after the resolution of thoracic empyema. Therefore, delving further into the treatment of thoracic empyema fell beyond the scope of this review, especially considering its perspective from reconstructive plastic surgery.

**Changes in the text:** None.

#### Reviewer C

This review article focuses on open-window thoracotomy and chest wall closure surgery for empyema. The number of cases of empyema is increasing due to several reasons, such as the COVID-19 pandemic and emerging immunosuppressive treatment for autoimmune disease. Empyema is an old disease, but the etiology of empyema is not old. This review may be a good guide for surgeons considering surgical intervention for empyema.

**Comment 3:**

As the authors mentioned, the initial treatment for empyema is chest drainage and giving intrapleural fibrinolysis such as t-PA. Please add rationale (reference article) to this information.

**Reply 3:** The existing reference article by Redden et al. (2017) provides, among other things, insights into the application of intrapleural fibrinolytics in the treatment of pleural empyema. In addition, a new reference article by Cameron et al. (2008) is included, which focuses specifically on the use of fibrinolytics.

**Changes in the text:** The phrase '*such as tissue plasminogen activator (tPA)*' was added to provide an example and another reference was added to the text (page 3, line 60).

**Comment 4:** Another challenging issue of empyema is the existing fistula (broncho-pleural or pleuro-pleural), which often indicates surgery. Please add information on the management of empyema with fistula.

**Reply 4:** Thank you to the reviewer for their valuable comment. This comment was also brought up by Reviewer A, and as a result, we have now included the definition of a bronchopleural fistula and its treatment in the introduction section.

**Changes in the text:** The following text was added to the introduction: '*Empyema may also occur in association with bronchopleural fistula. The morbidity associated with bronchopleural fistula varies between 25% and 71%. Treatment often involves primary closure with the use of flaps. Additionally, the use of airway stents, coils and fibrin glue have been described (8-10).*' (page 3, lines 63-67).

**Comment 5:** I agree with the authors that combining negative pressure wound therapy is another option. Related to the above question, the following reference may be additional information for authors; Management of thoracic empyema with bronchopulmonary fistula in combination with negative-pressure wound therapy. Gen Thorac Cardiovasc Surg. 2021 May;69(5):843-849. doi: 10.1007/s11748-020-01554-5.

**Reply 5:** We are grateful to the reviewer for bringing this article to our attention. It appears that our search did not yield this article, presumably due to the focus on reconstruction using pedicled and free flaps rather than specifically searching for VAC-

therapy. Since our search resulted in some relevant articles on VAC-therapy, we decided to add a table on VAC-therapy as well. As the information in the article mentioned by the reviewer is valuable, we have added it through hand-search.

**Changes in the text:** The abovementioned article is included in *Table 5*, as well as in the accompanying text (page 13, lines 291-296). Furthermore, the total number of included articles has been changed from 20 to 21 in the *Methods* section (page 6, line 129).

**Comment 6:** Results section is the essential part of this article, and the tables summarize the several procedures. For readers, please add the representative figure of each surgical procedure (several kinds of flaps) for each section, pedicled flaps, and free flaps.

**Reply 6:** We understand the reviewer's request. However, we currently do not have the resources to generate any figures, nor do we possess any visual material of the procedures described in the manuscript. This because the procedures are not commonly performed in the centers where the authors are affiliated (Maastricht University Medical Center+ and Zuyderland Medical Center).

**Changes in the text:** Not applicable.

#### **Reviewer D**

Thank you for allowing me to review this exciting and challenging theme, "Chest wall reconstruction after the Clagett procedure and other types of open window thoracostomy."

The authors reviewed the closure method after empyema treatment, including pedicled flaps, free flaps, and the application of a vacuum-assisted closure device.

**Comment 7:** After reading the manuscript, I wondered if I had still not reached the best solution for chest wall reconstruction after empyema treatment. This etiology is based on case-specific, and each method selection is highly biased in previous articles. The authors showed the flowchart for the reconstruction method, which was not practical in the actual patient in front of the surgeon since the situation, including cavity location, patient nutrition, history of the previous operation, or other circumstances strongly restrict the technique.

**Reply 7:** We agree with the reviewer's observation that the flowchart does not take into account the patient's specific situation. However, to our opinion, incorporating such details would make the flowchart overly extensive. The present flowchart was only intended to give a clear overview of the different options for soft tissue reconstruction based on the status of the thoracostomy. It is also important to mention that the flowchart is based on the plastic surgeon's expert opinion.

**Changes in the text:** None.

**Comment 8:** The original Clagett procedure was the treatment for post-pneumonectomy empyema. Post-lobectomy empyema seemed similar, but the severity and difficulty of treatment were quite different. That's why the original Clagett procedure was modified to apply the post-lobectomy empyema that remained lung as a shock-absorbing material.

Especially, VAC application after pneumonectomy is challenging. The description of the VAC treatment option and cavity information must be indicated to avoid the dangerous application of VAC by misleading readers.

**Reply 8:** Thank you for your attentive comment. We fully concur with the reviewer's suggestion to include information about VAC therapy, including its indications and the importance of exercising caution in certain cases. Therefore we have modified the text as advised, by adding a general explanation of VAC therapy, along with potential disadvantages.

**Changes in the text:** The following general explanation of VAC therapy was added to the section 'vacuum-assisted treatment options': *'Vacuum-assisted negative pressure wound therapy (VANPWT), also known as vacuum-assisted closure therapy, is a technique to facilitate wound healing and reduce the need for extensive reconstruction. The foam dressings are generally changed every three to four days.'* (page 13, lines 287-290)

Furthermore, at the end of the section the following text was adjusted and added on possible disadvantages: *'However, the time to recovery might be longer and it is questionable which option is more cost-effective. On the other hand, using VANPWT as an adjunct therapy might shorten the overall treatment duration. Nonetheless, the use of VANPWT is contraindicated in patients with prolonged and/or severe infection (40-43). However, severe infection could be mediated via irrigation treatment as proposed by Morodomi et al. (41).*

*Possible disadvantages of VANPWT include pain syndrome and sponge adherence to the cavity. The risk of hemodynamic complications, bleeding and injury of mediastinal structures can be minimized by applying low negative pressure (up to 125 mm Hg) and ensuring viable lung parenchyma serves as a buffer, as is often the case in post-lobectomy empyema (44). The suitability of VANPWT should be evaluated on a case-by-case basis.'* (page 14, lines 310-320)

**Comment 9 :** This article focuses on the chest wall reconstruction. Even though the chest wall defects after open window thoracotomy sometimes close spontaneously. It indeed depended on the wound condition and cavity formation, although sometimes

we experienced this unique healing observed after long-term watchful observation of patients. As a prerequisite, the description of spontaneous recovery, which does not require reconstruction, should be mentioned in the background. Thus in the abstract, the authors noted "reconstruction of the chest wall is generally challenging" that seemed "sometimes challenging."

**Reply 9:** We agree with the reviewer, for this reason this has been clarified in the text.

**Changes in the text:** In the abstract, the word '*generally*' has been replaced by '*sometimes*' (page 2, line 27).

In the introduction, it has been added that it is possible that the wound closes spontaneously after open-window thoracostomy (page 4, line 87-90).

### **Reviewer E**

**Comment 10:** The first branch in the flow chart in Figure 1 should be the presence or absence of bronchopleural fistula. If the choice of reconstruction method is then discussed on that basis, this paper will be even more meaningful.

**Reply 10:** We thank the reviewer for their remark. Treating bronchopleural fistula, if present, is indeed a crucial initial step. If required, this may involve the application of a muscle flap as well.

**Changes in the text:** The presence or absence of bronchopleural fistula has been incorporated into the flowchart shown in *Figure 1*, as well as some examples of options to treat bronchopleural fistula.

### **Reviewer F**

Thank you to the authors for this interesting paper.

I have some questions and comments.

**Comment 11:** Please describe the average and/or optimal length to when chest reconstructions are performed after the Claggett.

**Reply 11:** Thank you for your thorough review of our manuscript. There is no average or optimal length after which a reconstruction should be performed after a Claggett procedure. The patient and local status are most important. Is the empyema fully resolved? No recurrence without antibiotics? What is the nutritional status of the patient, life expectancy and so on.

**Changes in the text:** None.

**Comment 12:** Was there a difference between Claggett and Eloesser in terms of outcomes for chest wall reconstruction?

**Reply 12:** The majority of studies included in this review did not explicitly state the method used for open-window thoracostomy. They often referred to it simply as

‘fenestration’ or ‘open-window thoracostomy’, making it challenging to determine from these studies whether there are any differences in outcomes between the Clagett and Eloesser procedures. This is also shown in the tables, where the method is mainly listed as ‘open-window thoracostomy NOS (not otherwise specified)’.

Given that the Eloesser open-window thoracostomy is theoretically smaller than the Clagett open-window thoracostomy, one can speculate that the reconstruction of the Eloesser thoracostomy might be more manageable. However, the outcome primarily depends on the individual patient’s circumstances and condition, such as the size of the cavity, the size of the thoracic defect, the nutritional status, etcetera.

**Changes in the text:** None.

**Comment 13:** Can you comment more on the omental flap and any recent studies? It seems pretty outdated but wanted to see if there were any recent advances or studies?

**Reply 13:** Thank you for your comment. The use of the omental flap is already discussed quite extensively in the manuscript, where it is stated that it is the most commonly used pedicled flap in this review (page 7-8, lines 159-176).

When conducting a specific search on ‘omental flap’ in combination with ‘open-window thoracostomy’ in recent years, the results mainly consist of case reports rather than large-scale studies (see the references below). In recent years it seems to be applied more often for the closure of a bronchopleural fistula than for the reconstruction of the cavity afterwards. Given the scope of this review is soft tissue reconstruction of the thoracic wall, the use of the omental flap for closure of a bronchopleural fistula is not further discussed in the manuscript.

**Changes in the text:** None.

#### **References comment 13:**

1. Fukui, T., Matsukura, T., Wakatsuki, Y., & Yamawaki, S. (2019). Simple chest closure of open window thoracostomy for postpneumonectomy empyema: a case report. *Surgical Case Reports*, 5(1). <https://doi.org/10.1186/s40792-019-0612-y>
2. Ulasan, A., Benli, M. Y., Ekici, M. A., Sanli, M., & Isik, A. F. (2019). Omentum transposition as a solution for bronchopleural fistula and empyema. *Indian Journal of Surgery*, 82(1), 74–80. <https://doi.org/10.1007/s12262-019-02028-6>
3. Wali, A., & Bille, A. (2021). Complications of thoracic surgery: post-pneumonectomy bronchopleural fistula. *Shanghai chest*, 5, 3. <https://doi.org/10.21037/shc.2020.03.02>

**Comment 14:** What do the authors think of WvAC, do they actually help decrease time

to reconstruction? what are the benefits and risks of using it?

**Reply 14:** In response to feedback from Reviewer D, we have added additional information regarding the application of VAC-therapy, its potential benefits, disadvantages and associated risks. While it remains uncertain whether VAC therapy reduces time to reconstruction, it might reduce the need for extensive reconstruction.

**Changes in the text:** The following general explanation of VAC therapy was added to the section ‘vacuum-assisted treatment options’: *‘Vacuum-assisted negative pressure wound therapy (VANPWT), also known as vacuum-assisted closure therapy, is a technique to facilitate wound healing and reduce the need for extensive reconstruction. The foam dressings are generally changed every three to four days.’* (page 13, lines 287-290)

Furthermore, at the end of the section the following text was adjusted and added on possible disadvantages: *‘However, the time to recovery might be longer and it is questionable which option is more cost-effective. On the other hand, using VANPWT as an adjunct therapy might shorten the overall treatment duration. Nonetheless, the use of VANPWT is contraindicated in patients with prolonged and/or severe infection (40-43). However, severe infection could be mediated via irrigation treatment as proposed by Morodomi et al. (41).*

*Possible disadvantages of VANPWT include pain syndrome and sponge adherence to the cavity. The risk of hemodynamic complications, bleeding and injury of mediastinal structures can be minimized by applying low negative pressure (up to 125 mm Hg) and ensuring viable lung parenchyma serves as a buffer, as is often the case in post-lobectomy empyema (44). The suitability of VANPWT should be evaluated on a case-by-case basis.’* (page 14, lines 310-320)

### **Reviewer G**

Thank you for the opportunity to review this interesting paper.

**Comment 14:** I would like to suggest rewriting the introduction to focus more on the chronic empyema problem and less on the general concept of pleural infection.

**Reply 14:** The introduction has been revised and restructured to put more emphasis on chronic empyema. It has been explained in more detail when there is chronic empyema.

**Changes in the text:** Changes have been made to the introduction as advised (page 3, lines 53-63).

**Comment 15:** I also suggest, if possible, including figures exemplifying the types of reconstruction.

**Reply 15:** We understand the reviewer’s request. However, we currently do not have

the resources to generate any figures, nor do we possess any visual material of the procedures described in the manuscript. This because the procedures are not commonly performed in the centers where the authors are affiliated (Maastricht University Medical Center+ and Zuyderland Medical Center).

**Changes in the text:** Not applicable.

**Comment 16:** I get confused with the information on lines 275 e 276 that "review by Chen et al. (2011) the overall success rates are similar, with pedicled flaps reported at 73% and free flaps at 83-100%" so do you think that free flaps are better? If not, explain why.

**Reply 16:** Thank you for your feedback. To clarify, the authors' perspective on the success rates has been included.

**Changes in the text:** The following text has been added to the relevant paragraph: ).  
*'However, the success of the reconstruction is heavily contingent on the local status and general the patient's general condition. The studies reviewed in this paper collectively suggest that it is essential to evaluate each patient individually to determine the optimal approach based on a multitude of factors.'* (page 13, lines 277-280).

I have no further suggestions. Congratulations on the fine work.