

# Vertical musculocutaneous trapezius flap for the closure of postpneumonectomy empyema

*Colgajo musculocutáneo vertical de trapecio para cierre de empiema tras neumonectomía*

Mónica Francés-Monasterio<sup>1\*</sup>, Fernández-Palacios<sup>1</sup>, Orlando García-Duque<sup>1</sup>, Laura Cano-Contreras<sup>2</sup>, and Jorge Freixinet-Gilart<sup>2</sup>

<sup>1</sup>Department of Plastic and Reconstructive Surgery; <sup>2</sup>Department of Thoracic Surgery. Hospital Universitario de Gran Canaria Doctor Negrín, Las Palmas de Gran Canaria, Spain

## Abstract

**Objective:** The aim of the study was to present our experience with the vertical musculocutaneous trapezius (VMCT) flap and highlight its utility in the thoracic wall reconstruction in patients with bronchopleural fistula (BPF). **Materials and methods:** We present a five case series of patients with long-standing cavities and BPF. The VMCT flap was used, and a direct pathway into the defect was made through a separate posterior thoracotomy shortening the distance between the flap and the defect. **Results:** In 80% of the cases, the flap succeeded in solving the fistula and filling the defect, quality of life improved, and the need for oxygen decreased. **Conclusions:** Management of open window thoracostomy is challenging. Debridement, thoracoplasty, and flap coverage are the mainstream of their treatment, but these patients have scarce available muscle. The VMCT flap represents the major non-affected musculocutaneous unit in the thoracic area after lung surgery. Its dermal component offers a rigid matrix to form a seal over the bronchial stump. Its muscular component adds a good amount of vascularized tissue. No functional impairment has been described after its use.

**Keywords:** Bronchopleural fistula. Toracoplasty reconstruction. Trapezius flap.

## Resumen

**Objetivo:** Exponer nuestra experiencia con el colgajo vertical de trapecio y destacar su utilidad en la reconstrucción de la pared torácica en pacientes con fístulas broncopleurales. **Material y métodos:** Presentamos una serie de cinco pacientes con cavidades y fístulas broncopleurales de larga evolución. Utilizamos el colgajo musculocutáneo vertical de Trapecio, con un redireccionamiento del mismo a través de una ventana costal que permite acortar la distancia entre el colgajo y el defecto. **Resultados:** La fístula y el defecto fueron solucionados en el 80% de los casos. La calidad de vida mejoró y las necesidades de oxígeno disminuyeron. **Conclusiones:** El manejo de las toracotomías es un reto. El desbridamiento, toracoplastia y cobertura con colgajo son los pilares de su tratamiento, pero estos pacientes tienen escasa disponibilidad muscular. El colgajo musculocutáneo vertical de Trapecio representa la mayor unidad intacta musculocutánea en el tórax tras cirugía pulmonar. Su componente dérmico ofrece una matriz rígida para sellar el muñón bronquial, su componente muscular añade una gran cantidad de tejido vascularizado. No se han descrito déficits funcionales tras su uso.

**Palabras clave:** Fístula broncopleurale. Reconstrucción de toracoplastia. Colgajo trapecio.

### \*Correspondence:

Mónica Francés

E-mail: m.francesmon90@outlook.com

0009-7411/© 2022 Academia Mexicana de Cirugía. Published by Permanyer. This is an open access article under the terms of the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Date of reception: 10-04-2022

Date of acceptance: 29-07-2022

DOI: 10.24875/CIRU.22000210

Cir Cir. 2023;91(5):615-619

Contents available at PubMed

[www.cirugiaycirujanos.com](http://www.cirugiaycirujanos.com)

## Introduction

Bronchopleural fistula (BPF) appears after pneumonectomy in up to 4.4 % of cases<sup>1</sup>. Open window thoracostomy (OWT) is carried out if conservative measures fail. They are often left to second intention spontaneous healing. Flaps are later used with obliterating purposes<sup>2</sup>.

These patients are complex to manage because the amount of available muscle is scarce, they have poor nutritional status, coexisting lung diseases, and other comorbidities.

Pectoralis major and minor muscles, serratus, intercostal, paraspinous, and rectus abdominis muscle flaps are used, but there are several drawbacks<sup>3</sup>. Free flaps are not the best option for such patients since they require complex procedures. Latissimus Dorsi, the major muscular source in this area, is split transversally through the pneumonectomy approach.

Conversely, the vertical musculocutaneous trapezius (VMCT) flap is left untouched and stays close to the problem, offering an elegant solution to this challenging scenario<sup>4</sup>.

Our experience with the VMCT flap in five cases is shown here.

## Patients and methods

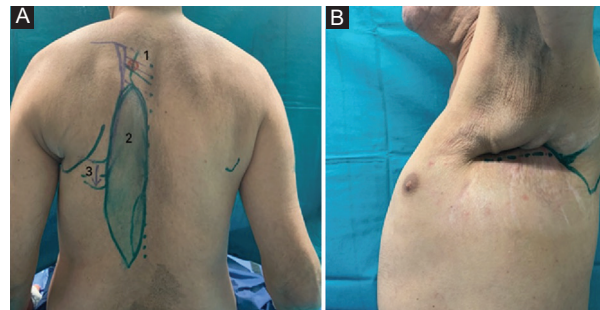
### *Surgical anatomy and technique*

The blood supply of the VMCT flap is based on the deep branch of the transverse cervical artery. Between minor and major rhomboids, it gives a branch to the inferior part of the trapezius, which is the flap-feeding vessel. It travels caudally in a paravertebral axis along the trapezius muscle up to the 12<sup>th</sup> thoracic vertebrae. The flap design can even reach a lower level based on its random reserve<sup>5</sup>.

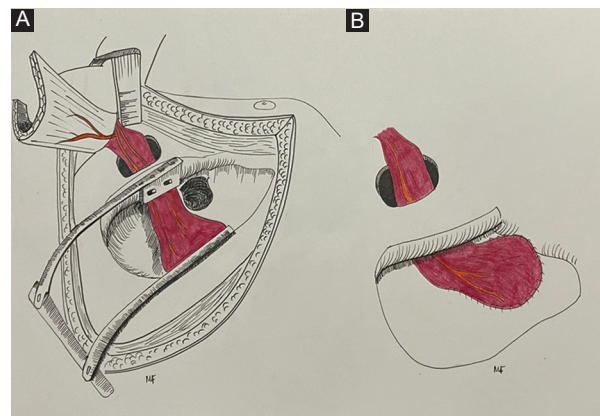
The lateral decubitus position allows joining both the thoracic window and the flap donor site in a single surgical field.

Debridement of the cavity is carefully done, and air leakages are identified if present.

On the paravertebral ipsilateral flap donor area, the vessel and its route is identified with a Doppler ultrasound (Fig. 1). Once the vascular pedicle is identified, the whole flap is islanded. Then, a costal fenestration is done near the flap origin to allow for its intrathoracic passage<sup>6,7</sup>. This gateway into the thorax has to be in



**Figure 1. A:** flap design: 1 Perforator nutrition vessel, 2 flap, 3 costal fenestration for rerouting. **B:** defect.



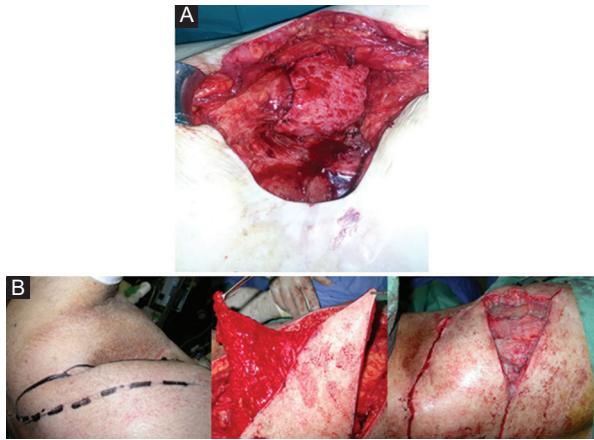
**Figure 2. A:** a costal fenestration is performed near the flap origin to allow its intrathoracic passage. **B:** this gateway into the thorax has to be in line with the transposition axis possibilities of the flap, allowing the rerouted flap to get a straight and direct pathway to the defect.

line with the transposition axis possibilities of the flap, allowing the rerouted flap to get a straight to the defect (Fig. 2) It is applied wrapping the bronchial stump after its closure if there is an air leak present (Fig. 3A). Other flaps may be used in combination if the cavity is still to be filled. We used a fasciocutaneous local flap (Fig. 3B).

### *Clinical cases (Table 1)*

#### **CASE 1**

A 47-year-old male diagnosed with a lung carcinoma tumor treated with right superior lobectomy in 2005 and right pneumonectomy in 2010. He developed a BPF which was initially managed with an OWT and later closed and sealed with a VMCT flap.



**Figure 3.** A: deepithelialized trapezius flap sealing the bronchopleural fistula. B: additional adipofascial flap. Inset of flap and skin grafted donor area.

### CASE 2

A 58-year-old woman with a history of tuberculosis and diagnosed with destroyed lung treated with a superior left lobectomy in 2012. She subsequently developed a BPF treated with an OWT. In 2013, a VMCT flap was performed. The BPF reappeared a month after surgery, and a second OWT was carried out.

### CASE 3

A 71-year-old male with history an epidermoid lung cancer was treated with right pneumonectomy in 2014. He developed a BPF treated with OWT. In 2015, a VMCT flap was done.

### CASE 4

An 80-year-old male with a history of epidermoid lung cancer treated with right medial and inferior bilobectomy in 2006. He developed a BPF 2 months after the surgery and was treated with an OWT. In 2016, a VMCT flap was done.

### CASE 5

A 61-year-old male with a history of left lung epidermoid cancer treated with left pneumonectomy in 2007. In 2016, he developed a BPF that was treated with an OWT. In 2019, a VMCT flap was performed.

### Quality of life (QoL) and basic daily life activities (BDLA) assesment

QoL was assessed by the Spanish version of the SF-36. Each dimension of the questionnaire was assessed by questions in the survey, and item responses were coded and transformed into scores ranging from 0 (worst possible health state measured) to 100 (best possible health state)<sup>8</sup>. Barthel index was used to evaluate the BDLA and five additional questions that we considered relevant were asked: presence of (1) dyspnea, (2) dysphagia, (3) pain, (4) remaining wounds that required additional care, and (5) O<sub>2</sub> requirements.

### Results

In 80% of the patients, the BPF was sealed, the empyema residual cavity was filled and the patients' QoL improved.

Additional fasciocutaneous local flaps were used in 60% of the patients. Surgical time was under 3 h in all cases.

The average of the SF-36 score after flap surgery was 61.78. In 80% of the patients, QoL improved after surgery.

Dyspnea was present after surgery in all patients: 20% at rest, 40% with minor efforts, and 40% when walking long distances.

80% of the patients required oxygen before surgery and 20% after surgery.

All patients were independent for the BDLA after surgery with an average of the Barthel Index of 94/100.

Time average from empyema to flap in months was 45 (12-120); the cause of pneumonectomy was lung cancer in four cases (80%) and tuberculosis in one case (20%). Only one case had adjuvant radiotherapy (RT) (20%), and two cases had adjuvant chemotherapy (40%). Four cases had a history of smoking (80%). Time average of hospital stay in days after VMCT flap surgery was 18, 6 (9-30). Average of number of total surgeries was 4.2 (3-6). Average of percentage of pneumonectomy was 86, 4% (66-100%). Average of follow up in months since VMCT flap was 52, 2 (12-84).

### Limitations

This represents an infrequent complication and more cases would be necessary to make more sustainable conclusions and the perfection of the surgical technique.

Table 1. Patients' characteristics and data

Case	Time from empyema to flaps in months	Cause of pneumonectomy	Adjuvant Radiotherapy	Adjuvant Chemotherapy	History of smoking	Infection of the BPF	Hospital stay in days after VMCT flap surgery	Number of total surgeries	Albumin level	% of pneumonectomy	Follow-up in months since VMCT flap
1	36	Lung cancer	No	No	Yes	Pseudomonas aeruginosa	30	6	7.69	100	84
2	12	tuberculosis	No	No	No	Mycobacterium abscessus	23	6	-	66	78
3	21	Lung cancer	No	Yes	Yes	-	9	3	6.1	100	44
4	120	Lung cancer	No	no	Yes	-	10	3	5.2	66	43
5	36	Lung cancer	Yes	Yes	Yes	Staphylococcus aureus	21	3	6.9	100	12

Case	SF-36	Dysphagia	Dyspnea	QoL improved after surgery	Remaining wounds that require additional care	Presence of pain in the thoracic area/Need of painkillers	O2 requirements before flap	O2 requirements after flap	Barthel Index	Current patient situation
1	48.61	No	Yes. With minor efforts	Yes	No	Yes/No	Yes	No	100/100	Stable
2	61	Occasional	Yes. At rest	No	Yes. Requires serial dressings every 72h	Yes/Every 8h	No	No	80/100	Chronic Mycobacteria infection with multiple admissions to the hospital for antibiotic treatment, Chronic BPF and wound.
3	76.38	No	Only walking long distances in hot weather	Yes	No	No/No	Yes	No	100/100	Stable
4	74.30	No	Only walking	Yes	No	Yes/No	Yes	No	90/100	Stable
5	48.61	No	Yes. With minor efforts	Yes	Yes. Requires serial dressings every 24h	No/No	Yes. 24h a day	Yes. 22h a day	100/100	Chronic ulcer in donor site due to previous RT. Worsening of the contralateral respiratory function

BPF: bronchopleural fistula; QoL: quality of life; VMCT: vertical musculocutaneous trapezius.



## Discussion and Conclusions

The VMCT flap represents the major non-affected musculocutaneous unit in the thoracic area after lung surgery. The rerouting of the flap through a costal fenestration allows a direct passage into the thorax, shortening the distance between the flap and the defect. Its dermal component offers a rigid matrix to form a seal over the bronchial stump. Its muscular component adds a good amount of vascularized tissue to the defect to fill and clean up the pleural cavity increasing antibiotic levels thanks to its rich vascular supply. No functional impairment has been described after its use. BPF can have an early or late presentation, the most frequent being those that occur within the first 12 postoperative days<sup>9</sup> Early BPF can be a vital emergency with high mortality, especially related to empyema and sepsis. Its treatment includes rethoracotomy, cavity drainage and OWT. There are different techniques to perform OWT, and we describe them as follows<sup>10,11,12,13</sup>:

- Caglett's OWT consists in drainage of the pleural cavity by thoracostomy leaving the fistula open and daily changes of intracavitary bandage for a long period of time until its final closure with flaps.
- The Eloesser Flap OWT consists in making an “H” or “U” incision and creating a permanent drainage thoracic window towards the pleural space.

Other techniques used in the treatment of BPF were thoracoplasties which consisted in the resection of several costal arches to reduce the cavity which are no longer used. Endoscopic devices or VAC therapy are currently being studied.

## Acknowledgments

The authors thank all the surgeons from the plastic and the thoracic surgery departments, for the dedication with patients and participating in the surgeries.

## Funding

The authors received no financial support for the research, authorship, and/or publication of this case report letter.

## Conflicts of interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this case report letter.

## Ethical disclosures

**Protection of human and animal subjects.** The authors declare that no experiments were performed on humans or animals for this study.

**Confidentiality of data.** The authors declare that they have followed the protocols of their work center on the publication of patient data.

**Right to privacy and informed consent.** The authors have obtained approval from the ethics committee for analysis and publication of routinely acquired clinical data, and informed consent was not required for this retrospective observational study.

## References

1. Okuda M, Go T, Yokomise H. Risk factor of bronchopleural fistula after general thoracic surgery: review article. *Gen Thorac Cardiovasc Surg*. 2017;65:679-85.
2. Hochberg J, Ardenghy M, Yuen J, Graeber GM, Warden HE, Gonzalez-Cruz R, et al. Utilization of muscle flaps in the treatment of bronchopleural fistulas. *Ann Plast Surg*. 1999;43:484-92.
3. Michaels BM, Orgill DP, Decamp MM, Pribaz JJ, Eriksson E, Swanson S. Flap closure of postpneumonectomy empyema. *Plast Reconstr Surg*. 1997;99:437-42.
4. Can A, Orgill DP, Dietmar Ulrich JO, Mureau MA. The myocutaneous trapezius flap revisited: a treatment algorithm for optimal surgical outcomes based on 43 flap reconstructions. *J Plast Reconstr Aesthet Surg*. 2014;67:1669-79.
5. Haas F, Weiglein A. Trapezius flap. In: Wei FC, Mardini S, editors. *Flaps in Reconstructive Surgery*. 1<sup>st</sup> ed. Barcelona: Elsevier; 2011. p. 249-69.
6. Nomori H, Horio H, Hasegawa T, Kobayashi R. Intrathoracic transposition of the muscle flap of the trapezius and rhomboideus in treating empyema. *Nihon Kyobu Geka Gakkai Zasshi*. 1996;44:198-201.
7. Watanabe H, Imaizumi M, Takeuchi S, Murase M, Hasegawa T. Treatment of empyema by transposition of contralateral lower trapezius flap. *Ann Thorac Surg*. 1997;63:837-9.
8. Physiopedia: About; 2020. Available from: [https://www.physio-pedia.com/36item\\_short\\_form\\_survey\\_\(SF-36\)](https://www.physio-pedia.com/36item_short_form_survey_(SF-36)) [Last accessed on 2020 Oct 04].
9. Eloesser Flap Thoracostomy Window». «Eloesser Flap Thoracostomy Window» Operative Techniques in Thoracic and Cardiovascular Surgery. 15(1):61-9.
10. Jacobsen K. Bronchopleural Fistula after Pulmonary Resection: Risk Factors, Diagnoses and Management [Internet]. *Pleura - A Surgical Perspective*. IntechOpen; 2022. <http://dx.doi.org/10.5772/intechopen.100209>.
11. Denlinger CE. Eloesser flap thoracostomy window. *Oper Tech Thorac Cardiovasc Surg* [Internet]. 2010;15(1):61-9. <http://dx.doi.org/10.1053/j.optechstcvs.2010.03.003>
12. Sugarbaker D, Bueno R, Burt B, Growth S, Loor G, Wolf A, et al. *Sugarbaker's adult chest surgery*. New York: McGraw Hill Education; 2020.
13. Dal Agnol G, Vieira A, Oliveira R, Ugalde Figueroa PA. Surgical approaches for bronchopleural fistula. *Shanghai Chest* [Internet]. 2017;1:14. <http://dx.doi.org/10.21037/shc.2017.06.01>.