

Use of the Serratus Anterior Muscle Flap for Postoperative Empyema – A Single Center Experience with 25 Consecutive Cases

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Rezumat

Folosirea lamboului muscular de dințat anterior în empiemele postoperatorii – analiza experienței unui singur centru cu 25 de cazuri consecutive

Obiectiv: Scopul acestei lucrări este de a analiza posibilitățile și rezultatele folosirii lamboului muscular de dințat anterior în cursul reintervențiilor la pacienți cu complicații postoperatorii după intervenții chirurgicale toracice majore.

Material și Metodă: Am efectuat un studiu retrospectiv pe 25 de pacienți consecutivi operați într-un singur centru în perioada 01.01.2002-01.01.2012, la care s-a folosit lamboul de dințat anterior în cursul unor intervenții complexe de toracomoplastie pentru empieme postoperatorii. În toate cazurile dințatul anterior a fost mobilizat păstrând intacte atât ramura toraco-dorsală cât și vasele toracice laterale. Următorii parametri au fost urmăriți: mortalitate, morbiditate, spitalizare, viabilitatea lamboului și statusul funcțional al pacienților la 3 luni de la operație.

Rezultate: Am întâlnit un deces postoperator (4%) și o recidivă a supurației intratoracice (4%). Spitalizarea în secția de terapie intensivă a variat între 1-9 zile, cu o valoare medie de 2 zile. Spitalizarea postoperatorie totală a variat între 8-87 de zile, cu o valoare mediană de 34. Nu am întâlnit nici o necroză postoperatorie a lamboului muscular. La 3 luni postoperator, 92% din pacienți s-au întors la un regim de viață normal. Tipul

primei toracotomii (postero-laterală versus antero-laterală) nu a avut nici un impact semnificativ statistic asupra evoluției pacienților – spitalizare sau complicații locale ($p > 0.05$).

Concluzii: Ca și lambou pur muscular, dințatul anterior este extrem de util în tratamentul unor complicații infecțioase după intervenții de chirurgie toracică. Acest lambou poate fi folosit în cursul intervențiilor de toracomoplastie cu mortalitate și morbiditate acceptabilă și cu rezultate funcționale bune.

Cuvinte cheie: dințat anterior, lambou muscular, empiem postoperator

Abstract

Objective: The aim of this study is to analyse the possibilities and the results of using the serratus anterior muscle flap during reoperations in patients with a complicated course after major general thoracic procedures.

Material and Methods: We performed a retrospective study on 25 consecutive patients operated in a single center between 01.01.2002-01.01.2012, in whom we used the serratus anterior muscle flap during complex thoracomyoplasty procedures for postoperative empyema. In all cases the serratus anterior was mobilized keeping both the thoraco-dorsal branch and the lateral thoracic vessels intact. The following parameters were followed: mortality rate, morbidity rate, hospitalization, viability of the flap and the functional status of the patients at 3 months after surgery.

Results: We encountered one postoperative death (4%) and one recurrence of the intrathoracic suppuration (4%). Intensive care unit hospitalization ranged between 1-9 days, with a median of 2 days. Overall postoperative hospitalization ranged between 8-87, with a median of 34 days. We have encountered no post-

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operative flap necrosis. At 3 months after surgery, 92% of the survivors returned to a normal life. The type of the first thoracotomy incision (postero-lateral versus antero-lateral) had no statistically significant impact on the outcome of the patients – hospitalization or rate of local complications ($p > 0.05$).

Conclusions: As a pure muscular flap, the serratus anterior is extremely useful to treat infectious complications after general thoracic surgery procedures. It can be used during thoracomyoplasty procedures with an acceptable mortality and morbidity and with good functional results.

Key words: serratus anterior, muscle flap, postoperative empyema

Introduction

General thoracic surgery procedures are now frequently performed for a great variety of benign and malignant diseases (1,2,3,4). Despite overall good results, some patients develop complications that require a major procedure for a definitive solution (4,5,6,7). Beginning with the 1950-60's, plastic surgeons have shown the value of different flaps based on clear anatomical landmarks, which were used to solve a very wide range of defects (8,9,10,11,12,13,14,15). Beginning with the 1980-90's, thoracic surgeons overtook some plastic-reconstructive surgical techniques and started to use extensive mobilization of muscle flaps to solve different intrathoracic defects, including postoperative complications (16).

The aim of this study is to analyse the possibilities and the results of using the serratus anterior muscle flap during reoperations in patients with a complicated course after major general thoracic procedures. A comparative analysis was also performed to determine the importance of the type of the first thoracotomy incision (postero-lateral or antero-lateral).

Method

Patients

This is a retrospective study on 25 consecutive patients operated in our unit between 01.01.2002-01.01.2012. Inclusion criteria were the existence of an infectious complication after major surgery (postoperative empyema with or without bronchial fistula or external – cutaneous fistula) and the use of the serratus anterior (alone or with other flaps) during the reoperation. This study does not include patients with residual pleural cavities after simple tube-thoracostomy since this is not a major procedure – does not involve any muscle sectioning and most of these patients are usually treated by decortication of the lung.

Demographic data show a male/female ratio of 4/1; age of the patients ranged between 17 and 74 years, with an average of 54 years. A number of 9 patients (36%) were referred to our

team after being operated in other units. The initial procedure was: lung decortication in 12 cases (alone in 4 cases, associated with other lung procedures in 8 cases), pneumonectomy in 4 cases, lobectomy in 3 cases, non-anatomic resection in 5 cases and thoracoplasty in 1 case. The type of the first incision was postero-lateral in 17 cases and antero-lateral in 8 cases.

Technical details

The overall strategy was to achieve complete obliteration of the suppurated defects with well-vascularised tissues using complex thoracomyoplasty procedures (17). Preoperative local preparation and intraoperative debridement were performed according to the current principles of wound management (18). In cases operated first through postero-lateral thoracotomy, the wound was simply re-opened using the first incision and the entire portion of the serratus anterior located above the incision was mobilized (Fig. 1). In cases operated first through antero-lateral thoracotomy, we performed a postero-lateral skin incision, trying to include at least some part of the first thoracotomy; after dissection of the subcutis and identification of the local anatomy we mobilized the portion of the serratus anterior located above the thoracotomy and the adjacent muscle mass (Fig. 2). In two cases with intact blood supply after the first procedure, we were able to mobilize the entire flap. In all the cases we preserved both the thoraco-dorsal branch and the lateral thoracic vessels.

Rib resection ranged between 1 and 6, with an average of 3.6 resected ribs/patient; we resected only the portions of the ribs located above the empyema and not the entire rib. Bronchial fistula was present in 11 patients and was in all of them closed or reinforced with the use of flaps. The wounds were primary closed in all cases with a separate drainage of the intrathoracic cavities and of the subcutaneous space resulted after the mobilization of the flaps.

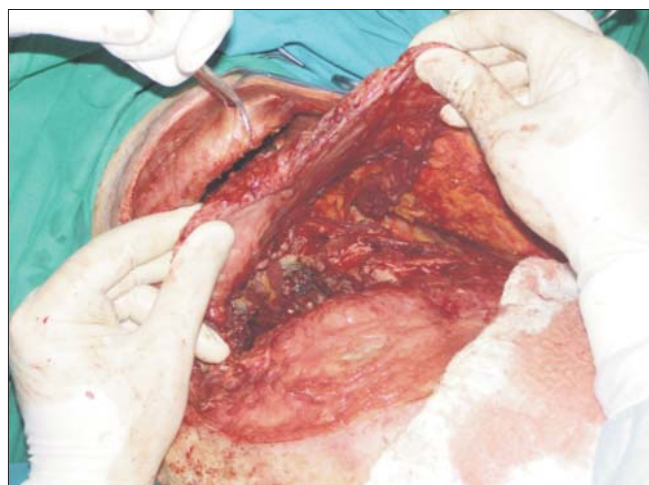


Figure 1. A serratus anterior flap raised for a postoperative empyema after decortication performed through a postero-lateral thoracotomy

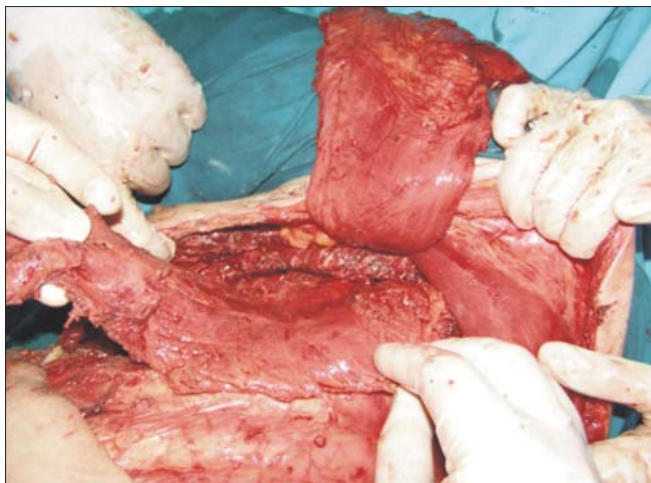


Figure 2. A combined serratus anterior and latissimus dorsi flap used to obliterate a postoperative empyema after left upper lobectomy performed through an antero-lateral thoracotomy

Statistical analysis

Data about the patients were collected using Microsoft Excel datasheets and analysed using the GraphPad Prism 5 software (GraphPad Software Inc, CA, USA). Data were expressed as ranges, median and mean as appropriate. For comparing the outcome of the two subgroups defined according to the type of the first thoracotomy incision we have used Fisher's exact test and the unpaired t test, considering a p value of less than 0.05 to be statistically significant.

Results

Mortality rate

We have encountered one postoperative death (4%) due to bronchopneumonia with secondary respiratory and heart failure.

Local morbidity rate

There was one recurrence of the intra-thoracic suppuration (4%), that was solved by a re-operation with filling of the residual cavity with a latissimus dorsi (upper part) flap; this patient had a multi-drug resistant tuberculosis infection and we believe that the recurrence was related to the poor control of the tuberculosis infection.

We encountered no postoperative seroma, no hematoma and no need for reoperation for hemostasis. One patient developed a minor skin necrosis that was solved by simple excision and secondary suture with local anesthesia. One patient (initial operation – pneumonectomy for cancer) developed a local tumoral recurrence that required a local excision.

Hospitalisation

Intensive care-unit stay ranged between 1 and 9 days, with

an average of 2.4 and a median of 2 days. Overall postoperative hospitalization ranged between 8 and 87 days, with an average of 36 and a median of 34 days. All the patients were discharged with completely healed wounds, with no need for any additional local care at the moment of discharge. If necessary, patients were referred to our pneumology or oncology colleagues to continue specific tuberculostatic or oncologic treatment.

Viability of the flap

The viability of the flaps was carefully assessed at the end of surgery, before introduction inside the chest and after the final arrangement. In only one case we noticed some ischemic changes that required excision of the distal part (3 cm) of the muscle. There was no post-operative flap necrosis as determined by the clinical course and postoperative CT scans. In one patient with local recurrence of the infection, the serratus anterior was found viable at reoperation, but without complete filling of the cavity.

Functional aspects

At the 3 month follow-up, 22 of the 24 survivors (92%) returned to a normal way of life, with no need for medical assistance. In 2 cases (8.3%) we encountered a minor asymmetry of the scapulas and in 5 (20%) of them a reduction of the maximal upper arm abduction, none of them interfering with normal activities. We have encountered no case of true winged scapula.

Choice of flaps and the importance of the first incision

The serratus anterior was used alone in 5 cases and in combination with other flaps in 20 cases, in order to achieve a complete obliteration of the diseased space. The serratus anterior was used alone more frequently after postero-lateral thoracotomy, but without reaching a statistical significance when comparing postero-lateral versus antero-lateral subgroups (5/17 vs 1/8, Fisher's exact test – $p=0.6237$).

When comparing the outcome of the two subgroups (postero-lateral versus antero-lateral) we found no statistically significant difference in terms of:

- intensive-care unit stay (ranges 1-9, median of 2 days vs ranges 1-5 days, median of 2 days, unpaired t test $p=0.4711$);
- overall postoperative hospitalization (ranges 7-62 with a median of 33 days versus ranges 8-87 with a median of 35 days, unpaired t test $p=0.6356$);
- incidence of postoperative local complications (1/17 vs 1/7, Fisher's exact test $p=0.5072$).

Discussions

Muscle flaps have clearly shown their value in the treatment of different infections and suppurated defects inside the chest (16,19,20). The serratus anterior flap is used by plastic

and reconstructive surgeons in a great variety of defects and technical variants (22,23,24). However, despite some good published results (25, 26), it is used less frequently than other flaps in general thoracic surgery, including chest wall reconstruction (27). Our experience shows that as a muscle flap alone, it is very reliable, has an important volume – comparable to the latissimus dorsi, and may be mobilized to reach almost any part of the upper half of the chest, including the hilar region (26).

Probably the main advantage of the serratus anterior flap is that it remains almost intact after standard postero-lateral thoracotomy, which sections the latissimus dorsi. Also, after antero-lateral thoracotomy, a significant portion of the muscle may be still mobilized and used to solve defects inside the chest. Our statistical analysis showed that the type of the first incision does not have a statistically significant impact on the outcome of the patients as long as a complete obliteration of the space is achieved; however, the value of our analysis is limited by the heterogeneity and the relatively small number of patients. Considering the rarity and heterogeneity of these patients, we believe that only multicenter studies may achieve more confident results.

In order to improve the vascularization of this flap we have always preserved the two main vascular pedicles – the serratus branch from the thoraco-dorsal vessels and the lateral thoracic vessels. We believe that this technical detail is important since it allows an improved blood supply and mobilization of a high-volume flap; since the two vessels have an almost trajectory their preservation does not limit the possibilities of rotation of the serratus anterior muscle flap, which is mainly a latero-medial one. In the particular circumstance of intrathoracic transposition, any problems with the viability of the flaps will lead to the occurrence of an empyema.

The serratus anterior has also been used for prevention of some complications – mainly reinforcement of bronchial sutures in patients considered at high risk to develop a bronchial fistula (28). We believe that mobilization of a large extrathoracic muscle flap is too aggressive as a pure prophylactic measure, since other less complicated solutions are available (29). However, if a complication occurs, a very well vascularized flap is almost mandatory in order to achieve good results.

The functional and esthetic aspects require special attention. Our experience shows that the intrathoracic transposition of the serratus anterior flap is not associated with a significant morbidity rate. In order to avoid the development of a winged scapula we always preserve the trapezius muscle; according to the topography of the lesion we also preserve the first 1-2 digitations of the serratus anterior muscle, preserve or reconstruct the latissimus dorsi and fix the tip of the scapula to the chest wall with late-resorbable stitches. However, a detailed functional analysis is difficult to perform in these cases since the exact impact of the first operation and of the associated procedures (rib resection, bronchial fistula closure etc.) is impossible to quantify (26).

Conclusions

The serratus anterior is a good option to treat infectious complications occurring after general thoracic surgery. After most standard thoracotomies, a significant part of the muscle can be mobilized and used inside the chest. Keeping both the thoraco-dorsal branch and the lateral thoracic vessels allows a good blood supply without significant reduction of the mobilization of this flap for intrathoracic transposition. As a pure muscular flap, it is a safe one that is very easy to mobilize and move inside the chest in complicated cases. In patients with postoperative empyema, the intrathoracic transposition of the serratus anterior flap can be done with acceptable mortality and morbidity; however, the use of other neighbouring flaps is frequently necessary to achieve complete obliteration of the suppurated space.

Acknowledgements

This research was funded through an internal research grant by the University of Medicine and Pharmacy of Tîrgu-Mureş, Romania (CIGCS 2012).

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