CASE REPORT

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Upper thoracic empyema and concomitant superior vena cava syndrome treated with reconstructive surgery using a pedicled omental flap

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ABSTRACT

Superior vena cava (SVC) syndrome refers to a constellation of symptoms secondary to obstruction of blood flow through the SVC. In this condition, venous blood that usually drains into the SVC is diverted into the inferior vena cava (IVC) via collateral veins. Reconstructive surgery is challenging in such cases owing to the anomalous venous system. In this case report, we describe reconstructive surgery using a pedicled omental flap in a patient with upper thoracic empyema and concomitant SVC syndrome. A 68-year-old man underwent resection of malignant thymoma, the bilateral brachiocephalic veins, and a part of the right upper lobe, followed by polytetrafluoroethylene (PTFE) graft placement for venous system reconstruction, 2 years prior to presentation. He developed postoperative upper thoracic cavity empyema, which necessitated PTFE graft removal. Although the infection was controlled after 2 months, multiple right upper lobe pulmonary fistulas persisted, and the patient was referred to our department for further evaluation. Contrast-enhanced computed tomography revealed SVC syndrome characterized by SVC obstruction and consequent drainage of venous blood from the upper trunk into the IVC via collateral vessels. We debrided necrotic and infected tissues, and a pedicled omental flap was placed for upper lobe fistula coverage. The patient showed an uncomplicated postoperative course, and no recurrent empyema or pulmonary fistulas were observed 3 years postoperatively. Flaps associated with the SVC system show high venous pressures. The use of a pedicled omental flap was deemed feasible because this graft reaches the upper thorax even though it is associated with the IVC system.

Keywords: empyema, superior vena cava syndrome, reconstructive surgery, omental flap

Abbreviations:
SVC: superior vena cava
IVC: inferior vena cava
PTFE: polytetrafluoroethylene
CT: computed tomography

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INTRODUCTION

Empyema may occur secondary to severe pneumonia or as a complication of intrathoracic surgery. It is often accompanied by a bronchopleural fistula, which is associated with a mortality rate of 50% in the absence of appropriate treatment.[1] Conservative therapy alone, such as antibacterial agent administration is invariably ineffective against empyema with bronchopleural fistula, and surgical treatment is often required in these cases. The principles of surgical treatment include the following: (a) debridement of necrotic and/or infected tissues in the thoracic cavity, (b) accurate identification and obliteration of bronchial and pulmonary fistulas to the greatest extent possible and, (c) obliteration of the intrapleural defect to eliminate all dead space.[2] However, selection of a reconstructive approach is challenging in patients with hemodynamic abnormalities secondary to an anomalous venous system in patients with SVC syndrome.

We report a case of reconstructive surgery using a pedicled omental flap for upper thoracic empyema and concomitant SVC syndrome in a patient who showed favorable results postoperatively.

CASE REPORT

A 68-year-old man with a history of malignant thymoma underwent extended thymectomy and partial resection of the right upper lobe. Intraoperative evaluation revealed tumor invasion of the bilateral brachiocephalic veins, which required resection. Venous system reconstruction was performed using a polytetrafluoroethylene (PTFE) graft. The patient developed empyema and multiple right upper lobe fistulas secondary to aspergillosis, 3 years later and underwent open thoracotomy using an Eloesser flap; the skin edge surrounding the window was folded inward and secured to the pleural cavity with PTFE graft removal. The immediate postoperative intravenous pressure in the jugular vein measured 28 mmHg. The patient was diagnosed with SVC syndrome and was treated with a diuretic and steroid to avoid laryngeal edema or headache. The infection was controlled after several weeks; however, multiple fistulas persisted in the residual right upper lobe, and the patient was referred to our department for further evaluation. Preoperative evaluation revealed air leakage in the right upper lobe and exposure of the ascending aorta with varicose veins over the chest and back, which indicated the development of collateral vessels secondary to SVC system obstruction. Preoperative computed tomography (CT) revealed a defect in the right pulmonary apex with multiple pulmonary fistulas and exposure of the ascending aorta at the defect site (Fig. 1). Contrast-enhanced CT angiography revealed that the collateral vascular network drained the venous flow from the upper body into the IVC system via the azygos vein (Fig. 2).

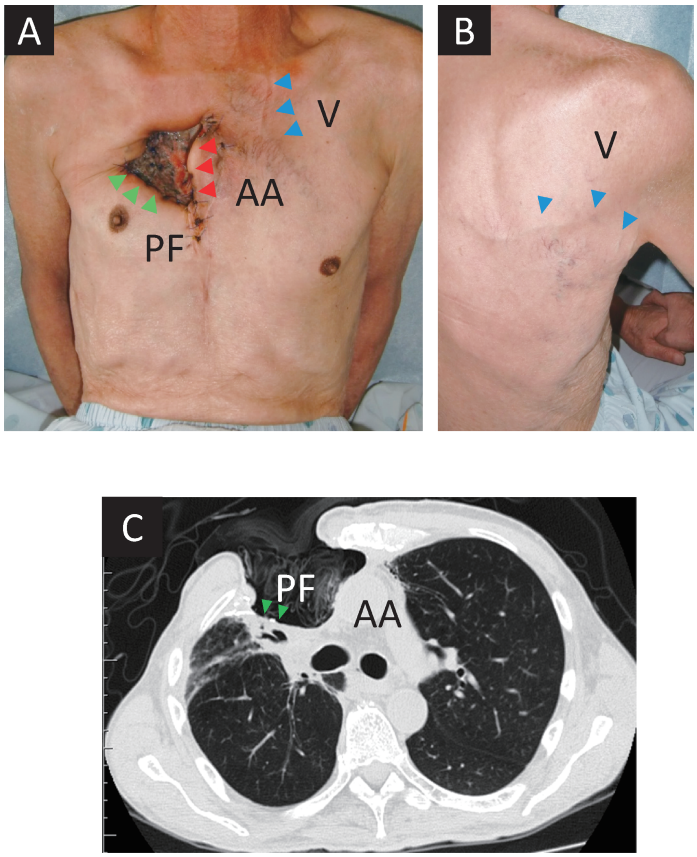

Fig. 1 Preoperative images

Fig. 1A: Preoperative appearance of the chest. Pulmonary fistulas (PF) and exposure of the ascending aorta (AA) with varicose veins (V) were observed.

Fig. 1B: Preoperative appearance of the back. Varicose veins (V) over the back were observed.

Fig. 1C: Preoperative CT image. Pulmonary fistulas (PF) and exposed ascending aorta (AA) were observed.

PF: pulmonary fistulas

AA: ascending aorta

V: varicose veins

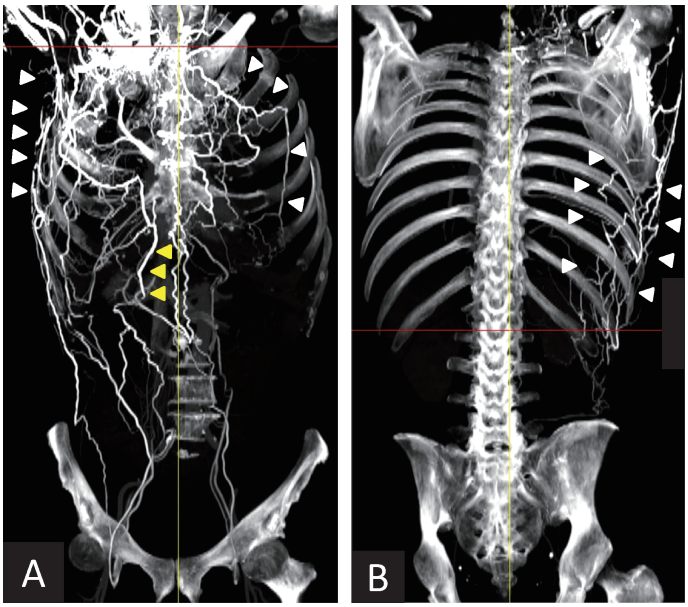

Fig. 2 Preoperative contrast-enhanced CT angiography
Fig. 2A: Front view
Fig. 2B: Back view
The collateral vascular network (white arrowheads) drained the venous flow from the upper body into the IVC system via the azygos vein (yellow arrowheads).

OPERATIVE PROCEDURE

Flaps associated with the SVC system show high venous pressure and were not suitable in our patient; therefore, we performed reconstruction using a pedicled omental flap associated with the IVC system. Initially, all necrotic and infected tissues were debrided, and the area was thoroughly irrigated using saline to cleanse the pyothoracic cavity. Mild leakage from the lung fistula sites was plugged with fibrin glue, and a leak test was performed at 20 cmH_2O positive pressure. Thereafter, we elevated the pedicled omental flap and confirmed that the flap was intact and healthy with adequate blood flow. We created a 4 cm incision in the lesser omentum, and the flap was passed through it. This process extended the flap arc distance (Fig. 3). The flap was transferred to the upper lobe to cover the fistulas and to obliterate all dead space, and finally, a meshed skin graft was placed on the omentum. The patient showed an uncomplicated postoperative course without recurrent empyema or pulmonary fistulas over 3 years postoperatively. Postoperative CT revealed adequate coverage of the defect by the omental flap, without any evidence of air leakage (Fig. 4).

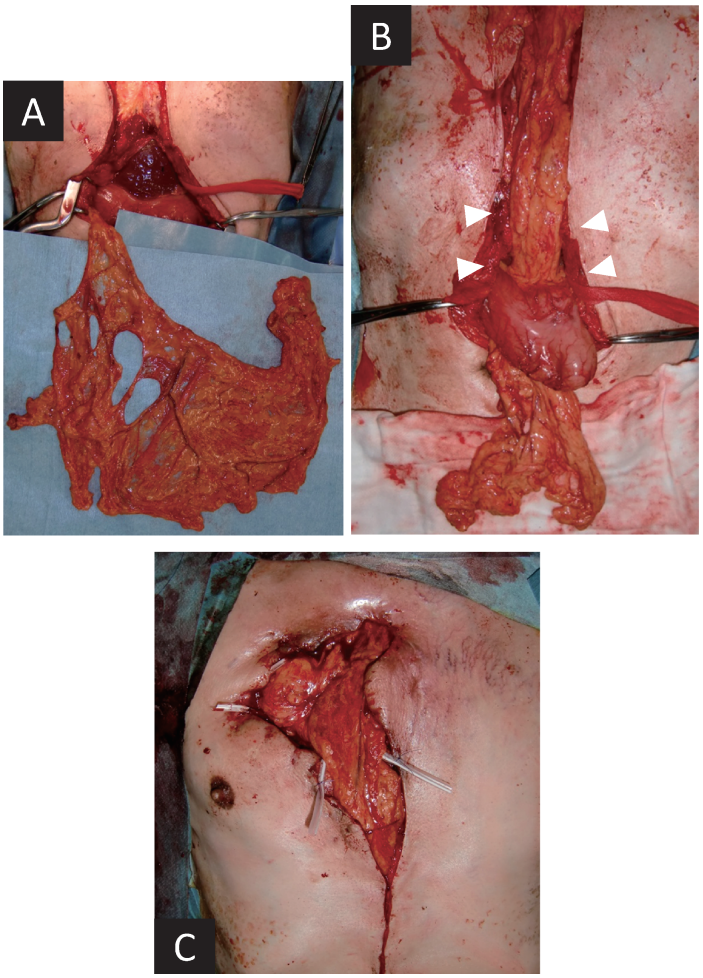

Fig. 3 Intraoperative photographs
Fig. 3A: The pedicled omental flap was harvested.
Fig. 3B: The flap was passed through the lesser curvature route (white arrowheads).
Fig. 3C: The flap was transferred to the pulmonary fistulas and to obliterate all dead space.

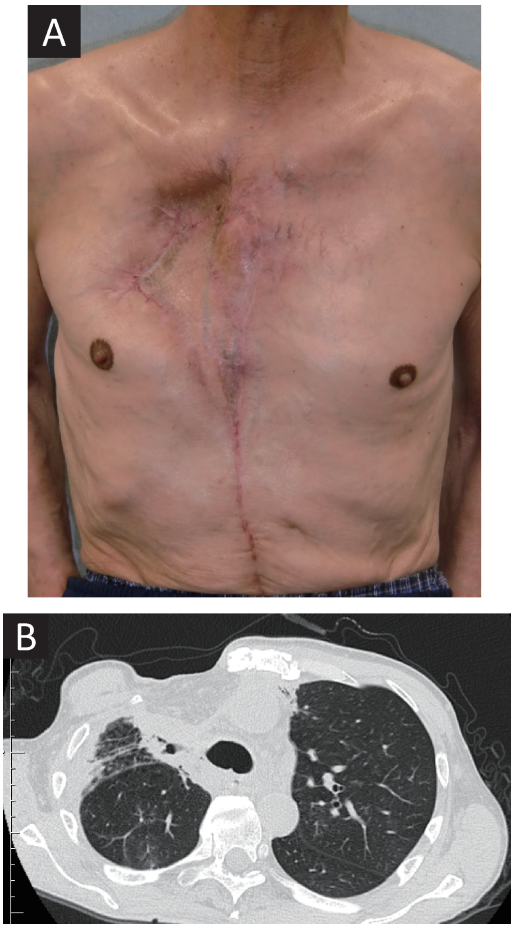

Fig. 4 Postoperative images
Fig. 4A: Postoperative appearance of the chest. No recurrent empyema was seen.
Fig. 4B: Postoperative CT image. The space was sell obliterate by the flap.

COMMENT

SVC syndrome includes a constellation of symptoms caused by SVC occlusion. The SVC drains blood from the head, arms, and upper torso to the heart and transports approximately 33% of the venous return to the heart.[3] Previously (more than 50 years earlier), most cases of SVC obstruction were attributable to infectious diseases such as syphilitic aortic aneurysm or tuberculosis; however, thoracic neoplasms and semipermanent intravascular devices are known to contribute to most instances of SVC obstruction in recent times.[4] The cervical venous pressure is usually increased to 20–40 mmHg (normal range 2–8 mmHg) in patients with SVC occlusion, which clinically manifests with symptoms of facial, laryngeal, and brain edema, or varicosities that involve the upper body. Venous pressure was not measured during reconstructive surgery in our patient; however, upper body varicosities were indicative of residual high venous pressure in the SVC. Blood overflow into the collateral vascular network enters the azygos vein or the IVC, which effectively decreases the high venous pressure in the head and neck region; however,

significant hemodynamic alterations tend to affect local hemodynamics in tissues, including in flaps. To date, no study has reported flap transfer in a patient with SVC syndrome; however, a similar example would be helpful in understanding this pathology. Kato et al reported a case of bilateral internal jugular vein resection with free jejunum transfer; however, high venous pressure resulted in flap congestion, which necessitated changing the recipient vessel.[5] Another study has reported that a high venous pressure (> 50 mmHg) is not suitable for free flap recipient vessels.[6]

To our knowledge, no study has reported reconstructive surgery for empyema concomitant with SVC syndrome. (Table 1) shows categorization of reconstructive approaches based on the venous system and the typical transfer locations.[2,7] Flaps associated with the SVC system cannot be used in such cases because of the high venous pressure in the pedicle vein, and free flaps anastomosed to veins associated with the SVC system are infeasible for reconstruction for the same reason. Therefore, an omental flap or free flap transfer using the gastroepiploic vein was deemed a suitable option in our patient. Conventional transfer of an omental flap may not easily reach the upper thorax; therefore, the lesser curvature was selected as a route for transfer. This procedure enabled successful transfer of a sufficient volume of omental flap to the upper thorax and achieved satisfactory postoperative outcomes.

Table 1 Categorization of reconstructive approaches based on the venous system

Pedicle vein		**Pedicled flap**	**Location**
SVC system	Thoraco acromial v	PM	Apical
	Thoraco dorsal v	LD	Hilar
	Intercostal v perforator	LD	Base
	Upper epigastric v	RA	Base
IVC system	**Gastro epiploic v**	OM	Apical Hilar Base
Recipient vein		**Free flap**	**Location**
SVC system	Thoraco acromial v Thoraco dorsal v Internal mammary v	Any flap available	Apical Hilar Base
IVC system	**Gastro epiploic v**		

v: vein
PM: pectoralis major muscle
LD: latissimus dorsi muscle
RA: rectus abdominis muscle
OM: omentum

CONCLUSIONS

We describe reconstructive surgery using a pedicled omental flap in a patient with upper thoracic empyema and concomitant SVC syndrome. In our view, flaps associated with the SVC

are not useful in such cases because of insufficient venous return. A pedicled omental flap associated with the IVC system may be a suitable option for thoracic empyema with concomitant SVC syndrome.

COMPLIANCE WITH ETHICAL STANDARDS

Disclosure of interests

No funding was received for this study, and all authors declare that they have no conflict of interest.

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