Usefulness of a temporary shunt by cannulation during superior vena cava combined resection

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Abstract

Superior vena cava invasive thoracic malignancy requires combined resection of the superior vena cava to achieve en bloc resection of the involved structures with negative margins. The superior vena cava combined resection requires the creation of collateral circulation from the head to the heart before performing the combined resection. Even for a short time, total superior vena cava clamping without a procedure is unsafe and should be avoided. We will present a surgical resection with superior vena cava reconstruction, involving a temporary extrathoracic shunt from the left brachiocephalic vein to the right auricle using a venous return cannula. This is an optional technique for convenient and safe superior vena cava combined resection. It provides an excellent intrathoracic surgical view by venous return via the unilateral brachiocephalic vein, with the advantages of being a simple procedure requiring short surgical time.

Introduction

Locally advanced lung cancers sometimes invade the superior vena cava (SVC). In the case of SVC combined resection, there are multiple reports from a single institution with a relatively large number of participants (> 40) [1-3]. The incidence of fatal complications is 4–10%, the 5-year survival rate is 24–31%, and N2 is also a poor prognosis factor [1-4]. A recent report by the Joint Committee on Lung Cancer Registry in Japan described no significant difference in the 5-year survival rate depending on the infiltrating T4 organ. The 5-year survival rate exceeded 50% for T4N0 in patients under 70 years of age [5]. Similarly, mediastinal malignancies may require combined resection with SVC.

The SVC combined resection requires the creation of collateral circulation from the head to the heart before performing the combined resection. A total SVC clamping without any intervention is not safe even for a short time and should be avoided. Therefore, after creating a temporary shunt by cannulation into the left brachiocephalic vein and the right auricle, we performed a combined resection. The SVC is reconstructed after resection, and finally, the shunt is removed. The advantages of this technique are simple performance and short surgery time.

Technique

Cannulation

Intraoperative anticoagulant therapy administers heparin targeting activated clotting time 200 seconds.

1. Thoroughly separate the left brachiocephalic vein from the surrounding tissues and encircle it on the distal side of the tumor using vessel loop.
2. Apply a purse-string suture to the left brachiocephalic vein on the distal side of the tumor using 5-0 polyvinylidene fluoride monofilament.
3. Introduce the 22Fr right-angle venous return cannula into the left brachiocephalic vein.
4. Make an incision in the pericardium and apply a purse-string suture to the right atrial appendage using 5-0 polyvinylidene fluoride monofilament.
5. Insert the 28Fr wire-reinforced cannula completely in the right atrial appendage.
6. Connect each cannula using straight connector with luer port and pull out the air.
7. When the clamp is released, blood flows into the temporary shunt, creating collateral circulation.

Comment

We had traditionally created a bypass with an artificial blood vessel from the left brachiocephalic vein to the right auricle at the time of SVC combined resection. After resection, the SVC was reconstructed with an artificial blood vessel, resulting in two bypasses on the left and right. The problem with this method was the time required for

surgery and the subsequent obstruction of the left bypass. Therefore, recently, after creating a temporary shunt by cannulation of the left brachiocephalic vein and the right auricle, we started performing a combined resection. The SVC is reconstructed with an autologous pericardial conduit or artificial blood vessel after completing the combined resection, and finally, the shunt is removed. The advantages of this method are a straightforward procedure and short surgery time. If the tumor had invaded and the left brachiocephalic vein could not be cannulated, the procedure could be done through the jugular vein. Similarly, if the blood removal cannula cannot be inserted into the right atrial appendage, an inferior vena cava or femoral vein graft may be used instead. We performed this procedure in the past six cases during SVC combined resection. The average time to create an extrathoracic temporary shunt from the left brachiocephalic vein to the right auricle is completed was 11 minutes. All patients have recovered successfully (Table 1). Because we basically reconstruct the SVC with the autologous pericardium, we do not have postoperative anticoagulation. In fact, Suzuki et al. [3] reported that postoperative thrombosis of the venous system would be largely related to anastomotic technique, not the use of anti-thrombotic agents, and he basically did not use postoperative antithrombotic agents [3]. In patients with SVC obstruction before surgery, we use postoperative anticoagulant therapy because the blood flow of the reconstructed SVC decreases due to the collateral circulation.

This is an optional technique for convenient and safe SVC combined resection. It

provides an excellent intrathoracic surgical view by venous return via the unilateral brachiocephalic vein, with the advantages of being a simple procedure requiring short surgical time.

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IRB approval statement: Since this study is "Non-Experimental Surgical Innovation," IRB review and approval are not required.

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Figure Captions

Fig 1 An image from the surgical procedure with median sternotomy. By cannulating the left brachiocephalic vein and the right auricle and connecting them with a connecting tube, blood flows from the head to the right atrium, enabling total SVC clamping.

Table 1. Patients' characteristics and postoperative results

Age (years), sex	Tumor	Preoperative SVC occlusion	Shunt	Shunt creation time (min)	Reconstruction materials	Postoperative anticoagulation	Graft patency	Prognosis
50, F	Thymoma	None	LBCV and RAA	22	Autologous pericardium	None	Patent	Alive with no exidence of recurrence at 112 months postoperatively
44, F	Thymic Ca.	Occluded	From LBCV to RAA	19	10mm PTFE x 2	Warfarin	Occluded	Died 76 months later due to cancerprogression.
67 M	LCNEC	None	From RSV to LFA	32	None	None	Patent	No recurrence. Died 36 months later due

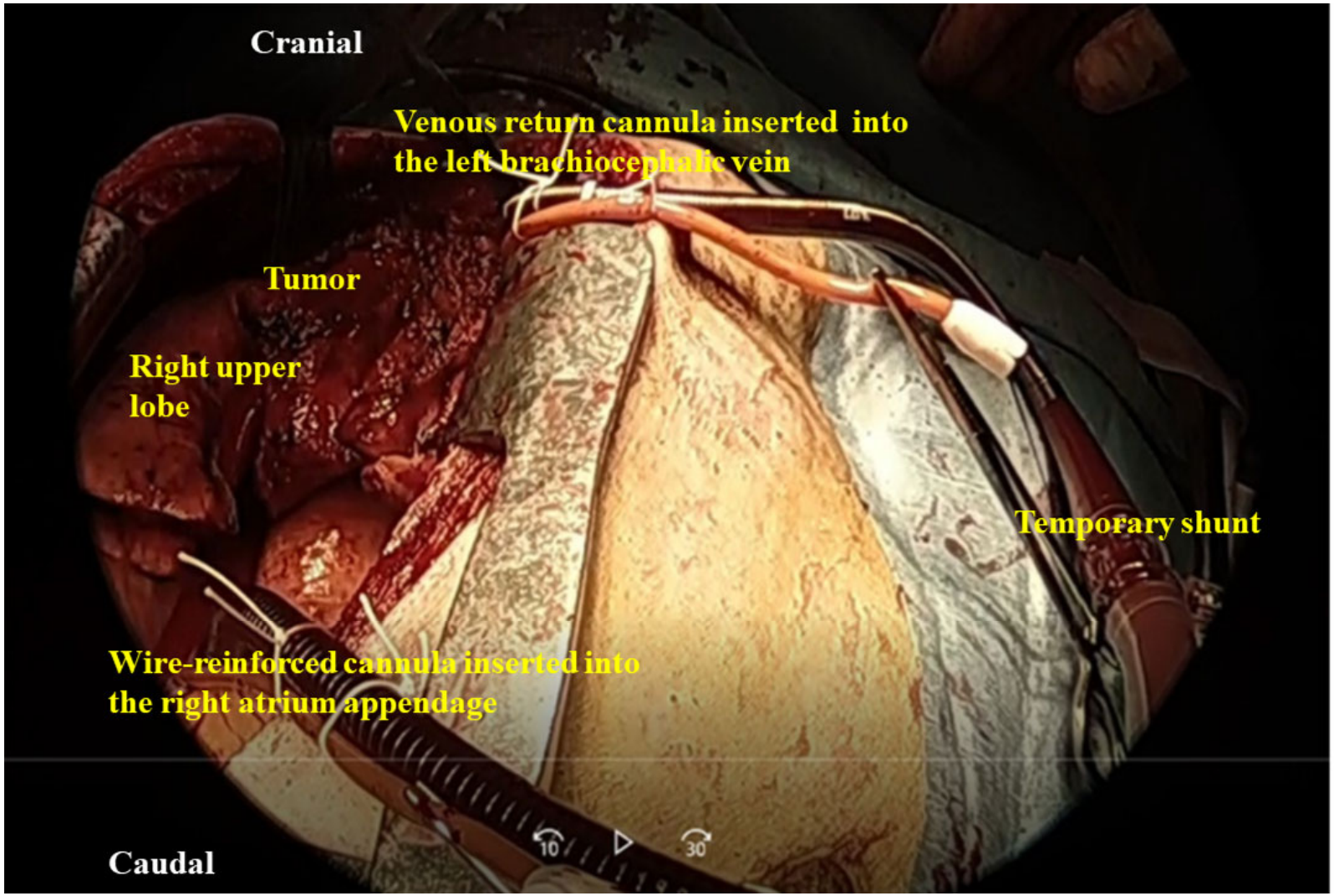
								to another cancer.
28, F	DLBLC	Occluded	From RIVV to RAA	6	16mm PTFE	Warfarin	Patent	Alive with no exidence of recurrence at 35 months postoperatively
53, M	Thymoma	None	From LBCV to RAA	5	Autologous pericardium	None	Patent	Alive with no exidence of recurrence at 42 months postoperatively
58, F	Ad	None	From LBCV to RAA	5	Autologous pericardium	Edoxaban tosilate hydrate (For Af)	Patent	Alive with no exidence of recurrence at 5 months postoperatively

2 LBCV: left brachiocephalic vein, RAA: right atrial appendage, LCNEC: Large cell neuroendocrine carcinoma,, RSV: Right subclavian vein,

3 LFA: left femoral vein, DLBLC: diffuse large B-cell lymphoma, RIJV: right internal jugular vein, PTFE: polytetrafluoroethylene, Ad:

4 adenocarcinoma, Af: atrial fibrillation,

Fig 1


Cranial
Venous return cannula inserted into the left brachiocephalic vein
Tumor
Right upper lobe
Temporary shunt
Wire-reinforced cannula inserted into the right atrium appendage
Caudal
10
30