Artificial reconstruction for a thymoma invading superior vena cava

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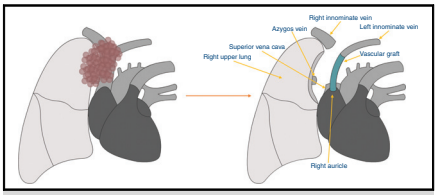

Diagram of surgical resection for thymoma with superior vena cava syndrome.

CENTRAL MESSAGE

Complete resection for thymoma with superior vena cava syndrome can be achieved with extended resection combined with artificial reconstruction between the left innominate vein and right auricle.

Video clip is available online.

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Thymoma is the most common malignant tumor of the anterior mediastinum. Complete resection of the thymoma is the most important treatment for patients with thymoma and can significantly prolong the survival time of such patients.[1] However, complete resection of thymoma with the superior vena cava (SVC) syndrome caused by thymoma invading the SVC is still technically challenging. Herein we share a case of a patient with thymoma with SVC syndrome who underwent an artificial reconstruction combined with extended tumor resection to achieve complete resection of the thymoma.

CASE PRESENTATION

A 63-year-old woman presented to the hospital with cough and chest tightness. A chest computed tomography examination revealed a right anterior mediastinal mass of approximately 8 cm × 5.5 cm in size, invading the SVC (Figure 1, *A*). The pathology using core needle biopsy diagnosed a World Health Organization type B2 thymoma. The patient was then referred to the mediastinal multidisciplinary diagnosis and treatment center at our hospital, and received a treatment strategy of surgical resection after induction chemoradiotherapy. The protocols of induction chemoradiotherapy (Figure 1, *A* and *B*) were developed by experienced radiologists and oncologists in the multidisciplinary diagnosis and treatment team. Soon the patient received 3 cycles of chemotherapy with paclitaxel liposome 60 mg day 1 and cisplatin 40 mg day 1, and intensity-modulated radiation therapy with a prescription dose of 56 Gy in 28 fractions over a 6-week period. The patient was reassessed after chemoradiotherapy. Although the thymoma had regressed, it had not achieved the expected therapeutic purpose for surgical resection. After a 2-month recovery period, the patient received an additional 2 cycles of standard chemotherapy with paclitaxel liposome 240 mg day 1 and cisplatin 120 mg day 1 over a 2-month period (Figure 1, *B* and *C*). The thymoma was significantly regressed and underwent a complete surgical resection (Figure 1, *C* and *D*). The Zhongshan Hospital Research Ethics Committee approved the study protocol and publication of data (B2021-454; June 28, 2021). The patient provided informed written consent for the publication of the study data.

The details of the surgical procedure are presented in Video 1. Briefly, median sternotomy was performed to access the chest cavity, mobilize the thymus (Figure 2, *A*), open the pericardium, fully expose the right auricle, and

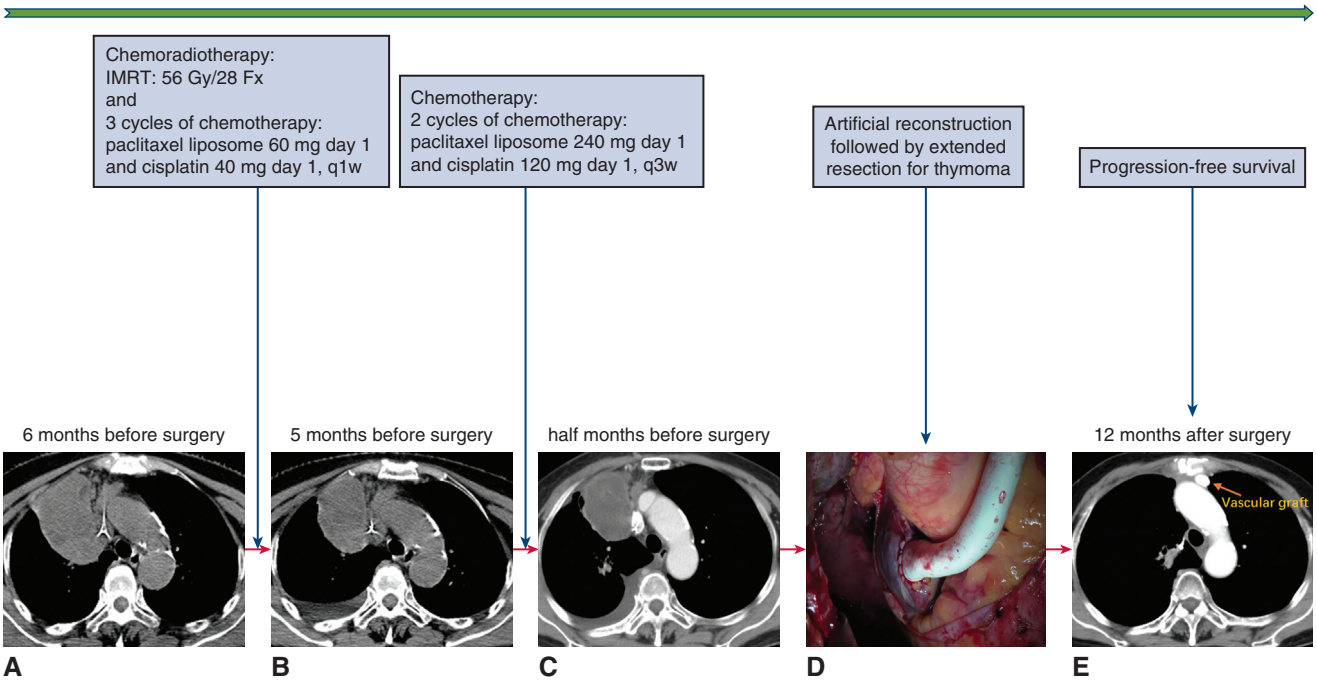


FIGURE 1. Flow chart of the patient's treatment process. The patient underwent 6 weeks of chemoradiotherapy and a further 8 weeks of standard chemotherapy after 2 months' recovery from chemoradiotherapy (A, B, C). The patient then underwent superior vena cava reconstruction followed by extended resection to achieve a complete resection for thymoma (D). No tumor recurrence was detected and the artificial vessel was patent 12 months after surgery (E). *IMRT*, Intensity-modulated radiation therapy; *Fx*, fraction; *q1w*, once weekly; *q3w*, once every 3 weeks.

dissect the left innominate vein (Figure 2, *B*). Heparin with 1 mg/kg was given for anticoagulation, and a polytetrafluoroethylene artificial vessel with a 10-mm diameter was anastomosed to the distal end of the left innominate vein (Figure 2, *C*). The other end of the artificial vessel was anastomosed to right auricle (Figure 2, *D*). Then the

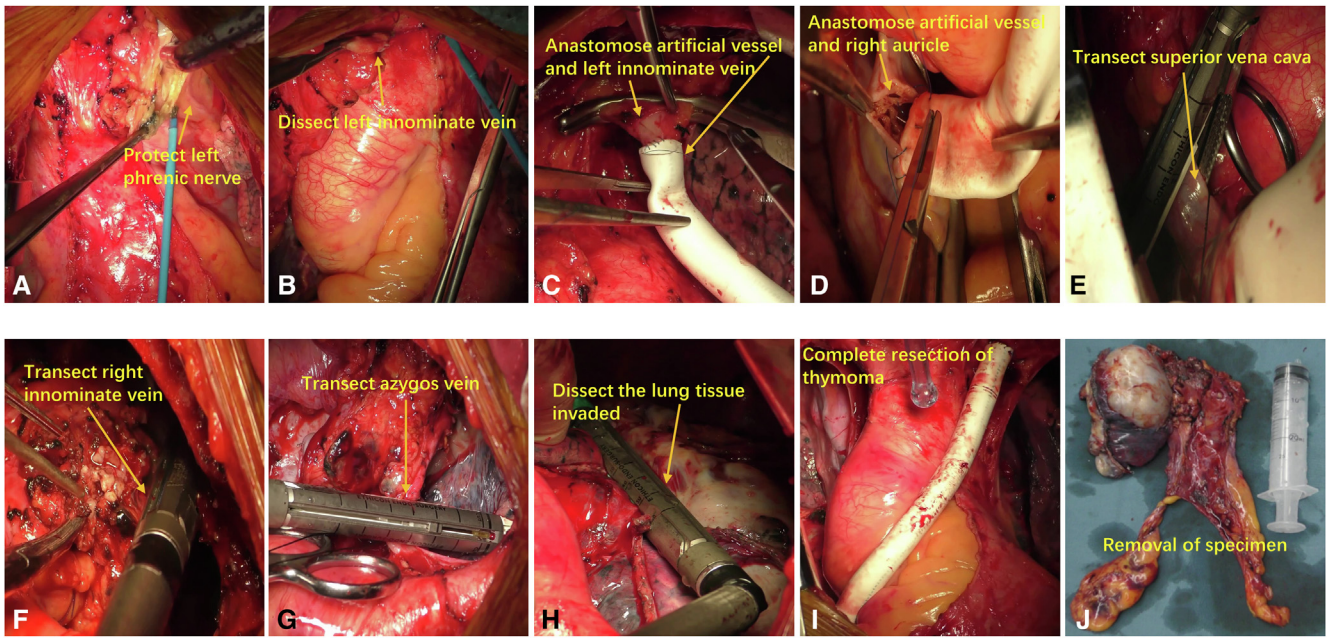
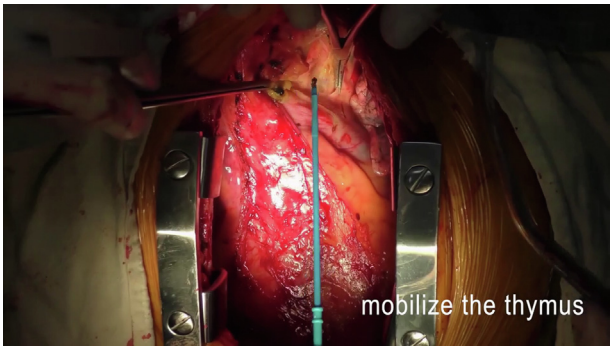


FIGURE 2. Surgical procedure of superior vena cava (*SVC*) resection and reconstruction between a *left* innominate vein and *right* auricle. A, Mobilize the thymus and protect the *left* phrenic nerve. B, Block and dissect the *left* innominate vein. C, Anastomose artificial vessel to the *left* innominate vein. D, Anastomose artificial vessel to *right* auricle. E, Block and transect the SVC. F, Block and dissect the *right* innominate vein. G, Block and dissect the azygos vein. H, Dissect the *right* upper lung tissue invaded by thymoma. I, Complete resection of thymoma and the invaded SVC. J, Removal of the specimen.



VIDEO 1. Details of the surgical procedure. Video available at: https://www.jtcvs.org/article/S2666-2507(22)00373-X/fulltext.

SVC, right innominate vein, and azygos vein were transected (respectively, Figure 2, *E*, *F*, and *G*). The right upper lung tissue invaded by the thymoma was dissected (Figure 2, *H*) and the specimen was finally removed (Figure 2, *I* and *J*).

The operation time was 185 minutes and the intraoperative blood loss was 300 mL. No complications occurred in the perioperative period. The duration of chest tube was 9 days, and the hospital stay after surgery was 10 days. Oral rivaroxaban, 10 mg once daily, was used for long-term postoperative anticoagulation. By the follow-up date, it had been 12 months since the surgery, and no tumor recurrence was detected, and the artificial vessel was patent (Figure 1, *E*).

DISCUSSION

SVC resection and reconstruction might be the best treatment for SVC syndrome. However, SVC reconstruction is a challenging procedure that requires a detailed preoperative assessment of the vascular situation and a skilled vascular anastomosis technique.[2] We recommend a surgical strategy of SVC reconstruction followed by extended resection of the thymoma because we believe that completion of SVC reconstruction avoids complete blockage of the SVC and facilitates the subsequent tumor resection procedure. In this case we performed a single artificial vessel from the left innominate vein to the right auricle for SVC reconstruction, and no complications due to the artificial vessel were detected during the follow-up of up to 12 months. Therefore, a single artificial vessel might be sufficient for SVC reconstruction in some cases.[3]

Many materials, such as bovine pericardial conduit and artificial synthetic materials, have been used to create artificial vessels for SVC reconstruction,[4,5] each with its own advantages and disadvantages. The choice of artificial vascular material should be determined according to the patient's condition and the situation of the surgical center. An artificial blood vessel made of biomaterials that does not require long-term anticoagulation might be a better option. Although we still adopt a conservative long-term anticoagulation because of concerns about postoperative embolic complications, the strategy of long-term anticoagulation after SVC reconstruction is still controversial and needs to be addressed in the future.

Finally, it is worth noting that when performing tumor resection, care should be taken to block the SVC first to prevent embolism caused by tumor thrombus shedding in the SVC. Care should also be taken to protect the left phrenic nerve to avoid causing bilateral phrenic nerve injury. In conclusion, extended resection of thymoma combined with SVC resection and reconstruction can be used to treat patients with thymoma with SVC syndrome.

Webcast

You can watch a Webcast of this AATS meeting presentation by going to: https://www.aats.org/resources/1551.

References

1. Bacha EA, Chapelier AR, Macchiarini P, Fadel E, Dartevelle PG. Surgery for invasive primary mediastinal tumors. *Ann Thorac Surg*. 1998;66:234-9.
2. Kameyama K, Okada S, Shimomura M, Numata S, Yaku H, Inoue M. Extrathoracic superior vena cava bypass with venous return cannulas in malignant mediastinal tumor surgery. *Ann Thorac Surg*. 2021;112:e87-9.
3. Sekine Y, Suzuki H, Saitoh Y, Wada H, Yoshida S. Prosthetic reconstruction of the superior vena cava for malignant disease: surgical techniques and outcomes. *Ann Thorac Surg*. 2010;90:223-8.
4. Ciccone AM, Venuta F, D'Andrilli A, Andreetti C, Ibrahim M, De Giacomo T, et al. Long-term patency of the stapled bovine pericardial conduit for replacement of the superior vena cava. *Eur J Cardiothorac Surg*. 2011;40:1487-91; discussion 1491.
5. Maurizi G, Poggi C, D'Andrilli A, Vanni C, Ciccone AM, Ibrahim M, et al. Superior vena cava replacement for thymic malignancies. *Ann Thorac Surg*. 2019;107:386-92.

Discussion

Presenter: Dr Jia-Hao Jiang

Dr Erino Angelo Rendina *(Rome, Italy)*. Thank you very much for the privilege of discussing this paper, which is very interesting, however, we have a totally different strategy. So, I will do some comments, more comments than questions, I'm afraid. The others should certainly be commended for presenting an unusual strategic approach to SVC reconstruction associated with thymoma, that is first replace the SVC and subsequently resect the tumor, which is the opposite of what we normally do for some reasons.

First of all, because the graft is in your way while doing the resection. Second reason is because we did reconstruct the left innominate vein 25 years ago, but then we realized that trimming it to the proper length with the sternum open and spread is very difficult, and sometimes, it coils and bends, and it might cause thrombosis. Another thing that might cause thrombosis is the anastomosis on the auricle on the right atrial appendage which as we all know has a trabecular anatomy and is very uneven. So, this is the reason why our preferred strategy, when possible, for tumors of the thymus abutting on the right side is to close the left innominate vein, clamp the right innominate vein, clamp the superior vena cava into the pericardium, which is never infiltrated. Tumors in that area usually infiltrate the lung, infiltrate the phrenic nerve, but because of the pericardial fold, the origin of the superior vena cava is almost never infiltrated. At least, this is with my personal experience. Speaking about clamping, no shunt is needed. We used to use it many years ago but now with proper cerebral monitoring, we can safely clamp the venus access completely even up to an hour, which is enough time to do anastomosis and resect the tumor, and with no consequences for the patient.

So, having said this, we prefer to resect the patient first, reconstruct the access, which is a direct access from the right innominate vein to the superior vena cava. Straightforward, very smooth endocardium in the superior vena cava, easy anastomosis, and the regular access. Having said this, I have one question. Why use PTFE and maintain long-term anticoagulation when you can use biological prosthesis like pericardium, which is what we usually use? Thank you very much.

Dr Jia-Hao Jiang *(Shanghai, China)*. Thank you. Can you repeat your question?

Dr Rendina. Why use PTFE? Why PTFE and anticoagulation at long-term? We use pericardium, 4 weeks anticoagulation, and then it's over with anticoagulation.

Dr Jiang. Okay, thank you. I see. I'm sorry. There's only 1 type of artificial vessel available for SVC reconstruction at our center for many years, so we don't have the artificial vessels made of other materials. I'm sorry. Thank you.

Unidentified Speaker. Thank you. Reno, if you happen to reconstruct the left side like he did with biological material, what do you think about the patency of that with or without anticoagulation?

Dr Rendina. The thing is that we never reconstruct the left. It's useless. You have swallowing of the left upper limb for some time but then it recovers, so we never reconstruct the left. We have reconstructed the left in the past with awful results. It's almost always invariably thrombosis. It may be because of us. The technique that our colleague showed us is a wonderful technique. I'm not discussing that. It's clean. The video was beautiful. But in my opinion, the strategy could be better.

Dr Jiang. Thank you.

Unidentified Speaker. Thank you. Beautiful video.