Salvaging an accidental superior vena caval transection during a right pneumonectomy by creating a Glenn shunt: A case report and review of the literature

Kallol Dasbaksi, MBBS, MS, MCh (CTVS), Kaushik Mukherjee, MBBS, MS, MCh (CTVS), Enakshi Saha, MBBS, MD (Anaesthesiology), and Plaban Mukherjee, MBBS, MS, MCh (CTVS), Kolkata, India

An iatrogenic injury to superior vena cava (SVC) during a right pneumonectomy for a tubercular destroyed lung can be a life-threatening situation. It may be difficult to control because of severe adhesions in the area and also because of

anatomic distortions. We describe how SVC transection during right-sided pneumonectomy was successfully tackled by clamping the ends, creating a temporary bypass from the SVC to the right atrium (RA) with 2 cannulas, completing the pneumonectomy, and then reestablishing the circulation by anastomosing the SVC to the right pulmonary artery (RPA; Glenn anastomosis).

From the Department of Cardiothoracic and Vascular Surgery, Medical College, Kolkata, India.

Disclosures: Authors have nothing to disclose with regard to commercial support. Received for publication June 11, 2013; revisions received March 7, 2014; accepted for publication April 11, 2014; available ahead of print June 2, 2014.

Address for reprints: Kallol Dasbaksi, MBBS, MS, MCh (CTVS), Medical College, Kolkata, Department of Cardiothoracic and Vascular Surgery (CTVS), 88 College St, Kolkata 700073, India (E-mail: kalloldb@yahoo.com or kalloldasbaksi@gmail.com).

J Thorac Cardiovasc Surg 2014;148:e147-9

0022-5223/\$36.00

Copyright © 2014 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2014.04.027>

CLINICAL SUMMARY

An 18-year-old female patient with symptoms and a diagnosis of tubercular destroyed right lung was undergoing pneumonectomy through a right posterolateral thoracotomy. During dissection at the hilum, the SVC was injured, and during subsequent attempts to control bleeding, the SVC was transected and retracted, resulting in profuse

FIGURE 1. A and B, Intraoperative photographs. C and D, Schematic diagrams. A and C, Vascular clamps were applied to the severed upper end of the superior vena cava (SVC; upper arrow). The horizontal lower arrow points toward the stump of the clamped right pulmonary artery (RPA) after pneumonectomy was completed. A right-angled Pacifico cannula was inserted into the upper stump of the superior vena cava, and a straight cannula was inserted into the right atrial (RA) appendage, maintaining superior vena caval flow to the right atrium. B and D, Completed end-to-end anastomosis between the upper end of the superior vena cava and the right pulmonary artery before removal of the superior vena caval cannula. The azygos vein is seen left intact. LPA, Left pulmonary artery; MPA, main pulmonary artery.

FIGURE 2. Postoperative images from the fourth postoperative year. A, Chest radiography showing opacity in the right hemithorax with dextroposed heart. B, Computed tomographic scan confirming the findings of chest radiography with a hyperinflated left lung. C, The cannula is in the right internal jugular vein (*Int JUG*), and passage of radiopaque contrast on superior vena caval (*SVC*) angiography into both the left pulmonary artery (*LPA*) and the azygos vein. D, Passage of contrast mainly into the azygos vein. E, Contrast in subsequent frames returning through the inferior vena cava (*IVC*) into the right atrium (*RA*), faintly opacifying these structures and the aorta. Some contrast is still present in the azygos vein.

bleeding and hypotension. Clamping the ends of the SVC (Figure 1, A and C) controlled the bleeding but resulted in venous congestion in the SVC territory, and end-to-end repair appeared impossible. After the pericardium was opened, blood transfusion, fluids, and inotropes were infused directly into the RA. Heparinization was done (2 mg/kg), and a temporary shunt was created between the SVC and the left brachiocephalic vein junction and the RA appendage (RAA) with 2 venous cannulas (Figure 1, A and C) for SVC decompression. Creation of the shunt

took about 20 minutes, and the SVC return remained obstructed during this period. We took measures to reduce the rising intracranial pressure (ICP) and possible brain damage by (1) administering a 1000-mg intravenous bolus of thiopental sodium, (2) raising the head end, (3) placing ice packs around the head, and (4) inducing hyperventilation. Incidentally, the azygos vein was found to be draining into the upper stump of the SVC, which also helped in its decompression by flow reversal. After creation of the shunt, a difficult pneumonectomy was completed. Because no

grafts were immediately available, SVC drainage was restored by an end-to-end anastomosis between the cut end of SVC and the cut end of the RPA (Figure 1, B and D). The lower end of the SVC near the RA was closed. Decannulation was performed. Heparin was reversed with protamine. Postoperative recovery was uneventful, although the patient had edema of the face, which resolved slowly thereafter. The patient was discharged in a stable condition after 2 weeks. She was unavailable for follow-up but did come to us again after 4 years for a checkup. At that time she had no symptoms and an oxygen saturation of 98% on room air. The postoperative chest radiograph and computed tomogram in the fourth year showed a hyperinflated left lung and a right-sided opacity, as is expected after a pneumonectomy (Figure 2, A and B). Cardiac catheterization showed the pulmonary arterial pressure to be 20/10 mm Hg (mean, 13 mm Hg). Because the catheter could not be negotiated into the SVC, a separate SVC catheterization was done through the neck; this showed its mean pressure to be 14 mm Hg. SVC angiography (Figure 2, C) demonstrated the contrast to freely flow into the left pulmonary artery, although the majority of the contrast was entering the azygos vein (Figure 2, D) and the inferior vena cava was faintly opacified in subsequent frames (Figure 2, E).

DISCUSSION

The main problems arising from an accidental transection of SVC are (1) maintenance of hemodynamic stability and (2) management of the raised ICP that occurs as a result of the SVC clamping needed to control the bleeding. Planned clamping of an unobstructed SVC has been done during creation of bidirectional Glenn shunt (off pump) or for resection and anastomosis of invasive tumor involving the SVC.¹ Unplanned clamping may be needed for accidental injury to the SVC.² Because there are no venous collaterals in an unobstructed SVC, the ICP can rise markedly. This was treated in our case with thiopental sodium to decrease brain metabolism³ and by creating a shunt from the SVC to the RA to reduce ICP and to maintain hemodynamics.^{2,3} The role of steroids for reduction of raised ICP, as advocated in the past, has not been substantiated by recent studies. Existence of patent azygos vein also facilitates decompression of the SVC by reversal of flow a few minutes after clamping of the SVC, as observed in clinical¹ and experimental models.³

Restoration of SVC-RA continuity in cases of SVC injury or obstruction can be done with polytetrafluoroethylene, autologous or bovine pericardial tube grafts, superficial femoral vein grafts, or composite saphenous spiral vein grafts. In the absence of any graft, end-to-end direct anastomosis between the RAA and end of the left brachiocephalic vein after its transection from its junction with the SVC and rotation may be a feasible option in patients with large RAA. The RAA was small in our case. We made an end-to-end anastomosis of the SVC to the RPA, which did not appear to be difficult in the lateral position. Rescue cavopulmonary shunt has been reported in cases of intractable right ventricular failure⁴ when weaning from cardiopulmonary bypass was not possible, massive right ventricular fibroma, and right ventricular endomyocardial fibrosis. To our knowledge ours is the first case of a “rescue Glenn shunt” for iatrogenic transection of the SVC.

We have not reoperated to restore SVC-RA continuity because the patient has no symptoms, with a normal pulmonary arterial pressure and an acceptable SVC pressure. Had there been any evidence of symptomatic pulmonary arterial hypertension affecting drainage of the SVC, however, reoperation to restore SVC-RA continuity would have been considered. Even in the presence of preoperative moderate pulmonary arterial hypertension, a cavopulmonary shunt would have been feasible in such a scenario, because there is evidence that pulmonary arterial hypertension may regress after its causal factors have been removed by pneumonectomy.⁵

References

1. Leo F, Della Grazia L, Tullii M, Gasparri R, Borri A, Venturino M, et al. Hemodynamic instability during superior vena cava crossclamping: predictors, management, and clinical consequences. *J Thorac Cardiovasc Surg.* 2007;133:1105-6.
2. Agaskar R, Goswami J, Bartarya S. Successful resuscitation in accidental complete transection of superior vena cava during right pleuropneumectomy. *Ind J Anaesth.* 2008;52:569-72.
3. Gonzalez-Fajardo JA, Garcia-Yuste M, Florez S, Ramos G, Alvarez T, Coca JM. Hemodynamic and cerebral repercussions arising from surgical interruption of the superior vena cava. Experimental model. *J Thorac Cardiovasc Surg.* 1994;107:1044-9.
4. Kunihara T, Dzindzibadze V, Aicher D, Schäfers HJ. Bidirectional cavopulmonary shunt for acute right ventricular failure in an adult patient. *Ann Thorac Surg.* 2004;78:1066-8.
5. Tanaka H, Matsumura A, Okumura M, Iuchi K. Pneumonectomy for unilateral destroyed lung with pulmonary hypertension due to systemic blood flow through broncho-pulmonary shunts. *Eur J Cardiothorac Surg.* 2005;28:389-93.