Commentary: No flow? Quick, re-sew

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Pulmonary vein thrombosis is an unusual complication after bilateral cadaveric lung transplantation. In one single-institution series, this condition was diagnosed in just 0.9% of cases,¹ although we have not recorded it at our own institution of more than 700 lung transplant recipients. The morbidity of this complication is high, because the lung can suffer irreversible damage in a short period of time because blood ceases to flow through the lung and the bronchial circulation has been interrupted. The clinical picture may mimic that of primary graft dysfunction, as radiography of the chest shows progressive infiltrates leading to a “white-out” of the lung, as described in this report by Sertic and colleagues.² Pulmonary vein thrombosis is currently diagnosed by transesophageal echocardiogram (TEE), although contrast pulmonary arteriogram has been used in the past. TEE allows us to make a more rapid diagnosis at the bedside, without the risk of contrast toxicity.

The venous anastomosis is usually the widest of the anastomoses performed during lung transplant, because the anastomosis is usually between an atrial cuff from the donor to the common inferior and superior vein opening (Figure 1). Although the literature is lacking in terms of reports of risk factors for thrombosis, risks are thought to include narrowing of the anastomosis, exposure of atrial muscle to the inner aspect of the anastomosis, an increased coagulable state, low blood flow through the organ, or “kinking” of the anastomosis due to extra tissue used for the anastomosis (usually when the donor heart was not harvested and ample atrium is harvested with the lung block). Several techniques have been developed to decrease the amount of thrombogenic atrial muscle exposed to the interior of the venous anastomosis, especially to decrease embolic phenomena (Figure 1). We have also found that previous percutaneous therapy (eg, radiofrequency ablation) for atrial arrhythmia can scar and contract the recipient's venous cuff, making venous anastomosis especially challenging.

It is now standard practice for the anesthesiologist to perform a TEE assessment of the velocity of flow across the venous anastomosis at the time of transplant, once the

Endocardium is apposed to endocardium for venous anastomosis during lung transplantation.

Central Message

Rapid progression of infiltrates should prompt consideration of venous stenosis or thrombosis after lung transplant. Precise techniques and evaluation of flows across the anastomosis are critical.

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organ is reperfused. The velocity should be less than 1 m/s. If there is any doubt, pressures across the anastomosis can be directly measured by the surgeon with a needle connected to a pressure transducer. The pressure gradient should be less than 10 mm Hg. If increased or turbulent flow is apparent or if the pressure gradient is high, takedown and reanastomosis should be considered.

In the current study, the TEE-measured velocities across the venous anastomoses at the time of implantation appeared to be acceptable and showed no kinking or stenosis. However, the need for venoarterial extracorporeal membrane oxygenation (ECMO) postimplantation likely resulted in a low flow state across the anastomosis, and the blood products given to assist with postoperative bleeding likely resulted in a relative hypercoagulable state, promoting thrombosis. Although venovenous ECMO relies on full flows through the transplanted lung, venoarterial ECMO will result in bypassing of the lungs, with significantly decreased blood flow across the pulmonary venous anastomosis. The point of this report by Sertic and colleagues² is that it is important to consider venous thrombosis in the postoperative period when new developing infiltrates or edema are seen.

Fortunately, venous thrombosis was considered fairly early in the reported patient, and the graft could be partially salvaged. This may not always be the case, and pneumonectomy may be required if the graft is necrotic. It is interesting to note that, even with a “short” period of time with venous thrombosis, the lung sustained major damage and its function was ultimately severely compromised. Additional

A

B

FIGURE 1. Intraoperative photograph (A) and artist's rendering (B) depict the technique in which endocardium is apposed to endocardium for venous anastomosis during lung transplantation. This method avoids exposure of the blood flow to thrombogenic myocardium. Used with permission from Norton Thoracic Institute, Phoenix, Arizona.

procedures (eg, pneumonectomy or retransplant) were avoided. The surgeons are to be commended on their care of this technically challenging patient, particularly in terms of the use of venoarterial ECMO as a bridge to transplant and the management of the perioperative challenges. I believe their decision to redo the anastomosis was entirely appropriate. The surgeon should avoid placing a clamp across the atrium, because this could dislodge the thrombus and cause potentially catastrophic embolic complications. Fortunately, with precise implantation techniques and

adequate evaluation of flows across the anastomosis after reperfusion using TEE, this complication should remain uncommon.

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