Surgical Technique

Pulmonary artery anastomosis during lung transplantation: a novel technique

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Abstract: Pulmonary artery anastomosis (PAA) is a critical step in lung transplantation. The conventional approach involves end-to-end anastomosis, which can lead to arterial tortuosity, oozing, stenosis, and thrombosis. Here, we present a modified PAA technique for lung transplantation. The anesthesia protocol and the incision for lung transplantation adhere to standard lung transplantation protocols. The primary innovation is the enhanced pulmonary anastomosis technique. The donor and recipient artery stumps are adjusted to restore their natural anatomical alignment. The donor-recipient stump is everted, ensuring precise alignment of the intima of the donor and recipient arteries. Both ends of the anastomosis are secured using 5-0 Prolene sutures to ensure stability and traction, followed by continuous suturing. In this study, seven patients underwent PAA using this novel technique. Notably, no bleeding was observed upon unveiling and deaerating the anastomosis, eliminating the need for additional sutures. Furthermore, no pulmonary artery torsion or significant prolongation of the anastomotic procedure was observed. Postoperative computed tomography of the chest revealed no anastomotic stenosis or mural thrombosis. This novel cuff anastomosis technique can reduce the risk of thrombosis and prevent torsion and stenosis in the reconstructed artery.

Keywords: Pulmonary artery anastomosis (PAA); lung transplantation; technique

Submitted Jul 26, 2023. Accepted for publication Dec 08, 2023. Published online Jan 05, 2024.
doi: 10.21037/jtd-23-1147
View this article at: https://dx.doi.org/10.21037/jtd-23-1147

Introduction

Pulmonary artery anastomosis (PAA) is a critical step in lung transplantation. However, the techniques used in this procedure can vary among medical centers (1-4). Conventional suture techniques include interrupted, simple continuous, and stapler-assisted sutures, each of which has advantages and disadvantages (5-7). Although PAA is relatively straightforward, conventional suture techniques can lead to severe intraoperative complications, such as profuse bleeding, stenosis, distortion of the reconstructed vessels, and postoperative anastomotic mural thrombus. To enhance surgical field exposure and reduce bleeding and anastomotic torsion, we have introduced the use of Prolene sutures and a polyester cardiovascular patch and assistance to facilitate pulmonary stump traction. However, these experiences are limited to isolated case reports; detailed records on PAA techniques during lung transplantation are limited.

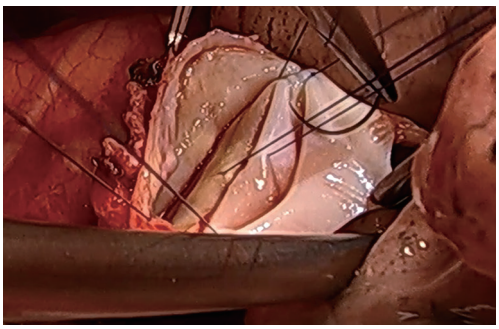


Figure 1 Everted and suspended at both ends and midpoint.

Figure 2 Suture the posterior wall.

Here, we present a modified PAA technique to address these potential complications without increasing the anastomosis time. We present this article in accordance with the SUPER reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1147/rc).

Preoperative preparations and requirements

Indications for lung transplantation include a wide range of pulmonary diseases affecting the airways, parenchyma, and vasculature. All seven patients in our study had end-stage lung disease.

The anesthesia protocol and the incision for lung transplantation adhere to standard lung transplantation protocols. The primary innovation is the enhanced pulmonary anastomosis technique. This novel approach requires the donor and recipient to have an adequate length of pulmonary artery.

Highlight box

Surgical highlights

- The donor-recipient stump was everted, ensuring precise alignment of the intima of the donor and recipient arteries.

What are conventional and novel/modified techniques?

- The conventional technique involves end-to-end and simple continuous pulmonary artery anastomosis (PAA).
- In a novel technique, the donor-recipient stump is everted, ensuring precise alignment of the intima of the donor and recipient arteries. Both ends of the anastomosis are secured using 5-0 Prolene to ensure stability and traction.

What are the implications, and what should change now?

- Notably, no postoperative complications, such as thrombosis, torsion, and stenosis, were observed in patients who underwent PAA using the novel technique. These findings indicate that the novel cuff technique reduces the risk for these complications without prolonging the anastomosis time, making it a promising technique for lung transplantation.

Step-by-step description

Prior to commencing PAA during lung transplantation, it is essential to realign the donor and recipient stumps to their natural anatomical alignment. This process involves the eversion of the donor-recipient stump, ensuring precise alignment of the intima of the donor and recipient arteries. Both ends of the anastomosis are secured using 5-0 Prolene sutures (Ethicon, Somerville, NJ, USA) to ensure stability and traction. Subsequently, these sutures are straightened at both ends of the anastomosis to facilitate the suturing of the posterior wall of the arterial anastomosis. Furthermore, an additional 5-0 Prolene suture is typically introduced to the posterior wall to optimize the alignment of the donor and recipient pulmonary arteries while ensuring a clear field of vision. This suture is knotted at one end of the anastomosis and used to execute a sleeve-like simple continuous suture; this involves suturing to the hanging thread, followed by sequential trimming of the hanging thread (*Figures 1-4*). After a lap of continuous suturing and exhaustion, the arterial anastomosis is finalized through knotting. This technique is demonstrated in *Video 1*.

Postoperative considerations and tasks

No differences were observed between the novel and conventional PAA techniques in the postoperative management of patients. After the completion of pulmonary vein anastomosis, the last suture was left untied (a needle cannot be tied). The pulmonary artery was fully exhausted before the pulmonary vein was tied. After opening, the

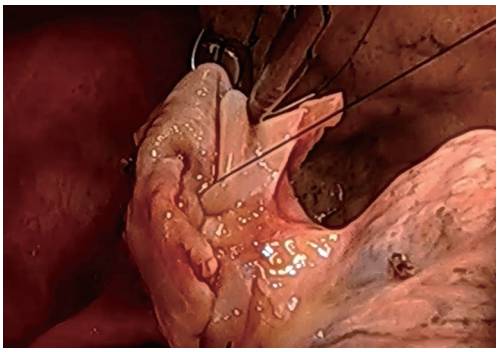


Figure 3 Suture the anterior wall.

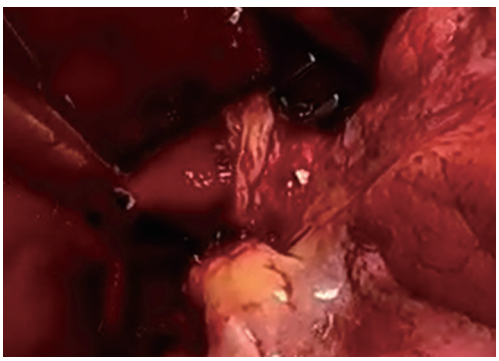
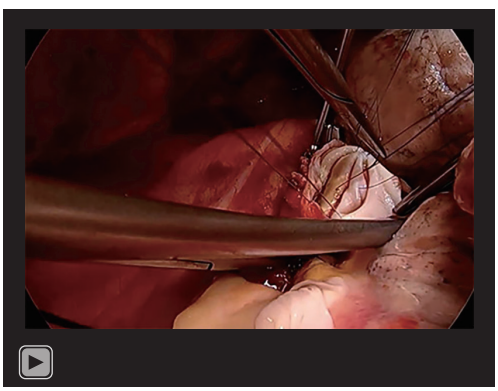


Figure 4 PAA in the partially open state. PAA, pulmonary artery anastomosis.



Video 1 Pulmonary artery anastomosis technique.

artery was observed for torsion, angulation, oozing, and color changes to the lung surface after reperfusion. Postoperative computed tomography was performed as needed.

Tips and pearls

Evert the donor-recipient stump before performing pulmonary anastomosis to ensure precise alignment between the intima of the donor and recipient arteries.

Discussion

PAA is a crucial step in lung transplantation; the quality of the anastomosis has a significant impact on the circulation and function of the transplanted lung (1-3). Conventional PAA techniques, such as interrupted, simple continuous, and stapler-assisted sutures, can be associated with varying degrees of bleeding, torsion, deformity, and other complications (4-7).

We have introduced a novel PAA technique without increasing the anastomosis time. This technique involves end-folding the stumps of the donor and recipient pulmonary arteries, which is equivalent to using a polyester cardiovascular patch before anastomosis. A unique traction line suspension system allows the anastomosis to be performed by a single surgeon.

In 2022, we used this novel technique to perform lung transplantation in seven patients. All patients were male, aged 53–74 years (median age, 66 years), with a median body mass index of 19.66 kg/m^2. Four and three of them underwent left and right lung transplantation, respectively.

The mean duration of arterial anastomosis was 14.14±3.48 minutes. Notably, no instances of blood leakage, angulation, or torsion were observed at the arterial anastomosis site after opening the pulmonary artery. Postoperative computed tomography of the chest revealed no stenosis or thrombosis at the anastomosis site (*Figures 5*,*6*). Our method has several advantages over conventional techniques. First, the end-folded pulmonary artery acts like a gasket, preventing distortion and angulation caused by poor alignment, avoiding leakage, and reducing the risk for postoperative mural thrombosis of the anastomosis by ensuring proper alignment of the vascular intima. Second, the suspension wire system allows for effective anastomosis of mismatched pulmonary arteries by aligning the pulmonary artery and reducing the needle distance on the side with the smaller diameter. It also has a few limitations. First, sufficient length of the pulmonary artery must be preserved in the donor and recipient. Second, care must be taken to avoid over-rotating the pulmonary artery during the turning process to prevent excessive tension in the anastomosis.

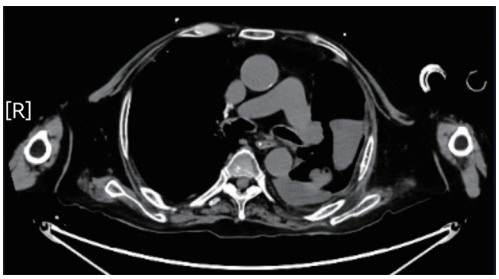


Figure 5 Computed tomography after left lung transplantation.

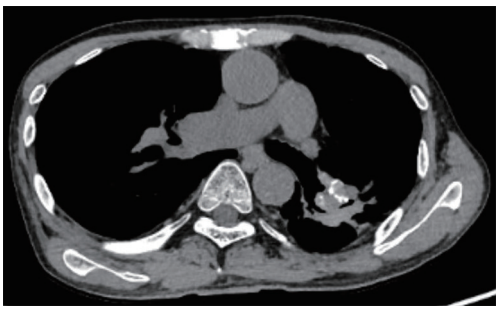


Figure 6 Computed tomography after right lung transplantation.

Conclusions

Our novel cuff anastomosis method reduces the risk of thrombosis, torsion, and stenosis in reconstructed arteries without increasing anastomosis duration. This method is a critical step in improving the process of lung transplantation.

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the SUPER reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1147/rc

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1147/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1147/coif). J.H. serves as Executive Editor-in-Chief of *Journal of Thoracic Disease*. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this article and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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Cite this article as: Liu M, Peng G, Yang C, He J, Xu X. Pulmonary artery anastomosis during lung transplantation: a novel technique. J Thorac Dis 2024;16(1):768-772. doi: 10.21037/jtd-23-1147