A modified technique for single-stage repair of complete tracheal rings and pulmonary artery sling in a symptomatic newborn

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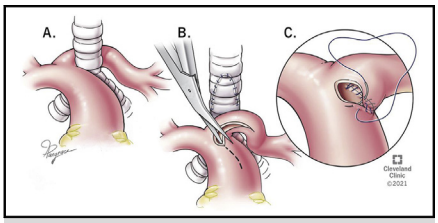


Illustration of tracheal reconstruction and left pulmonary artery "U-plasty."

CENTRAL MESSAGE

We elucidate a modified technique that facilitated successful repair in a 4-kg infant with left pulmonary artery sling, complete tracheal rings, and tracheal diverticulum.

See Commentary on page 451.

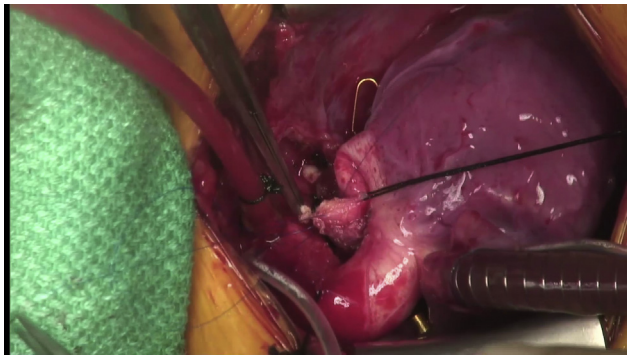
Video clip is available online.

Left pulmonary artery sling (PAS) is a rare condition characterized by the left pulmonary artery (LPA) originating from the right pulmonary artery and coursing behind the trachea to the lung. PAS is associated with complete tracheal rings, a pair of findings termed "ring-sling complex."[1] We describe our modified technique for complete one-stage repair of this entity in an infant with associated tracheal diverticulum (Video 1). Institutional review board approval was not required for this single case report, given that the parents provided informed written consent for the publication of the study data.

CASE SUMMARY

A 2-month-old male patient weighing 4.53 kg presented with stridor requiring heliox and difficulty feeding. Echocardiography demonstrated a structurally normal heart, and cardiac computed tomography confirmed PAS (Figure 1). The trachea measured 3 mm at the level of the aortic arch and narrowed at the level of the LPA. Bronchoscopy showed anterior compression and complete tracheal rings.

Through a median sternotomy, the trachea was approached between the aorta and superior vena cava above the right pulmonary artery. The trachea and carina were skeletonized in the posterior mediastinum, and mobilization was extended on the inferior aspect of the carina and the 2 main bronchi, with care taken to avoid the recurrent nerves running parallel in the tracheoesophageal groove. The patent ductus arteriosus was then divided. Cardiopulmonary bypass was established, and the LPA was fully mobilized. The stenotic airway segment measured 28 mm. The trachea was divided in the middle of the stenotic segment, beveling the posterior and anterior components. The tracheotomy in the proximal portion was made anteriorly and extended beyond the stenotic segment, while the distal segment was incised posteriorly. This mismatch necessitated removing one tracheal ring from the proximal portion to equalize these segments (Figure 2, *A*). With the tracheal segment opened, anterior translocation of the LPA was facilitated. Given that an Achilles' heel of pulmonary artery reconstruction in small infants can be anastomotic narrowing or "kinking," we avoided the need for transection of the LPA and reimplantation. Instead, after tracheal division and control of both branch pulmonary arteries with vascular clips, the LPA was moved anterior to the trachea but then was sewn directly in an in situ manner to the main pulmonary artery



VIDEO 1. Video demonstrates a modified technique for complete repair of pulmonary artery sling, including the anterior-posterior tracheal incisions used for slide tracheoplasty and the left pulmonary artery "U-plasty." Video available at: https://www.jtcvs.org/article/S2666-2507(21)00586-1/fulltext.

(MPA) using a "U-plasty." This modified technique involves incising the MPA–LPA junction longitudinally and closing it transversely as a "U" plasty to the MPA with running 6-0 PROLENE suture (Figure 2, *B*). This maneuver effectively straightened the LPA segment to avoid kinking due to excessive length. Slide tracheoplasty was performed with running 5-0 PROLENE suture, which is our preference. Airtight anastomosis was confirmed with insufflation of 30 mm Hg positive pressure. The patient was then separated from cardiopulmonary bypass with excellent hemodynamics, and intraoperative bronchoscopy confirmed a widely patent airway. Postoperative course was uncomplicated, and the patient was discharged in 14 days with postoperative echocardiogram showing mild turbulence across the LPA (peak velocity of 2 m/s) without stenosis and rigid bronchoscopy showing no evidence of stenosis. At 18 months postoperatively, echocardiograms demonstrated no important LPA stenosis, and the baby has been orally feeding with adequate weight gain.

DISCUSSION

This case details a modified approach to repair of complete tracheal rings, PAS, and tracheal diverticulum in a small infant with the "U-plasty" technique. We are aware of 1 other report of successful repair of all 3 lesions by Jabari and colleagues[2] in a patient aged 11 months, via anterior-posterior sliding tracheoplasty with LPA translocation anterior to the trachea. Although LPA translocation without detachment or reimplantation is not a novel technique, we believe that the described "U-plasty" approach in our case is an innovative application of the more commonly used "V-plasty" approach in pulmonary artery

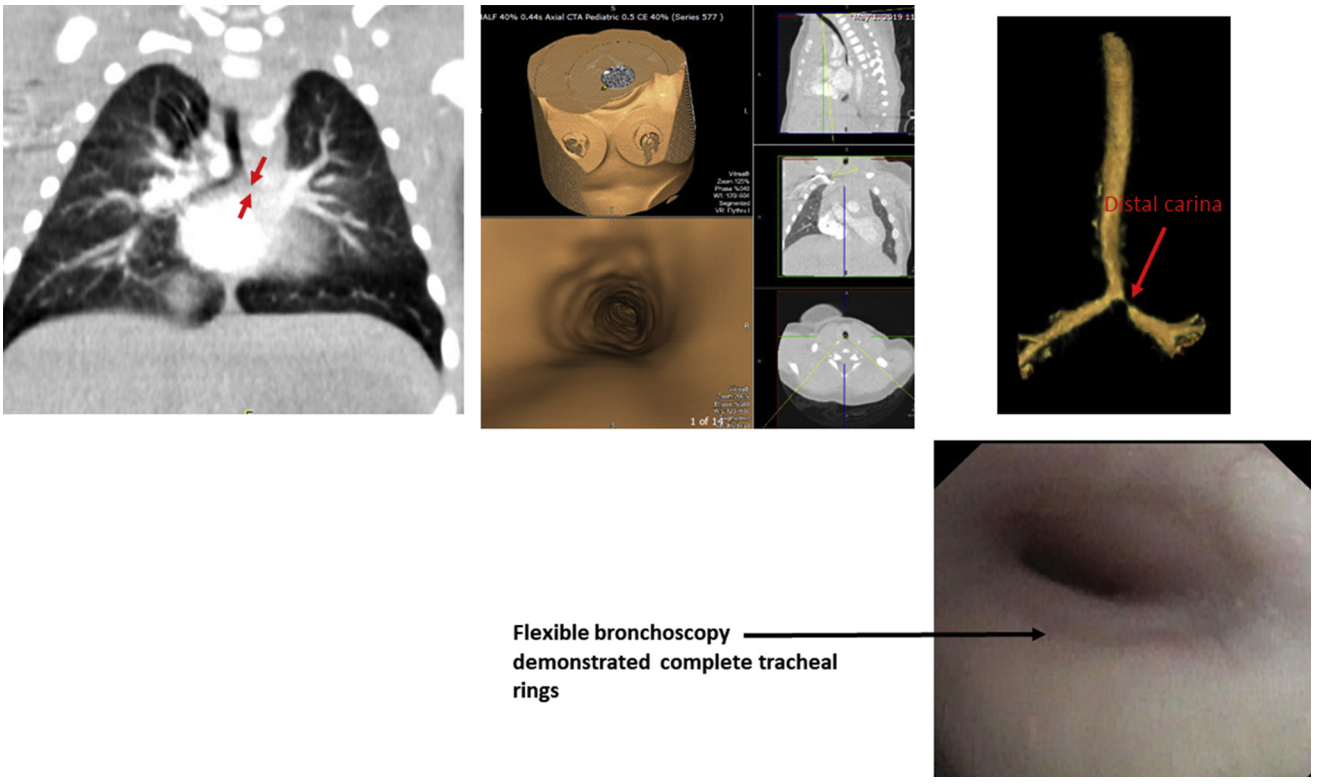


FIGURE 1. Computed tomography evaluation preoperatively with reconstructions illustrates a narrowed airway segment, which was approximately 30 mm in length. Preoperative flexible bronchoscopy confirms complete tracheal rings.

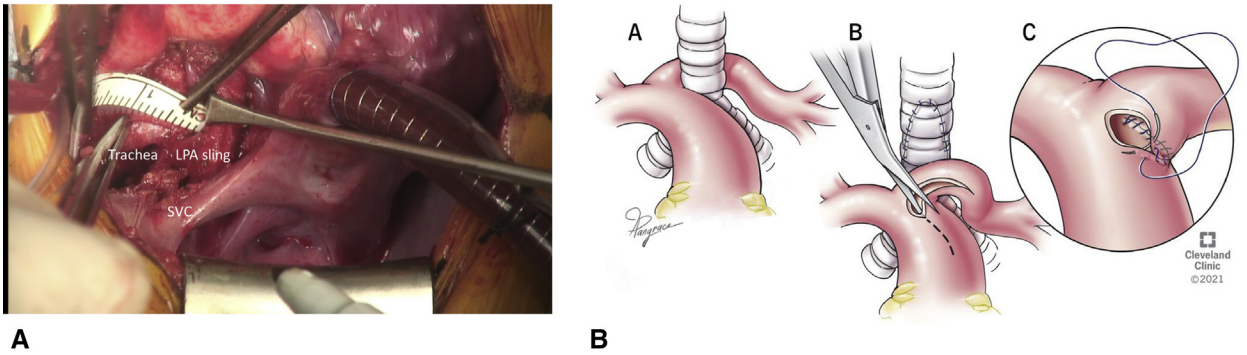


FIGURE 2. A, Intraoperative image shows fully dissected trachea, left pulmonary artery (*LPA*) sling coursing posterior to the trachea, and the superior vena cava (*SVC*). The ruler is used to equalize the proximal and distal segments for tracheotomy during repair. B, Drawing demonstrates the "U-plasty" technique in 3 panels: (A) demonstrates the initial anatomy; (B) shows the incision at the junction between the main pulmonary artery (MPA) and left pulmonary artery (LPA); and (C) demonstrates the transverse closure, effectively completing the "U" plasty to the MPA.

reconstruction of other cardiac anatomic anomalies. The "U-plasty" technique in this case essentially leaves the LPA in an in situ anatomic configuration and may reduce postoperative anastomotic obstruction and LPA kinking, which are the most common complications following standard repair in earlier studies.[1,3] In contrast to other centers, we also elected to use non-absorbable sutures (we prefer PROLENE), as opposed to use of absorbable (ie, polytrimethylene carbonate suture), a practice we have performed in 5 patients in the last 4 years. However, we acknowledge that the use of nonabsorbable sutures is atypical and presents with its own challenges. Further long-term studies will be needed among our patient group.

We agree with Backer and colleagues[4] about the importance of systematic, multimodality evaluation to optimize triage and guide timing of operative intervention. Surveillance postoperatively is also critical, as the prevalence of recurrent tracheal stenosis is not rare, especially when tracheal reconstruction is performed in the early infant period.[5]

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