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Repair of type I truncus arteriosus with pulmonary artery branch preservation and use of a valved PTFE conduit

Corrección del tronco arterioso tipo I con preservación de la anatomía de las ramas pulmonares y uso de conducto valvulado de PTFE

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ABSTRACT

Truncus arteriosus type I is a rare and complex congenital heart defect, the surgical management of which is fraught with the risk of pulmonary branch obstruction. We describe a corrective approach utilizing the Alfieri technique, with a focus on preserving the native pulmonary branch architecture, complemented by the use of a handcrafted PTFE valved conduit for right ventricular outflow tract reconstruction. This strategy mitigates anastomotic tension, thereby reducing the risk of obstruction and endocarditis, and consequently, the need for early reintervention.

Keywords: type I truncus arteriosus, pulmonary artery preservation, PTFE valved conduit.

RESUMEN

El tronco arterioso tipo I es una cardiopatía congénita compleja que requiere tratamiento quirúrgico, el cual conlleva un riesgo significativo de obstrucción de las ramas pulmonares. Se presenta la corrección mediante la técnica de Alfieri, enfocada en preservar la arquitectura de las ramas pulmonares. Además, se utiliza un conducto valvulado de PTFE fabricado in situ para reconstruir el tracto de salida del ventrículo derecho. Esta estrategia reduce la tensión en las anastomoses, minimizando el riesgo de obstrucción y endocarditis, lo que a su vez disminuye la necesidad de reintervenciones tempranas.

Palabras clave: *tronco arterioso tipo I, preservación de amas pulmonares, conducto valvulado de PTFE.*

Abbreviations:
PTFE = polytetrafluoroethylene
VSD = ventricular septal defect

Truncus arteriosus is a rare congenital heart disease characterized by a single arterial trunk giving rise to the aorta, pulmonary arteries, and coronary arteries.[1,2] The classic Collett and Edwards classification distinguishes four anatomic types (I-IV) based on the origin and arrangement of the pulmonary arteries.[3] Type I *(Fig. 1)*, the most prevalent and surgically pertinent variant, features pulmonary arteries arising from a short common pulmonary trunk, thereby dictating the surgical approach required to preserve pulmonary artery integrity and architecture.[3,4] This anatomic consideration underpins the surgical technique described by Alfieris, which prioritizes preservation of the native pulmonary artery architecture during repair.[5]

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Standard surgical management entails separation of the pulmonary arteries from the common trunk, closure of the ventricular septal defect, and reconstruction of the right ventricular outflow tract using a valved conduit to the pulmonary arteries.[1,6] A frequent postoperative complication is pulmonary artery branch stenosis, typically precipitated by branch division, anatomic distortion, and tension at the distal conduit anastomosis, which may precipitate early reintervention and functional decline.[6-8]

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With the heart under aortic cross-clamping, moderate hypothermia, bicaval cannulation, and del Nido cardioplegia, a "hockey-stick" incision is made on the truncal artery and extended toward the left pulmonary artery, allowing clear identification of the common aortopulmonary window *(Fig. 2)*. This approach facilitates preservation of pulmonary artery architecture, a fundamental principle of the technique described by Alfieris.[5]

The defect within the truncal artery is closed using a 0.4-mm polytetrafluoroethylene (PTFE) patch with continuous 6-0 vascular polypropylene sutures, ensuring that the pulmonary artery confluence remains free of obstruction. Subsequently, a right ventriculotomy is performed to expose the ventricular septal defect (VSD), which is closed with a second 0.4-mm PTFE patch using continuous 5-0 vascular polypropylene sutures *(Fig. 3)*.

Prior to surgery, a 10-mm valved PTFE conduit is handcrafted using two 0.1-mm PTFE leaflets. The proximal anastomosis is initiated by positioning the valve as close as possible to the pulmonary artery confluence and suturing it with 6-0 vascular polypropylene suture. The conduit is then tailored and its distal end beveled to complete the distal anastomosis to the right ventricle using 6-0 polypropylene

Figure 1: Three-dimensional computed tomography angiography reconstruction demonstrating type I truncus arteriosus, with a single arterial trunk giving rise to the aorta and pulmonary arteries, including a short common pulmonary trunk and bifurcation into both pulmonary artery branches.

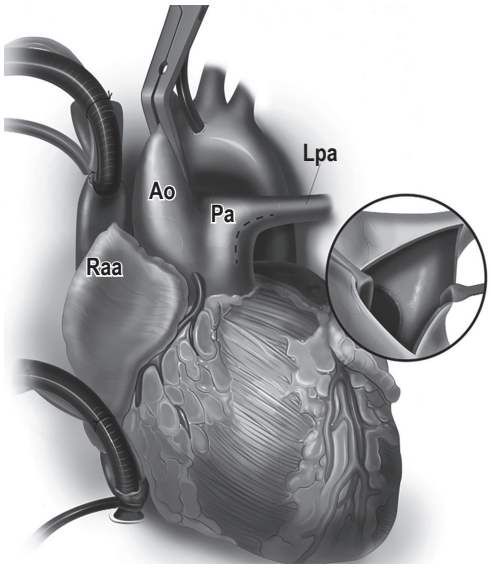

Figure 2: Surgical illustration depicting the aortopulmonary window in type I truncus arteriosus. A "hockey-stick" incision is shown on the arterial trunk, extended toward the left pulmonary artery, providing excellent exposure of the short common pulmonary trunk and facilitating preservation of pulmonary artery branch anatomy.

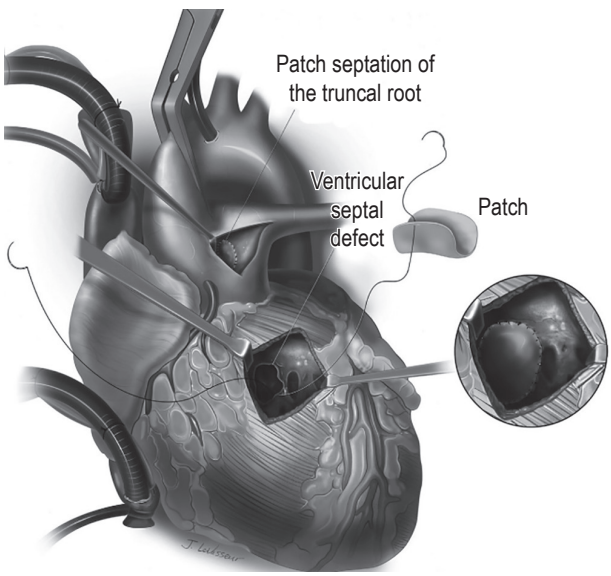

Figure 3: Surgical illustration demonstrating right ventriculotomy with exposure of the ventricular septal defect. Patch closure of the ventricular septal defect and separation of the truncal root using a patch are shown, completing intracardiac repair prior to right ventricle-pulmonary artery continuity reconstruction.

suture, thereby establishing continuity between the right ventricle and the pulmonary arteries. This anastomosis is performed with the heart beating *(Fig. 4) (Fig. 5)*, with the aim of minimizing tension and optimizing conduit alignment.

CONCLUSION

The Alfieris repair technique, which is based on preservation of the pulmonary artery architecture via a cryopreserved aortic homograft, has yielded excellent anatomic and functional outcomes, while reducing the incidence of pulmonary artery branch stenosis.[5] However, the scarcity of homografts in our setting constitutes a significant impediment to its routine implementation. In this context, the utilization of a handcrafted valved PTFE conduit has demonstrated good outcomes in right ventricular outflow tract reconstruction, exhibiting comparable performance to homografts in terms of patency and reintervention rates.[6,7] The combined use of the Alfieris technique, aimed at preserving pulmonary artery architecture, in conjunction with a handcrafted valved PTFE conduit, represents a viable alternative for patients with type I truncus arteriosus and, selectively, type II. This approach may reduce the risk of pulmonary artery obstruction, minimizes tension at the distal anastomosis, and attenuates the need for early reinterventions on the pulmonary arteries, without augmenting the risk of endocarditis or other major complications.[6-8]

Figure 4: Intraoperative image demonstrating the distal anastomosis of a valved PTFE conduit to the pulmonary artery confluence, highlighting the valve leaflets positioned close to the pulmonary bifurcation, with appropriate orientation and no anastomotic tension.

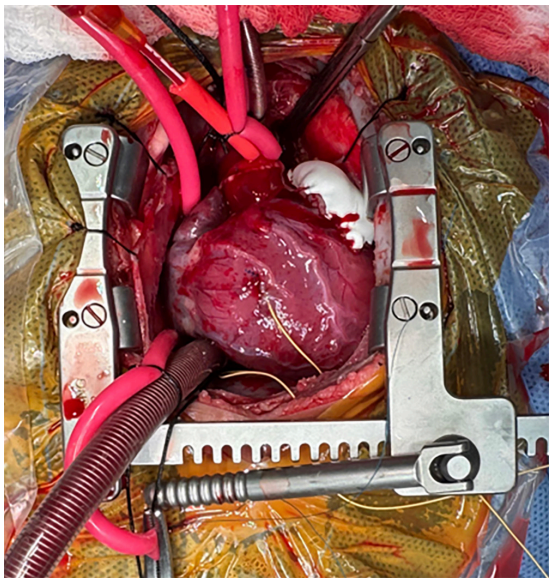

Figure 5: Final intraoperative image demonstrating the proximal anastomosis of the valved polytetrafluoroethylene conduit to the right ventricle, with a beveled conduit end, completing right ventricular outflow tract reconstruction and finalizing the surgical procedure.

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