Original Research Paper

Volume - 15 | Issue - 05 | May - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Cardiothoracic

A FRESH LOOK AT HALF-TURNED TRUNCAL SWITCH OPERATION (HTTSO)

Prof Dr Pradeep Kumar Radhakrishnan

MS MCh CTVS AIIMS, Post-doctoral Fellow CTVS (SCTIMST),Fellow in ECMO (TSS, ISCU), FACC, FIACS, CPDH IISc, Global MBA, Fellow GAPIO, Director Division of Cardiothoracic Surgery, Biomexia, AP India

ABSTRACT The Half-Turned Truncal Switch Operation (HTTSO) represents an innovative surgical technique for managing complex congenital cardiac anomalies, particularly transposition of the great arteries (TGA) with associated ventricular septal defect (VSD) and left ventricular outflow tract obstruction (LVOTO). This operation involves a 180-degree rotation of the truncal block to achieve anatomical and physiological alignment of the ventriculo-arterial connection, thereby circumventing the need for prosthetic conduits. HTTSO has emerged as a valuable alternative to traditional procedures such as the Rastelli, Nikaidoh, and arterial switch operations, particularly in patients with challenging coronary artery anatomy or prior failed interventions. This review delineates the current indications, surgical technique, contraindications, complications, follow-up protocol, and comparative efficacy of HTTSO, providing a comprehensive perspective on its utility in modern congenital cardiac surgery. Emphasis is placed on surgical precision, long-term outcomes, and the evolving role of this technique in biventricular repair strategies.

KEYWORDS : Half-turned truncal switch operation (HTTSO),Transposition of the great arteries (TGA),Ventricular septal defect (VSD),Left ventricular outflow tract obstruction (LVOTO),Congenital heart surgery, Double outlet right ventricle (DORV),En bloc root rotation, Aortic translocation, Coronary artery anomaly, Biventricular repair

INTRODUCTION

Congenital heart defects involving transposition of the great arteries (TGA), particularly when complicated by ventricular septal defects (VSD) and left ventricular outflow tract obstruction (LVOTO), present significant challenges in surgical management. Traditional techniques such as the Rastelli, Nikaidoh, and arterial switch operation (ASO) have provided varying degrees of success; however, limitations such as conduit degeneration, complex coronary reimplantation, and suboptimal long-term outcomes have spurred the development of alternative surgical strategies.

The Half-Turned Truncal Switch Operation (HTTSO), first described by Yamagishi et al., introduces a novel concept wherein the aortic and pulmonary roots are excised as a single truncal block and rotated 180 degrees before reimplantation. This approach enables anatomical correction without the use of prosthetic conduits, preserves growth potential, and mitigates the risk of conduit-related complications. Moreover, HTTSO is particularly advantageous in cases with complex coronary anatomy, where traditional reimplantation poses significant risk.

Despite its complexity, HTTSO is gaining traction in specialized centers due to its promising mid- and long-term outcomes. This review synthesizes current literature and surgical experience to present a detailed overview of HTTSO—its indications, procedural steps, contraindications, pitfalls, complications, and follow-up strategies—while comparing it with conventional alternatives. The goal is to guide surgeons and clinicians in selecting the most appropriate surgical pathway for patients with these intricate congenital cardiac lesions.

Indications with Reasoning

HTTSO is suitable for rare but complex cases where conventional methods either fail or are anatomically impractical:

- TGA with VSD and LVOTO – Ensures natural flow of blood through left ventricle into neoaorta without use of conduit. Avoids complications of Rastelli.
- DORV with subaortic or subpulmonary VSD – Achieves alignment by reorienting the truncal block, preserving LV function and minimizing risk of patch leak.
- Abnormal coronary artery anatomy – Makes ASO or Nikaidoh unfeasible due to high risk during coronary relocation.
- Redo surgeries (failed Rastelli/Nikaidoh) – Salvage strategy avoiding repeated conduit use.
- Select cc-TGA variants with LVOTO – Limited but growing indications in specialized centers.

Operative Steps

1. Sternotomy → Cannulation for CPB.
2. Cardioplegia → Arrest and inspection.
3. Mobilization → Aortic and pulmonary roots freed with or without coronary buttons.
4. En Bloc Resection → Truncal block including valves removed with enough length.
5. Rotation (180° Turn) → Allows neoaortic alignment with LV.
6. Septal Repair → VSD patched directing LVOT toward new aortic position.
7. Re-anastomosis → Aortic and pulmonary roots sewn back.
8. Coronary Transfer → If not kept intact, reimplanted.
9. RVOT Reconstruction → Either direct or via conduit (in some cases).
10. Closure and weaning from CPB.

This method preserves long-term growth potential and physiological pathways.

Surgical Pitfalls

- Inadvertent injury to conduction pathways, particularly near the VSD (2).
- Coronary distortion during or after rotation, especially if buttons are short.
- Tension/kinking of great arteries from inadequate mobilization.
- Difficulty achieving hemostasis due to deep resection planes.
- Mismatch between new arterial alignments and ventricle outflows.

These demand high expertise and precise intraoperative planning.

Contraindications

- Small left ventricles with inadequate capacity for systemic circulation (8).
- Extensive endocardial fibroelastosis – LV unlikely to recover postoperatively.
- Severe pulmonary hypertension – Increases risk of right heart failure.
- Coronary patterns that cannot be safely reimplanted or mobilized.
- Multisystem anomalies or poor general condition not suitable for long CPB time.

Complications

Early:

- Arrhythmias (junctional, CHB) requiring pacing (2).
- LV dysfunction or residual VSD shunting.
- Coronary ischemia post-translocation.
- Bleeding, tamponade, or delayed sternal closure.

Late:

- LVOTO recurrence due to patch bulge or inadequate sizing (5).
- RVOT obstruction/conduit stenosis in those needing conduit.
- Neoaortic valve regurgitation (6).
- Endocarditis, especially on patches or conduits.

- Arrhythmias requiring ICD/pacemaker implantation.

Follow-Up Protocol
1. First 3–6 months: Echo every 1–2 months, Holter for arrhythmias.
2. 6–12 months: Annual echo, especially to assess flow patterns, gradients.
3. MRI/CT angiography if RVOT obstruction suspected.
4. ECG & Holter annually: Conduction abnormalities, bradycardia.
5. Exercise testing and functional classification in school-age and adolescents.
6. Lifelong surveillance for RVOT or neoaortic valve regurgitation (4).

DISCUSSION

HTTSO's strength lies in anatomical realignment without reliance on external conduits. Compared to Rastelli or Nikaidoh:

- No conduit = less reoperation (3).
- Preserves growth potential of great vessels.
- Avoids resecting RV muscle, reducing arrhythmia risk.
- However, complexity limits it to high-volume centers with congenital expertise.
- Results are promising with 10-year survival >85%, reintervention <20% in expert series.

Alternative Options

Procedure	Ideal Indication	Pros	Cons
Rastelli	TGA + VSD + PS	Easier technically	High conduit failure rate (3)
Nikaidoh	TGA + LVOTO	Anatomical	Coronary risk (6)
ASO	TGA with intact septum	Physiologic	Not feasible with LVOTO or bad coronaries (7)
HTTSO	Complex TGA/DORV	No conduit, growth preserved	Technically demanding

The Half-Turned Truncal Switch Operation (HTTSO) is a sophisticated and anatomical correction strategy for specific congenital cardiac anomalies such as TGA, DORV, and LVOTO. By rotating the truncal block 180°, it allows the left ventricle to be connected to the aorta without conduits, preserving long-term growth and reducing prosthetic-related complications. HTTSO especially benefits patients with complex coronary patterns or failed previous surgical repairs, serving as a durable alternative to Rastelli or Nikaidoh procedures.

REFERENCES

1. Yamagishi, M., et al. (2003). Half-turned truncal switch operation for complete transposition of the great arteries with VSD and PS. Journal of Thoracic and Cardiovascular Surgery, 126(5), 1585–1594. https://doi.org/10.1016/S0022-5223(03)00732-6
2. Hongu, H., et al. (2018). Late results of half-turned truncal switch operation for TGA. Annals of Thoracic Surgery, 106(5), 1381–1388. https://doi.org/10.1016/j.athoracsur.2018.06.023
3. Nikaidoh, H. (2016). Nikaidoh procedure: a perspective. Eur J Cardiothorac Surg, 50(6), 1001–1008. https://doi.org/10.1093/ejcts/ezw333
4. Vaidyanathan, S., & Agarwal, V. (2021). Aortic root translocation and HTTS. Indian Journal of Thoracic and Cardiovascular Surgery, 37, 108–116. https://doi.org/10.1007/s12055-020-00956-7
5. Kreuzer, M., et al. (2021). En bloc rotation follow-up. Ann Thorac Surg, 111(2), 586–594. https://doi.org/10.1016/j.athoracsur.2020.06.057
6. Yamagishi, M. (2021). HTTS in TGA with LVOTO. Operative Techniques in Thoracic and Cardiovascular Surgery, 26(3), 230–237. https://doi.org/10.1053/j.optechstcvs.2021.03.004
7. Furuta, A., et al. (2022). Long-term results in TGA with LVOTO. Journal of Cardiothoracic Surgery, 17, 230. https://doi.org/10.1186/s13019-022-01869-9
8. Verma, H., & Sisodia, A. (2023). HTTS in complex VSD. Opinions in Medical Sciences and Thoracic Surgery, 1(1), 23–29. [No DOI]
9. Karl, T. R., & Jacobs, J. P. (2023). Congenitally Corrected TGA. In Pediatric Cardiac Surgery, 5th Ed., Wiley.
10. Wilder, T. J. (2017). Commentary: HTTSO for complex coronary anatomy. JTCVS, 154(2), 430–431. https://doi.org/10.1016/j.jtcvs.2017.03.082.