

Perioperative Use of Trans-Esophageal Echocardiography in a Case of Truncus Arteriosus

Mohit Prakash, MD, DM,* Parag Gharde, MD, DM,* Murtaza Sheikh Mohd, MS, MCH,†
Jijo Francis, MD,* and Rohan S. Thottan, MD*

Truncus arteriosus is a congenital cardiac lesion in which a single arterial trunk is associated with a single semilunar valve and ventricular septal defect (VSD). The common arterial trunk gives off the coronary, pulmonary, and systemic circulations. Transthoracic echocardiography (TTE), cardiac angiography, and computed tomography angiography are valuable tools for initial diagnosis and surgical planning. For the perioperative period, TEE not only confirms preoperative findings but also assesses the adequacy of repair by assessing the truncal valve, homograft function, and myocardial function, and guides hemodynamic management.

An extensive description of perioperative management of truncus arteriosus is available in the literature but lacks supportive TEE imaging. We report a patient presenting with type 1 truncus arteriosus scheduled for elective surgical repair and the implication of TEE in perioperative management along with TEE imaging. Written informed consent from the parents of the child was obtained for publishing this report.

CASE DESCRIPTION

A 1-year-old (7kg weight, 74cm height) male child was scheduled for truncus arteriosus repair. The patient had breathing difficulty and repeated lower respiratory tract infection from day 6 of life along with bluish discoloration of the skin and mucous membrane. The patient was evaluated for these complaints and on further investigation, TTE demonstrated a common arterial trunk with mild truncal valve regurgitation and severe pulmonary arterial hypertension. Computed tomography angiography corroborated the TTE findings. A diagnosis of type 1 truncus arteriosus was made and the patient was scheduled for truncus repair.

After the induction of anesthesia a pediatric TEE probe was introduced and a TEE examination was performed (GE, Vingmed ultrasound AS). In the midesophageal (ME) 4-chamber view, a perimembranous VSD with an inlet

extension (size 1.8cm) was seen (Figure 1A). In the ME aortic valve long-axis view, a large subtruncal VSD was seen with septum override of the common truncal valve (Figure 1B). In the transgastric midpapillary view the biventricular systolic function was normal, but there was left ventricular dilation and right ventricular hypertrophy. The probe was then maneuvered into deep transgastric position and the tip ante-flexed with the multiplanar angle at 52° resulting in a biventricular outflow view and septal override of the common truncal valve in diastole (Figure 1C). The left main coronary artery originated 1.5cm from the truncal valve (Figure 2). In the ME truncal artery short axis view, the main pulmonary artery (MPA) ostial diameter measured 1.1 cm, and originated from the left side of the truncal segment (Figure 3A and 3B). The MPA originated 2.9cm from the truncal valve, as seen in the ascending aorta short-axis view at 45° (Figure 3C).

After surgical repair and release of the aortic clamp, the truncal valve was assessed with TEE, and moderate severity regurgitation was found (Video 1). The aortic cross-clamp was reapplied, and repair of the truncal valve was performed with subcommissural plication. Its competency was checked by delivering root cardioplegia under TEE, and trivial regurgitation was seen (Video 2). An aortic homograft of size 12mm was used as the right ventricle (RV) to the MPA conduit (Video 3).

DISCUSSION

Truncus arteriosus represents 1% to 3% of congenital cardiac defects and occurs in 60 to 140 per million live births.¹⁻⁴ Based on the origins of the PAs Collett and Edwards classified truncus arteriosus into 4 types.⁵ Type I (most common) is described as having a short but developed main PA arising from the common trunk before giving off the left and right PAs. When the left and the right PAs originate from the posterior aspect of the common trunk it is classified as type II. In type III, the left and the right PAs originate separately from the lateral aspect of the common trunk. In type IV (rare) truncus arteriosus PA is absent and pulmonary circulation is supplied by major aorticopulmonary collateral arteries (pseudotruncus).

Van Praagh and Van Praagh gave another classification (types A1/B1–A4/B4) which was based on presence (type A) or absence (type B, rare) of a VSD and by relationships of the great arteries.⁶ Modified Van Praagh classification by The Congenital Heart Surgery Nomenclature and Database Project divided truncus arteriosus into 3 types: (1) truncus arteriosus with confluent or near confluent PAs, (2) truncus arteriosus with absence of 1 PA, and (3) truncus arteriosus with interrupted aortic arch or coarctation.⁷

Its anesthetic management focuses primarily on balance between pulmonary and systemic flow and maintaining

From the *Department of Cardiac Anaesthesia, Cardiothoracic Centre, All India Institute of Medical Sciences (AIIMS), New Delhi, India; and †Department of Cardiothoracic and Vascular Surgery, Cardiothoracic Centre, All India Institute of Medical Sciences (AIIMS), New Delhi, India.

Accepted for publication November 8, 2024

Funding: None.

The authors declare no conflicts of interest.

Address correspondence to Dr Parag Gharde, MD, DM, Department of Cardiac Anaesthesia, Cardiothoracic Centre, All India Institute of Medical Sciences (AIIMS), Ansari Nagar, New Delhi 110029, India. Address e-mail to parag.gharde72@rediffmail.com.

Copyright © 2024 International Anesthesia Research Society.

DOI: 10.1213/XAA.0000000000001883

A&A Practice. 2024;18:e01883.

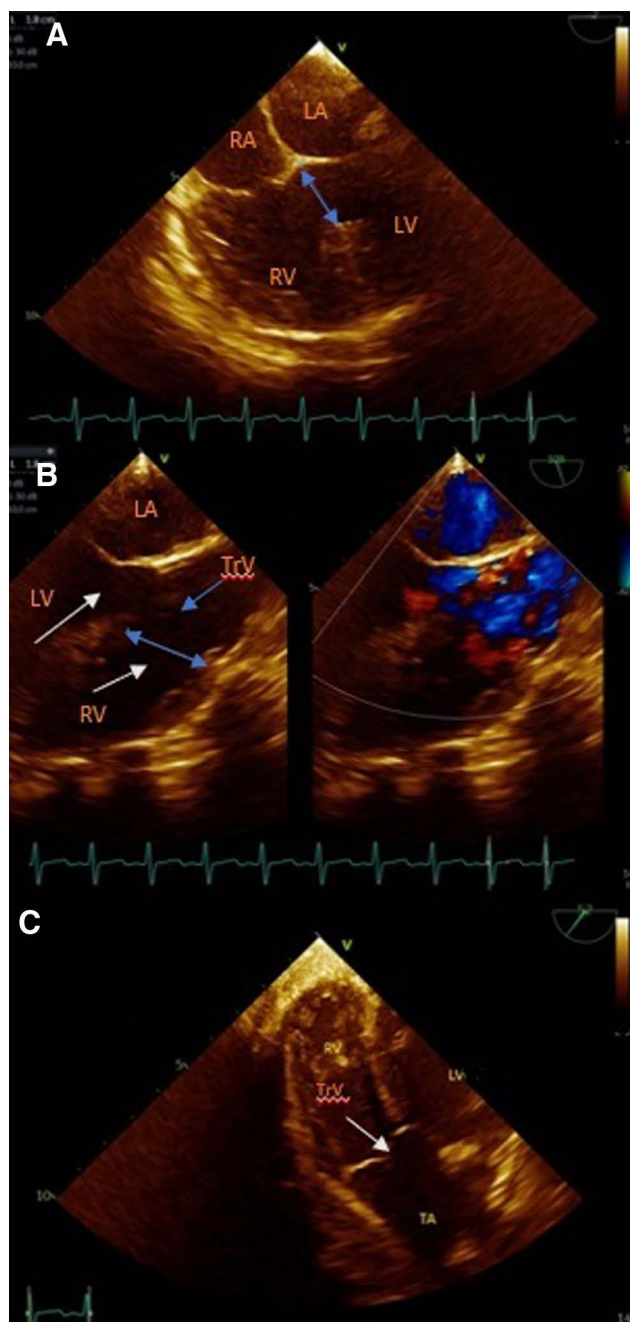


Figure 1. TEE view of VSD in Truncus arteriosus. A, ME 4-chamber view showing inlet VSD. The VSD is of size 1.8cm (blue arrow). B, An ME color compare of the truncal valve in long-axis view at angle 120°. The image shows a septal override of the truncal valve. There is a common outlet for both the left and the right ventricle (white arrow). The subtruncal VSD of size 1.8cm is seen (blue arrow). The color Doppler image in midsystole does not show turbulence across the truncal valve suggesting a nonstenotic truncal valve. C, Deep transgastric view with the probe anteflexed at 52° producing a biventricular outflow view that shows septal override of the common truncal valve (white arrow) in diastole. LA indicates left atrium; LV, left ventricle; ME, midesophageal; RA, right atrium; RV, right ventricle; TrV, truncal valve; TA, truncus arteriosus; VSD, ventricular septal defect.

coronary perfusion.⁸ Truncus arteriosus repair carries the highest risk of intraoperative cardiac arrest of any congenital heart surgery, and thus careful attention to hemodynamic balance is especially critical in this lesion.⁹

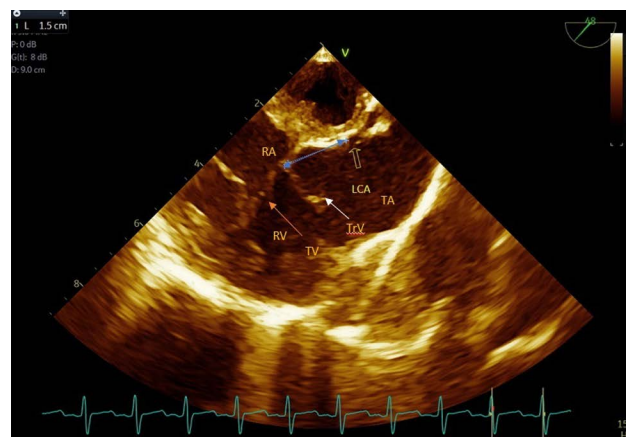


Figure 2. The ME RV inflow-outflow view at a multiplane angle of 48° showing the continuity between the tricuspid valve (orange arrowhead) and the truncal valve (white arrowhead). Also, the origin of the LCA (hollow arrow) from the truncal segment is seen and is at a distance of 1.5cm from the truncal valve (blue arrow). LCA indicates left coronary artery; ME, midesophageal; RA, right atrium; RV, right ventricle; TrV, truncal valve; TA, truncus arteriosus; TV, tricuspid valve.

During peri-operative management of the truncus arteriosus case, TEE can play an important role. The truncal valve is evaluated in its short-axis and long-axis views. The truncal valve short axis view (classically the aortic valve short axis) is obtained by rotating the imaging plane to approximately 45° from ME 5 chamber view.¹⁰ The short-axis view helps in the morphological assessment of the truncal leaflets and, the number of leaflets. In our case, the image attained from the ME 5 chamber with the multiplaner angle at 48° (Figure 2) shows the truncus in its long axis with continuity between the tricuspid and truncal valve and the origin of the left main coronary artery. The truncal valve long axis view (classically the aortic valve long axis) is obtained by rotating the imaging angle to approximately 110° to 130° with the probe at ME level¹⁰ (Figure 1A). This view highlights cusp thickening and mobility, and with the use of color Doppler, the direction of the regurgitant jet (central or eccentric). If there is regurgitation, the mechanism of regurgitation requires delineation so that the surgeon can determine what type of repair is feasible. To obtain the deep transgastric truncal valve long-axis view the probe is advanced further from the transgastric location, then maximally anteflexed and slightly withdrawn to get good contact of the probe with the gastric wall,⁷ thus providing a biventricular outflow view as seen in Figure 1C. This view helps in assessing gradients across the left ventricular outflow tract post VSD closure (Figure 1B), aortic valve function, and RV to MPA conduit (Video 3).

The VSD is classically subtruncal in location. It allows the mixing of the outflow streams coming from the left and RV. In our case, a large peri-membranous VSD with an inlet extension is seen in the RV inflow-outflow view (Figure 1A). The truncal valve long-axis view with the angle at 110° to 120° shares significant information (Figure 1B). Apart from the size of the VSD, it also shows the degree of truncal valve override and allows commenting on the adequacy of the left ventricular outflow passage post-VSD patch closure.

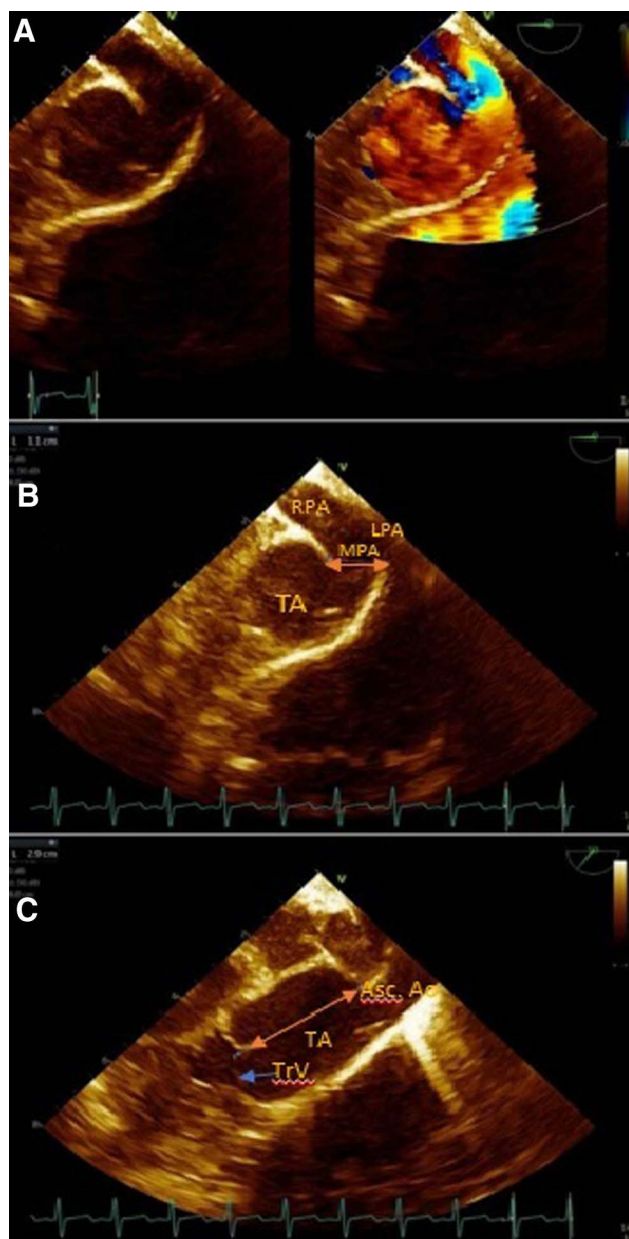


Figure 3. TEE view of Pulmonary Artery origin from Truncus arteriosus. A, The color compares midesophageal ascending aortic short-axis view at an angle of 0° showing the origin of the main pulmonary artery from the truncal artery. The color Doppler image shows turbulence at the main pulmonary artery origin that may be due to flow gradient. B, The midesophageal ascending aortic short axis view at an angle of 0°. The main pulmonary artery measures 1.1 cm at its origin. C, The main pulmonary artery originates at 2.9 cm from the truncal valve (blue arrow). The truncal artery thus is 2.9 cm long and continues as an ascending aorta from the point of origin of the main pulmonary artery. Asc indicates Ao-ascending aorta; LPA, left pulmonary artery; MPA, main pulmonary artery; RPA, right pulmonary artery; TA, truncus arteriosus; TrV, truncal valve.

It is important to look for the coronary artery origin as a high origin of the right coronary artery may result in inadvertent injury during aortotomy. Classically coronary origin is assessed in the aortic valve short-axis view with the angle at 45°, but it is the long-axis view that helps in determining the level of coronary artery origin. In our case at ME

45° view (right ventricular inflow-outflow view) the truncus was seen in its long axis with the left coronary artery (LCA) origin (Figure 2). The distance between the truncal valve and the LCA ostia was measured (Figure 2). Usually, the right coronary artery has a higher level of origin compared to the LCA and both are located below the level of the sino-tubular junction.

The truncal long and short axis view allows us to visualize the origin of the pulmonary artery (PA). The long-axis view gives us the distance of PA take-off from the truncal valve, while the truncal short-axis view informs us about its location. In our case, the anomaly was type I, with the MPA arising 2.9 cm from the truncal valve in the long axis view, while the short axis view showed its origin from the postero-lateral portion of the truncus. Both the axis views also help in measuring the diameter of the PA and with color Doppler reveal evidence of turbulence if the origin is stenotic (Figure 3).

Biventricular size and global and regional function should be noted. The postrepair presence of global ventricular systolic dysfunction suggests poor myocardial protection and prolonged aortic cross-clamp time. The regional wall motion abnormalities commonly suggest compromised coronary perfusion due to air embolism or poor myocardial protection in case of an early bifurcating left main coronary artery during ostial cardioplegia delivery. The transgastric midpapillary short-axis view provides a view that is commonly used to assess ventricular function. This view is obtained by advancing the probe from the ME to the transgastric location, the probe is anteflexed, and withdrawn until contact is made with the wall of the stomach.

Though TEE has an immense contribution, greater care is needed, especially in neonates, where ventilatory problems (high airway pressure and desaturation) can occur during the probe placement due to bronchial compression, endotracheal tube dislodgement during probe manipulation, hemodynamic issues associated with distal thoracic aorta compression and arrhythmias if the probe is anteflexed in the transgastric location. Fortunately, these events are rare (1%–3%).^{11,12} The presence of any vascular ring and its anatomy should also be evaluated as this leads to an increased risk of airway obstruction in these patients.¹³ Patients with truncus arteriosus have PA hypertension and probe placement should be attempted only in deep anesthetic plane or else it may trigger PA hypertension crisis or bronchospasm.

A systematic perioperative TEE evaluation generates voluminous information that can be used in meticulous surgical planning and postprocedure assessment of the adequacy of the repair performed. ■

CLINICIAN'S KEY TEACHING POINTS

- Truncus arteriosus (TA), a rare congenital heart defect, is characterized by a single arterial trunk with a single semilunar valve that provides pulmonary, systemic, and coronary circulations; an associated ventricular septal defect (VSD) is typically present. Various forms of TA exist and are differentiated based on the pulmonary artery (PA) origins from the common arterial trunk.

- Before surgical repair of TA, intraoperative TEE is used to evaluate competency of the truncal valve, determine PA locations, establish baseline ventricular function, and characterize the VSD. In addition, the locations of the coronary ostia are identified and communicated to the surgeon to avoid injury during opening of the common trunk.
- In this case, after initial TA repair, assessment of the truncal valve revealed moderate regurgitation necessitating additional repair.
- Besides assessment of truncal valve integrity, post-bypass TEE examination should include evaluation of ventricular function, interrogation of VSD repair, and evaluation of the newly placed right ventricle to PA conduit.

This manuscript was handled by: Kent H. Rehfeldt, MD.

REFERENCES

1. Urban AE, Sinzobahamvya N, Brecher AM, Wetter J, Malorny S. Truncus arteriosus: ten-year experience with homograft repair in neonates and infants. *Ann Thorac Surg.* 1998;66: S183–S188.
2. Brown JW, Ruzmetov M, Okada Y, Vijay P, Turrentine MW. Truncus arteriosus repair: outcomes, risk factors, reoperation and management. *Eur J Cardio-Thorac Surg.* 2001;20:221–227.
3. Hoffman JIE, Kaplan S. The incidence of congenital heart disease. *J Am Coll Cardiol.* 2002;39:1890–1900.
4. Hoffman JIE, Kaplan S, Liberthson RR. Prevalence of congenital heart disease. *Am Heart J.* 2004;147:425–439.
5. Collett RW, Edwards JE. Persistent truncus arteriosus: a classification according to anatomic types. *Surg Clin North Am.* 1949;29:1245–1270.
6. Van Praagh R, Van Praagh S. The anatomy of common aorticopulmonary trunk (truncus arteriosus communis) and its embryologic implications: a study of 57 necropsy cases. *Am J Cardiol.* 1965;16:406–425.
7. Jacobs ML. Congenital heart surgery nomenclature and database project: truncus arteriosus. *Ann Thorac Surg.* 2000;69:50–55.
8. Parikh R, Eisses M, Latham GJ, Joffe DC, Ross FJ. Perioperative and anesthetic considerations in truncus arteriosus. *Semin Cardiothorac Vasc Anesth.* 2018;22:285–293.
9. Odegard KC, DiNardo JA, Kussman BD, et al. The frequency of anesthesia-related cardiac arrests in patients with congenital heart disease undergoing cardiac surgery. *Anesth Analg.* 2007;105:335–343.
10. Perrino AC, Reeves ST. A Practical Approach to Transesophageal Echocardiography. Lippincott Williams & Wilkins; 2013. p.25.
11. Hilberath JN, Oakes DA, Shernan SK, Bulwer BE, D'Ambra MN, Eltzschig HK. Safety of transesophageal echocardiography. *J Am Soc Echocardiogr.* 2010;23:1115–27.
12. Puchalski MD, Lui GK, Miller-Hance WC, et al. Guidelines for performing a comprehensive transesophageal echocardiographic examination in children and all patients with congenital heart disease: recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr.* 2019;32:173–215.
13. Phoon CK, Bhardwaj N. Airway obstruction caused by transesophageal echocardiography in a patient with double aortic arch and truncus arteriosus. *J Am Soc Echocardiogr.* 1999;12:540.