Right main bronchus obstruction caused by transesophageal echocardiography probe in a pediatric patient during complete repair of tetralogy of fallot

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ABSTRACT
Intraoperative trans-esophageal echocardiography (TEE) is an important monitoring and diagnostic tool used during surgery for the repair of congenital heart lesions. Its ability to be used intraoperatively before and after cardiac repair makes it a unique tool. Although it is generally a safe procedure, due to the relatively large size and rigid nature of TEE probes airway complications, inadvertent extubation and insertion failures have been reported to occur predominantly in smaller patients (mean weight <7.15 kg). We would like to describe a case of complete correction of Tetralogy of Fallot in which intraoperative TEE resulted in right main bronchus compression.

Keywords: Pediatric patients, right main bronchus obstruction, trans-esophageal echocardiography probe

INTRODUCTION
The role of transesophageal echocardiography (TEE) during surgery for congenital cardiac disease to define complex anatomical structures, functional abnormalities, and to monitor hemodynamics is well established. According to practice guidelines established by the Society of Cardiovascular Anesthesiologists and the American Society of Anesthesiologists, there is strong evidence for the usefulness of TEE in surgery for congenital heart disease, because it significantly improves the clinical outcome of these patients. Before surgical correction, TEE helps to confirm the diagnosis, finds any additional lesion, and provides baseline parameters for comparison after the surgical correction. Thus, TEE is now widely used not only in adult but also in pediatric cardiac surgery.

CASE REPORT
A 12-year-old girl weighing 19 kg with Tetralogy of Fallot was scheduled for intracardiac repair. She had complaints of dyspnea on moderate exertion with cyanosis and squatting spells since 3 years of age with room air saturation of 92–95% and she was taking tablet propanolol 10 mg. Transthoracic echocardiography (TTE) showed large perimembranous nonrestrictive VSD with aortic override of 50%, anterior cephaled deviation of outlet septum, severe infundibular and valvular stenosis (PG-103 mmHg), hypoplastic pulmonary annulus (7 mm), pulmonary arteries (MPA-13 mm, RPA-12 mm, LPA-8 mm), and right-sided aortic arch.

On the day of the surgery to ease the separation of child from her parents in preop area, Inj ketamine 190 mg IM
with Inj glycopyrrolate 85 µg intramuscularly was given. Once she slept, she was taken to OT and after standard monitoring and lines was placed, further induction was done with Inj fentanyl 50 µg IV and Inj pancuronium 6 mg IV. The trachea was intubated with a 5.0 cuffed endotracheal tube, fixed at 15 cm, and on auscultation, breath sounds were heard bilaterally equal. A pediatric 2D TEE probe (S8-3t Sector array multiplane on i.e., 33 echo platform, HP) was gently inserted. There was no change in the peak airway pressure, and bilateral equal air entry was confirmed by auscultation after positioning. A complete TEE examination was done and the airway pressures never increased. She was mechanically ventilated with a tidal volume of 8–10 ml/kg, frequency–14/min, with a peak inspiratory pressure (PIP) of 16 cm H2O. Anesthesia was maintained properly with incremental timed doses of fentanyl, pancuronium along with propofol infusion. After sternotomy and heparinization, aortic and bicaval cannulation was done and cardiopulmonary bypass (CPB) was initiated with hypothermia to 28°C. The ventilation was stopped on complete CPB. The surgical steps included infundibular muscle resection, dacron patch closure of perimembranous VSD, and augmentation of pulmonary artery with autologous pericardial patch. In our case, the TEE probe tip could be palpated by the surgeon intraoperatively. After rewarming, the ventilatory support was started and she was weaned of CPB with minimal ionotropic support. Within a minute of weaning, SPO2 started to drop from 100% (FiO2-0.6) to 70% with rise in PIP 20 cm H2O. The right-side pleura was not moving, and on opening it, the right lung was found to be lying completely collapsed in the cavity. Suspecting a mucus plug, ET suction was done but it was clean. She was hand ventilated at a high airway pressure that resulted in sudden popping up of the right lung and improvement in SPO2 to 100%. The mechanical ventilation was started again but the right lung kept inflated at the same volume and it did not deflate and inflate in the cyclic manner. Ultimately, our suspicion was focused on the TEE probe and it was removed. On the examination, TEE probe tip was straight. The ventilation immediately returned to normal with PIP of 12 cm H2O. She had an uneventful postoperative course and was discharged on fourth day with the advice to remain in the follow-up.

**DISCUSSION**

TEE is considered a safe procedure in the pediatric patient when conducted properly. In a study by Stevenson et al. in 1650 pediatric patients to evaluate the complications of TEE, airway obstruction occurred in 14 (1%) patients that resulted in marked increase in airway pressure or marked increase in end-tidal CO2. In their study, they speculated that airway obstruction may be related to compression of the membranous trachea in smaller patients and adopted a policy of positioning the TEE probe in the esophagus at a level above the carina when not imaging. Smaller size of pediatric airway in relation to the size of TEE probe can cause airway compression despite proper probe selection. Large airways in pediatric patients are more readily compressible than in adults because of the greater pliability of their tracheal and bronchial cartilages.

Praveen Kumar Neema et al. described a case of left main bronchus compression in a 4-year-old child with sinus venosus atrial septal defect (ASD) and partial anomalous pulmonary venous connection (PAPVC) that resulted in rise in PIP from 17 to 35 mm Hg immediately after TEE probe insertion. This compression resolved after surgical closure of an ASD and rerouting of PAPVC. They reasoned about the compression of left main bronchus between distended left pulmonary artery anteriorly and the TEE probe in the esophagus posteriorly and this distension was relieved after surgery.

Whereas, in our case, the basic problem was on the right side. There was no airway malformation in our patient to begin with; therefore, it seems there was no compression of right main bronchus from outside. We had no problem in ventilation till weaning from bypass, and within a minute of weaning from bypass, saturation started to drop along with rise in PIP. When the ventilation was stopped, the right main bronchus may have fallen toward midline and it was probably facilitated by the finger of the surgeon when he inadvertently rolled the probe in esophagus during surgery. That had resulted in complete blockage of right main bronchus. The problem only resolved after the probe was pulled out.

In conclusion, right-sided airway obstruction by the TEE probe though rare can occur even after a long period of normal ventilation and after no evidence of airway compromise on initial insertion of the probe. Therefore, vigilance, early detection, and prompt intervention are important to minimize adverse outcomes.

**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.
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Conflicts of interest
There are no conflicts of interest.

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