A learning experience in the use of high-frequency oscillatory ventilation in infants post-cardiac surgery

Nikhil Bansal¹ · Abhinav Singh Chauhan¹ · Ramesh Pariyarath Menon²

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We have a dedicated intensive care unit (ICU) for post-cardiac surgery infants with rapid turnover. We want to bring to the reader's attention the feasibility of using high-frequency oscillatory ventilation (HFOv) in these babies especially those with severe pulmonary artery hypertension and pulmonary hemorrhage as its complication. We managed three such babies in the past 6 months, who were stabilized on HFOv (Carefusion 3100B).

The first baby was a 17-day-old, 2.3-kg neonate with ventricular septal defect (VSD) and coarctation of aorta (COA). He was brought to us in a state of septic shock with acute heart failure. He was medically stabilized and pulmonary artery banding with COA repair was done as a part of planned staged surgical procedure. He had a long post-operative course with inability to wean off ventilation and underwent subsequent tracheostomy. He developed ventilator-associated pneumonia with pulmonary hemorrhage on post-op day 45. HFOv was started when the baby failed to maintain saturation on conventional mechanical ventilator with a tidal volume (Vt) > 10 ml/kg and peak inspiratory pressure (PIP) of 35 mmHg with Fio2 of 100%. The baby was stabilized with improvement of ventilator parameters and hemodynamics over the next 12 h. He was maintained on HFOv for the next 9 days over which he improved. On post-op day 54, he had an episode of pneumothorax, which was managed by intercostal tube drainage. He was shifted back to conventional ventilator support, which he tolerated with settings of tidal volume (Vt) 8–10 ml/kg, Fio2 60–70%, and peak inspiratory pressure (PIP) 20–22 mmHg. However, the baby

developed cytomegalovirus (CMV) pneumonitis on day 70 and died after an ICU stay of 80 days.

The second was a 3-month-old, 3.2-kg baby who was operated for obstructed infra-cardiac total anomalous pulmonary venous connection (TAPVC) and was discharged after 15 days. He developed respiratory distress at the age of 6 months after an episode of pneumonia, for which he was admitted. The baby was intubated in view of respiratory failure and had progressive deterioration with ground glass opacities on chest X-ray (CXR). On day-4 of admission, the baby started having pulmonary hemorrhage for which he was put on HFOv. The condition of the baby stabilized showing an improvement in arterial blood gases and hemodynamics. Three days post HFOv, hyper-inflated lung fields were noted on CXR and the baby was switched to conventional ventilator support. However, the next day, there was recurrence of pulmonary hemorrhage along with cardiopulmonary arrest to which the baby succumbed.

The third was a 9-month-old, 3.6-kg baby who underwent surgical repair of obstructed infra-cardiac TAPVC. In the post-operative period, the baby had pulmonary hemorrhage and desaturation not responsive to conventional ventilation. HFOv was used and the baby was stabilized and hemorrhage was controlled. After 24 h, the baby had arrhythmia in the form of ventricular fibrillation and could not be revived.

The use of HFOv in critically sick babies has had benefits in terms of improvement of parameters. Herein, we wish to report that critically sick post-cardiac surgery infants with pulmonary hemorrhage can be stabilized with the use of HFOv, provided the expertise is available. Pulmonary hypertension and recurrent respiratory tract infections before surgery have been documented to be independent predictors of in-hospital mortality when HFOv is used [1]. The improvement in gas exchange without any cardiovascular compromise is remarkable, provided the preload is maintained. The disassociation of oxygenation and ventilation using HFOv appears feasible and effective.

Bojan et al. described the use of HFOv for lung-protective ventilation with small tidal volume being delivered below

✉ Ramesh Pariyarath Menon
rpmengi@gmail.com

¹ CardioThoracic and Vascular Surgery Department, CT Centre, AIIMS, New Delhi, India

² Pediatrics (Neonatology), CTVS; CT centre, AIIMS, New Delhi, India

dead space for effective pulmonary gas exchange, resulting in reduced risk of atelec-trauma [2, 3]. Two randomized control trials who investigated the use of HFOv, with the larger one including 58 patients, concluded that its use did not significantly improve survival (66% with HFOv versus 59% with conventional mechanical ventilation) or total ventilator days (20 ± 22 days with HFOv versus 22 ± 17 days with conventional mechanical ventilation) [4, 5]. Therefore, HFOv has not found its place in pediatric critical care.

The role of HFOv in such a setting needs to be explored, especially in identifying the pediatric patients who can benefit from its use and the ideal time to make a switch from conventional ventilator support to HFOv, as it is possible to maintain sufficient lung volume without large injurious pressure oscillations.

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