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Veno-arterial ECMO and Prone Ventilation

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Prone ventilation, a proven, effective method for improving oxygenation in acute respiratory distress syndrome (ARDS) patients is seldom used in cardiac surgery whenever there is a scenario with post-operative hypovolemic acute respiratory failure not responding to other ventilator strategies. The reasons are the unstable thoracic cage due to a fresh sternotomy, the presence of mediastinal and pleural drainage tubes, and their management.[1] This makes early use of prone ventilation a hesitant modality among cardiac surgical patients. Literature wherein a planned meticulous prone ventilation has been beneficial in post cardiac surgery patients is less and most of them being narrative reviews. In ARDS, as per the prone positioning in severe acute respiratory distress syndrome (PRO-SEVA) trial, the 28-day mortality was significantly lower in the prone ventilation group (16%) compared to the supine semi-recumbent group (32.8%) and it persisted even at 90 days. Extrapolating this data in cardiac surgery can only be done with a pinch of salt as sternotomy in the past 15 days was a non-inclusion in the trial.[2] Furthermore, one cannot say conclusively that prone ventilation is definitely going to help in hypoxemic respiratory failure in all cardiac surgery patient cohorts but a positive mortality effect in severe ARDS cannot be excluded.[3]

Another group of patients who often end up in acute respiratory failure in cardiac surgery is chronic thromboembolic pulmonary hypertension. Pulmonary thromboendarterectomy is the treatment of choice in these groups of patients. There has been literature mentioning the outcomes comparing the baseline pulmonary artery systolic pressure (PASP) <100 mmHg versus >100 mmHg, and clearly, reperfusion edema requiring prolonged mechanical ventilation was the most common complication in both the groups more so in the group with PASP>100 mmHg.

Significant pulmonary hemorrhage is reported to occur in around 1% of the cases post-cardiac surgery and is associated with a mortality of nearly 70%.[4] This poses a challenge in airway management with varying complications along with challenges in oxygenation and ventilation. Isolation of the bleeder with lung isolation with double lumen tube/bronchial blocker and fiberoptic bronchoscopy in such a scenario is of paramount importance if it is a significant bleed before considering extracorporeal membrane oxygenation (ECMO) as anticoagulation will have to be initiated and it might lead to uncontrollable bleeding. Identification of the culprit vessel and embolization in a hybrid catheterization laboratory may be attempted if the hemodynamics and logistics support the same.[5] In this issue of the Journal of Cardiac Critical Care, the article on the efficacy of prone ventilation on a veno-venous (VV)-ECMO shows the clear benefit in improving the gas exchange and improvement of oxygenation. Proning may be considered as a supplement to optimize the gas exchange in such cases. However, prone ventilation with a VV-ECMO in such a patient has added challenges of mechanical obstruction of the catheters, kinking, catheter dislodgement, and blood flow interruption and, hence, can only be tried as an adjunctive therapy on ECMO to improve the oxygenation of course in the presence of a team of intensivist, nursing

care, and perfusionist who are skilled in managing such a patient. The practical risk is far more than the theoretical risk.

Rycus and Stead, in the article in the current issue of the Journal of Cardiac Critical Care, on improving the ECMO quality with an Extracorporeal Life Support Organization (ELSO) registry clearly outline the benefit of having a proper ELSO registry with regard to ECMO usage. In the Indian scenario, ECMO is still in its nascent stage barring a few tertiary care centers and corporate hospitals and a paucity of data with regard to ECMO usability and reporting of complications and their management at the central level is not happening. Training and education on ECMO and registration of all such centers and upcoming centers under a national registry of ELSO should be made mandatory to have a central database that would help in research and training purposes. Statistically coordinated data collection is something that should be looked for.[6] Till that happens, we suggest that all ECMO centers should register and send data to ELSO.

Proning a patient in ARDS has implications with respect to the right ventricular and left ventricular function in isolation and interdependency. Heart-lung interaction in ARDS patients plays an important role in hemodynamic management.[7] Caregivers should also be vigilant with respect to the physiological aspects of the same as venous return in the prone position is dependent on an interplay between the mean systemic pressure, right atrial pressure, and the resistance to venous return. A rise in the intra-abdominal pressure (IAP) in a prone position may lead to an increased venous resistance; also any rise in the upstream resistance can lead to a decreased venous return. Minimizing the rise in IAP should be the goal overall. Prone positioning is known to improve the right ventricular dynamics by decreasing the right ventricle (RV) afterload which is of paramount importance in a pre-existing RV dysfunction in such patients. The changes in cardiac output in the prone position are dependent on the volume status and the degree of preload responsiveness before proning. Maintaining a good preload reserve might help in maintaining a good cardiac output.[8]

In this issue of the Journal of Cardiac Critical Care, the review article on ECMO and coagulation very nicely describes the pitfalls and requirements of viscoelastic testing monitoring by Malhotra *et al*.[9] coagulation for patients on veno arterial ECMO (VA-ECMO). The main hazards of VA-ECMO are thrombosis and hemorrhage. There is a scarcity of literature and guidelines for the same. This article describes in detail what is required and the authors have made a few recommendations based on their own experience at AIIMS.

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