Hypoxia during VV ECMO

Pranay Oza[1]

[1]Riddhivinayak Critical Care and Cardiac Centre, Mumbai, Maharashtra, India

Address for correspondence Pranay Oza, BHMS, Riddhivinayak Critical Care and Cardiac Centre, S.V. Road, Malad (W), Mumbai 4000064, Maharashtra, India (e-mail: drpranay.oza@gmail.com).

J Card Crit Care TSS 2017;1:57–59

Venovenous extracorporeal membrane oxygenation (VV ECMO) is the preferred mode for any kind of acute respiratory failure. The desired PO_2 is > 50 and SPO_2 > 88% but the acceptable values can be PO_2 > 45 and SPO_2 > 80%. In case if we are accepting lower PO_2, we have to keep a higher hematocrit and meticulously monitor neurological status, lactates, and urine output to maintain oxygen delivery. Saturation during ECMO run depends on ECMO circulation, native circulation, and ratio of ECMO flow to cardiac output (►**Table 1**). Whenever the effective ECMO circulation decreases, saturation decreases. So, decrease in ECMO flow, ECMO FiO_2, failing membrane oxygenator, and increase in recirculation will lead to hypoxia. Similarly, anything that decreases the contribution from native circulation will also lead to hypoxia. So, decrease in ventilator settings and worsening lung status lead to hypoxia. Anything that increases metabolism, such as fever and restlessness, will also cause hypoxia due to increased consumption.

Table 1 Causes of hypoxia during ECMO

Technical problem
Ventilator related
Ventilator malfunctioning
ET tube blockage
ECMO related Decreased ECMO flow or
FiO_2
Oxygenator failure
Increase recirculation
Lung condition worsening
Parenchymal worsening
Pneumothorax
Increased ratio of ECMO flow/cardiac output
Increased cardiac output

Abbreviation: ECMO, extracorporeal membrane oxygenation.

Recirculation is defined as the flow of oxygenated blood from the returning cannula to the draining cannula without entering systemic circulation. It decreases the efficacy of VV support. Around 30% of recirculation is average.[1] The factors on which the recirculation depends are pump flow (►**Fig. 1**), catheter position, cardiac output, and RA size or intravascular volume. The recirculation can be calculated with the help of following equation:[2]

$$R = \frac{S\ pre\ Ox - SvO2}{S\ post\ Ox - SvO2}$$

Management of hypoxia will depend on treating the underlying cause (►**Fig. 2**). The usual strategy is to increase oxygen transfer by increasing ECMO flow, ECMO FiO_2, or by increasing hematocrit and thereby improving oxygen delivery. Many a times hypoxia is secondary to increased metabolic rate and just controlling that (controlling fever, giving sedation) will improve saturation. Recirculation can be managed by adjusting the flow; sometimes a higher flow is the cause of recirculation and just by decreasing flow we can get better saturation.[3] Too close placement of tip of drainage and return cannula may lead to recirculation and just repositioning of

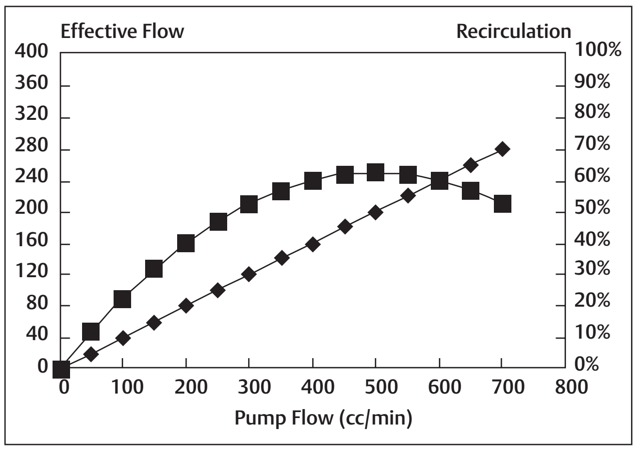

Fig. 1 Recirculation: defining the curve.

DOI https://doi.org/10.1055/s-0038-1626681.
ISSN 2457-0206.

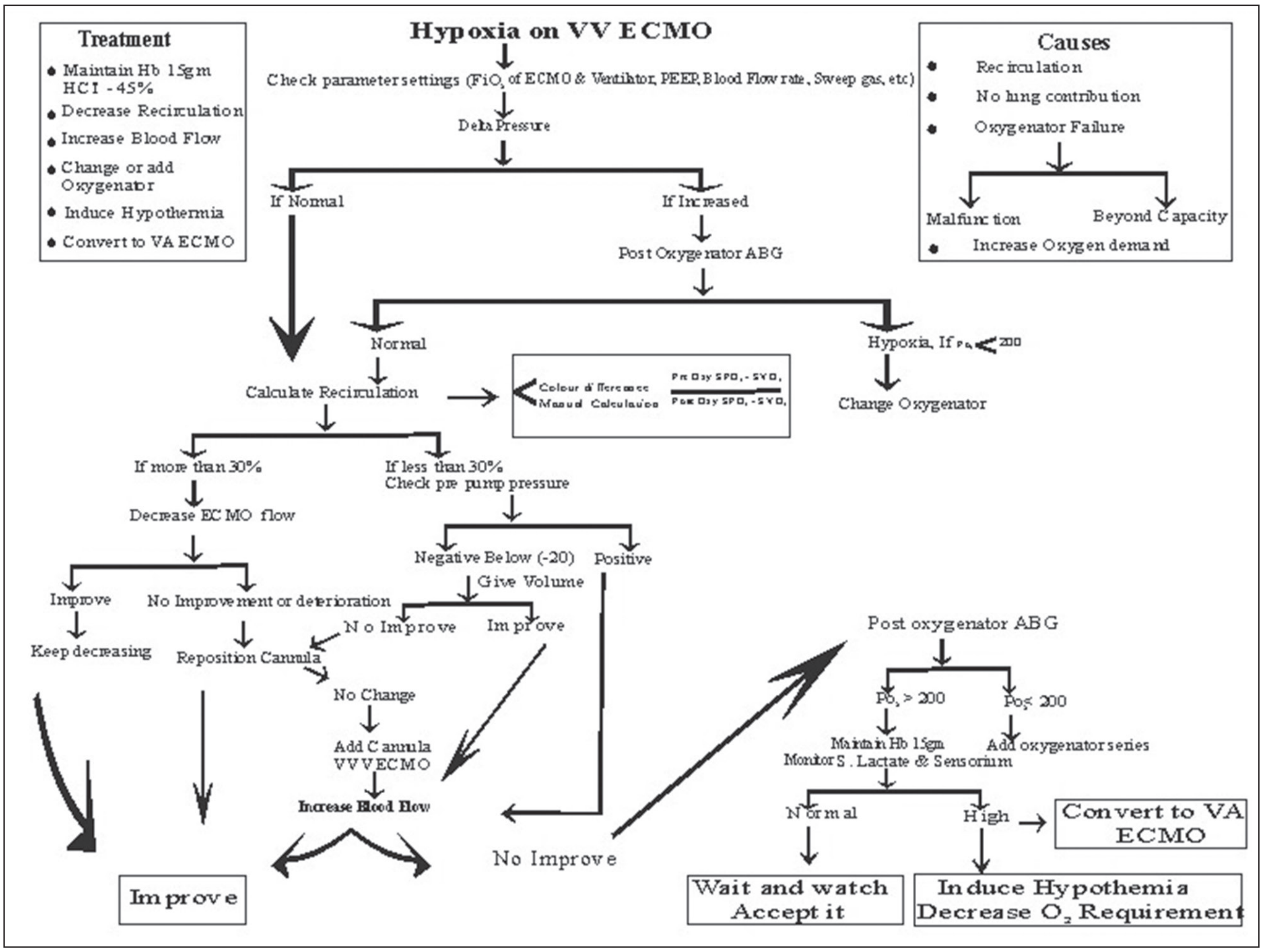

Fig. 2 Approach to hypoxia during VV ECMO. VV ECMO, venovenous extracorporeal membrane oxygenation.

cannula can improve saturation.[4] If the recirculation persists, the last solution is to put additional cannula for drainage and switch to VVV ECMO.

In spite of all the above measures if the patient remains hypoxic and lactates are rising, then the last resource is to induce hypothermia and ultimately switch to VA or VAV ECMO (►**Table 2**).

Conclusion

Management of hypoxia during VV ECMO requires attentive monitoring and expedited, algorithmic monitoring.[5] It is a balancing act that requires intense vigilance and expertise.

Acknowledgments

We sincerely thank the entire mobile ECMO team of the Riddhivinayak Critical Care and Cardiac center for their dedication and hard work.

Table 2 Management of hypoxia during VV ECMO

Maximizing gas transfer
Increase blood flow through the ECMO
Increasing FiO_2 of ECMO
Increasing hematocrit
Minimizing oxygen utilization
Decreasing metabolic rate: control fever, sedation, etc
Hypothermia
Decreasing recirculation in VV ECMO
Define the curve
Cannula reposition
Add cannula: for drainage, cannula can be added in IVC, SVC, and preferred cephalad cannula
Conversion to VA or VAV ECMO

Abbreviations: ECMO, extracorporeal membrane oxygenation; IVC, inferior vena cava; SVC, superior vena cava; VAV, veno-arterial-venous, VV, venovenous.

References

1 Goyal V, Oza P. Venovenous ECMO. ECMO Theoretical Manual 2012;2(1):77–89
2 Goyal V, Oza P. ECMO Volume I, Practical Manual. Vol. 1
3 Heard M, Davis J, Fortenberry J. Principle and practice of venovenous and venoarterial ECMO. ECMO Specialist training manual. Billie Lou Short, Lisa Williams MHA, BSN, RNC-NIC; 2010:59–76
4 Bartlett R. Management of ECLS in adult respiratory failure. In: Van Meurs K, Lally K, Peek G, Zwischenberger J, eds. ECMO Extracorporeal Cardiopulmonary Support in Critical Care, Red Book. 3rd ed. ELSO, Ann Arbor;2005:403–416
5 Goyal V, Oza P. Algorithm. ECMO Theoretical Mannual 2012;2(1):248–250