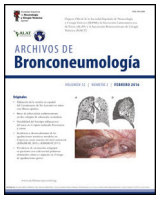
Archivos de Bronconeumología xxx (xxxx) xxx–xxx

Sociedad Española de Neumología y Cirugía Torácica SEPAR

ARCHIVOS DE
Bronconeumología

www.archbronconeumol.org



Clinical Letter

Application of Extracorporeal Membrane Oxygenation Combined With High-flow Nasal Oxygen Therapy in Tracheal Stenosis Reconstructive Surgery: A Case Report

To the Director,

Extracorporeal membrane oxygenation (ECMO) may provide complete respiratory support during complex airway surgery, facilitating optimal surgical conditions and allowing gas exchange under protective ventilation or even complete apnea.[1] High-flow nasal oxygen therapy (HFNO) is an emerging technique increasingly applied in anesthesia and intensive care, as it provides higher oxygen flow, improves ventilation, and reduces the respiratory burden.[2]

A 66-year-old male presented with increased hoarseness and dyspnea for 8 days. Upon admission, bronchography and computed tomography (CT) of the neck revealed significant collapse and tracheal stenosis at the thoracic inlet, indicating tracheal scarring and severe stenosis (Supplemental 1). At the age of 2, the patient underwent a tracheotomy due to diphtheria. Consequently, tracheoplasty and resection of the stenosed trachea were planned. Considering the serious stenosis and scarring and the location of the tracheal stenosis near the suprasternal notch, doing a tracheotomy would not bypass the lesion, and that the presence of tracheotomy would obstruct the surgical field. A multidisciplinary consultation recommended airway surgery with venovenous extracorporeal membrane oxygenation (VV-ECMO), along with general anesthesia combined with a regional nerve block anesthesia (right iliofascial block and the cervical plexus block).

The drainage catheter was established through the right femoral vein, with the tip placed at the inferior margin of the hepatic vein opening. The return catheter was established through the right internal jugular vein, with the tip positioned at the junction of the superior vena cava and the right atrium. Finally, after evaluating the cannula position using ultrasonography, the ECMO circuit was connected. Thereafter, the patient was administered general anesthesia. Once the patient lost consciousness, ECMO was initiated. Owing to volume status effects, the ECMO flow was maintained at only 2.8 L/min, with the patient's oxygen saturation dropping to 85%. The patient was immediately administered HFNO and underwent volume resuscitation, resulting in improved oxygenation and a 97% oxygen saturation (Table 1). During surgery, an ID 7.0 tracheal tube was inserted orally after resection of the narrowed trachea. The anesthetic machine was connected for mechanical ventilation, we adjusted the ECMO ventilation parameters and flow rates downward. ECMO was weaned after the surgery was completed.

The surgery lasted 4 h, with ECMO support provided for 5 h. The patient was transferred from the ICU 3 days later and was successfully discharged 17 days postoperatively. Follow-up CT of the airway indicated slight tracheal stenosis (Supplemental 2).

Table 1
Respiratory Support and Resulting Blood Gases and Vital Signs.

	Before ECMO	After ECMO	ECMO + HFNO	After Intubation	ECMO Stopped
ECMO parameters					
ECMO flow (L/min)	–	2.8	2.8	2	0
Gas flow (L/min)	–	3	3	2	0
Oxygen concentration (%)	–	100	100	60	0
Blood gas analysis					
PH	7.37	7.43	7.39	7.35	7.5
$PaCO_2$ (mmHg)	38	43	33	34	35
PaO_2 (mmHg)	112	57	80	102	86
Lactate (mmol/L)	1	1	0.6	0.5	0.8
High flow	2	–	30	–	–
Ventilator parameters					
Tidal volume (mL)	–	–	–	350	500
Respiratory rate (bpm)	–	–	–	10	12
Oxygen concentration (%)	–	–	–	60	40
PEEP (cmH_2O)	–	–	–	5	5
Vital signs					
MAP (mmHg)	89	76	85	92	95
Heart rate (bpm)	72	67	66	65	75
SPO_2 (%)	100	85	97	100	98

ECMO: extracorporeal membrane oxygenation; HFNO: high-flow nasal oxygen therapy.

https://doi.org/10.1016/j.arbres.2025.03.006

Please cite this article as: X. Liao, Q. Wang and B. Li, Application of Extracorporeal Membrane Oxygenation Combined With High-flow Nasal Oxygen Therapy in Tracheal Stenosis Reconstructive Surgery: A Case Report, Archivos de Bronconeumología, https://doi.org/10.1016/j.arbres.2025.03.006

VV-ECMO can lead to recirculation issues, adversely affecting oxygenation. The level of positive end-expiratory pressure generated by HFNO is influenced by the gas flow rates and whether the mouth is open or closed. When patients breathe through the closed mouth, the average airway pressure generated at flow settings of 10, 20, 40, and 60 L/min is 1.7, 2.9, 5.5, and 7.4 cmH_2O, respectively, indicating a linear increase in expiratory airway pressure with an increase in flow rate.[3] In our case, when HFNO was administered, the patient was under general anesthesia and therefore apneic, exhibiting no respiratory efforts or distress. The airway was kept open, and the mouth was maintained in a closed position. the patient exhibited good preoperative pulmonary function, and HFNO effectively improved oxygenation.[4]

Ethical Approval and Consent to Participate

Not applicable. This study is a retrospective study.

Consent for Publication

Informed consent was obtained from the patient in this case.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

No artificial intelligence writing was applied.

Funding

There was no funding for this study.

Declaration of Competing Interests

The authors declare that they have no competing interests.

Data Availability

Not applicable.

Appendix A. Supplementary Data

Supplementary data associated with this article can be found in the online version available at https://doi.org/10.1016/j.arbres.2025.03.006.

References

1. Voltolini L, Salvicchi A, Gonfiotti A, Borgianni S, Cianchi G, Mugnaini G, et al. Veno-venous extra-corporeal membrane oxygenation in complex tracheobronchial resection. J Thorac Dis. 2024;16(2):1279–88.
2. Kim HJ, Asai T. High-flow nasal oxygenation for anesthetic management. Korean J Anesthesiol. 2019;72(6):527–47.
3. Groves N, Tobin A. High flow nasal oxygen generates positive airway pressure in adult volunteers. Aust Crit Care. 2007;20(4):126–31.
4. Drake MG. High-flow nasal cannula oxygen in adults: an evidence-based assessment. Ann Am Thorac Soc. 2018;15(2):145–55.

Xiaozu Liao*, Qi Wang, Binfei Li

Department of Anesthesiology, Zhongshan City People's Hospital, Zhongshan, China

*Corresponding author.
E-mail address: liaoxiaozu@163.com (X. Liao).