Faculty of Medicine and Dentistry

UNIVERSITY HOSPITAL OLOMOUC

EXTRACORPOREAL MEMBRANE OXYGENATION FOR COVID-19-RELATED SEVERE RESPIRATORY FAILURE

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BACKGROUND:

COVID-19 is a severe acute respiratory syndrome coronavirus. Those who suffer from this illness may experience a clinical course ranging from being asymptomatic to a minority having a severe form of viral pneumonia, which can result in respiratory failure and death (1). Extracorporeal membrane oxygenation (ECMO) could play a role as a form of rescue therapy and may provide beneficial results in the hands of skilled and experienced clinicians in centers using ECMO appropriately in selected patients, where mechanical ventilation may not be enough (***Figure 1***.) (2). Our understanding of COVID-19 is ever-changing and the need for intensive care beds is rising, which means that ECMO will surely play a key role into the near future.

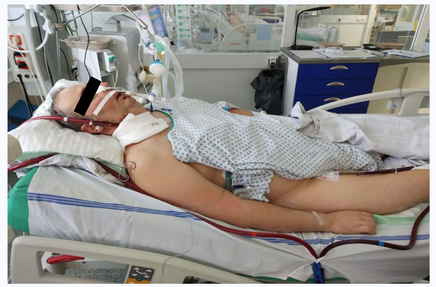

Figure 1: shows one of the patients under VV-ECMO

When do we use ECMO? - ECMO is a form of cardiopulmonary bypass and can be divided into VenoVenous (VV-ECMO) and VenoArterial (VA-ECMO), which can be used in the setting of respiratory failure and cardiogenic shock, respectively. VV-ECMO can provide respiratory support, can replace the gas exchange function and minimize lung injury, barotrauma and oxygen toxicity. **Indications** for VV-ECMO are hypoxic respiratory failure (mortality risk 50% or greater), severe hypercapnia (pH <7.2 for >6 h), prolonged ventilation <7 days and age <65 years (3).

Figure 2. shows the circuit & cannulation for VV-ECMO with reinjection via the superior vena cava and drainage via the inferior vena cava.

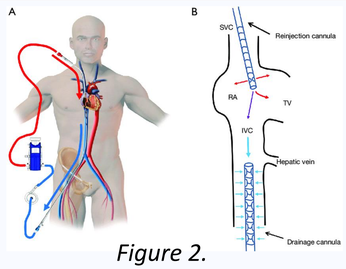

Figure 2.

Figure 3a. shows a patient's chest X-Ray with COVID-pneumonia, beginning VV-ECMO support. ***Figure 3b.*** shows the same patient now after sufficient use of the ECMO machine.

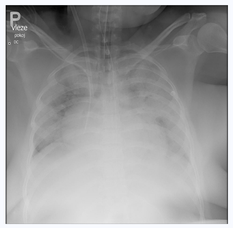

Figure 3a.

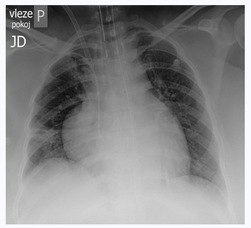

Figure 3b.

AIMS and OBJECTIVES:

Aim of this study was to evaluate interim results of VV-ECMO support for COVID-19-related severe respiratory failure during the 2nd wave of the pandemic. All patients were referred from North, Middle and East parts of Moravia and also East part of Bohemia to our centre.

METHODS:

A retrospective analysis of 23 consecutive patients with critical hypoxemic and/or hypercapnic COVID-19 related respiratory failure (**mean P/F ratio 69.8±12.3 mmHg, mean pCO2 78.0±15.7 mmHg**) who were VV-ECMO-supported in our centre from October 2020 to February 2021. Interim outcome analysis focused on 30-, 60-, and 90-day survival was conducted.

***The author declares that there is no conflict of interest**

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2. Zaim S, Chong JH, Sankaranarayanan V, Harky A. COVID-19 and Multi-Organ Response. Curr Probl Cardiol. 2020:100618. https://doi.org/10.1016/j.cpcardiol.2020.100618 [published online ahead of print, April 28, 2020].

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RESULTS:

Figure 4. (see right) shows there were no statistical differences in followed demographic and therapy characteristics prior ECMO cannulation. However in non-survivors' group higher incidence of pneumonia history and longer length of mechanical ventilation prior ECMO support were analysed.

Demographics	All (n=23)	Survivors (n=13)	Non-survivors (n=10)	p value
M/F ratio (%)	**78/22**	73/27	87/13	NS
Diabetes	**7 (30%)**	4 (33%)	3(30%)	NS
Hypertension	**17 (74%)**	9 (73%)	8 (80%)	NS
CAD	**1 (4%)**	0	1 (10%)	NS
rEFLV (%)	**2 (9%)**	0	2 (20%)	NS
RF krea>120 mmol/l)	**1 (4%)**	1 (13%)	0	NS
Malignancy	**1 (4%)**	0	1 (10%)	NS
Pneumonia history)	**3 (13%)**	**0**	**3 (30%)**	**0.048**
Age (y)	**54.3+-12.2**	53.2+-13.9	55,3+-8,6	NS
BMI (kg/m2)	**35.3+-8.5**	35.8+-9.8	34.4+-5.8	NS

	All (n=23)	Survivors (n=13)	Non-survivors (n=10)	p value
Symtoms to ECMO time (d)	**12.3+-4.9**	11.4+-4.9	14.0+-4.9	NS
MV to ECMO time (d)	**1.9+-2.2**	**1.28+-0.6**	**3.1+-3.5**	**0.044**
NIV/HFOT prior MV	**21(96%)**	11 (93%)	10(100%)	NS
CT angio)	**19 (83%)**	11 (93%)	8 (80%)	NS
Confirmed PE	**5 (22%)**	3 (23%)	2 (20%)	NS
Quadrant involment (1-4)	**3.6+-0.4**	3.5+-0.7	3.7+-0.4	NS
Corticosteroids	**23 (100%)**	13 (100%)	10 (100%)	NS
Remdesivir	**16 (70%)**	9 (69%)	7 (70%)	NS
Convalescent plasma	**5 (22%)**	3 (23%)	2(20%)	NS

Figure 4.

ECMO@device complications	All (n=23)	Survivors (n=13)	Non-survivors (n=10)	p value
ECMO support (h)	**211.8+-63.1**	**196.2+-61.3**	**241.3+-58.7**	**0.039**
Weaning	**17 (74%)**	**13 (100%)**	**4 (40%)**	**0.003**
Oxygenator trombosis	**2 (9%)**	1 (8%)	1 (10%)	NS
Circiut change	**1 (4%)**	0	1 (10%)	NS

Major complications	All (n=23)	Survivors (n=13)	Non-survivors (n=10)	p value
Ischemic stroke	**1 (4%)**	1 (8%)	0	NS
Intracranial bleeding	**0**	0	0	NS
Severe bleedling	**3 (13%)**	2 (15%)	1 (10%)	NS
Pulmonary superinfection	**19 (83%)**	9 (69%)	10 (100%)	NS
Sepsis	**17 (74%)**	**7 (54%)**	**10 (100%)**	**0.013**
RRT	**9 (39%)**	**4 (31%)**	**5 (50%)**	**0.048**
GI dysfunction	**18 (78%)**	8 (62%)	10 (100%)	NS
Coagulation disorder	**7 (30%)**	**1 (8%)**	**6 (60%)**	**0.013**
Tracheostomy	**14 (61%)**	10 (77%)	4 (40%)	NS
MOF	**16 (69%)**	**6 (46%)**	**10 (100%)**	**0.007**

Figure 5.

Figure 5. shows that the mean time of ECMO run reached 211 minutes, with 74% of patients weaned off. In the non-survivors group significantly longer ECMO support time was found as well as rate of major complications like sepsis, multiple organ failure, and need for renal replacement therapy which also dominated in causes of death.

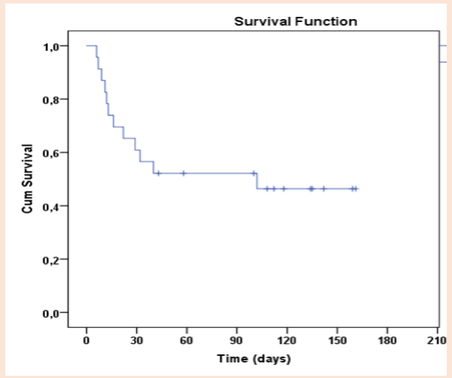

Figure 6.

Figure 6. shows a graph of the final results that 11 patients (47.8%) were discharged home with good neurological outcome (CPC 1,2), with 1 patient (4.3%) who remained hospitalized in the chronic rehabilitation centre and who was not dependent on mechanical ventilation.

During the follow-up, 30-, 60-, and 90-day, the survival rate was 65.2%, 52.2%, and 52.2%, respectively.

CONCLUSIONS:

All survivors, but one, were discharged with good neurological performance. With respect to limited value of Interim results, outcome of V-V ECMO support for COVID-19-related severe respiratory failure is promising even in the scope of low-volume ECMO centre. Long-term outcome analysis including evaluation of survivors' real quality of life and pulmonary function is needed. There may be scope for the use of ECMO as rescue therapy and this intervention should, therefore, be strongly considered in patients with severe lung injury secondary to COVID-19.