**Supplemental Digital Content for Extracorporeal Membrane Oxygenation Characteristics and Outcomes in Children and Adolescents with COVID-19 or Multisystem Inflammatory Syndrome Admitted to U.S. Intensive Care Units**

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**Supplemental ECMO Overcoming COVID-19 Case Report Form**

Patient ID: COVR-XXX-XXX

Type of ECMO Support (if both, check both):

Veno-venous [ ]  Yes [ ]  No

Veno-arterial [ ]  Yes [ ]  No

If the patient received both VV and VA ECMO, what was the initial mode?

 [ ]  Veno-venous [ ]  Veno-arterial

Date and time of ECMO initiation: \_\_\_\_ / \_\_\_\_ / \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

Date and time of ECMO discontinuation: \_\_\_\_ / \_\_\_\_ / \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

*Discontinuation defined as time of ECMO cannula removal AND cessation of ECMO support for a time period greater than 12 hours.*

Date and time of second ECMO initiation (if applicable): \_\_\_\_ / \_\_\_\_ / \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

Date and time of second ECMO discontinuation (if applicable): \_\_\_\_ / \_\_\_\_ / \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

Reason for ECMO Support According to Site PI (mark all that apply):

*if available to adjudicate, copy de-identified note from EMR at time of ECMO initiation*

[ ]  Primarily Cardiac (low cardiac function)

 [ ]  Primarily Respiratory (hypoxia with lung disease)

 [ ]  Other, describe: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Was ECMO done as part of ECPR Rescue?

 [ ]  Yes [ ]  No [ ]  Unclear

*ECPR is the application of rapid-deployment veno-arterial ECMO, usually by peripheral cannulation, to provide circulatory support in patients in whom conventional CPR is unsuccessful in achieving sustained return of spontaneous circulation (sustained ROSC). Sustained ROSC is deemed to have occurred when chest compressions are not required for 20 consecutive minutes and signs of circulation*

*persist.*

Which vasoactive agent(s) was the patient receiving in the 4 hours prior to ECMO initiation? Check all that apply and indicate the highest dose given in those 4 hours.

 [ ]  Dopamine, highest dose: \_\_\_\_\_\_\_ μg/kg/min

 [ ]  Dobutamine, highest dose: \_\_\_\_\_\_\_ μg/kg/min

 [ ]  Epinephrine, highest dose: \_\_\_\_\_\_\_ μg/kg/min

 [ ]  Norepinephrine, highest dose: \_\_\_\_\_\_\_ μg/kg/min

 [ ]  Milrinone, highest dose: \_\_\_\_\_\_\_ μg/kg/min

 [ ]  Vasopressin, highest dose: \_\_\_\_\_\_\_U/kg/min

Pre-ECMO Oxygenation Index within 6 hours of ECMO initiation (mark -6 if unavailable):

PaO2: \_\_\_\_\_\_ mmHg

FiO2 (at time of PaO2): \_\_\_\_\_\_\_\_

Mean airway pressure: \_\_\_\_\_\_\_\_\_ cmH2O

pH: \_\_\_\_\_\_\_

PaCO2: \_\_\_\_\_\_\_\_mmHg

 Date and time of measurement: \_\_\_\_ / \_\_\_\_/ \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

Pre-ECMO Lactate Closest to ECMO initiation:

 Lactate level: \_\_\_\_\_\_\_ mmol/L

 Date and time of lactate: \_\_\_\_ / \_\_\_\_/ \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

 [ ]  Not measured

Pre-ECMO Troponin Closest to ECMO initiation:

 Troponin level: \_\_\_\_\_\_\_ ng/mL

 Date and time of troponin: \_\_\_\_ / \_\_\_\_/ \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

 [ ]  Not measured

Worst Troponin while on ECMO:

Troponin level: \_\_\_\_\_\_\_\_ ng/mL

 Date and time of troponin: \_\_\_\_ / \_\_\_\_/ \_\_\_\_\_\_ \_\_\_\_:\_\_\_\_

[ ]  Not measured

ECMO Discontinuation Reason:

*if available to adjudicate, copy de-identified note from EMR at time of ECMO discontinuation*

[ ]  Recovery

[ ]  Poor prognosis/redirection of goals of care

[ ]  Transition to other cardiac supports (VAD or Impella)

[ ]  Lung transplant

[ ]  Death on ECMO

[ ]  Other, describe: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Comments regarding this patient’s ECMO course:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Supplemental Table 1** – Additional Baseline Characteristics of 2,733 Patients <21 Years Admitted to the ICU for MIS-C or Acute COVID-19 Stratified by ECMO requirement

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Clinical Characteristics** | **MIS-C not Receiving ECMO (n=1,493)** | **MIS-C Receiving ECMO (n=37)** | **P-value** | **Acute COVID-19 not Receiving ECMO (n=1,132)** | **Acute COVID-19 Receiving ECMO (n=71)** | **P-value** |
| **SARS-CoV-2 testing, no. (%)** |  |   |  |   |   |  |
| SARS-CoV-2 RT-PCR Performed | 1463 (98) | 36 (97) | 0.54 | 1132 (100) | 71 (100) | 1.00 |
| SARS-CoV-2 RT-PCR Positive | 585/1463 (40) | 18/36 (50) | 0.30 | 1132/1132 (100) | 71/71 (100) | 1.00 |
| SARS-CoV-2 Antibody Test Performed | 1368 (92) | 35 (95) | 0.76 | 240 (21) | 19 (27) | 0.30 |
| SARS-CoV-2 Antibody Test Positive | 1320/1368 (97) | 32/35 (91) | 0.13 | 122/240 (51) | 14/19 (74) | 0.06 |
| **Year of admission, no. (%)**  |  |   |  |   |   |  |
| Hospitalized in 2020 | 618 (41) | 20 (54) | 0.17 | 501 (44) | 12 (17) | <0.001 |
| Hospitalized in 2021 | 875 (59) | 17 (46) | 631 (56) | 59 (83) |
| **Underlying conditions, no. (%)**a |  |   |  |   |   |  |
| Previously healthyb | 1008 (68) | 22 (60) | 0.39 | 283 (25) | 13 (18) | 0.26 |
| Respiratory | 200 (13) | 4 (11) | 0.81 | 402 (36) | 22 (31) | 0.52 |
| Cardiac | 37 (3) | 0 (0) | 1.00 | 140 (12) | 10 (14) | 0.81 |
| Neurologic | 49 (2) | 3 (8) | 0.13 | 254 (22) | 12 (17) | 0.35 |
| Oncologic or immune compromised | 28 (2) | 4 (11) | 0.006 | 95 (8) | 3 (4) | 0.27 |
| Hematologic | 28 (2) | 0 (0) | 1.00 | 81 (7) | 7 (10) | 0.54 |
| Renal | 16 (1) | 0 (0) | 1.00 | 84 (7) | 3 (4) | 0.48 |
| Gastrointestinal | 43 (3) | 3 (8) | 0.10 | 228 (20) | 9 (13) | 0.17 |
| Endocrine | 43 (3) | 3 (8) | 0.10 | 182 (16) | 11 (16) | 1.00 |
| Genetic/Metabolic (excluding obesity) | 18 (1) | 0 (0) | 1.00 | 111 (10) | 5 (7) | 0.58 |
| BMI-based obesityc | 481/1425 (34) | 13/36 (36) | 0.91 | 453/923 (49) | 37/59 (63) | 0.06 |

Abbreviations: SARS-CoV-2=Severe Acute Respiratory Syndrome CoV-2; COVID-19 = coronavirus disease 2019; MIS-C= Multisystem Inflammatory Syndrome in Children; ICU = intensive care unit; IQR = interquartile range; ECMO = extracorporeal membrane oxygenation; RT-PCR = reverse transcriptase polymerase chain reaction; No. = number.

aPatients may have more than 1 underlying condition.
b”Previously healthy” was defined as an absence of reported underlying conditions (including obesity) and on no prescription medications.
cThe determination of BMI-based obesity was based on CDC national reference standard for age and sex among patients who were at least 2 years of age

**Supplemental Table 2** –Admission Laboratory Values Among Acute COVID-19 and MIS-C Patients With and Without ECMO Support

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Clinical Characteristics** | **MIS-C, not receiving ECMO (n=1,493)** | **MIS-C, receiving ECMO (n=37)** | **P-value** | **Acute COVID-19, not receiving ECMO (n=1,132)** | **Acute COVID-19, receiving ECMO (n=71)** | **P-value** |
| **Admission laboratory markers (units)** | N | Median (IQR) | N | Median (IQR) |  | N | Median (IQR) | N | Median (IQR) |  |
| Absolute neutrophil count (103/µL) | 1,286 | 7.61 (4.88, 11.3) | 31 | 12.85 (8.53, 20.49) | **0.043** | 822 | 4.93 (2.88, 8.14) | 53 | 6.15 (4.11, 11.42) | **0.004** |
| White blood cell count (103/µL) | 1,470 | 10.04 (7.10, 14.10) | 36 | 15.53 (12.10, 23.24) | **<0.001** | 1,025 | 7.71 (4.70, 11.50) | 67 | 8.30 (6.30, 14.74) | **0.006** |
| Neutrophil to lymphocyte ratio | 1,283 | 8.93 (4.98, 15.00) | 31 | 12.34 (5.00, 23.56) | 0.06 | 820 | 3.90 (1.96, 7.88) | 53 | 5.93 (2.92, 12.86) | **0.004** |
| Lactate (mmol/L) | 727 | 1.7 (1.3, 2.6) | 24 | 4.6 (3.2, 11.1) | **<0.001** | 376 | 1.6 (1.0, 2.8) | 44 | 1.5 (1.1, 3.0) | 0.83 |
| Creatinine (mg/dL) | 1,379 | 0.64 (0.46, 0.99) | 32 | 1.32 (0.74, 2.93) | **<0.001** | 909 | 0.57 (0.37, 0.78) | 59 | 0.72 (0.49, 0.93) | **0.005** |
| Alanine transaminase (U/L) | 1,300 | 38 (23, 65) | 30 | 53 (23, 81) | 0.26 | 756 | 31 (19, 57) | 55 | 44 (23, 69) | 0.06 |
| Procalcitonin (ng/mL) | 646 | 5.73 (2.14, 18.00) | 15 | 8.91 (2.90, 30.87) | 0.42 | 306 | 0.24 (0.11, 1.03) | 22 | 0.92 (0.26, 12.43) | **0.004** |
| Ferritin (ng/mL) | 1,071 | 527 (290, 990) | 23 | 1170 (280, 1965) | 0.14 | 318 | 274 (112, 598) | 16 | 913 (219, 1938) | **0.014** |
| C-reactive protein (mg/dL) | 1,230 | 18.1 (10.7, 25.0) | 24 | 22.0 (15.6, 33.8) | **0.044** | 539 | 4.0 (1.4, 8.9) | 36 | 7.1 (3.8, 12.7) | **0.008** |
| Hemoglobin (g/dL) | 1,365 | 11.3 (10.2, 12.4) | 34 | 12.4 (10.8, 13.7) | **0.014** | 910 | 12.6 (11.1, 14.0) | 61 | 12.4 (10.5, 13.9) | 0.26 |
| Platelet count (103/µL) | 1,353 | 155 (108, 213) | 33 | 198 (134, 259) | **0.013** | 889 | 221 (165, 311) | 59 | 202 (138, 283) | 0.10 |
| Absolute lymphocyte count (103/µL) | 1,318 | 0.87 (0.51, 1.48) | 32 | 1.33 (0.66, 1.91) | **0.043** | 844 | 1.19 (0.70, 2.19) | 53 | 1.15 (0.60, 1.85) | 0.31 |

**Supplemental Figure 1 –** Supplemental Admission Laboratory Values.


\*Denotes significant difference between ECMO and non-ECMO patients (p<0.05)

Abbreviations: ECMO: extracorporeal membrane oxygenation; MIS-C: multisystem inflammatory syndrome in children; COVID-19: coronavirus disease 2019