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Topic: 2 - Adult - Cardiac failure

Abstract: 6

Application of ECMO support during transcatheter valvular procedures

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Objective: ECMO has gained use as a rescue therapy in refractory cardiovascular and respiratory compromise. Increasingly, it is considered for cardiopulmonary support during percutaneous coronary and structural heart interventions.

Methods: We report 3 cases wherein ECMO successfully facilitated transcatheter valvular procedures in patients who were not surgical candidates due to the severity of their illness.

Results: A 51-year-old male presented with myocardial infarction and cardiogenic shock. Echocardiogram showed severe mitral regurgitation from posterolateral papillary muscle rupture. He developed refractory hypoxia from pulmonary edema. He underwent emergent MitraClip under VV-ECMO. He was decannulated 4 days post-procedure and discharged home on day 7 of hospitalization.

A 47-year-old female presented with acute coronary syndrome, and despite revascularization, arrested from ventricular fibrillation. She was emergently placed on VA-ECMO. Echocardiogram showed severe functional mitral regurgitation. After optimization of hemodynamics and volume status on ECMO, she underwent MitraClip procedure 5 days later and was decannulated the same day. She was discharged a week later.

A 34-year-old male presented to an outside hospital with cardiac arrest from myocardial infarction requiring VA-ECMO and Impella support. Following decannulation, he was found to have acute severe aortic regurgitation related to a flail aortic valve cusp, which was likely injured during Impella placement. VV-ECMO was subsequently instituted for refractory hypoxemia. At our center, he underwent transcatheter aortic valve replacement (TAVR) with VV-ECMO support. His pulmonary status rapidly improved and efforts were directed at weaning ECMO. Unfortunately, the patient suffered a large intracranial hemorrhage and expired 6 days after his TAVR.

Conclusions: The emerging patient population with compromised cardiopulmonary function undergoing percutaneous therapies has seen the use of ECMO as a rescue intervention or for perioperative prophylaxis. Our cases illustrate instances that utilize ECMO for stabilization during high-risk percutaneous valvular procedures which might otherwise not be tolerated. Applications of ECMO in these situations deserve further examination.

Abstract: 9

The role of extracorporeal membrane oxygenation in major aortic surgery with particular reference to aortic dissection

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Objective: Very little is known about the role of extracorporeal membrane oxygenation for the management of patients undergoing major aortic surgery with particular reference to aortic dissection. We sought to review the available literature to determine if there was any evidence

Methods: A systematic literature search was undertaken through PubMed and EMBASE according to specific key words combined as follows: ECMO and aortic surgery; ECMO and aortic dissection; ECLS and aortic surgery; ECLS and aortic dissection

Results: The search retrieved 29 publications relevant to the subject: 1 brief communication; 1 surgical technique report; 1 invited commentary; 1 retrospective case review; 1 observational study; 4 retrospective reviews; 13 case reports and 7 conference abstracts. A total of 194 patients were included in these publications of whom 77 survived. The articles had been published between 1994

Conclusions: Impella CP and PA cannula on top of VA ECMO offer significant LV unloading and adequate end-organ perfusion. Impella CP guarantees a stronger LV unloading effect, reducing more effectively the total mechanical energy generated by the left ventricle.

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A new, minimally invasive and highly effective extracorporeal CO_2 removal device combined with a continuous renal replacement therapy

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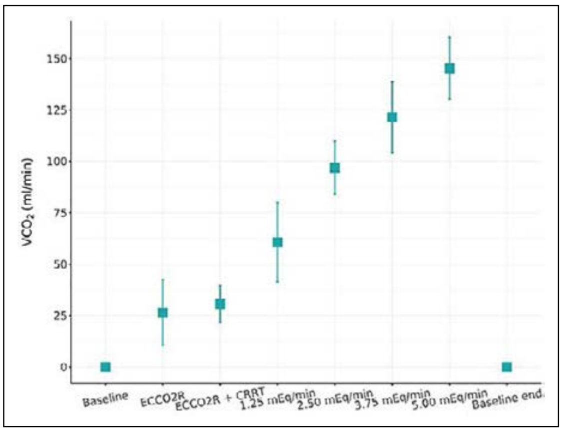
Objective: Extracorporeal carbon dioxide Removal ($ECCO_2R$) is used to treat patients suffering from acute respiratory failure. Its use is hampered by the high blood flow required to achieve a relevant CO_2 clearance.

We developed an ultra-low blood flow device to effectively remove CO_2 and perform continuous renal replacement therapy (CRRT).

Methods: Six pigs were connected to an extracorporeal circuit where 200 ml/min of blood flowed through a hemofilter connected to a closed-loop dialysate circuit. An ion-exchange resin acidified the dialysate flow upstream a membrane lung to increase PCO_2, thus enhancing CO_2 removal. Different levels of acidification were tested (from 0 to 5 mEq/min). Two l/h of post-dilution CRRT were constantly performed. At each step, we decreased the respiratory rate to maintain arterial PCO_2 at 50 mmHg

Results: Increasing acidification increased CO_2 removal of the membrane lung from 30±5 (0 mEq/min) up to 145±8 ml/min (5 mEq/min), a 483% increase, representing the 73±7% of the total CO_2 production. Minute ventilation decreased accordingly from 6.5±0.7 to 1.7±0.5 l/min. No major side effects occurred, but transient tachycardia episodes

Conclusions: This new extracorporeal ion-exchange resin-based multiorgan support device, proved extremely high efficiency in CO2 removal and continuous renal support. Future evaluations of long-term efficacy and safety will be required.



Extracorporeal VCO2 at each experimental step.

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Temperature monitoring during ECMO: An in vitro study

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Objective: Monitoring patient central temperature during ECMO is not clear, but potentially useful for the detection of "unexpressed" fever, related to septic complications.

We conducted two in vitro experiments to estimate ECMO heat dispersion and, consequently, patient central temperature during extracorporeal support.

Methods: Exp.A. We analyzed ECMO circuit heat dispersion (Maquet Rotaflow PLS System) at 36 combinations of BF (1-3-5 L/min), GF (0-5-10 L/min) and T set (36-37-38-39°C). Heat dispersion was considered equal to the power (Watts) generated by heat exchanger at steady state, defined as stable temperature throughout the circuit.

Exp.B. By a reservoir bag, we connected two circuits (pump+oxygenator+heat exchanger), simulating patient and ECMO circuit. Patient and ECMO T set ranged 36-39 and 35-39°C, respectively, for overall 63 conditions; ΔT was patient - ECMO circuit T set difference. The power generated by the two heat exchangers was recorded at constant patient BF (5 L/min) and ECMO BF and GF (3 L/min each).

Results: A) Overall, BF was 3.0±1.7 L/min, GF 5.0±4.1 L/min, pump rate 1299±615 rpm, T set 37.5±1.1°C and circuit heat dispersion 58±12 W (range 37.5-90), corresponding to a supposed patient metabolic consumption of 1196±246 Kcal/die (range 774-1857) in case of heat exchanger absence or inactivation. It was affected by GF and T ($p < 0.001$), but not by BF ($p=0.9$).

B) For $\Delta T>0$ heat exchanger did not generate energy, while for $\Delta T<0$ it supplied energy proportional to ΔT ($p < 0.001$). For $\Delta T=0$ heat exchanger power was 49±7 W (range 40-55).

Conclusions: ECMO heat dispersion depends on GF and temperature, but not on BF. Therefore, heat