

The use of extracorporeal life support systems in patients with acute respiratory insufficiency

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Summary

The thesis is focused on the use of Extracorporeal Membrane Oxygenation (ECMO) for the treatment of the respiratory failure. Particularly, it takes in account: 1. Which is the major benefit in term of lung stress, offered by the ECMO support, 2. Validation of a new device, for measuring the carbon dioxide elimination (identified as one of the variables to control the lung recovery), 3. Study of a new parameter to describe the native lungs recovery (or ECMO dependency) in patients with ARDS that underwent to ECMO support., 4. Which are the impact of the extracorporeal support to the blood rheology, in specific the hemolysis phenomenon and 5. Which are the best configuration, in terms of cannula system, to reduce the risk of neurological complications.

In the first chapter we measured the mechanical power before and after ECMO start in a population of severe ARDS, and we found that the values after the ECMO implantation are below the dangerous values, and it seems that the respiratory rate chosen during ECMO support could be correlated with a higher survival rate. In the second chapter we tested a new volumetric capnometer, created for the ECMO oxygenator/membrane lung (ML), with the capacity of measuring continuously the CO₂ removal done by the ML and calculating the ML dead space, to obtain a monitoring of ECMO performance and ML aging. In the third chapter we applied the volumetric capnometry to the patient's native lungs and to the ML, in a population of ECMO patient with respiratory failure. We found that the ratio (RCO₂ ratio) between the CO₂ elimination provide by the ML ($V'CO_{2ML}$) and the total $V'CO_2$ produce by the patients ($V'CO_2\ tot$) is a good index to detect the right time for ECMO liberation (ratio > 40%). In the fourth chapter we analyzed the hemolysis produced during prolonged ECMO support and we found that in our patients the factors that cause the hemolysis are the too negative drainage pressure and the dialysis machine connected to the ECMO circuit directly. In the fifth chapter we studied retrospectively the incidence of neurological complications occurred in patient on ECMO support, and we tested the cannula configuration affects the incidence of these complications. We compared the single lumen jugular cannula setting versus the double lumen cannula setting and we confirmed that both approaches are equal safe in terms on incidence of neurological complications. As conclusion, this thesis demonstrates the safety and efficacy of ECMO as respiratory support for severe ARDS patients and suggested to use a new index, the RCO₂ ratio, could help to detect the right time for ECMO liberation, the connection of the dialysis directly to the ECMO circuit enhances the hemolysis and the double lumen jugular cannula is safe as the single lumen approach in terms of neurological complication.