

## COMMENTARY TO HABILITATION THESIS<sup>1</sup>

Mechanical life support, and in particular extracorporeal membrane oxygenation (ECMO), has become an integral part of intensive care medicine, not only in university medical centres. The safety and effectiveness of these supports are therefore essential imperatives in the management of these critically ill patients. The habilitation thesis consists of publications that aspire to enhance the management of resuscitation using ECMO (ECPR), increase the safety of anticoagulation with novel agents such as direct thrombin inhibitors, and improve the safety of mechanical ventilation in patients with the most severe pulmonary impairment. This is a compilation of five papers for which I am the first author, and which are the result of several grant-funded projects.

The most significant challenges associated with ECPR are the clinical indications, the ECMO cannulation procedure itself, and, most crucially, the implementation of the system within regional healthcare. Since 2022, the Ostrava ECMO Centre, under my leadership, has performed ECPR for out-of-hospital cardiac arrests (OHCA ECPR) 24/7, and since 2026 it has also provided on-scene ECPR. This study provides a prospective evaluation of ECPR patients and offers a detailed analysis of their long-term outcomes. The system's efficacy is demonstrated by the fact that one-third of patients with refractory cardiac arrest are discharged home, experiencing a quality of life comparable to that of the general population. The current system is the result of over 15 years of development at our ECMO centre.

Anticoagulation is an integral part of ECMO support. Haemorrhaging has the potential to be fatal and also to exhaust limited supplies of blood products and transfusions, whilst concomitantly causing considerable complications during ECMO. New medications are not always accepted as easily as the gold standard of unfractionated heparin (UFH). Our original study compared UFH with argatroban, a direct thrombin inhibitor which is considered to be a promising class of medication. Anticoagulation with argatroban resulted in fewer transfusions, fewer life-threatening bleeds and easier achievement of target argatroban anticoagulation levels. A subsequent original study found that setting argatroban anticoagulation targets based directly on the strength of thrombin inhibition (anti-IIa), rather than targeting aPTT as standard, confirmed a lower risk of bleeding when targets are set lower than previously reported.

Not only in patients on ECMO, mechanical ventilation must allow for the recovery of damaged lung parenchyma. The effects of mechanical ventilation on the lungs can be characterised as mechanical energy (ME). Our team has developed a real-time bedside ME monitoring system that can be used to adjust mechanical ventilation parameters individually. Although no statistically significant difference in ME was observed between the intervention and control groups in a prospective randomised study, the study confirmed the feasibility of the concept. At our highly specialised centre, ME levels were too low to cause lung damage from the mechanical energy itself, which demonstrates the high level of specialised care provided at our ECMO centre.

A systematic review of the long-term outcomes of ECMO has further increased recognition of this method as an effective and meaningful approach, enabling patients who would otherwise have little chance of recovery to return to their families and work.

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<sup>1</sup> The commentary must correspond to standard expectations in the field and must include a brief characteristic of the investigated matter, objectives of the work, employed methodologies, obtained results and, in case of co-authored works, a passage characterising the applicant's contribution in terms of both quality and content.

**[1]<sup>2</sup> BURSA, Filip**, Michal FRELICH, Peter SKLIENKA, Marek BEBEJ, Juraj RODINA, Nela WALACHOVA, Jan VARADY, Jan NEISER, Radan SWACZYNA, Zuzana KUCEROVA, Marcela KANOVA, David HOLES, Michaela LSKOVA, Michal BURDA, Martin PORZER and Jan MACA. Extracorporeal cardiopulmonary resuscitation in a large tertiary center in the Czech Republic: three years' experience and future directions. *Scandinavian Journal Of Trauma Resuscitation \& Emergency Medicine* [online]. 2026, 34(1, Article 78). ISSN 1757-7241. Available at: doi:10.1186/s13049-026-01592-7

| Experimental work (%) | Supervision (%) | Manuscript (%) | Research direction (%) |
|-----------------------|-----------------|----------------|------------------------|
| 30                    | 50              | 80             | 80                     |

**[2] BURSA, Filip**, Jan MACA, Jiri SAGAN, Peter SKLIENKA, Simona NEMCOVA, Zuzana KUCEROVA, Tereza ROMANOVA, Ondrej JOR, Adela KONDE, Jaroslav JANOSEK and Michal FRELICH. A safety comparison of heparin and argatroban anticoagulation in veno-venous extracorporeal membrane oxygenation with a focus on bleeding. *Transfusion Medicine* [online]. 2025, 35(1), 75–81. ISSN 1365-3148. Available at: doi:10.1111/tme.13102

| Experimental work (%) | Supervision (%) | Manuscript (%) | Research direction (%) |
|-----------------------|-----------------|----------------|------------------------|
| 70                    | 50              | 80             | 75                     |

**[3] BURSA, Filip**, Michal FRELICH, Peter SKLIENKA, Simona NEMCOVA, Zuzana KUCEROVA, Ondrej JOR, Tereza ROMANOVA, Adela KONDE, Jaroslav JANOSEK, Jiri SAGAN and Jan MACA. Activated Partial Thromboplastin Time and Anti-IIa Monitoring in Argatroban Anticoagulation in COVID-19 Patients on Venovenous Extracorporeal Membrane Oxygenation. *Clinical And Applied Thrombosis-Hemostasis* [online]. 2025, 31(10760296251341315, Article 10760296251341315). ISSN 1938-2723. Available at: doi:10.1177/10760296251341315

| Experimental work (%) | Supervision (%) | Manuscript (%) | Research direction (%) |
|-----------------------|-----------------|----------------|------------------------|
| 70                    | 40              | 75             | 80                     |

**[4] BURSA, Filip**, Michal FRELICH, Peter SKLIENKA, Zuzana KUCEROVA, Jiri SAGAN, David OCZKA, Marek PENHAKER, Michal BURDA and Jan MACA. Protective mechanical ventilation controlled by the real-time mechanical power measurement. *Journal Of Clinical Monitoring And Computing* [online]. 2026, 40(1), 103–111. ISSN 1573-2614. Available at: doi:10.1007/s10877-025-01369-wA safety comparison of heparin and argatroban anticoagulation in veno-venous extracorporeal membrane oxygenation with a focus on bleeding

| Experimental work (%) | Supervision (%) | Manuscript (%) | Research direction (%) |
|-----------------------|-----------------|----------------|------------------------|
| 90                    | 50              | 75             | 75                     |

**[5] BURSA, Filip**, Michal FRELICH, Peter SKLIENKA, Ondrej JOR and Jan MACA. Long-Term Outcomes of Extracorporeal Life Support in Respiratory Failure. *Journal Of Clinical*

<sup>2</sup> Bibliographic record of a published scientific result, which is part of the habilitation thesis.

Medicine [online]. 2023, 12(16, Article 5196). ISSN 2077-0383. Available at:  
doi:10.3390/jcm12165196

| <b>Experimental work (%)</b> | <b>Supervision (%)</b> | <b>Manuscript (%)</b> | <b>Research direction (%)</b> |
|------------------------------|------------------------|-----------------------|-------------------------------|
| .15                          | .70                    | .80                   | .60                           |