Establishing a Large Animal Model of VA-ECMO-Induced Pulmonary Low Flow and Ist Systemic Effects

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BACKGROUND

Extracorporeal membrane oxygenation (ECMO) and emerging artificial lung devices represent promising therapeutic options for patients with severe or chronic respiratory failure, serving as a bridge to recovery or transplantation. Advances in ECMO technology have extended support duration from days to weeks, enabling some patients to remain awake and mobile during therapy. However, both VA-ECMO and artificial lungs create a chronic right-to-left shunt that markedly reduces pulmonary blood flow. The long-term consequences of this chronic low-flow state—particularly its effects on pulmonary and subsequent impact on other organ systems—are poorly understood and have never been systematically investigated in a controlled setting.

AIM

(1) To establish a novel long-term, 5-day VA-ECMO large animal model capable of inducing sustained oxygenated right-to-left shunting and complete decompression of the pulmonary vasculature, replicating the chronic low-flow state observed in clinical VA-ECMO or artificial lung support.
(2) To investigate comprehensively the pathophysiological mechanisms triggered by chronic pulmonary low flow, focusing on changes in the pulmonary, including processes of remodeling and effects on systemic hemodynamics and immunological responses, thereby generating the first integrative dataset to elucidate the multi-system impact of long-term pulmonary flow reduction.

METHODS

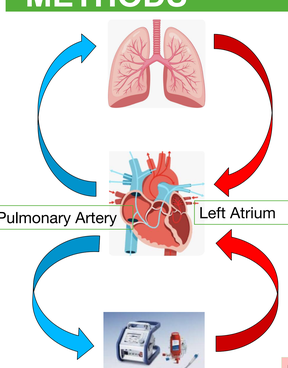

Figure 1. VA-ECMO-induced pulmonary low flow.

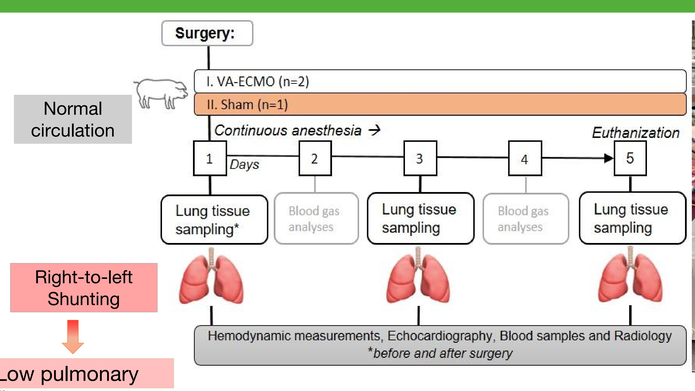

Figure 2. Overview of the experiment.

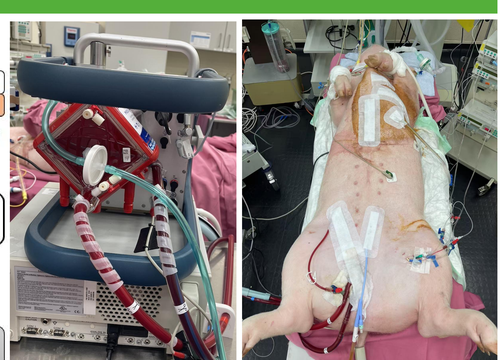

Figure 3. Image showing an anaesthesized and intubated pig with a VA-ECMO.

RESULTS

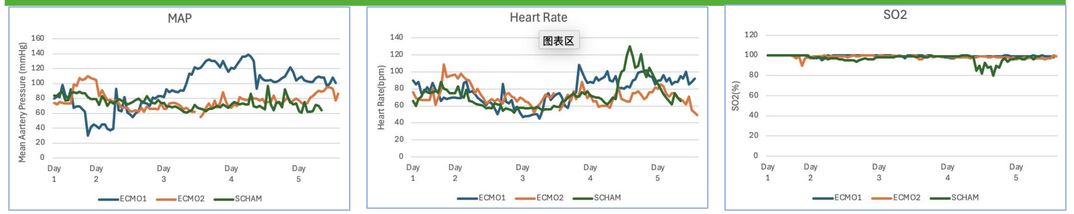

Figure 4. Stable Haemodynamics of the pigs during the experiment.

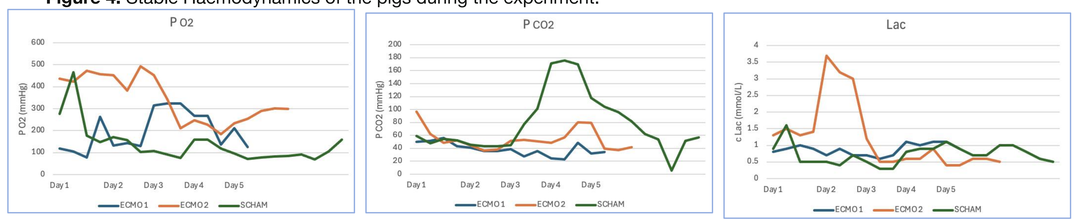

Figure 5. BGA analysis of the pigs during the experiment

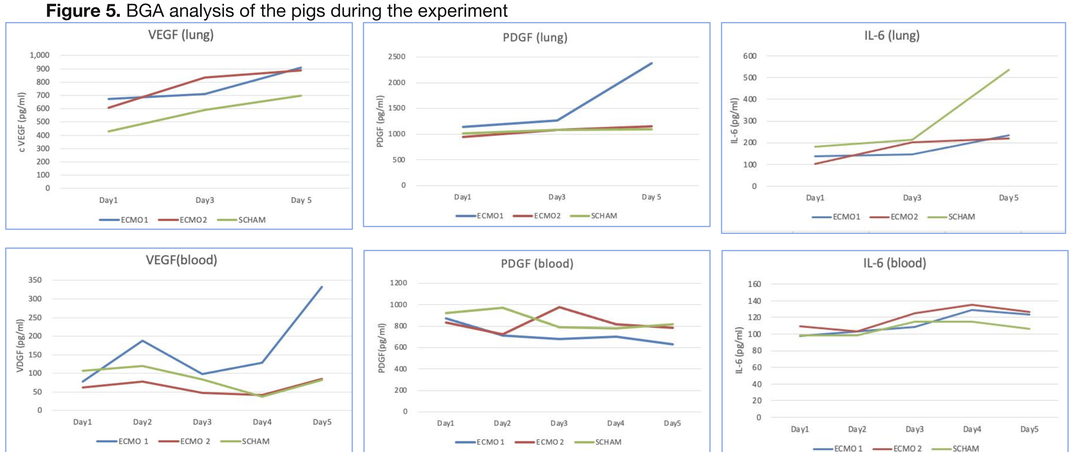

Figure 6. ELISA analysis of the lung remodeling and immunological response during the experiment.

CONCLUSIONS

1.Successful 5-Day VA-ECMO Model – A large animal model was established to study chronic pulmonary low-flow effects.
2.Increased Remodeling & Inflammation – Rising IL-6, VEGF, and PDGF levels indicate lung remodeling and immune activation under low-flow conditions.
3.Multi-Organ Impact – The model reveals systemic hemodynamic and immunological changes, highlighting broader consequences of reduced pulmonary flow.