System for Reducing Oxidative Stress in Extracorporeal Blood Circulation Systems

Removal of Highly Reactive Oxygen and Nitrogen Species from Blood Using a Radical Trap (Absorber)

Technology

The invention describes an innovative flow-through device that selectively inactives reactive oxygen and nitrogen species (ROS/RNS) during the passage of blood (e.g., during dialysis, the use of the cardiopulmonary bypass, ECMO, or other mechanical circulatory support systems). The binding agent consists of a carrier substrate whose surface is covalently functionalized with a material that acts as a spin trap, and either chemically binds free radicals or inactivates them via electron transfer. Covalent attachment ensures that the captured radicals remain within the material compound and are thus permanently removed from the blood..

Extracorporeal circuits and technical surfaces increase the formation of ROS/RNS in the blood and cause oxidative stress leading to secondary damage, e.g., in dialysis and cardiovascular patients. The device decreases the radical load before blood is returned to the body, stabilizes the redox balance, and aims to reduce oxidative stress and resulting complications.

Innovation

- Spin trap functionalization: covalently bound nitron/nitroso-based capture molecules that rapidly and selectively bind or inactivate highly free radicals.
- CMH, TMTH as well as further spin-trapping molecules; copolymer approaches allow tailored selectivity and reaction kinetics. Status monitoring: for color-changing reagents (e.g., CMH), optical detection of consumption status via sensor or visually.
- Secure retention: covalent binding prevents desorption of reaction products; in bulk variants, a retention component ensures particle retention.

Application

- Integration into extracorporeal circulations: ECMO/ECLS, heart-lung machine, dialysis, lipid apheresis, mechanical circulatory support.
- Tubing systems with blood or priming solutions as well as blood sampling/transfusion systems

Development Status

- Functional principle

Responsible Scientist

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Extracorporeal circulations

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