BLOOD-DERIVED ANTIMICROBIAL PEPTIDES FOR MANUFACTURING ANTISEPTIC MEDICAL SURFACES

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Introduction: The aim of this study was to functionalize surfaces with endpoint attached (EPA) heparin to incorporate blood-derived cationic antimicrobial peptides and proteins (AMPs) to form an antiseptic surface.

Methods: A adsorbent consisting of carboxylated polyacrylamide (PA) was functionalized with EPA-heparin using the method described by Larm et al [1]. Heparin functionalization was performed using unfractionated heparin (PA-UFH) and low molecular weight heparin (PA-LMWH). The functionalized adsorbents were incubated with human blood for 4 hours, during which neutrophil-derived cationic AMPs bound to the surface, which resembles the glycocalyx lining the human endothelium. The functionalized adsorber was packed into a 1 ml column to measure the clearance of *Staphylococcus aureus*. An aliquot of 6 ml human serum albumin solution (HSA 4%) spiked with 50,000 colony forming units (CFU)/ml of *S. aureus* was pumped through the column, and CFUs were determined pre and post column (Figure 1). A non-functionalized PA adsorbent and a commercial available heparin functionalized adsorbent (Seraph100, ExThera Medical, Martinez, US) were included in this study. An empty column served as control.

Results: Both, the non-modified and the heparin-functionalized adsorbent, pre-incubated in human whole blood, showed a significant reduction in *S. aureus* CFUs, while the same adsorbents pre-incubated in physiological saline showed no significant pathogen clearance (Figure 2).

Discussion: These findings highlight the vital role of the endothelial glycocalyx and its interaction with AMPs in infection, leading to the formation of a protective shield around the site of infection. Potential applications include pre-impregnating medical implants with human blood-derived antimicrobial substances to enhance blood compatibility and reduce the risk of infection. Additionally, EPA-heparin functionalized adsorbents could be integrated into extracorporeal blood purification systems, mimicking the endothelial glycocalyx, to deplete heparin-binding cytotoxic compounds, such as histones, platelet factor 4 or platelet-derived extracellular vesicles in sepsis patients.

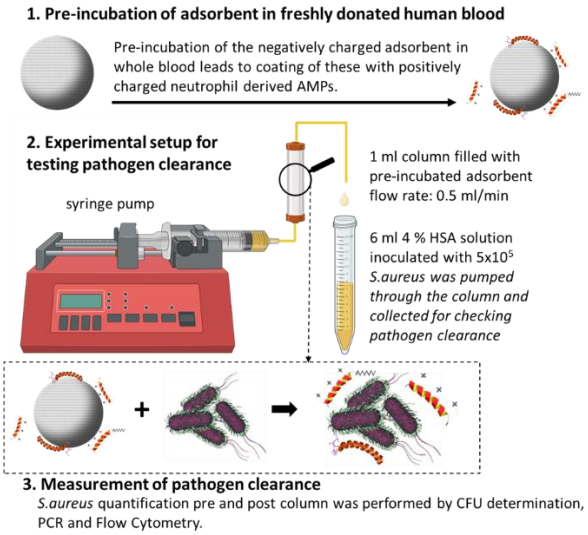

Figure 1: Setup of the dynamic model for pathogen clearance of heparin functionalized adsorbents.

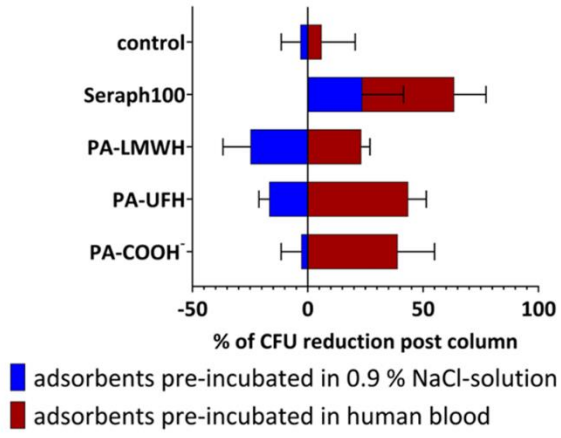

Figure 2: The graph illustrates the percentage decrease in colony forming units per milliliter (CFUs/ml) of the S. aureus suspension after the single pass through the column. An empty column without adsorbents served as control.

References

[1] *Biomater Med Devices Artif Organs* 1983, 11, (2-3), 161-73.