Antimicrobial properties of blood-derived products against biofilm-forming bacteria commonly found in burn wounds

Federica D'Asta¹, Mark Webber², Jonathan Bishop³, Fenella Halstead^{2,3}, Naiem Moiemmen^{3,5}, Janet Lord^{4,5} Paul Harrison^{4,5}

1. Birmingham Children's Hospital, Burns Centre, Birmingham, UK 2. Institute of Microbiology and Infection, University of Birmingham, Birmingham, UK 3. NIHR Surgical Reconstruction and Microbiology Research Centre Queen Elizabeth Hospital, Birmingham, UK 4. Institute of Inflammation and Ageing, University of Birmingham, Birmingham, UK 5. The Scar Free Foundation Centre for Burns Research, Queen Elizabeth Hospital, Birmingham, UK

Introduction

Platelet-Rich Plasma (PRP) is widely used to promote wound healing and tissue regeneration. This research study aimed to explore the antimicrobial properties of blood products against free bacteria and bacteria-forming biofilm.

Methods

In vitro studies were conducted to test isolated neutrophils, PRP, Platelet Poor-Plasma (PPP) and Leucocyte and Platelet Rich Plasma (L-PRP) against planktonic *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. Blood products were obtained from eight healthy volunteers, using a handmade sterile centrifugation technique. Components of products were confirmed using a full blood analyser (Sysmex XN1000). Assays to determine microbicidal and cytostatic properties of the preparations included disk diffusion, and growth kinetics. The ability of the blood-derived products to prevent *P. aeruginosa* and *A. baumannii* biofilm formation was tested using crystal violet biofilm formation assays and the biomass read as level of absorbance. Linear mixed models, ANOVA, Levene's test, Welch's statistic and Games-Howell adjustments were used.

Results

ABILITY TO CONTROL BACTERIAL GROWTH PRP and PPP preparations significantly reduced *Pseudomonas* (PA01) and *Acinetobacter* (AYE) growth over a 12-hours period compared to the positive control (p-value <0.0001). The only preparation showing growth control of *S. aureus* was the L-PRP preparation.

ABILITY TO PREVENT BIOFILM FORMATION

Against the Gram-negative bacteria, all the biomaterials tested gave a reduced level of biofilm biomass formation compared to positive control. (Donor 1: activated L-PRP, L-PRP, PRP vs *Acinetobacter* in broth p < 0.0001, and PPP p < 0.05. All blood-derived products vs *Pseudomonas* p <0.0001).

Discussion

Blood-derived products showed different antimicrobial properties according to the bacterial target and the cellular composition of the product tested. Whilst PRP products showed significant control of Gram negative bacteria in both their planktonic and biofilm growth, only the preparation including leucocytes seems to exert anti-bacterial effects against planktonic *S. aureus*.

Conclusion

This *in vitro* study provides preliminary evidence that blood-derived products can inhibit growth of key burn wound pathogens, both in their planktonic and biofilm forms. Blood-derived products have the potential of accelerating burn wound healing and reducing wound colonisation and infection.

Birmingham Women's and Children's NHS Foundation Trust

University Hospitals Birmingham NHS Foundation Trust