COLD ATMOSPHERIC PLASMA THERAPY: A NOVEL TREATMENT FOR BERLIN HEART EXCOR CANNULA INFECTIONS

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Introduction

Cold atmospheric plasma (CAP) therapy has been recognized as an effective treatment option for reducing bacterial load in chronic wounds, such as ventricular assist device (VAD) driveline exit-site infections [1]. Currently, there have been no reports on the safety and efficacy of CAP therapy for cannula infections and inflammations in paracorporeal pulsatile VADs.

Methods

The mechanical properties of Berlin Heart EXCOR cannulas were tested in-vitro both before and after Cold Atmospheric Plasma (CAP) treatment (SteriPlas, Adtec Healthcare Limited, UK) to investigate possible material alterations (Figure 1A).

Figure 1: CAP treatment of (A) EXCOR cannula samples in-vitro and (B) in-vivo of a pediatric EXCOR patient

A ring tensile test (Figure 2) was conducted on 20 untreated and 20 CAP-treated (5 min) EXCOR cannulas (Ø12mm) to assess the force at the breaking point of the cannulas (F_{max}), at 25% ($F_{25\%}$), and 50% ($F_{50\%}$) of the maximum displacement.

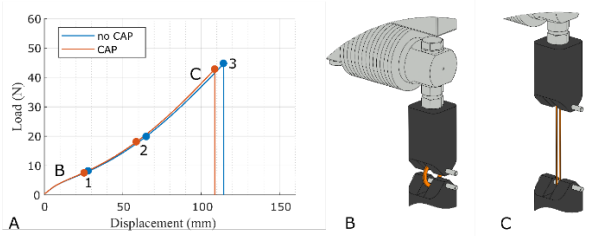

Figure 2: (A) Example tensile test curve, (B) Setup with ring sample at start of measurement and (C) stretched ring during measurement. (1) Force at 25% and (2) 50% of maximum displacement, and (3) maximum force at specimen breaking point. CAP: Cold Atmospheric Plasma

Additionally, scanning electron microscope (SEM) micrographs were taken for both groups to examine any surface changes. Finally, the case of a 13-year-old male EXCOR patient with cannula infections, treated with CAP over 100 days, is presented (Figure 1B).

Results

The in-vitro measurements revealed no statistically significant differences in mechanical strength between the control and CAP groups for $F_{25\%}$ (8.18±0.36 N vs. 8.02±0.43 N, p=0.21), $F_{50\%}$ (16.87±1.07 N vs. 16.38±1.32 N, p=0.21), and F_{MAX} (44.55±3.24 N vs. 42.83±4.32 N, p=0.16). Additionally, no surface structure alterations were identified in the SEM micrographs. The patient's cannula exit sites showed visible improvement in DESTINE wound staging (Figure 3), along with a reduction in bacterial load and inflammatory parameters after CAP treatment, all achieved without any observed side effects.

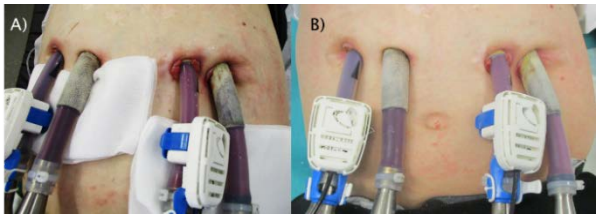

Figure 3: In-vivo situation (DESTINE 2) at the beginning (A) and end of CAP treatment (B)

Discussion

The in-vitro assessments indicated that there were no notable alterations in the mechanical strength or surface structure of the EXCOR cannulas after CAP treatment. The clinical utilization of CAP therapy proved to be safe and effective as an adjuvant treatment for EXCOR cannula exit-site infections.

References

1. Hilker L, von Woedtke T, Weltmann KD, Wollert HG. Cold atmospheric plasma: a new tool for the treatment of superficial driveline infections. Eur J Cardiothorac Surg. 2017;51:186–7.