TNF-α binding capacity *in vitro* of alginate and silver containing alginate wound dressings

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Introduction

TNF-α is an important pro-inflammatory immune modulator that leads to increased cytokine expression and elevated protease secretion. Extremely high levels of TNF-α have been reported in non-healing wound fluid compared to those from healing wounds. This overproduction in chronic wounds would result in severe tissue damage and impaired healing. Therefore the reduction of this mediator seems to be a suitable way to improve the healing outcome [1].

Within the present study we investigated the binding capacity of an alginate wound dressing (Suprasorb® A, Lohmann & Rauscher) for TNF-α . As well as the effect of two alginate wound dressings containing ionic silver (Suprasorb® A+Ag, Lohmann & Rauscher) and nano silver (Acticoat® Absorbent, Smith & Nephew) respectively.

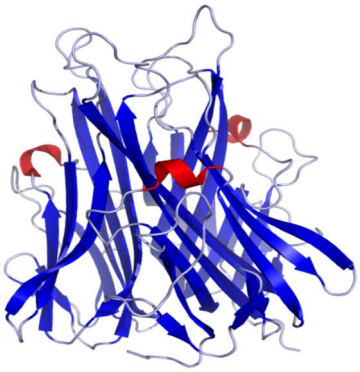

Fig. 1: Crystal structure of TNF-α created from the Protein Data Bank [Ramin Herati created from PDB 1TNF, 2006]. The active form of mature TNF-α has been determined to be a compact, bell-shaped trimer [2].

Material and methods

The wound dressing samples were cut into pieces by means of punch biopsies (8 mm diameter, corresponding to 0.5 cm^2). Each specimen was taken in a final volume of 1 mL of TNF-α solution (100 pg/ml). Samples were incubated up to 24 h at 37°C on a plate mixer. Subsequent, the supernatants were collected and the wound dressing samples washed with PBS (+ 0.5 % BSA) for 1 h to recover bound TNF-α. The concentration of unbound cytokine in both, the supernatants and eluates, was determined by means of specific ELISA (Mabtech AB, Sweden).

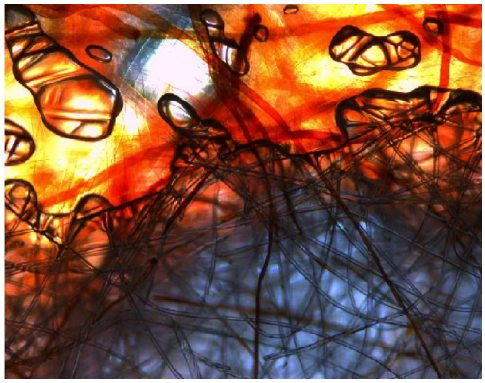

Fig. 2: Light microscopy image of partially welled alginate containing silver

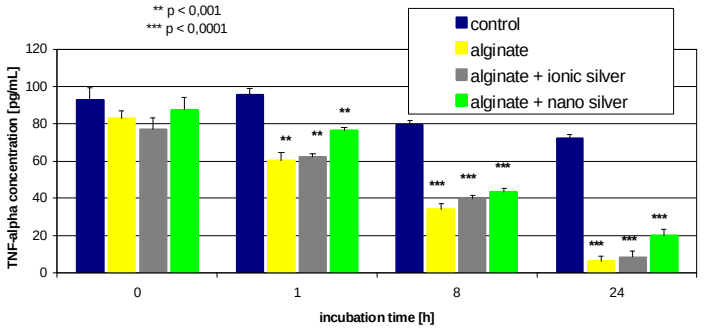

Fig. 3: Reduction of TNF-α concentration by alginate and alginate containing ionic silver or nano silver (mean ± SE).

Results

The alginate wound dressing is able to bind TNF-α. Already after 1 h a highly significant ($p < 0.001$) decrease of the TNF-α concentration was observed. The wound dressings of alginate + ionic or nano silver were also able to reduce the level of TNF-α significantly over the examined period (fig. 3). At which the alginate + nano silver exhibited a lower binding capacity for TNF-α than the alginate wound dressing and the alginate + ionic silver ($p < 0.05$). Nonetheless, the binding of TNF-α seems to be irreversible as it was only possible to elute marginal amounts of the cytokine from the wound dressing samples after incubation (fig. 4).

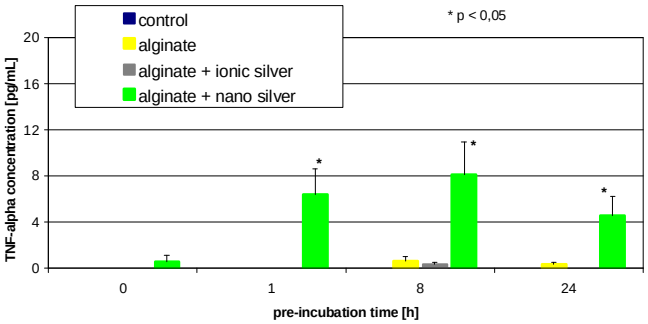

Fig. 4: Elution of TNF-α concentration from alginate and alginate containing ionic silver or nano silver after incubation (mean ± SE).

Conclusions

Alginate (fig. 2) can absorb fluids efficiently and the wetting results in the formation of a hydrated gel which promotes healing by retaining a moist environment [3]. As our previous studies have shown, it possesses a high binding capacity for the pro-inflammatory protease elastase and inhibits the formation of free radicals [4]. We have now been able to demonstrate that alginate and silver containing alginate are also able to bind significant amounts of TNF-α in vitro. The exudates of chronic wounds contain elevated concentrations of this pro-inflammatory cytokine and its activity keeps the chronic wound trapped in the inflammatory phase [1]. Therefore, the decrease of the excessive TNF-α concentration should aid to establish a physiological wound environment and to promote wound-healing.

References

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