Polyacrylate-superabsorbers bind inflammatory proteases *in vitro*

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Introduction

Non-healing wounds contain elevated levels of neutrophil elastase and matrix metalloproteinases (MMPs) which are responsible for the degradation of extracellular matrix and growth factors. These destructive processes prevent wound closure and lead to persisting wounds. It has been shown, that the binding of the proteolytic enzymes contributes to the treatment of chronic wounds. The aim of this study was to investigate the binding capacity of a polyacrylate-superabsorber for elastase and MMP-2 *in vitro*. Wound dressings containing polyacrylate-superabsorber are able to take up large quantities of exudates while keeping the wound environment moist; an additional binding of matrix degrading proteases would be a beneficial attribute.

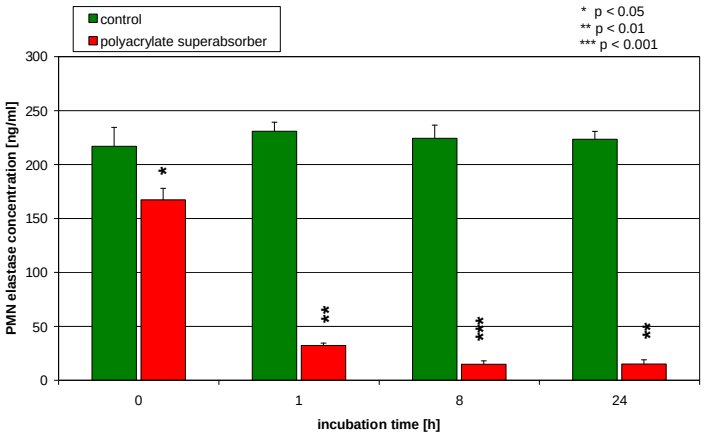

Fig. 1: Reduction of the neutrophil elastase concentration in the supernatant by the polyacrylate-superabsorper (mean ± SE).

Material & Methods

The wound dressing* was cut into equal pieces (0.5 cm^2), taken in a final volume of 1 mL of protease solution (PMN elastase: 250 ng/ml and MMP-2: 4000 pg/ml), and incubated up to 24 h at 37°C. Supernatants were collected and stored at -20 °C. The concentrations of unbound protein in the supernatants were determined by specific ELISAs (neutrophil elastase ELISA, milena biotec; and Quantikine Immunoassays for total MMP-2, R&D Systems).

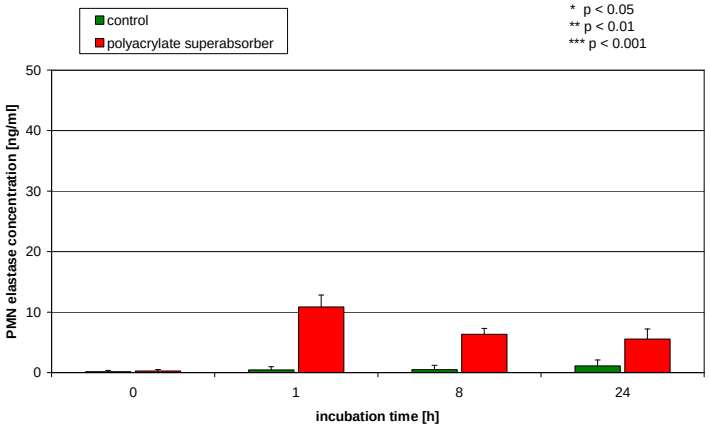

Fig. 2: Only marginal amounts of neutrophil elastase can be eluted from the polyacrylate-superabsorber after incubation (mean ± SE).

***polyacrylate-superabsorber containing wound dressing: Vliwasorb®, Lohmann & Rauscher**

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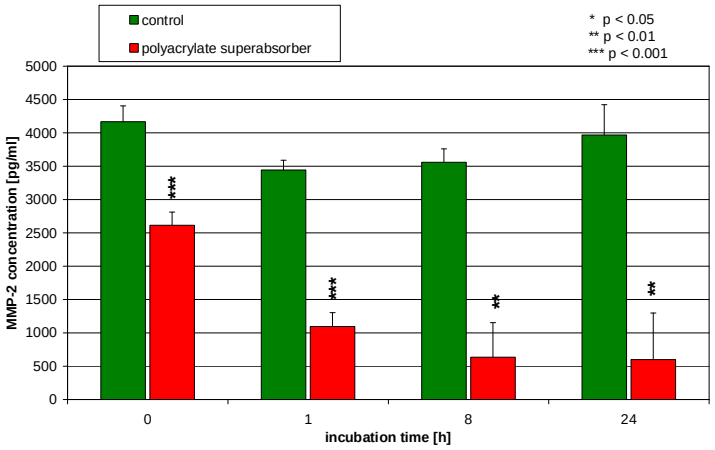

Fig. 3: Binding of MMP-2 by the polyacrylate-superabsorber (mean ± SE).

Results

The polyacrylate-superabsorber containing wound dressing exhibited a high binding capacity for neutrophil elastase (fig. 1) and MMP-2 (fig. 3). Most noticeable was the very fast uptake of the proteases by the polyacrylate superabsorber leading to a reduction of protease concentration right after contact (0h of incubation). Subsequently, only marginal amounts of elastase (fig. 2) could be eluted from the samples after incubation, while MMP-2 could not be detected at all in the eluate (data not shown).

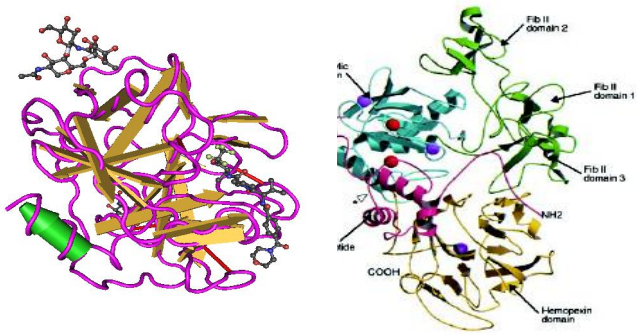

Fig. 4: Crystal structures of human neutrophil Elastase created from the Protein Data Bank (left; Nevit Dilmen, 2002) and pro-MMP-2 (right; Science 1999; 284:1667-70).

Conclusions

Polyacrylate-superabsorbers are able to absorb large amounts of fluid, because of their porous structure and high capillary activity, while retaining a moist environment which is thought to promote wound healing [1]. Furthermore, Eming et al. have been able to show that polyacrylate superabsorbers can inhibit MMP activity [2]. The presented study reveals that the polyacrylate superabsorber tested is not only able to shortly bind large amounts MMP-2 but also exhibits a significant binding capacity for neutrophil elastase. Elution of the wound dressing samples revealed a strong, possibly irreversible binding of both proteases. The decrease of these matrix degrading proteases should aid the establishment of a physiological wound milieu *in vivo* and thus support the healing process especially in highly exuding wounds.

References

1. Edwards JV, Bopp AF, Batiste SL, Goynes WR. Human neutrophil elastase inhibition with a novel cotton-alginate wound dressing formulation. J Biomed Mater Res 2003; 66A:433-40

2. Eming s, Smola H, Hartmann B, Malchau G, Wegner R, Krieg T, Smola-Hess S. The inhibition of matrix metalloproteinase activity in chronic wounds by a polyacrylate superabsorber. Biomaterials. 2008 Jul;29(19):2932-40.