Influence of the collagen origin on the binding affinity for neutrophil elastase

Friedrich-Schiller-Universität Jena

seit 1558

C. Wiegand[1], M. Abel[2], P. Ruth[2], U.-C. Hipler[1]

[1]Department of Dermatology, University Medical Center, Jena, Germany
[2]Lohmann & Rauscher GmbH & Co. KG, Rengsdorf, Germany

Introduction

Non-healing wounds contain elevated levels of neutrophil elastase which are responsible for the degradation of extracellular matrix and growth factors (Fig. 1). These destructive processes prevent wound closure and lead to persisting wounds [1]. It has been shown that the binding of the proteolytic enzymes by collagen wound dressings contributes to the treatment of chronic wounds. The aim of this study was to investigate the influence of the collagen origin (bovine*, porcine** and equine***, respectively) on neutrophile elastase concentration *in vitro*.

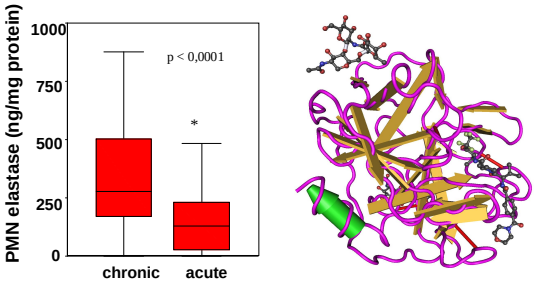

Fig. 1: Comparison of the PMN elastase concentration in the fluid of chronic and acute wounds [2], left. Crystal structure of human neutrophil Elastase created from the Protein Data Bank [Nevit Dilmen, 2002] , right.

Material and methods

Wound dressings consisting of bovine*, porcine**, and equine*** collagen have been used. Samples were cut into equal pieces (0.5 cm^2), taken in a final volume of 1 mL of neutrophil elastase solution, and incubated up to 24 h at 37°C. Subsequent, the supernatants were collected and the wound dressing samples washed with PBS (+ 0.5 % BSA) for 1 h to recover bound elastase. In both, supernatant and eluate, elastase concentration was determined by specific ELISA (PMN elastase ELISA, milena biotec).

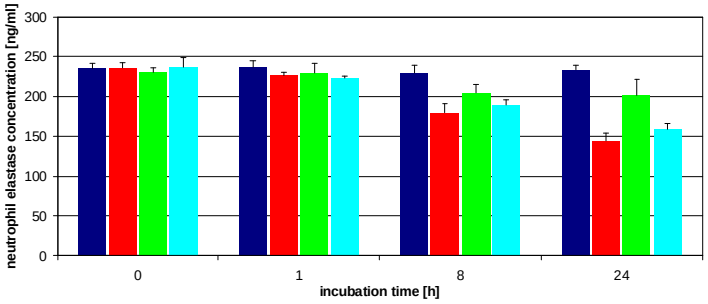

Fig. 2: Reduction of the neutrophil elastase concentration in the supernatant by collagen of bovine, porcine** and equine*** origin (mean ± SE).*

Results

All three tested collagens exhibited binding capacity for neutrophil elastase (Fig. 2). Bovine* and equine*** collagen type I significantly reduced the concentration of elastase already after an incubation of 1h. However, the binding affinity of porcine** collagen for elastase was lower compared to bovine* and equine*** collagen. Subsequent only a marginal amount of the enzyme could be eluted (Fig. 3). The binding of elastase seems to be irreversible.

* Bovine collagen: Suprasorb® C, Lohmann & Rauscher
** Porcine collagen: Nobakoll®, Noba Verbandmittel Danz
*** Equine collagen: Kollagen-resorb, Resorba® Clinicare

Fig. 3: Elution of neutrophil elastase from bovine, porcine** and equine*** collagen after incubation for up to 24h (mean ± SE).*

Conclusions

The physical properties of collagen type I such as porous structure (Fig. 4) and capillary activity allow the absorption of large quantities of fluid. As the results of this study demonstrate, collagen is able to bind considerable amounts of the enzyme *in vitro*. Elution of the wound dressings revealed a strong, possibly irreversible binding of the enzyme by collagen. Proteases like neutrophil elastase promote degrading processes and delay wound healing [1, 3-4]. Absorption of elastase into the wound healing may contribute to maintenance of growth factors and thus support the healing process. However, the choice of the collagen origin does influence the wound dressing performance.

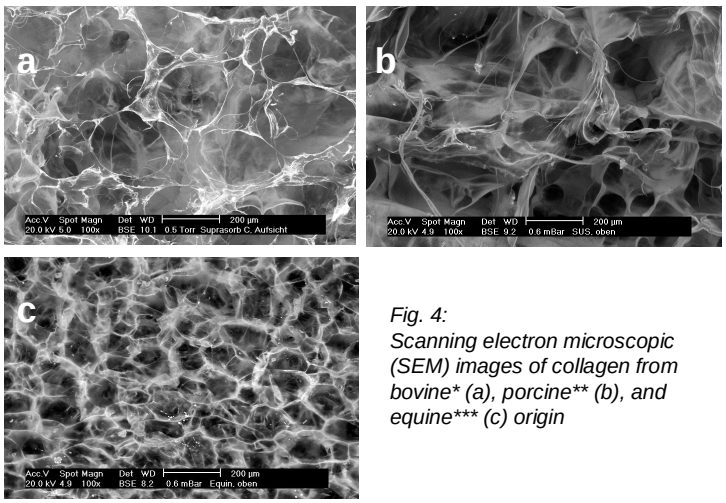

Fig. 4: Scanning electron microscopic (SEM) images of collagen from bovine (a), porcine** (b), and equine*** (c) origin*

References

1. *Trengove NJ, Bielefeldt-Ohmann H, Stacey MC. Mitogenic activity and cytokine levels in non-healing and healing chronic leg ulcers. Wound Rep Reg 2000; 8:13-25.*
2. *Norgauer J, Schönfelder U, Wiegand C, Abel M, Elsner P, Hipler U-C. Influence of the collagen wound dressing Suprasorb® C on proteases and cytokines in vitro. Poster presentation at the Conférence des plaies et cicatrisations (CPC), January 2007, Paris*
3. *Diegelmann RF. Excessive neutrophils characterize chronic pressure ulcers. Wound Repair Regen 2003;11:490–5.*
4. *Yager DR, Chen SM, Ward SI, Olutoye OO, Diegelmann RF, Cohen K. Ability of chronic wound fluids to degrade peptide growth factors is associated with increased levels of elastase activity and diminished levels of proteinase inhibitors. Wound Repair Regen 1997;5:23–32.*

18th Conference of the European Wound Management Association (EWMA), 14.-16. May 2008 Lisbon