Binding capacity of collagen from different origin for PDGF-BB

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seit 1558

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Introduction

Chronic wounds contain elevated levels of neutrophil elastase which is responsible for the degradation of growth factors such as platelet-derived growth factor (PDGF) [1]. In order to support the normal wound healing process the protection of growth factors is essential. Previous studies have shown that a wound dressing composed of bovine collagen type I is able to bind significant amounts of PDGF-BB, protect it from proteolytic degradation and maintain its biological activity [2]. The aim of this study was to investigate the influence of collagen of different origin (bovine*, porcine** and equine***, respectively, Fig. 1) on PDGF-BB concentration as well as biological activity *in vitro*.

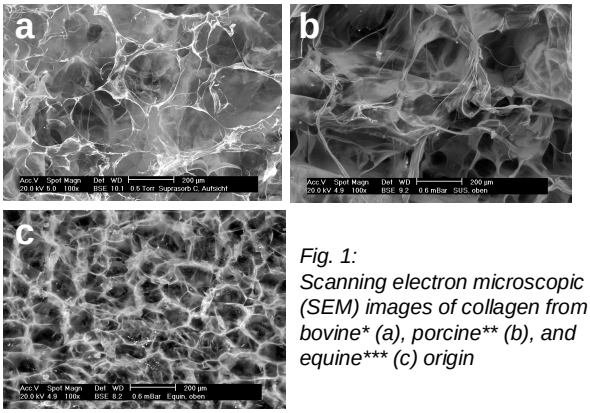

Fig. 1: Scanning electron microscopic (SEM) images of collagen from bovine (a), porcine** (b), and equine*** (c) origin*

Material and methods

Wound dressings consisting of bovine*, porcine**, and equine*** collagen have been used. Samples were cut into equal pieces and incubated in PDGF-BB solution. Supernatants were collected and the samples washed to recover bound PDGF-BB. PDGF-BB concentration was determined by specific ELISA (R&D Systems). Supernatants and washing solutions were incubated with human dermal fibroblasts. Cell proliferation was assayed by determination of dsDNA amount (PicoGreen, Molecular Probes) and ATP content (ATPlite, Perkin Elmer).

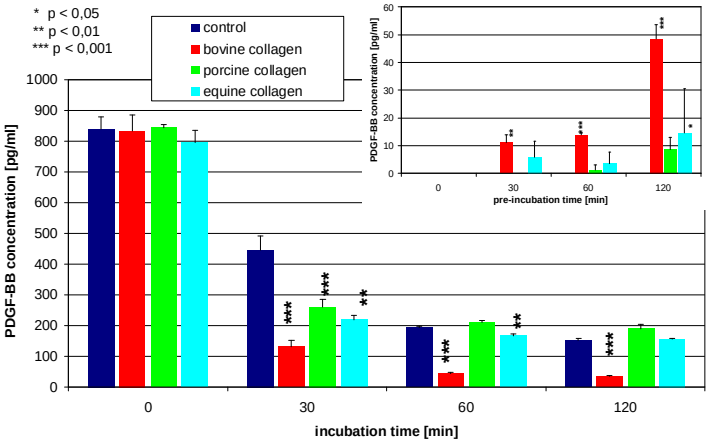

Fig. 2: Reduction of the PDGF-BB concentration in the supernatant by collagen of bovine, porcine** and equine*** origin (mean ± SE). Insert: Elution of PDGF-BB from bovine*, porcine** and equine*** collagen after incubation (mean ± SE).*

* Bovine collagen: Suprasorb® C, Lohmann & Rauscher

** Porcine collagen: Nobakoll®, Noba Verbandmittel Danz

*** Equine collagen: Kollagen-resorb, Resorba® Clinicare

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

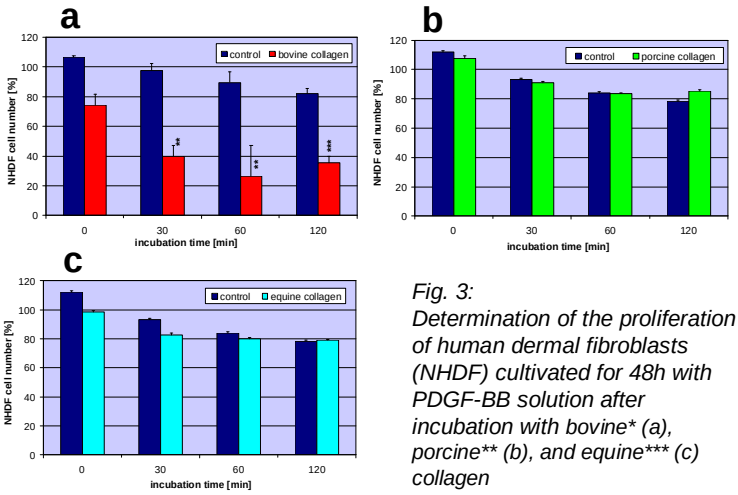

Fig. 3: Determination of the proliferation of human dermal fibroblasts (NHDF) cultivated for 48h with PDGF-BB solution after incubation with bovine (a), porcine** (b), and equine*** (c) collagen*

Results

As Fig. 2 shows, the bovine* collagen wound dressing binds considerable amounts of PDGF-BB. As a result of the binding, the effective concentration of the growth factor was reduced. As a consequence, the proliferation of fibroblasts treated with the pre-incubated PDGF-BB solution decelerates in a time- and dose-dependent manner as demonstrated in Fig. 3a. The binding capacity of porcine** and equine*** collagen for PDGF-BB was much lower (Fig. 2). Bound PDGF-BB can be regained from bovine* collagen by elution (Fig. 2, insert). The release of PDGF-BB from porcine** and equine*** collagen was much less distinct due to the lower binding capacity. The PDGF-BB elution from bovine* collagen correlated with increased fibroblast proliferation as shown in Fig. 4, almost reaching the proliferation level of medium control + PDGF-BB.

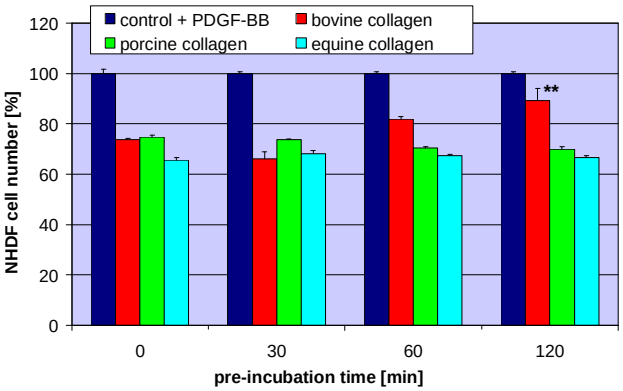

Fig. 4: Determination of the proliferation of human dermal fibroblasts (NHDF) cultivated for 48h with PDGF-BB eluted from collagen of bovine, porcine**, and equine*** origin after pre-incubation with the growth factor*

Conclusions

Collagen is able to bind PDGF-BB at different rates depending on its origin. In particular, bovine* collagen has a considerable binding capacity for the growth factor. During the binding, PDGF-BB is not only protected from proteolytic degradation but preserves its biological activity as well. Porcine** and equine*** collagen showed less binding affinity for PDGF-BB.

References

1. *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.*
2. *Schönfelder, U., Abel M., Elsner, P., Hipler, UC.; Chronic wound fluid influenced by the wound dressing Suprasorb® C – Effect on plateled-derived growth factor and coagulation factor XIII. Poster presentation at the 2nd World Union of Wound Healing Societies' Meeting, July 2004, Paris*