Comparison of the binding capacity of collagen from different origin for IL-1β and TNF-α

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Introduction

Chronic wounds contain elevated levels of pro-inflammatory cytokines like IL-1β and TNF-α. Prolonged inflammation is associated with an elevated release of reactive oxygen species by neutrophils and increased expression of proteases. This overproduction leads to severe tissue damage and impairs wound-healing. Hence, the reduction of these pro-inflammatory mediators is a suitable way to promote normal healing [1]. Collagen is known to be able to bind significant amounts of cytokines. At present, a variety of wound dressings containing collagen of different type and origin are used. Thus, we have investigated the influence of the collagen origin (bovine, porcine and equine) on the binding capacity for IL-1β and TNF-α.

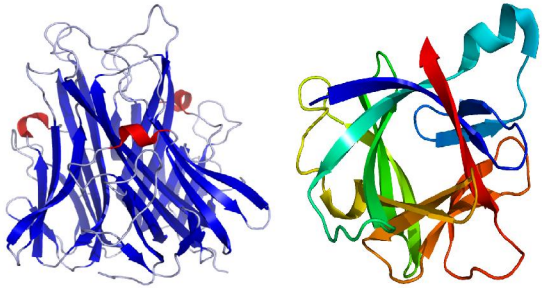

Fig. 1: Crystal structure of TNF-α (left) and IL-1β (right) created from the Protein Data Bank [Ramin Herati created from PDB 1TNF, 2006; PDB 31BI, 2008].

Materials & Methods

Wound dressings consisting of bovine (Suprasorb® C, Lohmann & Rauscher), porcine (Nobakoll®, Noba Verbandmittel Danz) and equine (Kollagen-resorb, Resorba® Clinicare) collagen have been used. Samples were cut into equal pieces, taken in 1 mL of IL-1β (100 pg/ml) or TNF-α solution (200 pg/ml), and incubated up to 24h at 37°C. Concentrations of unbound cytokines in the supernatants were determined by specific ELISAs (human IL-1 β , milenia biotec and human TNF- α Mabtech AB).

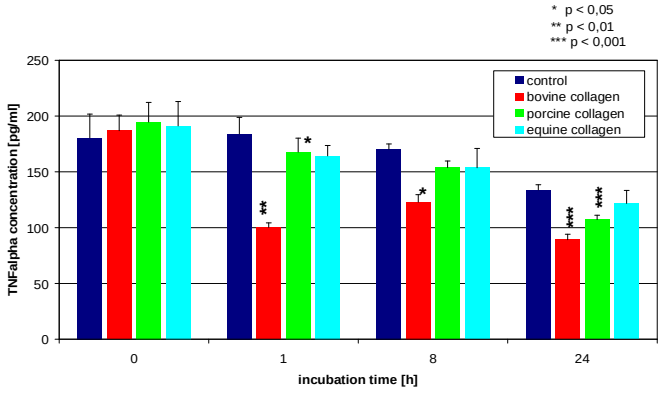

Fig. 2: Reduction of the TNF-α concentration in solution by bovine, porcine and equine origin (mean ± SE).

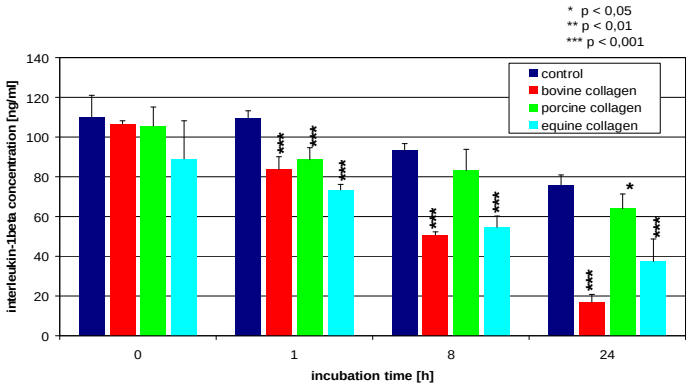

Fig. 3: Binding of IL-1β from a defined cytokine solution by collagen of bovine, porcine and equine origin (mean ± SE).

Results

The collagen wound dressings are able to bind both cytokines at different rates. Equine and porcine collagen showed a comparable capacity to bind TNF-α (fig. 2), although the interleukin reduction was not significant for equine collagen. In contrast, equine collagen had a higher affinity for IL-1β than porcine collagen (fig. 3). Bovine collagen performed best in the binding assays. Already after 1h a highly significant decrease of the TNF-α concentration (fig. 2, $p < 0.001$) and a distinct reduction of the IL-1β amount (fig. 3, $p < 0.01$) was observed.

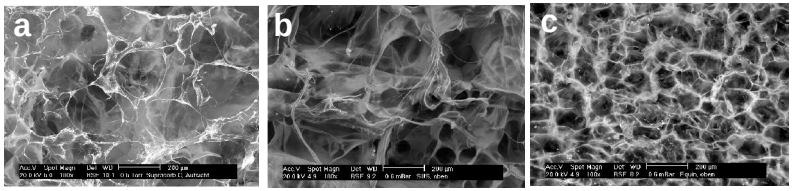

Fig. 4: Scanning electron microscopic (SEM) images of collagen from bovine (a), porcine (b), and equine (c) origin

Conclusions

Collagen is able to absorb a large amount of fluid, because of its porous structure and capillary activity, while retaining a moist environment which is thought to promote wound healing [2]. Furthermore, it possesses a high binding capacity for different inflammatory mediators, like proteases and cytokines, *in vitro*. Therefore, collagen containing dressings should be able to improve the healing outcome of chronic wounds by decreasing these excessive mediator concentrations. Nonetheless, we have now been able to show, that the choice of the collagen origin does influence the wound dressing performance. Collagen of various origin exhibits a different binding capacity for IL-1β and TNF-α. We found that bovine* collagen performed best in the binding assays.

References

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2. 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

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