The influence of β- and γ- radiation on the binding capacity of bovine collagen for PDGF-BB

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seit 1558

Introduction

Non-healing wounds lack essential growth factors e.g. platelet-derived growth factor (PDGF). This is due to an increased proteolytic degradation by proteases such as neutrophile elastase [1] and matrix metalloproteinases (MMPs). In order to support the normal wound healing process, the protection of growth factors is essential. As a previous study has shown, a wound dressing composed of bovine collagen type I (Suprasorb® C), is able to bind significant amounts of PDGF-BB and to release it successively afterwards [2]. Since the binding, PDGF-BB is partly protected from proteolytic degradation [2]. In this study, we investigated whether β- and γ- radiation modify the binding capacity of the collagen wound dressing for PDGF-BB. Radioactive radiation is a common way to sterilise wound dressings during the production process.

Material and Methods

Wound dressing samples were irradiated with β- or γ-radiation (20 kGy). Afterwards, the collagen sponge was cut to pieces with biopsy punches of 8 mm in diameter (corresponding to 0.5 cm^2). Each sample was incubated up to 30 min at 37°C in 1 mL PDGF-BB (1 ng/mL) solution. Non-irradiated Suprasorb® C obtained from the same lot served as control. Subsequent, the supernatants were collected and the wound dressing samples washed with PBS (+ 0.5 % BSA) for 1 h to recover bound PDGF-BB. The concentration of PDGF-BB in both the supernatants and the washing solutions was examined by ELISA (R&D Systems, Wiesbaden).

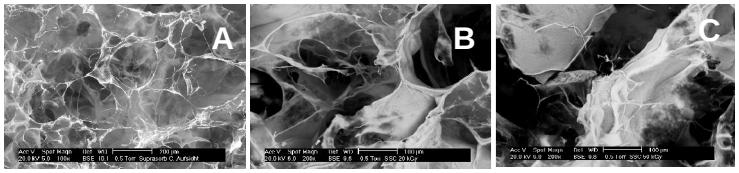

Fig 1: Scanning electron micrographs of the collagen wound dressing Suprasorb® C. A native; B γ-irradiated (20 kGy); C γ-irradiated (50 kGy)

Results

As shown in fig. 1, radioactive irradiation influences the structure of the wound dressing. Whereas in the non-irradiated control, the pourous textur of the collagen sponge is clearly visible (fig. 1A), a dose-dependent destruction of the specific structure was observed in γ-irradiated samples (fig. 1B,C). β-irradiation revealed similar effects on the dressing (micrographs not shown). As presented in fig. 2, the native collagen dressing binds significant amounts of PDBF-BB (red bars). Collagen samples, irradiated with 20 kGy β- or γ-radiation exhibit nearly the same binding capacity for PDGF-BB as the non-irradiated control (yellow and green bars).

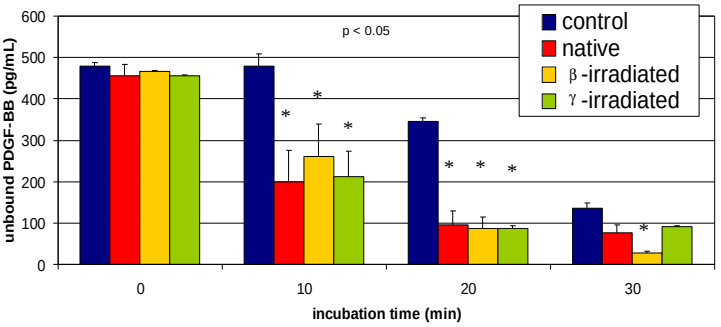

Fig. 2: Binding of PDGF-BB by the collagen wound dressing Suprasorb® C from solution: native (red bars), β-irradiated (yellow bars), γ-irradiated (green bars).

After 1 h elution time, about 20 % of the bound growth factor could be recovered from native Suprasorb® C (fig. 3, red bars). Within the same time period, the β- and γ–irradiated samples (20 kGy) release significantly higher amounts of the initial PDGF-BB concentration (yellow and green bars).

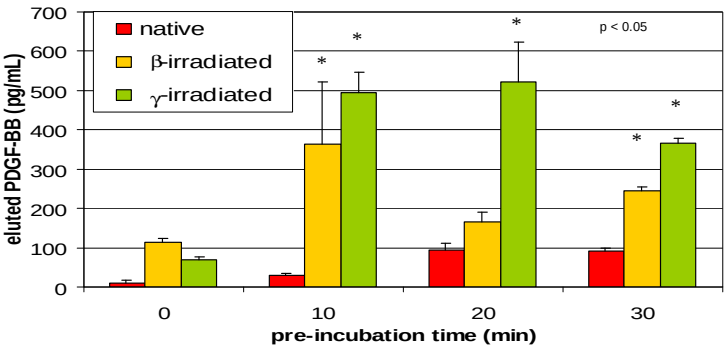

Fig. 3: Release of PDGF-BB from the collagen wound dressing Suprasorb® C: native (red bars), β-irradiated (yellow bars), γ-irradiated (green bars).

Discussion

The physical properties of Suprasorb® C such as porous structure and capillary activity enable the dressing to absorb large quantities of fluid. Furthermore, the collagen sponge absorbs substantial quantities of the platelet-derived growth factor (PDGF-BB). Despite the fact that radioactive radiation partly destroy the three-dimensional structure of the collagen dressing as scanning electron micrographs reveal, radiation doses up to 20 kGy have no significant effect on its binding capacity for PDGF-BB. However, the bound growth factor was released more rapidly from the irradiated samples and is thus again vulnerable to proteolytic degradation.

References

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