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ORIGINAL PAPER

Induction of PDGF-B in TCA-treated epidermal keratinocytes

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Abstract Trichloroacetic acid (TCA) is one of the most widely used peeling agents, and induces full necrosis of the whole epidermis, followed by reconstitution of the epidermis and the matrix of the papillary dermis. The cytotoxic effects of TCA, such as suppressing proliferation of keratinocytes and fibroblasts and protein synthesis by fibroblasts, have already been reported. However, the entire biological mechanism responsible for TCA peeling has yet to be determined. Hypothetical activation effects of TCA treatment on epidermal cells to induce production of growth factors and cytokines are examined, and are compared with its cytotoxic effects in terms of time course and applied TCA concentrations. After various periods of incubation with TCA, viability of Pam212 murine keratinocytes was investigated with MTT assay and dye exclusion assay, and production of growth factors and cytokines with reverse transcription-polymerase chain reaction (RT-PCR). Changes in platelet-derived growth factor (PDGF)-B mRNA expression and protein production in the human skin specimens after TCA application were then examined by RT-PCR and immunohistochemistry, respectively. Incubation with TCA showed cytotoxicity and induced death of Pam212 cells, depending on the incubation period and the TCA concentration. In addition, expressions of PDGF-B, tumor growth factor (TGF)-α, TGF- β1 and vascular endothelial growth factor, which are the growth factors reportedly secreted from keratinocytes during wound healing, were all detected in Pam212 cells after short-term treatment with TCA. Expressions of inflammatory cytokines such as interleukin (IL)-1 and IL-10 were also induced. In TCA-treated NIH-3T3 fibroblasts, in contrast, observed was upregulation of only keratinocyte growth factor, which is reportedly secreted from fibroblasts, as well as the similar cytotoxic effect. In human skin, PDGF-B mRNA expression became significantly upregulated after TCA application, and then immediately downregulated. Immunoreactive PDGF-B in the cytoplasm of keratinocytes became detectable throughout the epidermis after TCA application, reached maximum after the peak of mRNA expression, and then declined significantly over 24 h when the epidermis became completely necrotic. The TCA-treated epidermis acts as a major source of growth factors, including PDGF-B, before undergoing full necrosis. This effect might contribute to a promotion of re-epithelialization and dermal regeneration without wound contraction and scarring.

Keywords Chemical peeling · Keratinocyte · Growth factors · Platelet-derived growth factor · Trichloroacetic acid

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Introduction

Chemical peeling is a rejuvenation method in which chemical reagents are used on the skin surface, thereby improving photoaged skin such as actinic lentigines and wrinkles [4]. Peeling reagents such as various acids and phenol have a protein coagulation effect, thus causing tissue injury into various depths of the skin. Trichloroacetic acid (TCA) is one of the most widely used peeling agents, and is used for