Chemical Peeling - A Histological Study on The Skin of Guinea Pigs

Duck Taik Shim, M.D., Young Keun Kim, M.D.

Department of Dermatology, Soochunhyang University College of Medicine, Seoul, Korea

Background: It is a recent trend in Korea that the uses of trichloroacetic acid(TCA) have been increased as the usual chemical peeling agent for treating abnormal pigmentation like solar lentigo, freckle, melasma, or actinic keratoses, rhytides, acne scar and other facial problems. We made an experiment to see how the different concentrations of TCA affect the guinea pig skin histologically.

Objective: The purpose of this study was to evaluate the histologic changes using various concentrations(35%, 50%, 90%) of TCA.

Methods: At first, 35%, 50% or 90% of TCA was applied to the each right ear of guinea pigs. After the application, we checked these specimens in intervals - one hour after (D1hr), the following day(D1), the third(D3), fourth(D4), fifth(D5) day, one week(D1wk), two weeks(D2wk), sixteen weeks(D16wk) later. The specimens were processed and stained with hematoxylin and eosin (H & E), Verhoeff elastic, and alcian blue stain.

Results: 1. In D1hr of 35% and 50% TCA treated groups, some keratinocytes with eosinophilic cytoplasm and pyknotic nuclei were scattered in the epidermis. The higher the concentrations of TCA, the more evidence of homogenization of the epidermis. The homogenization of epidermis and dermis was most prominent in 90%.

2. In D1 and D2, necrosis of the epidermis were proportional to the concentrations of TCA. We could see infiltrates of inflammatory cells in the whole dermis when 90% of TCA was tried.

3. Desquamation of the necrotic epidermis appeared in each group between 3 and 7 days after the treatment.

4. In groups treated with 50% and 90% TCA, reepithelialization arising from skin appendages was prominent.

5. Hyperplasia of epidermis appeared in every group between the second and sixteenth weeks but dermal hyperplasia was prominent only in the group of 90% TCA at sixteen weeks.

Conclusion: While thirty-five per cent TCA solutions produced partial destruction of the epidermis, 50% and 90% of TCA destroyed the entire epidermis and upper dermis. Regeneration of epidermis from skin appendage is a significant base of deep chemical peeling. Epidermal hyperplasia was found in 50% and 90% of TCA, but dermal hyperplasia was only found in 90% of TCA. (Ann Dermatol 7;1(1)45-50, 1995)

Key Words: Trichloroacetic acid (TCA)

Trichloroacetic acid(TCA) has been used for the treatment of actinic keratoses, wrinkles, abnormal pigmentation, acne scars, and other facial skin problems. TCA is a time-honored peeling agent that has no known systemic toxicity. TCA is a derivative of acetic acid whose protein-precipitating properties have been used to the medical benefit of patients for over 100 years. The pre-
sumed therapeutic effects of TCA are destruction of the epidermis and dermis with subsequent reepithelialization and stimulation of new collagen formation. Dermatologists have utilized a wide spectrum of agents and formulas for peeling including retinoic acid, solid carbon dioxide (CO₂), sulfur solutions, resorcinol, salicylic acid, solid carbon dioxide (CO₂), sulfur solutions, resorcinol, salicylic acid, alpha hydroxy acid, TCA, phenol, and phenol formulas as early as 1926. The therapeutic effects of using various dilutions of TCA were first reported in 1945 by Monash. Since 1962, TCA chemical peel has gained popularity and is widely used cosmetically for its smoothing and rejuvenating effect on skin and therapeutically for its ablative effect on actinic keratoses, although various peeling agents have been the subject of experimentation. In reviewing the literature, we have not found a comparative study of the effects of varying and modifying concentrations of this chemical on the skin in Korea. Using the guinea pig, we have tried to investigate histological changes 1 hour to 16 weeks after chemical peeling. We designed an experiment to evaluate the wound depths produced by varying concentrations of TCA.

MATERIALS AND METHODS

Each 35%, 50%, and 90% TCA concentration is obtained respectively by mixing TCA (United States Pharmacopeia; USP) crystals with distilled water. Six albino female guinea pigs were chosen as the animal model whose average weight was 240 to 300gm at the onset. The fur of both sides of the ears was removed by thioglycolic acid. The dorsal surfaces of the ears were washed with soap, rinsed with water, and then scrubbed for 1 minute with acetone-soaked gauze. Then 0.1ml of 35%, 50% and 90% TCA (35, 50, 90gm/100ml) was applied to 2.0x2.5cm areas on the right sides of their ears twice in a uniform fashion with cotton-tip applicators and the contralateral sides were used as a control group.

Three-mm punch biopsy specimens were obtained from each ear of the guinea pigs respectively on each experimental day. The specimens were processed and stained with hematoxylin and eosin (H&E), Verhoeff elastic, and alcian blue stain. The characteristics described herein include the depth of destruction, cell morphology, and the thickness and reepithelialization of the epidermis.

RESULTS

The specimen treated with 35% TCA demonstrated homogenization of the epidermis and a few scattered individually necrotic keratinocytes 1 hour after the treatment (Fig.1a.). After 3 days, desquamation of necrotic keratinocytes was found with normal appearing dermis (Fig.1b.). On the fifth day, the entire epidermis had recovered completely and there were no specific differences of epidermis and dermis compared with those of the control skin.

The specimen treated with 50% TCA demonstrated homogenization of epidermis and upper dermis after one hour (Fig.2a.). Three days after the treatment, the whole epidermis was conspicuously necrotic and partially separated (Fig.2b.) and the dermis demonstrated papillary dermal edema and telangiectasia. By the fifth day, it showed reepithelialization arising from the follicular infundibulum with mixed dermal inflammatory infiltrates (Fig.2c.) One week after the treatment, the area of chemical peel had become completely covered by the epidermis. The newly formed epidermis appeared to be slightly thicker and the rete ridges were thicker and deeper than those found in normal skin. The dermis had slightly increased in thickness, and many fine, delicate, apparently newly generated collagen fibers were found in the upper dermis.

One hour after the treatment, TCA at 90% concentration caused homogenization of epidermis and superficial reticular dermis and nucleus of homogenized keratinocytes were repleted with ghosts of nuclei in epidermis (Fig.3a.). Numerous telangiectatic vessels were also seen in the upper dermis. Three days after peel treatment full epidermal and partial dermal necrosis with marked mononuclear cell infiltration (Fig.3b.) was noted. Two weeks after the treatment, the epidermis and dermis were completely resurfaced and showed evidence of reepithelialization arising from follicular infundibulum (Fig.3c.). Ectactic vessels were also detected along with many dense bundles of collagen and an increased number of fibroblast in the upper dermis. At the 16th week hyperplasia of the epidermis and dermis appeared.

When Verhoeff elastic and alcian blue stain was