REMOVAL OF STRATUM CORNEUM IN VIVO: AN IMPROVEMENT ON THE CELLOPHANE TAPE STRIPPING TECHNIQUE*

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ABSTRACT

The removal of stratum corneum in vivo by cellophane tape stripping is a traumatic procedure, as evidenced by considerable acute erythema. This may render the skin less suitable for subsequent experimentation. Hydration of the stratum corneum by occlusion under a water-saturated patch for 24 hours prior to stripping greatly facilitates the procedure. Removal is accomplished with less force, and with about \( \frac{1}{6} \) the number of strippings ordinarily required. Also, there is usually less erythema than after stripping of dry skin. Why hydration should loosen stratum corneum cells from each other is not known.

In the course of studying certain effects of irritants on human skin, we found it necessary to remove the barrier layer in preparation from some of the experiments. Past experience had taught us that the cellophane tape stripping procedure ordinarily employed for this purpose frequently elicits considerable erythema, which often persists for one or two days. The accurate assessment of reactions to irritants applied to skin so prepared is thus rendered more difficult. To wait for this erythema to fade completely would allow time for at least partial regeneration of the stratum corneum [1]. It occurred to us that the cause of the erythema might lie in the rather marked dermal stretching and deformation that occur as the tape is pulled off, and that therefore more gentle removal should be attempted. The technique of cellophane tape stripping as detailed by Pinkus [1], and particularly as mechanized by Lorincz [2], is rather harsh. Apparently no attempt was made to minimize the side effects, although Hunter et al reported later [3] that alternating the direction of stripping allows removal with fewer total strips. In this brief report we describe a variation on tape stripping of the stratum corneum. With this modification fewer strippings are required and the resultant erythema is less intense.

METHODS AND MATERIALS

Thirteen subjects (young, white adults) were prepared by application of a 2 x 8 inch cotton Webril (Johnson & Johnson) patch, soaked in tap water and occluded with Blenderm (3M Company) tape, to the lower back. Twenty-four hours later the water patch was removed. This hydrated stratum corneum and an adjacent site of dry control skin were immediately stripped with 1-inch Scotch (3M Company, #0600) cellophane tape. The tape was pressed firmly into place before each stripping maneuver. In contrast to rapid tape removal as described by Pinkus, we splinted the adjacent skin and applied countertraction, while slowly peeling the tape off by doubling it back on itself (Fig. 1). Stripping was continued until most of the area under the tape was glistening, and the number of strips required for each test area was recorded. Four-mm punch biopsies of both stripped areas were taken from seven subjects immediately after stripping for further assessment of the completeness of stripping. Erythema was rated immediately after stripping, and at 24 hours in some subjects, on an arbitrary zero through + + + scale.

RESULTS

In comparing the ease of stripping from dry and wet sites, we found that the initial 4 to 6 strips from wet skin separated much more freely than from dry skin. Also, each subsequent strip removed a larger quantity of stratum corneum from wet than from dry skin. The figures in Table I express the differences in the number of strips required to remove the stratum corneum with and without water pretreatment. Consistently more layers of stratum corneum are peeled off with each strip of wet skin than with dry skin. An average of 29 strips was required on dry skin, compared to an average of 10 strips on wet skin. The photomicrographs (Figs. 2, 3) confirm virtually complete removal of the stratum corneum in both dry and wet areas.

Table II expresses the amount of erythema observed at each stripping site immediately, and at 24 hours in the last eight subjects. Obviously the erythema elicited is quite variable from one subject to another, and does not correlate well with the number of strips performed. However, in five cases immediate erythema was greater in the dry area than in the wet area. In no case was the reverse true. In seven cases the reactions were equal. At 24 hours the erythema was greater in the dry area than in the wet area in seven cases. In no case was the reverse true. In one case the reactions were equal.

DISCUSSION

In this study we show that prior hydration of the stratum corneum facilitates its removal by cellophane tape stripping. Removal can be accom-
REMOVAL OF STRATUM CORNEUM IN VIVO

Fig. 1. Cellophane tape stripping technique. Fingers of left hand splint surrounding skin as tape is doubled back and slowly peeled off with right hand.

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* Subjects biopsied

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Number of stripplings required for stratum corneum removal

Intensity of erythema produced by stripping

plished with about the number of strips ordinarily required, and in most cases there is less traumatic erythema.

The lesser erythema in the wet areas, which was especially true at 24 hours after stripping, is probably due simply to the fact that they were subjected to less deformation by stretching.

The reason for easier removal of wet stratum corneum is not entirely clear. Keratinous structures are more easily stretched and broken when
Fig. 2. Photomicrograph (hematoxylin and eosin, × 100) of dry stripped skin. Subject P.D.
wet. Speakman [4], studying wool fibers, showed that only about 1/4 of the work required for 30 percent extension of dry fibers was needed for water-soaked fibers. Wildnauer et al [5] studying whole human stratum corneum in vitro, showed an 85 percent reduction in breaking strength under longitudinal traction in 100% relative humidity as compared to 0% relative humidity. This fact may not apply directly to the layer-by-layer peeling of stratum corneum. However, Wildnauer et al state that breakage occurs at the intercellular spaces. The same was true in the stripping studies of Hunter et al [3]. If this is true, then hydration must weaken the intercellular attachments. Just why this should happen, we do not know.

REFERENCES

Fig. 3. Photomicrograph (hematoxylin and eosin, × 100) of wet stripped skin. Subject P.D.