Granular parakeratosis induced by benzalkonium chloride exposure from laundry rinse aids

Keywords: Granular parakeratosis, benzalkonium chloride, contact dermatitis

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ABSTRACT:

Benzalkonium chloride is a quaternary ammonium cationic detergent present in a number of household products, which can act as a major skin irritant. We present the case of six children who developed granular parakeratosis after exposure to benzalkonium chloride in laundry rinse aids, presenting as a brightly erythematous, tender but minimally pruritic, intertriginous eruption followed by superficial desquamation. The eruptions resolved over three to four weeks after cessation of exposure.

INTRODUCTION:

Granular parakeratosis classically presents as an annular eruption of erythematous to brown hyperkeratotic papules, coalescing to plaques¹. It primarily affects intertriginous zones such as groin and axilla, but can also occur in other areas. Historically, granular parakeratosis was thought to be due to exposure to personal hygiene products such as deodorants and antiperspirants^{1,2} and products containing zinc oxide³. Recent reviews have speculated that granular parakeratosis may be more of a reactive pattern than a distinct disease entity¹.

Granular parakeratosis involves alteration of keratinocyte maturation from the stratum granulosum to the stratum corneum, and consequently retention hyperkeratosis^{1,3}. This is thought to be caused by a defect in the processing of profilaggrin to filaggrin, resulting in retention of keratohyaline granules, elevating stratum corneum pH, and consequently increased adhesion and defective barrier function¹.

Benzalkonium chloride is a quaternary ammonium cationic detergent, used as a skin disinfectant and also a sanitising agent in a number of household and industrial cleaners^{4,5}, along with personal hygiene products such as eye drops, bath oils, antibacterial soap free washes, and laundry rinse aids. Benzalkonium chloride acts as a biocidal agent and surfactant, which causes

disruption of cellular lipid bilayers, along with inactivating certain enzymes. As a result of these properties, it has activity against bacteria, fungi, some viruses and protozoa. Multiple studies have also reported the potential for benzalkonium chloride to act as a major skin irritant^{4,5}.

MAIN TEXT:

We present a case series of six children who presented with granular parakeratosis, all with a history of benzalkonium chloride exposure. Table 1 shows the demographics and details of all patients in this series. Each of these patients was exposed via their clothing, following the addition of either DettolTM or CanestenTM rinse solution as a post-wash rinse cycle to the household washing machine.

Each patient presented with a tender, minimally pruritic, brightly erythematous eruption affecting the axillae, groin, or open flexures, which progressed from these areas with an annular morphology, becoming dry, brown and scaly during resolution. Figures 1 and 2 show the similarity between patients in morphology and distribution.

Biopsies were undertaken from a subset of these patients, as described in Table 1. Each of these biopsies showed parakeratosis with retention of keratohyaline granules and a superficial predominately lymphocytic infiltrate. Significantly, there was no spongiosis, no evidence of psoriasis, and no evidence of fungal infection. Figure 3 shows a representative image of a punch biopsy, taken from the groin region of patient 5.

Following cessation of benzalkonium chloride exposure and supportive care with emollients, each patient's eruption resolved over the following three to four weeks, although for one patient (Patient 3) resolution took months. Whilst topical steroids were minimally helpful for alleviating pruritus in these patients, they did not seem to expedite resolution and patients were generally disappointed by their lack of effectiveness.

It is important to note that only a small subset of individuals exposed to benzalkonium chloride go on to develop granular parakeratosis. Indeed, the patients in our case series all had multiple other family members presumably exposed to benzalkonium chloride who did not develop GP. One of the patients who developed the granular parakeratosis had clinical evidence of ichthyosis vulgaris and a history of mild eczema. We postulate that in genetically susceptible individuals, exposure to benzalkonium chloride may result in a disruption of epidermal lipids, which in turn results in the cascade of pathology in granular parakeratosis. Based on the observation of a defect in filaggrin processing in granular parakeratosis¹, and some of the similarities in pathogenesis with ichthyosis

vulgaris⁶, we propose that the basis of this susceptibility may lie with particular genetic polymorphisms of the filaggrin gene, or possibly other genes involved in filaggrin processing.

CONCLUSIONS:

Benzalkonium chloride is a widely used agent, present in a number of household and personal hygiene products. We have observed that a small subset of patients exposed to this agent have the potential to develop granular parakeratosis, based on a mechanism that is at present not well understood. Based on these observations, we recommend that in all patients presenting with granular parakeratosis, that exogenous agents such as benzalkonium chloride be considered. Further research is required to elucidate the mechanism behind this relatively rare reactive pattern, and thus the risk factors for developing a reaction to agents such as benzalkonium chloride.

Figure legends:

Table 1: Table showing age, sex, medical history, exposure, presentation, histology and progress for the patients described in this series. "AFO": Advantan fatty ointment. "LPC": Liquor picis carbonis (coal tar), "SA": Salicylic acid.

Figure 1: Clinical photography of patient 1, showing the distribution of his eruption.

Figure 2: Clinical photography of patients 2-6, showing the similarity in morphology and distribution of their eruptions.

Figure 3: Biopsy from groin of patient 5, showing retention of keratohyaline granules in parakeratosis, consistent with granular parakeratosis (H&E x200 magnification).

References:

1. Ding CY, Liu H, Khachemoune A. Granular Parakeratosis: A Comprehensive Review and a Critical Reappraisal. *Am. J. Clin. Dermatol.* 2015; 16:495-500.
2. Urbina F, Sudy E, Misad C. Two episodes of axillary granular parakeratosis triggered by different causes: case report. *Acta. Dermatovenereol. Croat.* 2012; 20(2): 105-7.
3. Akkaya AD, Oram Y, Aydin O. Infantile granular parakeratosis: cytologic examination of superficial scrapings as an aid to diagnosis. *Paediatr. Dermatol.* 2015; 32(3): 392-6.

4. Basketter DA, Marriott M, Gilmour NJ et al. Strong irritants masquerading as skin allergens: the case of benzalkonium chloride. *Contact Dermatitis* 2004; 50: 213-217.
5. Wentworth AB, Yiannis JA, Davis MD et al. Benzalkonium Chloride: A Known Irritant and Novel Allergen. *Dermatitis* 2016; 27(1): 14-20.
6. Gruber R, Elias PM, Crumrine D et al. Filaggrin Genotype in Ichthyosis Vulgaris Predicts Abnormalities in Epidermal Structure and Function. *Am. J. Path.* 2011; 178(5): 2252-2263.

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Figure 1

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Figure 2

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Figure 3

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