

DRY SKIN: PATHOPHYSIOLOGY AND TREATMENT

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Synopsis

Dry cutis is found in different conditions, both hereditary and acquired due to general or local factors, and the condition is also found in old people as a result of natural skin aging.

The mechanisms accounting for this alteration of the eudermic state are complex and not always clear. As well as the involutionary changes of dermo-epidermal structures and functional components, particular attention must be drawn to the changed water/lipids/NMFs ratio.

From the standpoint of treatment, action must be directed towards the elimination of the specific causes in the case of cutaneous dehydration from acquired general factors. In the other cases, along with the local or general "cosmetic" treatment, action is needed to try and prevent damage.

We believe that the corrective cosmetic treatment must take into account that the principal of the cosmetic can have a replacing activity (collagen, PCA, urea) or restoring activity (glycine, hydroxyacids, vitamin A derivatives).

Riassunto

La cute secca si riscontra in diverse condizioni sia ereditarie che acquisite per fattori generali o locali, oltre che nell'anziano in seguito all'invecchiamento naturale del sistema cutaneo. I meccanismi con cui tale alterazione dello stato di eudermia si verifica sono complessi e non sempre del tutto chiari. In aggiunta alle modificazioni involutive delle strutture e delle componenti funzionali dermo-epidermiche occorre considerare in particolare il modificato rapporto acqua-lipidi-NMF. Dal punto di vista del trattamento, l'intervento deve essere rivolto alla eliminazione delle cause specifiche nel caso degli stati di disidratazione cutanea da fattori generali acquisiti. Negli altri casi, accanto al trattamento "cosmetologico" di tipo locale o generale, occorre anche intervenire per cercare di prevenire il danno.

Riteniamo che nell'intervento cosmetologico correttivo occorre considerare che il principio attivo del cosmetico può svolgere attività sostitutiva (collagene, PCA, urea) o attività ricostruttiva (glicina, idrossiacidi, derivati della vit. A).

PATHOPHYSIOLOGY

From a clinical point of view, we all know that dry skin (1) appears rough, stiff, thin, fragile, inelastic, dull and grey-yellow. Under these conditions, skin is more easily exposed to external attacks and aggression, and the frequent concomitant itch often produces typical injuries due to scratching.

Dry skin can affect the whole body or be more evident in some areas (legs, hands, face).

This change in the eudermic state is caused by many factors which are not always completely clear, and is found in both hereditary and acquired conditions. Besides natural aging, it is due to either general or local factors.

Hereditary conditions include mainly early skin aging such as progeriae, and especially the Werner syndrome (2), as well as xeroderma pigmentosum (3), and several forms of ichthyosis (4). In addition, dry skin conditions are found in particular dermatoses such as atopic dermatitis (5).

General acquired conditions (6) include prolonged fasting, persistent vomiting, unrestrainable diarrhoea (typical of dry cholera and Mouriquand syndrome), low sodium diet, prolonged use of diuretics, etc. As a result of these situations, the water contained in the skin - which is a major reservoir - is used by other parts of the organism, which leads to skin dehydration.

The conditions acquired due to local factors (6) which determine the clinical pictures of dry skin include:

- the negative influence of climate and environment (wind, cold, sun, reduced air humidity), which is particularly evident in certain areas and in subjects performing certain professions (farmers, sailors, etc.) especially if they have little natural photoprotection (pheomelanins);
- chemical attack linked to professional conditions (use of solvents, paints, detergents), incorrect hygienic habits (frequent washing, often with not very mild detergents), prolonged use of certain treatments (topical corticosteroids).

Finally, dry skin is a characteristic of old people due to the physiological involution of the cutaneous systems (6). The clinical picture first appears around 40 and becomes evident around 60. However, it originates around 25 with natural involutionary changes in dermo-epidermal structures and functional components.

Cutaneous aging, which is particularly evident in the senescence, generally presents (7-9):

* at dermal level:

- reduced fibroblast activity with decreased collagen production and altered ground substance due to the reduction of glycosaminoglycans (GAGs) and hyaluronic acid;

- reduced angiogenesis and consequent reduced vascularization with degeneration of elastic fibers and collagen;

* at epidermal level:

- strong reduction of the particularly fragile and rough horny layer, with altered barrier function;

- reduction of melanocytes resulting in reduced photoprotection;

- decrease in the number of Langerhans cells and consequent reduced local immunity defenses;

- flattening of dermal ridges and dermo-epidermal junction with minor adherence at this level and functional alteration;

- slow passage of keratinocytes into keratocytes with reduced horny lamellae balance.

In addition, the functional activity of sweat and sebaceous glands decreases.

Under these conditions, however, water, lipids and NMF (natural moisturizing factor) change their values (10).

Water travels to the epidermis from the dermis, which contains 70% of cutaneous water (equivalent to 10-20% of the total water in the organism). Water is reversibly bound to GAGs and mostly to hyaluronic acid (11). The mechanism regulating its passage through the basal membrane is not yet perfectly known. In the horny layer, water changes in physical state and evaporates in the form of perspiratio insensibilis when it exceeds the maximum imbibition gra-

dient. Water is bound in the horny layer (12) by certain substance: NMF (a complex of hydrophilic substances) and especially its constituent, PCA (2-pyrrolidon-5-carboxylic acid). These substances have a great water-retention capacity.

The presence of water in the horny layer can, thus, be reduced since less water is supplied by the dermis (reduced bond with GAGs), NMF water retention capacity is decreased, as well as the functional activity of the horny layer which is between 15% and 10%. This results in dryness.

Sebum is another factor which contributes to horny layer hydration (its secretion is highly reduced in old subjects). It prevents water loss at transepidermal level, and helps to keep a barrier function. This function is also ensured by bilayer phospholipids, whereas Odland lamellar bodies offer the possibility to bind water at deep horny layer level (14).

The surface hydrophilic film is an W/O emulsion where the oily continuous phase is made of sebum and apocrine sweat lipids, and the dispersion aqueous phase is made of water and eccrine sweat salts. Its insulating effect prevents water from being lost by the epidermis, and, under conditions of integrity and in synergy with other structures and substances, it allows skin to maintain optimum hydration.

An undamaged keratocyte protein structure and resistant horny lamellae play a considerable role in water retention at the cutaneous level. These conditions depend on involucrin and filaggrin. Filaggrin produces natural moisturizing factors (15) and is found only in small quantities in conditions of compromised cutaneous hydration, such as during ichthyosis vulgaris and psoriasis.

On the other hand, excessive hydration of the horny layer (a prolonged bath) determines permeability in the skin surface, as well as alteration of the barrier function and imbalance in the eudermic state.

Treatment

Skin dehydration due to general factors (fasting, vomiting, diarrhoea, etc.) requires actions which aim at eliminating the specific causes. In the case of "cosmetic treatment" for dry skin - be it local or general - prevention plays a significant role.

It is therefore necessary to start from clothing, which must be appropriate in terms of age, work, climate and environment. For example, profuse perspiration is detrimental since it involves a considerable loss of water and trace elements, and prolonged and repeated exposure to solar radiation accelerates skin aging.

Individuals with fair skin, blue eyes and reddish hair who are not protected with melanin (in addition, pheomelanins favour free radicals and consequent genetic mutation), and some professional categories which are repeatedly exposed to the sun, need to apply moisturizing day creams, containing long-lasting sun filters or sun screens with total protection over the exposed areas. This is to be associated with the administration of photoprotection substances (beta carotene) (16).

Too-frequent washing is to be avoided, as well as the use of highly aggressive detergents such as syndets (especially solid ones, which have a great quantity of surface-active agent) (17). The daily toilet should remove dirt from the skin surface, but respect the hydrophilic film and the integrity of the horny layer. This is why traditional soaps should be used such as Marseilles soap - less irritant than synthetic soaps (20) - enriched with collagen protein hydrolysates. They have, in fact, the property of counteracting the irritant action of the surface-active agent (18).

The skin acid pH, which is temporarily lost when using alkaline soaps, returns to the original values within one hour from rinsing (19). In addition, 5-10 minute baths with water dispersible oils at 34° - 35°C create a protective film and have a soothing effect.

The professional categories which make great use of detergents, paints, solvents and similar materials, are recommended to wear white-cotton gloves under rubber gloves. This should not be done over a long period, however, in order to avoid excessive insulation.

As well as prevention, corrective intervention is also deemed necessary for the clinical imbalance of the xerotic condition.

The corrective cosmetic can:

1) replace altered or lacking mechanisms or conditions; its rapid effect is not long-lasting, especially if the cosmetic is O/W rather than W/O emulsion;

2) have a restoring property; its curative effect lasts some days.

The principles with **replacing activity** can have:

a) a structure which is inadequate to penetrate the epidermis, such as collagen which, however, has a great capacity to bind water (2000-3000% of its weight) and tends to stratify on the cutaneous surface, when applied;

b) a structure which is able to penetrate the epidermis, creeping into the lamellae of the stratum corneum, such as NMF components (PCA and urea: we recall that continued and prolonged use of urea-based preparations can provoke the disgregation of lamellae and the alteration of the barrier). In this regard, some substances with a globular sub-microscopic structure and functioning as carriers (liposomes, niosomes, nanospheres) prove to be very useful (21). They are able, in fact, to transfer the principle in the epidermis, where it will be released in time (chronocosmetic effect). This is a remarkable break-through of scientific research which is present at the implementation stage.

The principles with **restoring activity**, assuring a more lasting curative effect, consist of amino acids, such as glutamic acid (precursor to PCA) and glycine (stimulating PCA production), as well as hydroxyacids (glycolic, citric, lactic, malic, tartaric, etc.) which are able to affect the quality of the forming horny layer. A restoring function is performed also by vitamin A. Reti-

nol, however, is scarcely effective at cutaneous level. Retinoic acid, on the other hand, which is classified as a pharmaceutical product and not as a cosmetic, can favour angiogenesis and the synthesis of new elastic fibers and collagen at dermal level, following percutaneous absorption.

The general treatment suggested includes a diet rich in vegetable oils containing essential fatty acids (EFA or vit. F) mainly represented by linoleic and linolenic acids contained in borage, soy and serotine primrose oils in high percentages. EFA deficiency results in the incapability of membranes and cutis to retain water; cutis thus becomes dry and squamous.

Other vitamins (A, E, C, PP, B1, B2, B6, B12, H, D) are also important in order to maintain orthokeratinogenesis (22).

The per os administration of glycine - an amino acid contained in large quantity in gelatin - has been recently (23) introduced. Gelatin enriched with glycine, in fact, increases skin hydration by 12% after 15 days, and by 30% after 30-45 days of treatment (24). The substance is postulated to promote the synthesis of collagen and activate one or more enzymatic systems needed for PCA production. Even if the glycine dose is reduced, the hydrating activity can be increased by 10-15%, by enriching the preparation with trace elements (iron, manganese, copper, and calcium) and vitamins (C and B6). Trace elements are, in fact, cofactors in forming bonds of collagen and elastin molecules, while vitamins activate enzymatic processes (24-25).

Supplementing the diet with zinc can be suggested to fight mineral deficiency (poor absorption, incorrect diets), since zinc is a constituent of enzymes, which are responsible for the development of different metabolic processes. It is important to recall, in this respect, that vitamin PP favours zinc digestive absorption, whereas fibers and phytates prevent it during a vegetarian diet. For functional needs, even low doses of zinc supplement are sufficient (50 mg/die).

Final remarks

Facing the complex physiopathological mechanism which leads to the beginning of the clinical picture of dry skin, our intervention can follow different lines: from the removal of the general pathology to prevention, from local to systemic therapy.

From a cosmetic standpoint, corrective prepara-

tions can contain principles with a replacing activity, whose effects are rapid but not long-lasting, and principles with restoring activity whose effects last longer (in this case, we should speak of "pharmacocosmetics" rather than cosmetics).

The dermatologists' task is to diagnose and treat dry skin in order to relieve, as far as possible, the anguish of patients complaining of this condition of eudermic imbalance.

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