What Is New on Sweat Glands

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The past decade's explosive progress in dermatological research is not only tightly linked to ever improving biochemical, immunological or micromorphological methodology, but also grounded in partnership with rapid and reliable distribution of data at an international level. The paper 'Idiopathic acquired generalized anhidrosis: Electron microscopic and immunohistochemical studies and analysis of lectin binding pattern of the cell membrane' by Terui et al. in this issue holds up as an example that this progress is recently expanding from originally epidermis-oriented efforts to appendageal structures, and in particular to sweat glands.

In fact, a great number of major studies on human sweat glands have been performed by Japanese researchers. Although Kurosumi et al. [1] in their comprehensive review discreetly attribute this circumstance to the frequent excisions of odorous axillary skin in their country, the application of advanced techniques on these samples and continuous monitoring of general knowledge are major impact factors on progress in this field. And undoubtedly, our views upon the structural and functional significance of sweat glands are presently changing.

Not only the differences between eccrine and apocrine secretion mechanisms have become vague. The sweat gland organ is also no longer merely a structure destined for cooling and elimination of waste products, but a physiologically most important part of the body participating in essential metabolic, hormonal and immunological aspects of human life as well as in psychosocial communication. Detailed ultrastructural studies have challenged the concept of distinct 'eccrine' and 'apocrine' secretion modes much more than was thought in the beginning. In secretory coils of 'eccrine' glands, a dark cell type has been found to show exocytotic discharge of granules, apical blebbing and eventually also cellular disruption as seen in typical 'apocrine' secretion. Therefore, the classification used in general mammalian biology should also be applied to human sweat glands. The distinction is made on the basis of the gland's relationship to the skin surface. Typical mammalian sweat glands open into the hair follicle and are thus called 'epitrichia' (= apocrine or 'a-gland'). For the primates, however, the characteristic sweat gland type is the tube-like 'atrichia' (= eccrine or 'e-gland'), opening freely onto the epidermal surface. Despite serious demands that the terms 'apocrine' and 'eccrine' should be discarded [2], they are still widely used and well understood even though they are only established names.

The morphology of human atrichial eccrine glands has been extensively studied in all its complicated 3-dimensional coiled or straight portions and excellently reviewed by Hashimoto et al. [3] in 1986. Five major portions have been identified and each section seems to be attributed to different functions. The secretory coils contain clear serous cells and a luminal rim of dark mucoid cells. Myoepithelial cells form a surrounding layer, which fades away as the coil passes over into the transitional portion. This first part of the dermal duct still seems to produce some

precursor sweat, whereas the next portions, the coiled duct as well as the following straight dermal duct, are probably more active in reabsorption of various molecules. The final intraepidermal portion, called acrosyringium, is lined by horny cells which inspite of their keratinization supply a number of hydrolytic and proteolytic enzymes. Careful studies of these glands and ducts have taught us that morphology depends largely upon the functional stage of the individual organ. After thermal stimulation, there is a marked increase in cytoplasmic vacuolization, particularly of luminal cells, a widening of the intercellular spaces and the presence of particulate matter in the lumen of activated glands and ducts [4]. Yet, even within the same biopsy the morphology of neighboring e-glands may differ conspicuously due to differences in individual stimulation. Thus, a need for further establishment of criteria correlating the structure of glandular cells with their actual functional stages emerges. The functional significance of sweat glands themselves is presently also subject to change. In contrast to the past, thermoregulation can no longer be looked upon as their domain, but metabolization of electrolytes, mucopoly-saccharides, hormones and other biologically important molecules comes into the focus of interest. Various

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enzymes, prostaglandins. receptors for steroid or sexual hormones, aldosterone responsiveness and high susceptibility to peptide hormones such as antidiuretic hormone or prolactin [5, 6] reflect the integrated position of sweat glands in the complex interactions of a living organism. In the light of recent findings it appears not unlikely that atrichial as well as epitrichial organs may also produce and secrete biological response modifiers and hormones by themselves. A most interesting report in this context presents evidence of a modulation of female menstrual cycles by male sweat gland secretions [F.J.G. Ebling, personal commun.. 1987].

Finally, the immunological performance of skin appears to be extended via sweating to regions unreachable for living cells under normal conditions. Immunoglobulin A. the major mediator of surface immunity, has been demonstrated in ductal and intercanalicular portions of atrichial sweat glands [7]. In addition, Okada et al. [8] showed that J-chain as well as epithelial-cell-derived secretory component are also present in sweat, thus proving that there is really active secretory IgA dimer present in sweat glands.

Secretion of immunoglobulins is not only a possibility to get rid of them but is usually purposefully performed in order to inactivate viral, bacterial, fungal or other anti-genic matter on the body surface. In fact, secretory IgA have also been detected on the membranes of pityrosporon species in human skin sections [9]. It appears therefore most likely that the protective potentials of humoral immunity can be extended to the external skin surface by active secretion via sweat.

The fact that epithelial sweat gland cells participate actively in this process by contributing the secretory component to the sIgA molecule should flare up an additional highlight in the changing view of human atrichial gland function.

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