

Early detection of skin damage; which markers from the wound healing process can be used?

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Early detection of skin damage; which markers from the wound healing process can be used?

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Introduction

Early detection of skin damage is necessary for the prevention of cutaneous disorders like pressure ulcers or skin irritation. Nowadays, no objective measure exist to assess skin damage. Risk score lists are used to determine the risk for an individual patient to develop pressure ulcers, but their predictive value is very low.[1] It is expected that an objective measure to assess epidermal damage is more useful in the prevention of pressure ulcers, irritation and other cutaneous disorders.

Objective

To find an objective measure for the early assessment of skin damage using ex-vivo measurements.

Wound healing

Directly after damage is applied to the epidermis, the wound healing process is initiated. This process is regulated by cytokines and growth factors that attract neutrophils and macrophages to the wound site. Other actions of these signalling molecules are the regulation of proliferation, migration and differentiation of keratinocytes in the epidermis and fibroblasts in the dermis, aimed at restoration of the skin function (Figure 1).

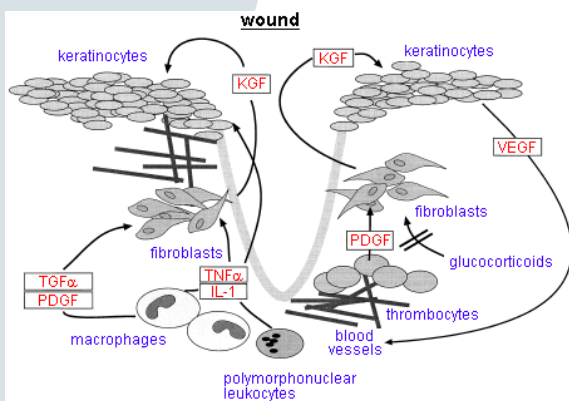


Figure 1: The wound healing process is regulated by different cytokines and growth factors.[3]

Several ion gradients exist in the epidermis, which are changed after epidermal damage. Consequently, ion fluxes into the cells are changed and this affect the processes that are upregulated after damage of the epidermal barrier.

Conclusion

Several cytokines, growth factors, and ion concentrations seem interesting to use in the assessment of epidermal dam-

age. IL-1 α , TNF- α , and MCP-1 are very promising since they are released by keratinocytes within two hours after wounding. Furthermore, ion concentrations may also be used to assess damage.

Future plans

To study the influence of cytokines, growth factors and ions on the development of skin damage, it would be useful to study first their behaviour in the normal dynamics of the epidermis. Therefore, a model will be developed that describes the interactions of several molecules in the normal renewal of the epidermis.

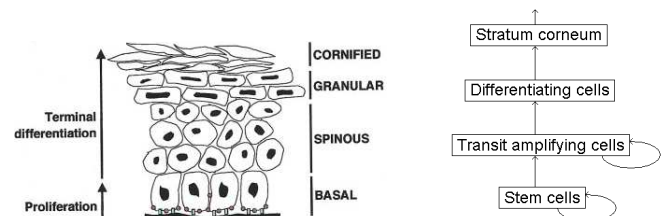


Figure 2: The left figure shows the differentiation of the cells in the epidermis.[2] A schematic representation is given in the right part.

This model should consist of different layers (Figure 2): a layer of stem cells that proliferate into other stem cell or transit amplifying cells, a layer of transit amplifying cells which have a proliferative capacity, but can also differentiate, a layer with differentiating cells and a layer with corneocytes (stratum corneum) which can peel off. The transition of cells from one layer to the other is regulated by growth factors, cytokines and ions. The exact mechanism that directs the cells towards proliferation or differentiation has to be investigated.

A parameter study with this model can point out which of the growth factors, cytokines or ions are the most important in the differentiation process and which may be used to assess skin damage. Afterwards, the model can be extended (according to experimental studies) to answer questions like:

- What occurs after applying pressure to the epidermis?
- Is it possible to assess damage by measuring molecules at the top layer?
- What is the influence of risk factors of the development of pressure ulcers (ageing, incontinence, etc.) on the differentiation process?

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