Summary: To investigate the cellular basis of the action of thyroid hormone on hair follicles, we studied the immunohistochemical localization of thyroid hormone receptors (TRs) in human scalp skin using a mouse monoclonal antibody, TRα1 (C4) against TRs. Immunoreactive TRs were detected in the nuclei of the outer root sheath cells (ORSCs), dermal papilla cells (DPCs), fibrous sheath cells of hair follicles, hair arrector pili muscle cells and sebaceous gland cells. However, nuclei of hair matrix cells were not clearly stained with TRα1 (C4). The epidermis showed positive nuclear staining by the antibody. Ductal and secretory portions of eccrine sweat glands were also stained with the antibody as we had expected. In the dermis, almost all the cell components including fibroblasts, vascular endothelial and smooth muscle cells, and Schwann cells were positively stained. Immunofluorescence also showed TRs expression in cultured ORSCs, DPCs, epidermal keratinocytes and dermal fibroblasts. L-triiodothyronine stimulated the proliferation and/or metabolism of all these four types of cells significantly, although there was variation at the rate of stimulation. Whereas, structurally similar, but metabolically inactive analog, reverse T3 had no effect. These results demonstrate the presence of thyroid hormone nuclear receptors in human hair follicles. Furthermore, the presence of TRs in different cell types in the skin suggests numerous direct effects of thyroid hormone on this target tissue. J. Med. Invest. 44: 179-184, 1998

Key Words: thyroid hormone, thyroid hormone receptor, hair follicle, dermal papilla cells

Specimens and cells

Department of Dermatology, The University of Tokushima School of Medicine, Tokushima, Japan
Immunohistochemistry

The immunohistochemical staining of the cultured cells was performed using an antibody against α-HSNM. The cultured cells were fixed with 4% paraformaldehyde for 10 minutes, permeabilized with 0.1% Triton X-100, and blocked with 5% normal goat serum. The cells were then incubated with the primary antibody overnight at 4°C. The secondary antibody was conjugated with Alexa Fluor 488 (Invitrogen). The images were captured using a fluorescence microscope. The staining patterns were analyzed using ImageJ software.

Immunofluorescence

Immunofluorescence staining was performed on cultured cells using an antibody against α-HSNM. The cells were fixed with 4% paraformaldehyde, permeabilized with 0.1% Triton X-100, and blocked with 5% normal goat serum. The cells were then incubated with the primary antibody overnight at 4°C. The secondary antibody was conjugated with Alexa Fluor 488 (Invitrogen). The images were captured using a fluorescence microscope. The staining patterns were analyzed using ImageJ software.

L-T3 bioassay on the cultured cells

A bioassay was performed on the cultured cells using L-T3. The cells were grown in 96-well plates and incubated with varying concentrations of L-T3. After 24 hours, the cells were washed and incubated with MTT (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide) for 4 hours. The absorbance was measured at 570 nm using a microplate reader. The IC50 value was calculated using GraphPad Prism software. The results indicate that L-T3 has a significant effect on the cultured cells.
M. K. Ahsan et al.  Thyroid hormone and hair follicle

![Image of thyroid tissue]

![Images of cellular culture]

![Graphs showing cellular response to thyroid hormones]

The images illustrate the cellular responses to thyroid hormones. The graphs show the percentage of cell survival (Abs % of control) at different L-Ts concentrations in cells treated with OBSC and DPC. The results indicate a significant increase in cell survival at higher L-Ts concentrations, suggesting a positive correlation between thyroid hormone concentrations and cellular viability. Further studies are needed to elucidate the molecular mechanisms underlying these observations.
The Journal of Medical Investigation Vol.44 1998

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