Hyperoxia may slow formation of wrinkles

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It's no secret that UVB radiation from the sun causes wrinkles. However, a Japanese study published in the *American Journal of Physiology -- Regulatory, Integrative and Comparative Physiology* indicates that oxygen may help combat the formation of wrinkles by lessening tissue damage done by UVB rays.

In the study, mice who were placed in an oxygen chamber after exposure to UVB radiation developed fewer wrinkles and showed fewer signs of tissue damage than mice who were exposed to UVB radiation alone.

UVB and Skin Damage

The readily visible hallmarks of skin damage are wrinkles and a thickening in the outer layer of skin, the epidermis. Together they make skin look and feel leathery.

The "sun-weathered" look is merely evidence of what is happening on a molecular level beneath the skin's surface, however. When skin is repeatedly exposed to UVB radiation, new blood vessels form from existing blood vessels in the skin in a process called cutaneous angiogenesis. Several transcription factors—proteins that bind to specific DNA sequences—play a role in angiogenesis, including hypoxia inducible factor (HIF-1) and its subunit HIF-1 α and vascular endothelial growth factor (VEGF).

The Study

In the study, the researchers assigned 24 hairless mice into three groups. The control group, the UVB group, and the UVB+HO group. The control group was not exposed to UVB radiation. Both the UVB and the UVB+HO groups were exposed to UVB radiation by a special fluorescent lamp three times per week for five weeks, but the UVB+HO mice were placed in an oxygen chamber for two hours after each irradiation.

Over the five weeks, the mice in the UVB and UVB+HO groups developed wrinkles, but the wrinkles were more pronounced in the UVB group. Likewise, both the UVB and UVB+HO group experienced increased epidermal thickness, but again, this result was more pronounced in the UVB group.

There were differences between the UVB and UVB+HO groups on a molecular level, as well. The level of HIF-1α increased significantly in the UVB group compared to the control group, whereas there was no significant increase in the UVB+HO group. VEGF levels increased in both the UVB and the UVB+HO groups, but the UVB+HO group experienced a smaller increase. This implies that oxygen and the excess amount of oxygen in body tissue, or hyperoxia, that it provides can lessen skin damage and wrinkling caused by UVB radiation.

A Surprising Result

The study had one surprising result, as well, one involving molecules called matrix metalloproteinases (MMPs). Like HIF-1 α and VEGF, they play a role in angiogenesis. Two MMPs in particular, MMP-2 and MMP-9, are thought to accelerate wrinkling by degrading the outer components of cells. However, in this study, MMP-2 levels tended to decrease with exposure to UVB radiation and MMP-9 levels remained the same, even in mice who did not receive oxygen. According to the researchers, this implies that MMP-2 and MMP-9 are not main factors

in wrinkle formation and angiogenesis, at least in the early stages of skin damage caused by UVB radiation.

The implications for humans remain to be seen, and the researchers note that further studies are required. In the meantime, the best way to avoid wrinkles caused by UVB radiation is to wear sunscreen.

More information: Shigeo Kawada, Masaru Ohtani, and Naokata Ishii, all of the University of Tokyo, conducted the study. The study is entitled "Increased oxygen tension attenuates acute ultraviolet-B-induced skin angiogenesis and wrinkle formation" (doi:10.1152/ajpregu.00199.2010).

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