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Sunlight, Skin Cancer, and Sunscreens

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THE SOLAR electromagnetic spectrum ranges widely from below the short ultraviolet wavelength through the visible light spectrum and beyond. The ozone in our stratosphere 25 km above the earth effectively protects us from the short-wave, high-energy ultraviolet (UV) light. But UV light that does penetrate the atmosphere contains the erythrogenic spectrum that causes the all-too-familiar sunburn reaction.

Redness begins two to eight hours after exposure and usually peaks at 24 hours. When the exposure has been longer than five times the minimum erythema dose (MED) (ie, the amount of energy from a defined light source, like the sun, producing a barely perceptible sunburn or erythema of the skin under stated conditions), blistering, pain, and fever may also occur. Although immediate darkening of pigment may accompany such erythema, due to oxidation of colorless preformed melanin already in the skin, it is transient, fading within a few hours. The socially sought-after, durable tan begins days later, with a peak about three weeks after exposure. This tan results from true melanogenesis, when stimulated melanocytes produce more brown pigment that is incorporated into the epidermis. The intensity, duration of exposure, and wavelength of light are all important in determining skin changes. The true sun-worshipper knows that the sun feels warmest and most intense between 10 AM and 2 PM. During this time, the shorter distance through the stratosphere allows for decreased absorption of rays by the ozone layer. Generally, sunlight is also most visible and intense during this time, but a cloudy or overcast day does not mean that erythrogenic rays are not present; many an uninformed patient has been burned during prolonged exposure on a cloudy day. Whether a city-dwelling jogger or a mountain-top skier, many an unwary sports enthusiast has been similarly damaged from reflected UV light from city pavement, sand, or snow.

Phototoxic and Photoallergic Reactions

On acute exposure, the erythrogenic spectrum causes not only sunburn but may also induce phototoxic and photoallergic reactions, and precipitate changes in xeroderma pigmentosum, solar urticaria, and systemic lupus erythematosus. Slightly longer UV light may exacerbate certain sun-sensitive diseases, including porphyria cutanea tarda and erythropoietic protoporphyria. Persistent changes can also be caused by sunlight. A single exposure to erythrogenic UV light has been shown to inhibit DNA, RNA, and protein synthesis in human skin. Thymidine dimers have been isolated and lysosome rupture may occur. Most persons who sustain acute sun-exposure injuries are young. They are carefree and usually ignorant of the chronic changes induced by such exposure.

It is commonly the woman in her forties or older, often with fair complexion, who asks her physician what to do about the "aging changes" she notices on her face and the sun-exposed areas of her chest, shoulders, and arms. The physician sees thin and atrophic or leather-like skin, the superficial, tiny, red vessels of telangiectasis, the brownish, flat "sun spots" of solar lentigo, and skin laxity and excessive wrinkling ("senile elastosis") due to loss of elasticity from degeneration or faulty production of elastic and collagen fibers in the upper dermis. While the patient is usually interested in appearance, her physician's primary concern is development of premalignant and malignant skin lesions, primarily actinic keratosis, basal cell carcinomas, and squamous cell carcinomas.

Actinic (Solar) Keratosis

The actinic or solar keratosis is found predominantly in sunny climates, on white-skinned persons who often have a poor ability to tan. The lesion usually has a red base or periphery and is covered by a yellowish-brown scale. It is often friable, bleeding easily with minor trauma such as shaving. The actinic keratosis is considered potentially malignant or "premalignant" because it may progress to frank squamous cell carcinoma and is often found in the company of both basal and squamous cell carcinomas.

In recent years, cryotherapy with liquid nitrogen or carbon dioxide snow ("dry ice"), by simple topical application, has been successful in

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treatment of isolated lesions. For more widespread areas of involvement, topically applied fluorouracil (5-FU) is effective, although it has the disadvantage of making the patient's sun-damaged skin appear lobster red and may erode or even ulcerate severely sun-damaged areas before re-epithelialization occurs. Fluorouracil does not inflame normal skin.

The basal cell carcinoma is usually a round or oval lesion with central depression, superficial telangiectasis, and a gray or translucent pearly border. Some lesions contain melanin pigment as well. While plastic and general surgeons prefer excision as the method of treatment, most dermatologists use electrodesiccation and curettage. Both methods have a 95% cure rate for primary lesions. Recurrence or unusual circumstances may dictate radiation therapy or chemosurgical techniques.

The squamous cell carcinoma has a variable clinical picture, from a small, firm, red nodule to a red, verrucose or scaly growth. Notably, squamous cell carcinomas arising in sun-damaged areas have a far lower incidence of metastasis than do squamous cell carcinomas arising in scars or de novo. Lipstick acts as a sunscreen and accounts for the lower incidence of basal cell and squamous cell carcinoma on the lips of women.

Prophylactic Measures

The most important factor in prevention of these unpleasant skin disorders is to avoid excessive sun exposure. Yet even when an alerted patient recognizes the danger of sun exposure, she may be confused at the pharmacy when facing a bewildering assortment of creams, lotions, oils, and lipsticks in the "suntan-sunscreen" department. The market has become enormous, and there are a number of items, many quite popular, that are completely valueless as sunscreening agents.

Sunscreens may be divided into physical and chemical blockers. The physical blockers or "sun shades" deflect and scatter light, providing a barrier to sunlight penetration. They have the general advantage of giving more inclusive coverage over a wider range of the UV light spectrum. Their disadvantage is chiefly cosmetic. Their opaqueness makes them visible and often mask-like on the skin. Traditionally, they include zinc oxide paste, talc, titanium dioxide, kaolin, ferric oxide (which also provides a skin tint to the preparation), red veterinary petrolatum, and bentonite. Even plain yellow petroleum jelly, when spread on the skin in a 0.05-mm thickness, allows only 4% transmission of erythemal UV light.

The chemical sunscreens absorb light of a particular wavelength. While they are usually more cosmetically acceptable, they have several disadvantages. They may cause sensitization or primary irritation. Most do not uniformly cover the complete UV light spectrum, and thus it is important to know which one to use for each particular purpose. For example, the benzophenones (eg, sulisobenzone [Uval]) absorb most effectively at the shorter wavelengths used in germicidal radiation in many operating rooms and at longer wavelengths nearer the visible spectrum, thus more effective for porphyria patients.

On the other hand, most investigators feel that the absorption characteristics and clinical efficacy studies performed with aminobenzoic acid (PABA) make it one of the best agents for protection within the erythrogenic spectrum. The vehicles used for these chemical sunscreens become increasingly important. Other effective chemical agents include the esters of aminobenzoic acid, digalloyl trioleate, the cinnamates, the anthranilates, the pyrones, and the salicylates. Some clinically effective sunscreens combine both physical and chemical blockers with actions that may be complementary or possibly synergistic (eg, A-fil, with titanium dioxide and menthyl anthranilate). Others may combine chemical sunscreens with different absorptive qualities (eg, Maxafil, with cinnamate and anthranilates).

For most effective results, the topical sunscreen should be reapplied after excessive sweating or swimming, despite claims to the contrary. Aminobenzoic acid has the disadvantage of staining clothes a light brownish-yellow color, but the stain usually washes out.

Systemic Photoprotective Agents

Systemic photoprotective agents have not found widespread acceptance. Some agents, like vitamin A plus colloidal calcium carbonate, seem valueless. The carotenemia induced by ingestion of massive doses of carrot juice or by oral dosage of β-carotene has ameliorated the photosensitivity to visible light that occurs in patients with erythropoietic protoporphyria. But it raises the MED only slightly in normal persons and has no effect on the degree of erythema once it develops. Intradermal and topical studies involving indomethacin and aspirin have indicated that these medicines cause a dramatic decrease in the erythema and elevated skin temperature of sunburn reactions; further clinical studies are indicated. Moreover, such changes might actually be deleterious in the long run if they simply masked the acute changes of sun exposure while doing nothing to prevent the long-term sequelae.

Additional Readings

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