Sunscreens: The Importance of UVA Protection

Disclosures

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Introduction

It is now known that ultraviolet-A radiation (UVA) plays an important role not only in skin cancer but also in cutaneous aging, immunosuppression, polymorphous light eruption, and urticaria. At a focus session on sunscreens at the 60th Annual Meeting of the American Academy of Dermatology, Robert Bissonette, MD, MSc, FRCPC,[1] Assistant Professor of Dermatology, University of Montreal, Quebec, Canada, concentrated on the evolving importance of UVA protection in sunscreens.

Ultraviolet Light

The solar radiation that penetrates the earth's atmosphere, thus hitting the earth's surface and our skin, is generally divided into ultraviolet light A (UVA) and ultraviolet light B (UVB) radiation. UVB encompasses the solar spectrum from 290 to 320 nanometers (nm), and UVA encompasses the spectrum from 320 to 400 nm. Thus, UVA radiation includes longer wavelengths, allowing deeper penetration into the skin. Luckily, UVC does not reach the earth's atmosphere. It was once thought that UVB rays were the most important contributors to wrinkling, skin disease, and skin cancer, but more recent studies have shown that UVA radiation is equally or even more important in the development of solar damage and skin diseases, such as lupus erythematosus and melanoma and nonmelanoma skin cancers.

Photodermatoses and Their Relationship to UVA

UVA has been well documented to have multiple effects on human skin, both therapeutic and detrimental. UVA induces polymorphous light eruption (PMLE) in most patients,[2] although it has been shown to reduce PMLE in others.[3] Solar urticaria can be induced by UVA and UVB.[4] Cutaneous lupus erythematosus is also exacerbated by UVA light. These are all cutaneous inflammatory diseases of unknown origin. Skin cancer and the overall health of the skin is another issue.

Skin Cancer and UVA

In the past, UVA was thought to be less important than UVB in the generation of sun damage and skin cancer, but it is now known that UVA does indeed induce mutations in DNA, leading to skin cancers in both animal and human skin.[5] It has also been shown that UVA can induce p53 mutations which can accumulate in human skin. These mutations can be reduced by using UVA sunscreens, thus demonstrating that there is less p53 accumulation with better UVA protection.[6]

A fish model for melanoma has been developed. Fish of the genus *Xiphophorus* develop melanoma after sufficient UVA exposure,[7] leaving no doubt that UVA can cause all types of skin cancers (both melanoma and nonmelanoma) in animals, and confirming what we have known for some time now. That is, skin cancer is induced primarily by ultraviolet light exposure, including UVA, making protection from UVA of paramount importance to preserving the longevity of the skin and, perhaps, the host living inside.

Aging Skin and the Effect of UVA

UVA and the aging process are intertwined. A mouse model has shown that sagging of the skin is produced by UVA exposure, and that this sagging can be reduced or prevented with *Mexoryl SX*, a sunscreen agent available in Europe and Canada but not the United States.[8] It has been demonstrated both histologically and clinically that these changes also can be induced in human skin.[9]

UVA actually decreases elastic fibers and increases elastosis, changes which remain for a full 12 weeks after exposure.[9] Elastosis has been decreased in patients who use oxybenzone, a sunscreen agent capable of blocking UVA.[10] With all the attention and money being paid to the cosmetic industry in the hope of turning back time and the signs of aging, one would expect that sun avoidance and the use of sunscreen should become more common and more mainstream.

Immunosuppression and Immunologic Surveillance

Immunosuppression can be induced after a single exposure to UVA. There is a decrease in the delayed-type hypersensitivity syndrome after UVA exposure, which is used to measure immunosuppression. UVB sunscreens do not alter or prevent this type of immunosuppression.[11] This fact makes UVA sunscreen protection very important in preventing a temporary lapse in the immune response. It is well known to most dermatologists that melanoma can occur in non-sun-exposed areas, but the reason why is not clear. Because we know that there is a temporary decrease in the immune response with UVA exposure, it has been proposed that this decrease allows a melanocyte to become malignant without proper immune system monitoring and regulation.

What is definitely agreed on is that UVA can cause melanoma and nonmelanoma skin cancers and promote the signs of aging. Thus, UVA protection is extremely important.

What to Know About Sun Protection Factor (SPF)

Sun Protection Factor (SPF) is measured in the laboratory with a solar simulator that induces UV erythema. However, erythema is primarily caused by UVB, making SPF testing primarily a measurement of UVB -- not UVA -- protection. In addition, the source of the UV may also influence SPF readings. Studies have shown that there can be a 50% difference in SPF measurement of sunscreens known to have a specific, predetermined SPF, depending on the light source.[12]

Another difficulty in measuring SPF is the fact that there is no ideal biological end point. Erythema can be used, but this requires patient exposure to UV radiation for long periods of time, and this measurement also underevaluates the longer wavelengths. Immediate pigmentation can be used to measure UVA protection, and low doses of UVA can be used, but results of this method vary with the light source. A light source's ability to induce a photodermatosis has been proposed as a way of measuring photoprotection, but this method is not optimal. Reflectance spectroscopy is a physical method used to measure photoprotection by measuring emitted and reflected light.[13] Suffice it to say that photoprotection measurement is not yet an exact science.

Types of Sunscreens

Sunscreen agents are classified as either chemical sunscreens, which absorb light, or physical sunscreens, which reflect, scatter, and absorb light. Chemical sunscreening agents include para-aminobenzoic acid (PABA) and derivatives, anthranilates, benzophenones, cinnamates, salicylates, camphor derivatives (*Mexoryl SX*), dibenzoylmethanes (*Parsol 1789*), and the benzotriazoles (*Tinosorb*). The physical sunscreens include titanium dioxide, zinc oxide, and ferrous oxide.

Benzophenones have been shown to have some protective effects against UVA and photocontact dermatitis. *Mexoryl SX* is a sunscreen that offers excellent protection against mid-range UVA wavelengths and is highly photostable, but it is not yet available in the United States. Avobenzone is the only chemical sunscreen agent that offers protection against long-wave UVA, but its photostability is variable and its protection against UVA can be lost (up to 60% in some studies) over time.[14] Loss of UVB protection can also occur with exposure.

The bottom line is that not all sunscreens are alike. The photostability of sunscreens is not quantified or labeled, and varies according to the chemical agent. These are important considerations when choosing a sunscreen, but not many consumers are aware of these issues or differences.

Physical sunscreening agents are particulate in nature and protect our skin by scattering and absorbing light. Comparison between zinc oxide and titanium dioxide showed that zinc oxide is superior for UVA protection in the 340-380 nm range and tends to be less pasty on the skin.[13]

Although protection from visible light is not as important as protection from ultraviolet light, certain agents are better than others at protecting the skin from visible light. Iron oxide may be better than zinc oxide and titanium dioxide for visible light protection. Dihydroxyacetone, a skin-staining agent, is not a sunscreen and offers no protection against UVA or UVB; however, dihydroxyacetone does offer some protection against visible light.

So how does one recognize a sunscreen with adequate UVA protection? In a study with 12 patients using 6 sunscreens, the worst performers were sunscreens that contained only physical sunscreening agents. *Anthelios* (a *Mexoryl*-containing sunscreen not available in the US) offered the most protection against a broad range of UVA.[15] In another study, it was determined that patients simply do not apply enough sunscreen.[16] So even though certain sunscreens offer better UVA protection than do others, if these sunscreens are not applied properly, it may not matter.

Which Sunscreen to Use?

So how does a dermatologist answer the question "Doctor, which sunscreen should I use?" The answer is still not simple. Patients should not rely only on sunscreens for protection from solar radiation. They should be advised to avoid the midday sun, seek shade whenever possible, wear tightly woven clothing with long sleeves, wear broad-brimmed hats, and, finally, apply plenty of sunscreen to sun-exposed areas. An SPF of at least 30 should be applied to the most fair-skinned individuals (Fitzpatrick skin types I-III) and reapplied after 4-6 hours. There is no such thing as a completely "waterproof" sunscreen, so reapplication is important.

Despite these recommendations, studies still show that only 43% of children use sunscreens,[17] and even when sunscreen is applied most children and parents do not apply an appropriate quantity of sunscreen regularly. These findings suggest that adults, including parents, probably do not apply sunscreen regularly or thickly enough either.

A broad range of UVA protection is optimal, and *Parsol 1789*, *Mexoryl SX*, and *Mexoryl XL* seem to be the best chemical sunscreens. *Parsol* is available in the United States. Zinc oxide is a better physical sunscreen than is titanium dioxide. Sun-savvy consumers need to become label-readers to find out what chemical and physical agents are in the sunscreens they are using.

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