ALLERGEN Focus

Focus on the *Non*-T.R.U.E. Test Allergen —

Cocamidopropyl Betaine

BY SHARON E. JACOB, M.D., AND SADEGH AMINI, M.D.

Since January of 2005, this column has highlighted a different thin-layer rapid-use epicutaneous (T.R.U.E.) test allergen each month and intended to answer some of the most frequent questions relating to their origin and most common uses. Each column has also highlighted appropriate products that affected patients should avoid, along with tips to avoid cross-reactions and exposures.

This month, we break from the tradition of this column to discuss a non-T.R.U.E. test allergen. Although the T.R.U.E. test screens for 46 distinct allergens and the Balsam of Peru mixture and it is a valuable first-line screening tool to assess for allergic contact dermatitis, it is thought to adequately *identify an allergen in approximately 25.5%* of patients with allergic contact dermatitis.[1] This being said, many relevant allergens are not detected with this screening tool alone and, for this reason we decided to expand this column this month to cover one of the notorious allergens — **cocamidopropyl betaine** — which received the designation of Allergen of the Year in 2004 from the American Contact Dermatitis Society.

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THE CONTACT DERMATITIDES

Allergic contact dermatitis is an important disease with high impact both in terms of patient morbidity and economics. The contact dermatitides include irritant contact dermatitis, contact urticaria and allergic contact dermatitis.

Irritant contact dermatitis, the most common form, accounts for approximately 80% of environmental-occupational based dermatoses.

Contact urticaria (wheal and flare reaction) represents an IgE and mast cell-mediated immediate-type hypersensitivity reaction that can lead to anaphylaxis, the foremost example of this being latex hypersensitivity. While this is beyond the scope of this section, we acknowledge this form of hypersensitivity due to the severity of the potential reactions and direct the reader to key sources.[2,3]

Allergic contact dermatitis affects more than 70 million Americans each year and has a high impact both in terms of patient morbidity and economics. The primary focus of this section is to highlight the educational component of this important inflammatory disorder.

CASE ILLUSTRATION

A man presented to the University of Miami Contact Dermatitis Clinic with an unresolving generalized dermatitis with itching despite avoiding the formaldehyde allergen that had been previously identified by T.R.U.E testing.

THE HISTORY OF SOAP MAKING

According to archaeological excavations in Babylon, the oldest inscriptions on the soap making process were found on clay containers dated at 2800 B.C.[4,5] The early Egyptians were also well versed in regular bathing practices. From 1500 B.C., The Ebers Papyrus describes the combination of animal and plant fats with alkaline salts to obtain a soap substance for use in the treatment of diseases and bathing.[4,5]

It is believed that when animals were sacrificed and cremated at Mount Sapo near ancient Rome, melted animal fat (tallow) mixed with wood ashes and clay soil was washed down by the rain into the Tevere River. Roman women promoted effective washing with this mixture.[4-6] By 312 B.C., the Terme Di Caracalla aqueduct-based Roman bathhouse was built.

The popularization of soap throughout the Roman Empire led to the foundation of soap factories, remnants of which can be seen in the ruins of the city of Pompeii, destroyed in 79 A.D.

BATHING BECOMES UNPOPULAR

With the fall of the Roman Empire in 476 A.D. came a marked decrease in bathing and clothes washing — ushering in the "darkness" of the Middle Ages. The populous superstitiously feared that it was the water that contaminated the inner body with illnesses through dilation of the skin's pores.[5]

In the 7th century, however, the Arab trade routes renewed the demand for soaps. And by the 10th century, the soap-manufacturing industry boomed once again in southern Europe (Italy, Spain and France) where raw materials such as olive oil were readily available.

Almost every European city was a major producer of soap, with the exception of England, which began mass manufacturing soap in the 12th century.

Of economic interest, governments enjoyed the heavy luxury tax added to soap for more than nine centuries, until the levy was lifted in the 19th century.

FLORENCE NIGHTINGALE RECOGNIZES THE POWER OF HYGIENE

During the Crimean War (1854-1857), British soldiers, dying of diseases rather than combat injuries, were saved when British nurse Florence Nightingale realized that hygienic reforms in field hospitals dramatically decreased the death rate.

When the American Civil War broke out in 1861, this knowledge was put into practice, exposing thousands of Americans to the use of soap and the concept of regular bathing.

THE EARLY EGYPTIANS WERE ALSO WELL VERSED IN REGULAR BATHING PRACTICES. FROM 1500 B.C., THE EBERS PAPYRUS DESCRIBES THE COMBINATION OF ANIMAL AND PLANT FATS WITH ALKALINE SALTS TO OBTAIN A SOAP SUBSTANCE FOR USE IN THE TREATMENT OF DISEASES AND BATHING.[4,5]

THE BIRTH OF PROCTER & GAMBLE

While candle maker William Procter and soap maker James Gamble formed an alliance in 1837, it was the American Civil War Army supply contracts attained by Procter & Gamble (P&G) that catapulted this company to the personal hygiene industry forefront.

Furthermore, soldiers returning home with P&G products introduced the company to domestic America and made P&G a household name.[5,7]

In 1879, James Norris Gamble, son of the co-founder and a trained chemist, developed an inexpensive white soap, which was equal in quality to the imported castiles.

Procter & Gamble continued to grow in response to the growing popularity for perfumed beauty soaps. In 1933 "Ma Perkins", a radio series program sponsored by P&G's Oxydol soap powder, aired nationally. The popularity led P&G brands to sponsor numerous new radio series, and hence "soap operas" were born.

Notably, the first major league baseball game aired on television accompanied by the first Ivory Soap television commercial.

Procter & Gamble's invention of Dreft, the first synthetic detergent for household use, laid the groundwork for a revolution in cleaning technology and the introduction of new product lines such as Tide "the washing miracle", Prell (1946), and Crest — the first fluoride cavity fighting toothpaste soap (1955).

When P&G celebrated its 150th anniversary in 1987, the company ranked as the second-oldest company among the 50 largest corporations.

Recently, the company introduced Pantene Pro-V, the fastest growing detergent shampoo in the world with sales exceeding $30 billion.[8]

DRAMATIC CHANGE IN SOAP MAKING

Sales alone speak to the competitive demand for synthetic detergents, but their creation was a circuitous road. The soap manufacturing process dramatically changed in 1916 with the advent of the first synthetic detergent developed by the Germans in the First World War to compensate for the shortage of available fats. And again, synthetics production

boomed with the WWII interruption of fat and oil supplies and the military demand for all-purpose "built" detergents, containing a dirt removing surface active agent (surfactant) and a catalyst (builder) in combination.

One of the major advantages these synthetic surfactants had over soap was that they performed much better in cold and hard water (high-metal composition: Ca, Mg, Fe or Mn). Another was the milder nature of the amphoteric (zwitterionic) betaines. The original betaine products were introduced to the market in 1947 by the Goldschmidt Chemical Corporation, a leader in textile industry detergents.

FIRST BETAINE-BASED HYGIENE PRODUCT

The betaine technology was introduced into the field of personal care and hygiene products when Johnson & Johnson developed the first cocamidopropyl betaine (CAPB) detergent-based shampoo: "No more tears" Baby Shampoo[9] (patented in 1967).[10]

CAPB's lipophilic (fat loving) terminal end is manufactured by combining coconut fatty acids of varying length. The anionic group (carboxylic group) and the cationic group (quaternary ammonium group) give the molecule its hydrophilic (water loving) end and its amphoteric properties.[11,12]

Coconut oil, expressed from the kernels of *Cocos nucifera* seeds, and its derivatives (coconut acid, hydrogenated coconut acid and hydrogenated coconut oil) are used as cleansers, foaming agents, or stabilizers in multiple cosmetics and personal hygiene products.

ALLERGIES TO CAPB

Case reports of allergy to CAPB were published as early as 1983. The first two case reports were women with erythematous lesions secondary to their cocobetaine-containing shampoos. In both cases, the lesions cleared with avoidance of cocobetaine shampoos.[13]

Many cases of CAPB-ACD have been reported in association with shampoos, liquid soaps, bath gels, toothpastes, contact lens solutions, make-up removers, and gynecologic and anal hygiene products, with a range of incidence between 3% to 7.2%.[12-16]

Of the 50 principal allergens found positive in patch tests performed by the North American Contact Dermatitis Group from 1995 to 2001, CAPB was the twenty-ninth most common.[1]

By 2003, the worldwide consumption of surfactant detergents and soaps was more than 27 million metric tons, with surfactants accounting for two-thirds (18 million tons) of the gross product.[5]

In the face of this multi-billion dollar industry, CAPB became the 2004 Allergen of the Year.

TESTING FOR CAPB SENSITIVITY

Although patch testing for CAPB allergy cannot be accomplished with the current T.R.U.E. test, it can be performed comprehensively.

Evaluation should include concomitant testing with manufacturing intermediaries, amidoamine and dimethylaminopropylamine because these impurities are thought to be responsible for a large proportion of CAPB allergies.

It is important to note that all surfactants have the potential to be irritants, and CAPB is no exception.

This irritant reaction has been described as mild erythema at the patch site, which characteristically improves in 24 to 48 hours. A 96-hour delayed read is recommended and serial dilution testing may also be performed, if necessary, to confirm the diagnosis.

THE VALUE OF THIS PATIENT CASE

Our patient tested positive for CAPB component of his body soap bar. By avoiding CAPB and formaldehyde, to which he had previously tested positive, this patient's full body dermatitis improved. ■

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