

Review

Airborne contact dermatitis: common causes in the USAJulie A. Schloemer¹, BS, BA, Matthew J. Zirwas², MD, and Craig G. Burkhart¹, MD

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Abstract

Airborne contact dermatitis (ABCD) is an inflammatory reaction involving the skin upon exposure to allergenic agents or irritants suspended in air. In allergic ABCD, the hypersensitivity is classified as a type IV reaction. Substances responsible for such reactions can be of plant or non-plant origin. Commonly reported plants include those of the Compositae family, which includes ragweed, goldenrod and sunflowers. Establishing an accurate diagnosis is critical for preventing exposure and improving symptoms in patients. Obtaining a detailed history and performing a physical examination to determine the sites of involvement, as well as patch testing to establish the causative allergen, are the main methods of arriving at the correct diagnosis. Treatment often involves avoidance of the allergens or irritants when possible and may also include the application of topical barrier creams or systemic therapy in more severe cases. This article reviews the topic of ABCD and highlights its most common etiologies in the USA.

Introduction

Airborne contact dermatitis (ABCD) is an inflammatory reaction caused by exposure to particles suspended in air. Exact prevalences of ABCD are difficult to determine because the term airborne is not always used in the literature and diagnoses can be difficult to prove.¹ According to the National Health and Nutritional Examination Survey (NHANES), the prevalence of all forms of contact dermatitis in the USA was estimated to be 13.6 per 1000 persons as determined by data collection over a 1-year period between 1999 and 2006.² However, this figure is likely to represent an underestimation of the true prevalence of contact dermatitis. Airborne contact dermatitis can be classified as either allergic or irritant contact dermatitis, depending on its etiology and the mechanism of inflammation. Allergic contact dermatitis (ACD) is classified as a type IV (delayed) hypersensitivity reaction and is characterized by an immune response to a specific antigen upon prior sensitization to that antigen. Skin lesions resulting from allergen exposure may extend outside the initial boundary of exposure, unlike the lesions of irritant contact dermatitis (ICD). Irritant contact dermatitis is generally more common than ACD, but actually occurs less commonly as a manifestation of reactions to airborne substances. Irritant contact dermatitis is a non-allergic inflammatory response to a physical or chemical irritant resulting in skin lesions confined to the initial area of exposure.² By contrast with ACD, relatively large amounts of irritant are necessary to produce

the reaction in ICD and a reaction does not require prior sensitization.

Many allergens and chemicals have been documented as causative agents of ABCD. Previously in India this type of dermatitis was solely attributed to exposure to plant pollens, particularly those belonging to the *Parthenium* genus of the Compositae family, often referred to as the scourge of India.³ In recent years, other irritants, chemicals and dusts have been recognized as causing ABCD, primarily in industrial environments. Hence, not only can ABCD be categorized based on its inflammatory mechanism (ACD vs. ICD), but it can also be classified based on the causative agent (plant origin vs. non-plant origin). In fact, most of the cases reported in the literature are caused by occupational exposures and in clinical practice the majority of causes tend to be plant-related.⁴

Plant-related causes of ABCD

Two major families of plants are responsible for the vast majority of cases of ABCD in the USA: the Compositae family and the Anacardiaceae family.⁴ Well-known plants of the Compositae family include ragweed, goldenrod, sunflowers and chrysanthemums. The flowers, leaves, stems and pollens of these plants are coated with sesquiterpene lactones, which are the primary substances responsible for producing an allergic reaction upon exposure. Airborne exposure can occur via direct contact with sesquiterpene lactones coating the pollen or through the release of these chemicals into the air through incineration.⁵ It is important

to note that patients who claim to be allergic to several different plants across a family are most probably sensitized to the sesquiterpene lactones. Interestingly, several authors have reported finding lower incidences and severity of allergic reaction to sesquiterpene lactones among East Asian populations in comparison with European populations.¹ The other group of plants commonly responsible for ABCD reactions belongs to the genus *Toxicodendron* of the Anacardiaceae family. These plants include poison ivy, poison oak and poison sumac, and produce sap which contains the highly allergenic oil urushiol. Although most cases of ACD related to urushiol result from direct contact with the plant source, the accidental burning of brush containing plants of the *Toxicodendron* genus can result in airborne exposure as the urushiol oil is carried downwind by smoke particles. Thus, there may be truth to the claim made by some patients that they are able to develop a reaction to poison ivy simply by walking through the woods. It is important to be aware that patients with allergies to plants of the genus *Toxicodendron* may develop cross-reactions to a number of other substances including mango skin, cashew nut oil and the fruit of the ginkgo biloba tree.

Other agents causative of ABCD

Many other agents responsible for causing ABCD have been reported in the literature. Those causing ACD include dust particles from wood, cement (potassium dichromate) and metals, including nickel, silver, mercury, gold and arsenic salts, pharmaceutical agents such as azathioprine, budesonide, famotidine, lansoprazole and methotrexate, pesticide additives, rubber latex and even particles from cigarettes.¹ The development of ABCD in response to medications can occur during the manufacturing process, during the compounding process at the pharmacy or after distribution to health care professionals and patients. Landeck and Skudlik⁶ reported 10 cases of ABCD in nursing personnel that resulted from exposure to tetrazepam brought about by the crushing of pills. Agents implicated in causing ICD include phosphates, metal dusts, carbon fiber and fiberglass, epoxy resin, isothiazolinones and animal dander.¹ Others include ammonia, anhydrous calcium sulfate, cleaning products and formaldehyde.² Of note, the incidence of ABCD caused by chemicals of the isothiazolinone family, including methylisothiazolinone and methylchloroisothiazolinone, is on the rise as these chemicals are used increasingly as preservatives in many household products.⁷ Additionally, dermatitis resulting from methylisothiazolinone and related compounds may be allergic in nature, as evidenced by positive patch testing.

Distribution of disease

Dermatitis caused by airborne allergens and irritants commonly affects the face, neck, the V region of the chest, and the forearms and hands, specifically the palmar surfaces (as the airborne substance deposits on surfaces which are then touched by the patient).³ Other areas distinctly involved in ABCD include the upper eyelids, posterior ears (Wilkinsons triangle) and submandibular region.¹ The upper eyelids are commonly affected in ABCD for two reasons: (i) airborne materials easily deposit on the upper eyelid while the eye is closed and are then trapped and occluded when the eye is opened, and (ii) the skin of the eyelids is particularly thin, which allows chemicals to penetrate easily.⁵ This unique distribution of dermatitis can be used to differentiate ABCD from photodermatitis, which is commonly confused with the former as the two have similarly diffuse distributions. Unlike photodermatitis, ABCD involves skin that is naturally exposed and skin that is unexposed to ultraviolet light.¹ Therefore, one clue to the fact that a reaction represents allergic or irritant ABCD and not a photodistributed drug eruption is the involvement of the submandibular area, upper eyelids and Wilkinsons triangle.⁸ Figure 1 shows the involvement of the upper eyelids in a patient with ABCD. Figure 2 shows diffuse involvement but sparing of the upper eyelids in a patient with photodermatitis.

Risk factors

Several factors are known to increase the risk for ABCD, the first of which is the environment.² In dry



Figure 1 Characteristic involvement of the upper eyelids in a patient suffering from airborne contact dermatitis caused by exposure to pollen from a plant of the Compositae family. Airborne contact dermatitis involves skin in both areas that are and areas that are not exposed to ultraviolet light



Figure 2 Diffuse skin involvement in a patient suffering from photodermatitis or chronic actinic dermatitis. Note that the upper eyelids are spared in photodermatitis

environments, the skin's protective barrier is disrupted as a result of decreased levels of ceramide within the stratum corneum.² Additionally, in the presence of excessive heat, perspiration increases and facilitates the adhesion and absorption of irritants or allergens through the skin.² Occupational hazards such as exposure to irritating chemicals and repetitive friction or abrasions to the surface of the skin can also pose a potential gateway for ABCD.² Certain occupations are associated with

increased exposure to common causative agents of ABCD and therefore workers have a greater risk for the development of reactions throughout their working lives. A list of these common compounds and associated occupations is found in Table 1. A personal history of atopy is also associated with increased risk for both ACD and ICD.² Particularly in cases of resistant atopic dermatitis, airborne proteins may be the underlying exacerbating factors. Some of the most commonly involved proteins include those from house dust mites, cockroaches, pet dander and plant pollen.⁹ The pathophysiology of atopic dermatitis involves impairment of the natural skin barrier, which allows for the easier penetration of airborne particles into the epidermis and subsequent ABCD. Once proteins have entered the deeper layers of the epidermis and dermis, atopic dermatitis may be worsened by: (i) the inherent proteolytic enzyme activity of these proteins; (ii) the activation of proteinase-activated receptors-2 (itch receptors) on keratinocytes and unmyelinated nerve fibers, and (iii) the direct binding of immunoglobulin E (IgE) antibodies, which initiates the type I hypersensitivity response.⁹

Diagnosis

Diagnosing ABCD and determining the causative agent can be quite difficult. Diagnosis relies heavily on patient history, the timeline of the disease, history of atopy and occupational exposures, as well as the physical examination. Allergic contact dermatitis can be confirmed by

Table 1 Common causative agents of airborne contact dermatitis and associated products and occupations at risk

Agent	Products	Occupations/industries
Ammonia	Disinfectants, fertilizers, bleaching agents, baking flour	Farming, homemaking, cleaning services
Chrome	Cement, concrete mix, cosmetics, paint, alloy metals	Construction, building, stonemasonry, metal working, paper industry
Epoxy resin	Glues, adhesives, paint, polyvinyl chloride products, electric insulators, plastics	Painting, paint manufacture, construction, building, carpentry
Fiberglass	Boats, cars, aircraft, building insulation, clothing, helmets	Automotive and aviation industries, insulation manufacturing, building, construction
Formaldehyde	Fabric finishes, cosmetics, toiletries, embalming, disinfectants, paper products	Textile industry, sanitary paper production, builders, construction
Gold	Jewelry, plating, cell phones, electronics, dental and orthodontic appliances	Jewelry, plating, photography, electronics manufacture, dentistry and dental hygiene
Isothiazolinones	Preservatives in cleaning products, cosmetics, paint	Homemaking, cleaning services, health care, painting
Natural rubber latex	Tires, gloves, adhesive tape, balloons, condoms, paint	Latex product manufacture, health care, hairdressing
Nickel	Plating, alloy metals including stainless steel, coins	Refining, electronics manufacture, hairdressing, cashier work, metal work
Medications	Azathioprine, budesonide, famotidine, lansoprazole, methotrexate	Pharmacy, pharmaceutical manufacture, health care
Wood dust	Tropical and domestic wood	Carpentry, building, construction, furniture manufacture, sawmills

patch testing.¹ The TRUE Test® (SmartPractice, Phoenix, AZ, USA) recently added parthenolide, which is a sesquiterpene lactone and should, therefore, detect most cases of plant-derived ABCD. In patients with underlying atopic dermatitis, the atopy patch test may be used. This test differs from the conventional patch test in that it uses protein allergens. If the history suggests an occupational exposure to known causes of ABCD, but the physician does not have all the relevant allergens available for testing in standard concentrations, there is a practical alternative. The patient can collect a small amount of dust from open areas in the workplace and bring this to the physician, who can then mix the dust with a tiny amount of petrolatum and use this mixture in a patch test. This method, although not standardized, can provide important evidence to either support or argue against the diagnosis of occupational ABCD. Alternatively, the sampling of air in the suspected environment and analysis of the concentrations of specific allergens or irritants can also be pursued, but is rarely helpful.¹

Treatment

The treatment of ABCD involves several different approaches. The first is the avoidance of the allergen or irritant; however, this can be difficult, particularly if the inciting agent is found in the patient's occupational environment. When the inciting factor is plant-based, the avoidance of outdoor activities during periods of high pollen count is advised, but is often not very effective. To decrease the overall burden of airborne proteins from house dust mites, the frequent laundering of clothing, sheets, pillows and mattress covers, and frequent vacuuming is advised. Barrier creams may also be applied to slow the rate of penetration of irritants or allergens to the skin.¹ Frequent bathing can also prove an effective method of removing airborne proteins or irritating substances from the skin and should be accompanied by frequent application of emollients, especially in patients suffering from atopic dermatitis. In severe or resistant

cases, immunosuppressive therapy with azathioprine or steroids has been shown to be successful.¹ If avoidance is not possible or effective and immunosuppressive therapy is inadequate or contraindicated, it is, unfortunately, often necessary for patients to either move to an area with low counts of pollens from the Compositae family (if they have plant-induced ABCD) or to change occupations (if they have occupational ABCD). Finally, patients should be educated on the possibility of cross-reactivity to other allergens in the case of allergic ABCD.

References

- 1 Handa S, De D, Mahajan R. Airborne contact dermatitis – current perspectives in etiopathogenesis and management. *Indian J Dermatol* 2011; 56: 700–706.
- 2 Cashman MW, Reutemann PA, Ehrlich A. Contact dermatitis in the United States: epidemiology, economic impact and workplace prevention. *Dermatol Clin* 2012; 30: 87–98.
- 3 Ghosh S. Airborne-contact dermatitis of non-plant origin: an overview. *Indian J Dermatol* 2011; 56: 711–714.
- 4 Swinnen I, Goossens A. An update on airborne contact dermatitis: 2007–2011. *Contact Dermatitis* 2013; 68: 232–238.
- 5 Habib TP. Contact dermatitis and patch testing. In: Habib TP, ed. *Clinical Dermatology: A Color Guide to Diagnosis and Therapy*, 5th edn. St Louis, MO: Mosby (Elsevier), 2009: 130–153.
- 6 Landeck L, Skudlik SMJ. Airborne contact dermatitis to tetrazepam in geriatric nurses – a report of 10 cases. *J Eur Acad Dermatol Venereol* 2012; 26: 680–684.
- 7 Lundov MD, Mosbech H, Thyssen JP, et al. Two cases of airborne allergic contact dermatitis caused by methylisothiazolinone in paint. *Contact Dermatitis* 2011; 65: 175–185.
- 8 Jacob SE, Breithaupt AD. An important difference between exposed and photodistributed underscores the importance of identifying common reactions. *J Clin Aesthet Dermatol* 2009; 2: 44–45.
- 9 Hostetler SG, Kaffenberger B, Hostetler T, et al. The role of airborne proteins in atopic dermatitis. *J Clin Aesthet Dermatol* 2010; 3: 22–31.