

Atopic Dermatitis and Implications for Military Service

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ABSTRACT Introduction: Atopic dermatitis is a common condition in the general population. Historically, it has been a disqualifying condition for military service despite its relatively high prevalence and low severity. As the barriers to service in the military decrease for individuals with atopic dermatitis, it is important to be aware of potential complications of this condition and their military implications. Materials and Methods: A literature search for topics relating to atopic dermatitis was performed utilizing PubMed. An internet search of the military regulations regarding this condition was also performed. Additionally, an independent request was made by the authors of this paper to the Armed Forces Health Surveillance Branch to look at evacuations given a specific diagnosis of atopic dermatitis at the time of evacuation from January 2003 to December 2006. The data obtained from this request were compared to data available in publications relating to this topic covering the same time period. Results: There are many complications of atopic dermatitis that are relevant to military service including the propensity to flare in harsh conditions, ocular complications, and risk of secondary infections. Despite this, there were fewer than expected reported casualties secondary to atopic dermatitis suggesting the possibility that screening against this condition prevents non-battle injuries during deployment. Conclusions: Atopic dermatitis is a very common disease that has the potential to complicate military service in many ways but the reported rates of these complications are actually very low. This is either because there is already an intervention in place or these complications are less common than theoretically anticipated. This is relevant because as it becomes easier to obtain waivers for a history of this condition there will be more individuals with atopic dermatitis in the military.

INTRODUCTION

Atopic dermatitis is a common condition in the general population. Historically, it has been a disqualifying condition for military service despite its relatively high prevalence and low severity. In other words, most people with mild to moderate disease live perfectly normal lives without complication. This is not always the case in the military as the propensity to flare in harsh environments, the increased risk of cutaneous infections, and the potential ocular sequelae create a scenario where military service can be complicated by even mild to moderately severe atopic dermatitis. However, it is important that this condition not be viewed as an absolute contraindication for military service especially as the nation struggles to identify and recruit qualified applicants for military service as a result of other social and medical factors such as the obesity epidemic.

THE REGULATIONS

The document *Medical Standards for Appointment, Enlistment, or Induction into the Military Services*¹ states that a history of atopic dermatitis or eczema after the 12th birthday or history of residual or recurrent lesions in characteristic areas (face, neck, antecubital or popliteal fossae, occasionally wrists and hands) are disqualifying for military service. The individual services have their own standards that fit within the limits of this overall standard. The Army² and Navy³ list their oldest age for active atopic dermatitis as 9 years of age while the Air Force's⁴ maximum age is 8 years. For those who are already in the service who develop symptoms of atopic dermatitis, the various services have similar but not identical standards. The Army mandates referral to a Medical Evaluation Board (MEB) to determine whether an individual is fit for continued service for disease that is more than moderate, is unresponsive to treatment, or interferes with the soldier's performance of duty. The Air Force sets their threshold at severe disease defined as requiring frequent absence from duty, duty limitation, repeated exacerbations despite adequate therapy, or requiring chronic topical steroid therapy. The Navy initiates an MEB for any chronic skin condition requiring frequent outpatient treatment or hospitalization, is unresponsive to conventional treatments, interferes with the satisfactory performance of duty in the operational environment, or interferes with the wearing of the uniform or personal safety equipment. Of note, in early 2018 the Air Force published a memorandum to their standards⁵ in which it was stated that select candidates medically classified as having mild forms of eczema will be processed for a waiver

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with certain occupational restrictions applied to secure personnel and mission safety.

FEATURES OF ATOPIC DERMATITIS

Atopic dermatitis is defined as a chronic pruritic inflammatory cutaneous disease that is diagnosed based on history, characteristic clinical findings and the exclusion of other dermatoses.⁶ It is relatively common, affecting up to 25% of children and 2–3% of adults and has a complex pathogenesis including genetic, immunologic and environmental factors that culminate in a dysfunctional skin barrier and dysregulation of the immune system.⁷ There is an association with mutations involving the protein filaggrin which is involved in preventing trans-epidermal water loss (TEWL). Despite this known association, this disease is best thought of as a genetically multifactorial condition.⁸

Clinically, atopic dermatitis can be thought of as occurring in three different stages of life with infantile disease occurring from 2 to 24 months, childhood disease from 2 to 10 years and adolescent and adult disease after the age of 10 years. Pruritus is an absolute criterion for diagnosis. Infantile atopic dermatitis is characterized by erythema and scaling of the cheeks that has the potential to spread to the scalp, neck, forehead, extensor extremities and buttocks and can be exudative. Childhood atopic dermatitis classically involves the antecubital and popliteal fossae in addition to the flexor wrists, eyelids, face and around the neck. Adolescents often present with a primarily childhood pattern of involvement while adults often have less characteristic disease distribution other than the propensity for localized disease such as hand dermatitis.⁹

Disease severity ranges from mild symptoms that respond to gentle topical therapy to severe dermatitis with an effect on quality of life similar to that of severe psoriasis¹⁰ which may require systemic medications for control. Fortunately, the trajectory for this illness is usually towards improvement. Most infants grow out of their atopic dermatitis by the age of two and even if it persists into adolescence and early adulthood, active constant symptoms are uncommon after middle age.⁹ However, the propensity for flaring persists and can be triggered by a number of environmental factors including heat, perspiration, aeroallergens, low humidity, and cold weather.

Allergic and irritant contact dermatitis may at times mimic or complicate atopic dermatitis. Other potentially confounding diagnoses to consider include psoriasis, scabies, seborrheic dermatitis, tinea corporis, or photodermatitis.

The management of atopic dermatitis classically focuses on improving the compromised skin barrier and targeting the aberrant cutaneous inflammation. Repair and maintenance of barrier function can be further divided into maintaining skin moisture and avoiding trauma and irritants. In practice, this means regular moisturization with topical moisturizers, daily short warm baths or showers, avoiding extremes in temperature and avoiding irritating clothing or chemicals. Inflammation is

approached topically in most instances through topical anti-inflammatory agents, most often in the form of topical steroids but also topical calcineurin and phosphodiesterase-4 inhibitors.¹¹ If this does not control symptoms, light therapy or systemic medications can be used.¹²

ENVIRONMENTAL TRIGGERS

Atopic dermatitis is born of errors that occur within the overlap between the skin barrier, the immune system and the environment. Conceptually, skin health can be thought of as a balance between moisturization, barrier and inflammation. In patients with atopy, this balance is more difficult to attain and maintain. Many of the first line interventions for this entity involve behaviors that improve and preserve the barrier function of the skin ranging from shorter and cooler baths, moisturizing soaps, liberal application of moisturizing creams, lotions or ointments, and avoiding environmental irritants. It has been anecdotally observed and there is evidence that barrier function decreases with decreasing humidity and temperature.¹³ Interestingly, another report looking specifically at atopic dermatitis showed that increasing temperature and sun exposure were associated with poorer disease control.¹⁴ A British study evaluated atopic dermatitis flares in children and identified exposure to nylon clothing, dust, unfamiliar pets, sweating and shampoo as risk factors¹⁵ while a case series out of South Korea was able to show short-term worsening of symptoms with increased air pollution.¹⁶ Finally, there is evidence that psychological stressors may also play a role in atopic dermatitis flares.¹⁷

This has military significance because service members must be ready for deployment anywhere in the world. Historically, atopic dermatitis has been among the most common wartime dermatologic disorders.¹⁸ If someone wanted to design an experience with the explicit goal to flare a person with otherwise well controlled atopic dermatitis it would probably look like a military deployment. Extremes in temperature and humidity can be expected. Uniforms and protective equipment are equally non-negotiable. Bathing opportunities can be limited and are often replaced with a quick wash with wet wipes, another potential source for skin irritation and inflammation. Air pollution is often found in the deployed environment whether it is produced by the local populace or by the deploying unit in the form of burn pits. The potential for psychological stressors is likely with separation from home and family to say nothing of physical danger with even relatively rearward personnel reporting the experience of regular mortar attacks.¹⁹

The significance of a service member suffering a non-battle injury requiring evacuation as a result of atopic dermatitis cannot be overstated as it deprives the deployed unit of the individual who has been specifically trained for their assignment. A study in 2009 evaluated dermatologic military evacuations from January 2003 to December 2006 in Central and Southeast Asia. They focused on the final diagnoses of

individuals with vague initial diagnosis, such as dermatitis not otherwise specified (NOS). They identified 170 such cases and among these there were eight eventually diagnosed with atopic dermatitis and another eight diagnosed with eczema.¹⁸

In the context of the previously mentioned paper, an independent request was made by the authors of this paper to the Armed Forces Health Surveillance Branch to look at evacuations given a specific diagnosis of atopic dermatitis at the time of evacuation from January 2003 to December 2006. This exercise identified an additional 19 cases bringing the total to 35 evacuations directly attributed to atopic dermatitis over a 3-year period.²⁰

OCULAR MANIFESTATIONS

Up to 20–43% of patients with atopic dermatitis will have eyelid or eye involvement with usual onset in the late 10s and early 20s.²¹ Potential complications include allergic conjunctivitis, atopic keratoconjunctivitis, cataracts, keratoconus, and retinal detachment.

Allergic conjunctivitis is very common even in those without atopic dermatitis. It is relatively mild and can be symptomatically treated with systemic and topical antihistamines. Alternatively, atopic keratoconjunctivitis is a chronic, noninfectious inflammatory condition that can affect patients with atopic dermatitis at any point during their disease regardless of current cutaneous disease severity and has the potential for blindness if left untreated. Signs and symptoms range in severity and include blepharitis, conjunctivitis, keratitis, tear dysfunction, recurrent herpes simplex infections, keratoconus, cataract formation and steroid induced glaucoma. It is thought to be caused by a combination of Th1 and Th2 responses indicated by increased tear levels of IFN-gamma, TNF-alpha, IL-2, IL-3, IL-4, IL-5, and IL-10. Additionally, the disease process is thought to be associated with increased levels of activated eosinophils and resultant release of gelatinase B, major basic protein and eosinophil cationic protein which is thought to contribute to the corneal complications of this entity.²¹ Treatment is important as this condition can be associated with vision loss. Treatment options should always include referral to ophthalmology and include good eye hygiene, topical mast cell stabilizer ophthalmic drops, topical antihistamines, oral antihistamines, cromones, and topical cyclosporine. Severe cases can be treated with systemic cyclosporine.

In the context of atopic dermatitis cataracts are divided into anterior subcapsular cataracts that are rarely part of the natural progression of the disease and posterior subcapsular cataracts that form as a sequelae of long-term periocular or ocular treatment with topical steroids or with systemic steroids. A cataract is an opacity in the normally clear lens of the eye. Usually the initial presentation of atopic dermatitis precedes the development of cataracts by years. Most cases have bilateral involvement and one case series showed that

56% of patients had decreased visual acuity. The pathogenesis for this phenomenon is complicated and not well-elucidated but is thought to relate to oxidative stress by free radicals, corticosteroid use as mentioned above, elevated IgE levels, filaggrin mutations in some patients and phototherapy. Unfortunately, the development of this complication has not been reliably associated with time of onset, duration or severity of the underlying atopic dermatitis.²² Cataracts are treated surgically.

Finally, keratoconus and retinal detachment can also be associated with atopic dermatitis. Keratoconus is defined as the protrusion of the central part of the cornea and is caused by constant rubbing of the eye in some patients with atopic dermatitis. The association of this condition with atopic dermatitis has recently been called into question.²³ Retinal detachment is also rarely associated with atopic dermatitis. This potentially catastrophic complication was postulated in one case series with 80 patients to be associated with increased anterior vitreoretinal traction.²⁴ Treatment is surgical reattachment.

Among the many characteristics of a successful pilot, the importance of visual acuity cannot be understated. Aviation is a crucial pillar in the military and subsequently the national defense of the USA and other developed countries. It is also incredibly expensive with modern fighter aircraft approaching and, in some cases, reaching 200-million-dollar individual price tags. Additionally, training pilots is time intensive and expensive with the cost of training a fifth-generation fighter pilot estimated at approximately 11 million dollars.²⁵ Any of the above-mentioned ocular conditions could potentially ground a pilot. The risk of cataracts is especially important as pilots are already at an increased risk for cataract formation when compared to the general population.²⁶

SECONDARY INFECTION

The skin is a major component of the innate immune system. As such, patients with atopic dermatitis, especially children, are at an increased risk of secondary infection with both bacteria and viruses as a result of an impaired skin barrier and modified cutaneous immune milieu.²⁷ As an example, the antimicrobial peptide beta defensin-2 is decreased in the skin of patients with atopic dermatitis.²⁸ Among other conditions that are more common in children, impetigo and eczema vaccinatum are potential infectious complications with special military implications.

The skin of the vast majority of patients with atopic dermatitis is colonized with staphylococcus aureus. This taken with the potential for breaks in the skin provided by eczematous skin and the above-mentioned cutaneous immune dysregulation creates a scenario in which secondary impetiginization may occur quite frequently. This is further complicated by the observation that the presence of bacterial infections serves to further flare an atopic patient's skin²⁷; creating a vicious cycle of infection and inflammation.

Impetigo and other cutaneous bacterial infections are already an issue in military populations where the potential for warmer climates, crowded conditions, shared living conditions and close physical contact is common for certain subsets of the military. There are various reports of impetigo and methicillin resistant staphylococcus aureus (MRSA) outbreaks affecting up to 245 soldier and military recruits.^{29,30} Preventive medicine, in regards to highly contagious cutaneous infections, is an ever-present challenge in the military and would be made even more challenging if a large percentage of service members who were at a higher risk of infection were mixed in.

A rarer but more serious issue relates to the entity eczema vaccinatum (EV), a potential complication of the vaccinia vaccination for smallpox. This condition is characterized by the cutaneous and sometimes systemic dissemination of vaccinia that almost exclusively occurs in individuals with a history of active or even quiescent atopic dermatitis. It classically involves the midface, neck and antecubital and popliteal fossae but can present in any location.³¹ Unlike other complications EV has an almost exclusive military significance as routine vaccinia vaccination has been discontinued in the general public for decades. Variola major (smallpox) was officially declared eradicated in 1980 after an extensive vaccination campaign utilizing the vaccinia virus. This makes the vaccinia vaccine one of the most successful vaccines in human history. A re-emergence of this illness would almost certainly be due to deliberate release³² and it is highly likely if not inevitable that the US Military would be involved either as a target of or in the response to such an attack. As such, large numbers of military members, close to 500,000 in a 6-month period in one report,³³ undergo vaccinia vaccination as it is thought that pre-vaccination is the best way to prepare for this type of attack. It has also historically been associated with high rates of vaccine-associated adverse events such as EV.

The vaccinia vaccine can complicate atopic dermatitis in two ways: these patients are more susceptible to infections and the design of the vaccinia vaccine creates a scenario where the likelihood of autoinoculation is high. A single drop of vaccine is placed on bifurcated needle and the skin is punctured approximately 15 times until a drop of blood is seen. If a patient does not have a major cutaneous reaction at the site of the inoculation within 6–8 days they require re-vaccination because there needs to be an inflammatory reaction. The desired reaction starts as papules that progress to vesicles and eventually form a scab that resolves with an underlying scar. If this does not happen, the vaccination is unlikely to work. There is viral shedding until the scab falls off usually at least 2 weeks later.³⁴

In a landmark publication by Copeman and Wallace, two-thirds of patients with eczema vaccinatum who had a history of atopic dermatitis did not have active disease at the time of exposure, some without active disease for up to 10 years. Of note, EV was more common and more severe in individuals

who were under the age of one.³² Also, it has been noted that cases caused by accidental contact were more common and severe than those in the primary vaccinee. One thought explaining this is that those with obvious atopic dermatitis would not be vaccinated with no such screening happening with accidental exposures.³⁵ This is not a benign condition and has a reported case fatality ranging from 1 to 6%.³² One tragic case was reported in 2008 in which the 28-month-old child of a service member developed EV after his father was inoculated with vaccinia. He survived but his treatment course required a 48-day hospital admission and skin grafts.³⁶ More recently, a case was described in which a service member contracted this infection in his facial hair follicles (sycosis vaccinatum) after completing combatives training with a sparring partner who had recently received the vaccine.³⁷

DISCUSSION

Atopic dermatitis is not currently a clinically significant problem in the military. From 2003 to 2006, there were between 106,000 and 159,000 troops in Iraq and Afghanistan³⁸ with 35 evacuations directly attributable to atopic dermatitis. If truly 2–3% of adults have atopic dermatitis that means that theoretically there were 2,120–4,770 service members with atopic dermatitis in Iraq and Afghanistan during this time period. If this were the case that is a casualty rate of 0.7–1.7% among service members with atopic dermatitis. There are two potential reasons for these low numbers. The first is that the theoretical concerns relating to atopic dermatitis and military service are not born out in actual practice or at least are less severe in adults than children. The other is that it is an incorrect assumption that 2–3% of deploying service members have atopic dermatitis because atopic dermatitis is used as a negative screening criterion for selection for military service. In reality, there is further pre-deployment screening as well so most if not all of these cases likely represent flared quiescent or previously undiagnosed mild atopic dermatitis. In other words, the numbers are low because the system works.

The numbers for eczema vaccinatum are also deceptively low. A revealing report mentioned above describes a mass vaccinia vaccination of approximately 500,000 service members during 2002 and 2003 in which there was not a single case of eczema vaccinatum.³³ However, if this data is juxtaposed against the data published in the early 1970s regarding vaccination of the general US population with rate of EV listed at 123 per million primary vaccines than there should have theoretically been 60 cases of eczema vaccinatum. This can partially be explained by the fact that rates of EV are lower in adults, but not entirely as the rate in adults older than 20 years old was still 30 per million primary vaccines.³⁴ If this incidence held true, there should have been approximately 15 cases in the more recent military vaccination effort.

Again, this highlights the benefits of the current medical screening guidelines for atopic dermatitis. By selecting against those with a history of atopic dermatitis after the age of 8–12 years of age the military has effectively avoided dealing with many of the potential complications of this condition and subsequently has decreased risk to personnel and mission. However, as the entrance standards become less stringent more people with history of well-controlled atopic dermatitis will find their way into the military after receiving medical waivers. An interesting report out of West Point looked at cadets who had received medical waivers for atopic dermatitis. It was shown that having received a waiver did not increase the likelihood of attrition although these cadets were more likely to utilize medical resources.³⁹ This is promising as we can expect more people to receive such waivers in the future. The relative relaxation of the medical standards likely reflects a level of pragmatism in the military in seeking to find qualified candidates in a population with an ever decreasing percentage of physically qualified candidates for military service.⁴⁰ The changes also reflect the reality that the military is made up of huge organizations with diverse assignments and duties allowing for a possible stratification of strict medical restrictions.

CONCLUSION

Atopic dermatitis is a very common disease that has the potential to complicate military service in many ways that are unacceptable. However, the reported rates of these complications are actually very low. This is either because there is already an intervention in place or these complications are less common than theoretically anticipated. Either way, with fewer restrictions there will be more people in the military with atopic dermatitis. This is potentially a good thing as it will give the military a larger pool from which to recruit but it will also likely result in increased complications related to atopic dermatitis with the potential to place both individuals and missions at risk.

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