



THE AUTHOR

Cisco Robles holds an MBA from the Rotterdam School of Management. He is General Manager SHIELD Scientific.



IF HANDS COULD SPEAK

Managing glove-associated reactions in the laboratory is becoming ever more important. Here, Cisco Robles gives us a complete guide to glove associated reactions

IF my hands could speak, we might pay more attention to the condition of our hands whilst wearing gloves. With the massive increase in glove usage¹, it may not be a surprise that the incidence of glove-associated reactions has also grown. Coupled with increased consumption are the frequency and the duration of glove use in the laboratory, both of which have increased exponentially in the last few years. Also we should not ignore the contribution of powder on gloves, along with constant hand washing towards exacerbating the problem. Whether it is personal protection from chemicals and biohazards or protecting laboratory assays from contamination, gloves are our constant companion. By being aware of the causes and symptoms of glove-associated reactions, we can continue to enjoy the protective properties of disposable gloves and undertake the necessary hand care regime to reduce the risk of such conditions developing.

A common fallacy is that glove wearers can only experience reactions when wearing natural rubber latex gloves. All gloves, whether synthetic or natural rubber latex, have the potential to elicit reactions in some individuals. The most common reaction is non-allergic irritant contact dermatitis and can be experienced with all glove materials. Roughly 40%-60% of all glove wearers experience this condition², so if you use gloves regularly in the laboratory the chances are you will be affected by irritant contact dermatitis. The next most common reaction is allergic contact dermatitis, which again can be caused by all glove materials. However, as this is an allergy only those individuals that have the genetic predisposition to be allergic to a certain chemical allergen are vulnerable. It is believed that some 12%³ of the population is potentially affected by allergic contact dermatitis. The least common reaction is natural rubber latex allergy, which is specific to the proteins found in natural rubber latex or cross-reactive plant allergens. Between 0.8% and 7% of the general population is reported to be potentially susceptible to natural rubber latex allergy⁴. Amongst health care workers the incidence of natural rubber latex allergy appears to be higher, with a recent study in South African hospitals reporting a prevalence of 9% to 20%⁵.

As we now know, the three glove associated reactions are irritant contact dermatitis, allergic contact dermatitis and natural rubber latex allergy. Each has unique characteristics that allow for distinguishing one from the other.

Irritant contact dermatitis (also known as irritation, irritant dermatitis or dermatitis)

Irritant contact dermatitis is a non-allergic condition and may be caused by either non-glove related or glove-associated irritants. Indeed there are over 85,000 chemicals with the potential to cause irritant contact dermatitis under the right conditions⁶. When making an assessment of irritant contact dermatitis, it is helpful to remember that there are both non-glove-related and glove-related conditions.

Non-glove-associated irritant contact dermatitis

Among the multitude of everyday products known to cause irritant contact dermatitis are detergents, chemicals in hand soaps, disinfectants, solvents, glues etc. Frequent washing and drying of hands have become part of the daily laboratory regime, but with it comes the potential to produce the right conditions for irritant contact dermatitis. In this context, scalding hot water helps to break down the natural skin barrier properties making it more vulnerable. With sudden changes in weather conditions, the skin may become chapped and more susceptible to developing irritant contact dermatitis. If you wear jewellery in the laboratory, then irritants can build up below or around rings particularly if there is inadequate rinsing.

Glove-associated irritant contact dermatitis

Glove-associated irritants are chemicals, powder, endotoxin, friction and air occlusion. Residual chemicals are a concern if they are not removed from the glove surface through extensive washing or processing. Powder is often used as a release agent on the ceramic moulds or to facilitate donning. It can have a drying and abrasive effect on the hands >>

Feature: Health and Safety



◀ leaving the skin vulnerable to cracking. Endotoxin is fragments from the cell wall of dead gram-negative bacteria. It is an inflammatory substance and is typically associated with irritant contact dermatitis. It is ubiquitous in nature and is not eliminated by sterilisation. Endotoxin has also been reported to accelerate the rate of sensitisation to allergens. Friction and air occlusion are often overlooked when considering the causes of irritant contact dermatitis. It happens when the glove fits too tightly and rubs continuously against the skin. Compounding this condition is long-term wet work or excessive sweating that creates a soggy condition on the skin surface, leaving the cells more vulnerable to friction and abrasive irritation.

Typically the onset of symptoms is evident within minutes to hours after the gloves are donned. Initial symptoms often include redness, itching and a burning sensation. In its chronic stage irritant contact dermatitis can lead to the thick, dry crusty skin, papules (small, hard bumps), blisters and sores. The accumulation of sweat next to the skin is a feature of air occlusion and can lead to another form of irritant contact dermatitis known as dyshidrosis. Here vesicular skin eruptions on the hands can eventually burst causing considerable discomfort. It is important to note that if the irritation is associated solely with the gloves, the irritant symptoms are normally confined to the area of glove contact.

Action for managing irritant contact dermatitis

- Consult your supervisor or occupational health professional.
- Select natural rubber latex or synthetic gloves that are low in residual chemicals and endotoxin (e.g. use gloves that have an undergone testing for irritation such as the Primary Skin Irritation Test).
- Wear a larger glove to increase air circulation until hands heal.
- Change gloves more frequently to allow air to get to the hands if gloves are worn for long periods.
- Wear powder-free gloves.
- Implement hand care regimen, using skin creams to restore natural barrier properties of skin. However, note that petroleum-based creams may degrade natural rubber latex.
- Wear glove liners, but be sure to replace them every time gloves are changed. Please note that glove liners do not replace hand washing.

Whilst irritant contact dermatitis may not be a serious occupational illness, it can lead to more serious conditions. As it is difficult to adequately scrub hands that have open cracks, irritant contact dermatitis can reduce the effectiveness of hand washing. In this way, microorganism such as staphylococcus can colonise the open lesions, thereby increasing the risk of infection. Furthermore, the rupture of the skin's natural skin barrier can facilitate the entry of allergens. In this context it has been demonstrated that latex protein penetration was 1% for those individuals without irritant contact dermatitis, but 23% for those with irritant contact dermatitis⁷.

Allergic contact dermatitis (also known as Type IV, Delayed Hypersensitivity or Chemical Allergy)

Only those persons who are genetically predisposed to specific chemical allergens are susceptible to experiencing an allergic response. In common with other allergies, repeated exposure to the specific allergen accelerates the sensitisation process until that individual's personal threshold is reached. Once this is achieved, subsequent exposure to the allergen will trigger a reaction. Depending on allergen exposure and the genetic profile of the individual, the process of sensitisation may take days, weeks, months, years or never. In common with irritant contact dermatitis, it is important to distinguish between non-glove associated and glove-associated allergic contact dermatitis.

Non-glove-associated allergic contact dermatitis

With more than 2,800 substances having the potential to cause allergic contact dermatitis⁸ it is important to take a holistic view when trying to identify the source of any dermal reaction. Consideration should be given to soaps, detergents, lotions, jewelry, nickel, fragrances, glutaraldehyde, quaternary ammonias, formaldehyde and many other substances in the laboratory, home and outdoor environment.

Glove-associated allergic contact dermatitis

The main agents responsible for glove-related allergic contact dermatitis are vulcanisation accelerators (typically thiurams, thiazoles, carbamates etc), which are used routinely in the manufacture of natural rubber latex and nitrile gloves. However, other chemical contact sensitisers are plasticisers, stabilisers, antioxidants, biocides, preservatives, processing agents, donning agents, colorants etc.

More recently it has been discovered that allergic contact dermatitis can be derived from the latex itself, with Sommer⁹ reporting a prevalence of less than 1% in a study covering 2738 patients.

Allergic contact dermatitis comes in various clinical forms, starting with an acute reaction (after an initial contact with the allergen) through to the chronic form (associated with persistent contact with the antigen). Symptoms at the early stage include redness, swelling, small blisters and itching. In its chronic form, these symptoms may be accompanied by dry, thickened skin, scaling, dryness, open lesions, development of papules etc. Typically the onset of symptoms is 6 to 48 hours⁹. Whilst differentiating allergic contact dermatitis from irritant contact dermatitis can be difficult, it is important to remember that whilst glove-associated irritant contact dermatitis is confined to the area of glove contact¹⁰ the symptoms of allergic contact dermatitis may extend up the arm beyond the area of glove contact.

Proposed action for managing allergic contact dermatitis

As diagnosis can be difficult, patch testing may be necessary. Here a range of allergens are used covering the most frequently encountered chemical contact sensitisers e.g. vulcanisation accelerators. Often a sample of both sides of the suspect glove are used in the patch test. As powder can act as a vector for chemical allergens, it is important to recognise the potential benefit of having a powder-free policy with a view to limiting allergic contact dermatitis. Other action that should be considered is as follows:

- Consult occupational health and a dermatologist if symptoms persist.
- Switch to gloves documented to be low in residual chemicals and low in chemical contact sensitisers.
- Select powder-free gloves only.
- Wear cotton or nylon glove liners, but be sure to replace them every time gloves are changed.
- If a specific chemical allergen has been identified through patch testing, switch to a glove manufactured without this chemical.
- Taking into account the likelihood of non glove-related causative agents, consider alternative allergen contact avenues e.g. the accelerator thiuram is found in fungicides and adhesive materials¹¹.

As selecting gloves that are low in chemical contact sensitisers is important for limiting the risk of allergic contact dermatitis, request from the glove manufacturer high performance liquid chromatography (HPLC) or thin layer chromatography (TLC) test data to demonstrate that it was not possible to detect the most commonly used chemical contact sensitisers in the gloves. To aid in determining whether the gloves have low levels of residual chemicals, seek confirmation from the glove manufacturer that the gloves have undergone sensitisation testing.

“Whilst natural rubber latex allergy is comparatively scarce, it is possibly the most feared due to its potential to cause anaphylactic shock.”

Natural rubber latex allergy (also known as Immediate Type) Hypersensitivity, Protein Allergy or Type I)

Whilst natural rubber latex allergy is comparatively scarce, it is possibly the most feared due to its potential to cause anaphylactic shock. In common with allergic contact dermatitis, it is dose and rate dependent. Natural rubber latex allergy is an immunoglobulin E (IgE) antibody mediated allergy and only those individuals that are genetically predisposed to sensitisation to a specific latex protein are vulnerable. Of the reported 250 protein peptides in raw latex, about 50 are reported to have the allergenic potential capable of inducing the production of IgE antibodies. Successive challenges by the specific latex protein allergen increases the production of IgE antibodies and leads to increasing sensitisation of cells. Clinical symptoms develop when the individual's unique "symptom threshold limit" is reached. Once a person's symptom threshold level is reached, subsequent contact with the specific protein allergen causes the sensitised cells to release immunological mediators such as histamine.

When discussing the mechanism of natural rubber latex allergy, it is important to understand the correlation between food allergies and latex protein allergies. Individuals who are allergic to food like avocados, bananas, cherries, chestnuts, kiwis, melons, peaches, pears, tomatoes etc, may have a higher probability of developing a latex protein allergy. In view of the cross-reactivity between natural rubber latex protein allergens and many commonly encountered plant allergens, any individual presenting with one or more food allergies should be screened for natural rubber latex allergy. Similarly whilst the traditional sources of exposure to natural rubber latex allergy in the laboratory are direct skin or mucosal contact, glove powder can be an important vector for triggering reactions generated by inhalation of aerosolised allergens.

Once an individual's symptom threshold is reached, the onset of symptoms may occur within minutes to an hour after exposure to the allergen(s), hence the alternative name for natural rubber latex allergy of immediate type hypersensitivity¹². The initial symptoms of natural rubber latex allergy are often itching and tingling, but with time may present in various forms. The potential of this reaction to exhibit systemic symptoms and progress to anaphylactic shock is unique to natural rubber latex allergy. The profile of natural rubber latex allergy is shared with penicillin, shellfish and peanut allergies.

The potentially serious symptoms associated with natural rubber latex means that this reaction is likely to remain in the spotlight. Reports by the TUC that natural rubber latex allergy is the third leading cause of occupational asthma in Europe¹³ and encouragement by the Health & Safety Executive to seek latex-free solutions¹⁴ means that this trend is likely to continue. Against this view is the increasing evidence emerging from Germany¹⁵ and Finland¹⁶ suggesting that wearing low protein non-powdered natural rubber latex gloves greatly reduces the risk of allergic reactions. Likewise the comfort and barrier properties of

natural rubber latex are well documented. However, for laboratory staff it should be noted that the risk of natural rubber latex allergy is likely to be higher than that for the general population, as repeated use of natural rubber latex gloves can increase the risk of sensitisation. In addition, the widespread use of organic solvents in the laboratory may render natural rubber latex unsuitable for use.

Action for managing natural rubber latex allergy

- Notify your supervisor.
- Consult Occupational Health.
- Avoid contact with products made from natural rubber latex (e.g. rubber bands, surgical masks, syringes, tubing etc) and wear synthetic gloves.
- Request that individuals wearing gloves in the workplace, use only powder-free latex or synthetic gloves.
- Notify your colleagues, GP and dentist of this allergy – wear a medic alert bracelet.
- Learn to recognise the symptoms of natural rubber latex allergy.
- Be aware that symptoms may develop after contact with cross-reactive allergens.

If our hands could speak, we would be more aware of the potential of our gloves to cause dermal reactions. We would also know that in the laboratory there are external factors such as soaps, disinfectants, skin creams etc that can contribute to the problem. Whilst natural rubber latex allergy is potentially the most serious glove-associated reactions, the risk is restricted to natural rubber gloves and a relatively small proportion of the general population. Allergic contact dermatitis is more frequently encountered and can be triggered by all glove materials. Irritant contact dermatitis is a non-allergic condition that can affect us all and is relatively common to the extent that all of us in the laboratory are likely to experience this dermal reaction. Like allergic contact dermatitis, all glove materials have the potential to elicit irritant contact dermatitis.

Whilst the increase in glove-associated reactions correlates closely with the increase in glove use in the laboratory, there are simple actions that we can take to reduce the risk. As the role of powder is associated with all three reactions, by introducing a powder-free laboratory we have already taken an important step to managing glove-associated reactions. Glove selection on the basis of their suitability for the work we are doing or seeking gloves that have low chemical residues is also important. For natural rubber latex gloves, selecting gloves with low latex protein is crucial.

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REFERENCES

For references see article on labnews.co.uk from 2nd January 2008

CONTACT

ecisco.robles@sheldscientific.com
www.sheldscientific.com

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For more information please call +44 (0)1371 820122

JENWAY

Gransmore Green, Felsted, Dunmow,
Essex, CM9 3JB United Kingdom
Tel +44 (0)1371 820122 Fax +44(0)1371 821083
Email: sales@jenway.com www.jenway.com