Occupational skin diseases: Why, How and When?

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Occupational Skin Disease

- A skin disease that is caused by physical, biological or chemical factor in work
- Also a worsening of pre-existing skin disease can be termed as occupational skin disease
- The start of occupational disease is considered to be the time a patient visited physician the first time
Occupational skin diseases - How common?

- In Finland approximately 1000 cases every year (pop. 5 Million).
- Approximately 20% of all occupational diseases
- Frequency is stable
Occupational skin diseases - what type?

- Most occupational skin diseases are contact dermatoses
- Allergic contact dermatitis
- Irritant contact dermatitis
- Contact urticaria
- Protein contact dermatitis
- Skin infections
OCCUPATIONAL SKIN INFECTIONS

- Scabies
- Fleas
- Paravaccinia
- Erysipeloides
OCCUPATIONAL SKIN CANCERS

- Basal cell carcinoma
- Squamous cell carcinoma
- Malignant melanoma
OCCUPATIONAL PIGMENT CHANGES

- Melanoderma
  - Increased pigmentation
- Leukoderma
  - Decreased pigmentation
OCCUPATIONAL ACNE

- Chloro-acne
- Oil acne
- Tar acne
CONTACT URTICARIA

• Immunologic contact urticaria
  – Caused by proteins that act as allergens
  – Proteins penetrate through skin and bind to IgE on the surface of mast cells
  – Binding causes histamine and other mediator release resulting in urticaria
  – Sometimes generalized reactions occur
  – Latex allergy
CONTACT URTICARIA

• Nonimmunologic contact urticaria
  – Caused by chemicals
  – Direct pharmacologic action on skin cells
  – No sensitization necessary
  – More common than suspected?
PROTEIN CONTACT
DERMATITIS

• Repeated contact urticaria from protein allergens cause eczema (dermatitis)
• Kitchen work (repeated exposure to food allergens)
PHOTOCONTACT DERMATITIS

- Toxic photocontact dermatitis (plants, psoralens)
- Allergic photocontact dermatitis (e.g., sunscreens)
- Permanent sensitization to light?
Irritant contact dermatitis (ICD)

- Accounts for approximately 80% of all contact dermatitis

- ICD is the result of a local toxic effect when the skin comes in contact with irritant chemicals such as soaps, solvents, acids, or alkalis

This 37-year-old woman developed a contact irritant dermatitis from obsessive-compulsive hand washing 20-30 times a day. www.drmatlas.org
Introduction to Irritant Contact Dermatitis

- ICD is a cutaneous inflammation resulting from a direct cytotoxic effect of a chemical or physical agent.
- Constitutes nearly 80% of occupational contact dermatitis (OCD).
- OCD is a matter of public health importance, contributing to combined direct and indirect annual costs (in the USA) of up to $1 billion when accounting for medical costs, workers compensation, and lost time from work.
The US Bureau of Labor Statistics data show that occupational skin diseases accounted for 10% to 15% of all occupational illnesses.

High-risk occupations with frequent irritant exposure in caterers, furniture industry workers, hospital workers, hairdressers, chemical industry workers, dry cleaners, metal workers, florists, and warehouse workers.
Epidemiology of ICD

- Clinical manifestations of ICD are determined by:
  - Properties of the irritating substance
  - Host factors
  - Environmental factors including concentration, mechanical pressure, temperature, humidity, pH, and duration of contact
  - Cold alone may also reduce the plasticity of the horny layer, with consequent cracking of the stratum corneum
  - Occlusion, excessive humidity, and maceration increase percutaneous absorption of water-soluble substances
Bilateral shoe irritant dermatitis resulting from chronic occlusive footwear
Epidemiology of ICD

• Important predisposing characteristics of the individual include:
  – Age, race, sex, pre-existing skin disease, anatomic region exposed, and sebaceous activity
  – Both infants and elderly are affected more by ICD because of their less robust epidermal layer
  – Patients with darkly pigmented skin seem to be more resistant to irritant reactions
  – Other skin disease such as active atopic dermatitis may predispose an individual to develop ICD
  – The most commonly affected sites are exposed areas such as the hands and the face, with hand involvement in approximately 80% of patients and face involvement in 10%
Pathogenesis of ICD

• Denaturation of epidermal keratins
• Disruption of the permeability barrier
• Damage to cell membranes
• Direct cytotoxic effects
### Table 16.2 Irritants and mechanisms of toxicity.

<table>
<thead>
<tr>
<th>Irritant</th>
<th>Mechanisms of toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detergents</td>
<td>Solubilization and/or disruption of barrier lipids and natural moisturizing factors in the stratum corneum</td>
</tr>
<tr>
<td></td>
<td>Protein denaturation</td>
</tr>
<tr>
<td></td>
<td>Membrane toxicity</td>
</tr>
<tr>
<td>Acids</td>
<td>Protein denaturation</td>
</tr>
<tr>
<td></td>
<td>Cytotoxicity</td>
</tr>
<tr>
<td>Alkalis</td>
<td>Barrier lipid denaturation</td>
</tr>
<tr>
<td></td>
<td>Cytotoxicity through cellular swelling</td>
</tr>
<tr>
<td>Oils</td>
<td>Disorganization of barrier lipids</td>
</tr>
<tr>
<td>Organic solvents</td>
<td>Solubilization of membrane lipids</td>
</tr>
<tr>
<td></td>
<td>Membrane toxicity</td>
</tr>
<tr>
<td>Oxidants</td>
<td>Cytotoxicity</td>
</tr>
<tr>
<td>Reducing agents</td>
<td>Keratolysis</td>
</tr>
<tr>
<td>Water</td>
<td>If barrier is disrupted, cytotoxicity through swelling of viable epidermal cells</td>
</tr>
</tbody>
</table>
Acute Irritant Contact Dermatitis

• Commonly seen in occupational accidents
• Irritant reaction reaches its peak quickly, within minutes to hours after exposure
• Symptoms include stinging, burning, and soreness
• Physical signs include erythema, edema, bullae, and possibly necrosis
• Lesions restricted to the area where the irritant or toxicant damaged the tissue
• Sharply demarcated borders and asymmetry pointing to an exogenous cause
• Most frequent irritants are acids and alkaline solutions
Cumulative Irritant Contact Dermatitis

- Consequence of multiple sub-threshold skin insults, without sufficient time between them for complete barrier function repair

- In contrast to acute ICD, the lesions of chronic ICD are less sharply demarcated

- Itching and pain due to fissures of hyperkeratotic skin are symptoms of chronic ICD

- Skin findings include lichenification, hyperkeratosis, xerosis, erythema, and vesicles
Airborne Irritant Contact Dermatitis

- Develops on irritant-exposed skin of the face and periorbital regions
- Often simulates photoallergic reactions
- Involvement of the upper eyelids, philtrum, and submental regions help to differentiate from photoallergic reaction
Frictional Irritant Contact Dermatitis

- Results from repeated low-grade frictional trauma
- Plays adjuvant role in ACD and ICD
- Characterized by hyperkeratosis, acanthosis, and lichenification, often progressing to hardening, thickening, and increased toughness

9 year old girl demonstrates a lichenified hyperpigmented round plaque on the top of her thumb produced by chronic thumbsucking. www.dermatlas.org
Differential Diagnosis

- Allergic and ICD, especially in chronic stage appear similar by clinical appearance, histology, and immunohistology

- Look identical with erythema, papules, xerosis, scaling, and lichenification with sharp borders

- ICD has remained a diagnosis of exclusion when dermatitis is not explained by positive patch test to a known allergen

- More frequent complaint of burning and stinging with ICD in contrast to pruritus in ACD
CLASSIFICATION OF HAND DERMATITIS

Hand dermatitis

Endogenous

Atopic dermatitis
- +PH/FH atopy
- Distal fingers affected by subacute and chronic change

Psoriasis
- Lesions of psoriasis elsewhere, including nails
- +FH
- Psoriatic arthritis
- Well-marginated plaques with silvery scale and pustules

Other, eg dyshidrotic
- Clusters of vesicles on palms and especially on volar edges of fingers

Infection

Tinea
- KOH
- Fungal culture

Superimposed S. aureus
- Gram stain
- Bacterial culture

Exogenous

Irritant contact dermatitis
- Risk factors: occupation, endogenous causes
- May show acute and/or chronic changes

Allergic contact dermatitis
- Allergen identified via patch testing
- Pruritus
- May show acute and/or chronic changes
Treatment

- Avoidance of causative irritants at home or in the workplace is the primary TX
- Engineering controls to reduce exposure in the workplace
- Shielding and personal protection such as gloves and special clothing
- Pre-exposure protection by protective creams, removal of irritants by mild cleaning agents, and enhancement of barrier function generation by emollients and moisturizers
- Emphasizing personal and occupational hygiene
- Establishing educational programs to increase awareness in the workplace
Chronic ICD Treatment

- Tx goal is to restore normal epidermal barrier function
- Topical corticosteroids frequently used
- Systemic corticosteroids although helpful in reducing inflammation, are not useful in treatment of chronic ICD unless offending contactants are avoided
- PUVA and Grenz ray considered for chronic dermatitis that does not respond to other tx
- Hyperkeratotic palmoplantar dermatitis from frictional or chronic ICD may benefit from the adjunctive use of systemic retinoids such as acitretin
Occupational irritant contact dermatitis

- 35% Washing
- 10% Solvents
- 6% Plastics and adhesives
- 6% Foodstuff
- 5% Dirty, wet work
- 5% Mineral oils
Allergic contact dermatitis (ACD)

- ACD accounts for approximately 20% of all contact dermatitis

- ACD is a type IV, delayed or cell-mediated immune reaction that is elicited when the skin comes in contact with a chemical to which an individual has been previously sensitized

- Synonyms include contact dermatitis and contact eczema
ACD

• Key Features

- ACD is a pruritic, eczematous reaction
- Acute ACD and many cases of chronic ACD are well demarcated and located to the site of contact with the allergen
- Prototypic reactions are ACD due to poison ivy and nickel
- Patch testing remains the gold standard for accurate and consistent diagnosis

This healthy adolescent developed an intensely pruritic vesiculobullous allergic contact dermatitis from hair dye. Dermatlas.org
• Classic picture of ACD is a well-demarcated erythematous vesicular and/or scaly patch or plaque with well defined margins corresponding to the area of contact.

• Chronic allergic contact dermatitis leading to hand dermatitis. This golfer wore one leather glove and had positive patch tests to potassium dichromate and a piece of his glove. Courtesy of Kalman Watsky, M.D.
Allergic contact dermatitis to leather shoes. Note the correspondence to sites of exposure. Courtesy of Yale Residents Slide Collection.
Because ICD and ACD are not always discernable clinically, patch testing is required to help identify an allergen or exclude an allergy to a suspected allergen.
Allergic contact dermatitis

• Caused by low-molecular weight haptens
• Hapten is “incomplete allergen”
• Binds to carrier protein for immunogenicity
• Low molecule weight enables penetration of hapten
**Induction of contact hypersensitivity.** Application of contact allergens (Ag) induces the release of cytokines by keratinocytes, Langerhans cells and other cells within the skin. These cytokines in turn activate Langerhans cells which uptake the antigen and emigrate into the regional lymph nodes. During this process, the Langerhans cells mature into dendritic cells. In addition, the antigen is processed, re-expressed on the surface and finally presented to naïve T cells in the regional lymph node. Upon appropriate antigen presentation, T cells bearing the appropriate T cell receptor clonally expand and become effector T cells. These alter their migratory behavior due to the expression of specific surface molecules like CLA. Effector T cells recirculate into the periphery where they may later meet the antigen again. Ag, antigen; KC, keratinocyte.
**Elicitation of contact hypersensitivity.** Application of contact allergens (Ag) into a sensitized individual causes the release of cytokines by keratinocytes and Langerhans cells. These cytokines induce the expression of adhesion molecules and activation of endothelial cells which ultimately attracts leukocytes to the site of antigen application. Among these cells, T effector cells are present which are now activated upon antigen presentation either by resident cells or by infiltrating Langerhans cells. Antigen-specific T cell activation again induces the release of cytokines by T cells. This causes the attraction of other inflammatory cells including granulocytes and macrophages which ultimately cause the clinical manifestation of contact dermatitis. Ag, antigen; DDC, dermal dendritic cell; KC, keratinocyte; CLA, cutaneous lymphocyte antigen.
Clinical features of ACD

• Acute blistering and weeping

• Chronic lichenified and scaly plaques

• Patchy and diffuse distributions may be seen with body washes and shampoos

• Acute bullous allergic contact dermatitis due to poison ivy. This distribution is seen in patients who wear gloves. Courtesy of Yale Residents Slide Collection

• Chronic allergic contact dermatitis due to glutaraldehyde. The patient was an optometrist
DDX of ACD

• Includes many forms of dermatitis: ICD, atopic dermatitis, stasis dermatitis, and seborrheic dermatitis, as well as the erythematous form of rosacea

• Hand and foot ACD need to be distinguished from psoriasis and tinea

• Widespread disease needs to be differentiated from other causes of erythoderma, Sezary syndrome
Pre-Patch Testing Questions

• Exposures both at work and home to understand mechanics of the work environment, Materials Safety Data Sheets (MSDS) can be helpful for workplace exposures

• Effect of vacations and time away from work or home should be ascertained

• All personal care products should be inventoried

• All hobbies should be explored
Patch Testing

• Chemicals brought in by patients should not be tested blindly, physician should be aware of the chemical ingredients because severe burns or ulceration may occur

• ‘Leave on’ personal care products such as moisturizers and make-up may be tested ‘as is’

• ‘Rinse off’ products such as soaps or shampoos need to be diluted prior to patch testing
Patch Testing

- Most common site is the upper back

- Patients should not have a sunburn in test area, and should not apply topical corticosteroids to the patch test sites for 7 days prior to test

- Systemic corticosteroids should be avoided for 1 month prior to testing

- Patches are applied to back and reinforced with Scanpor tape, patient instructed to keep back dry and patches secured until second visit at 48 hours

- Fixing allergens to patient’s back using Scanpor® tape.
Patch Testing

• When the patient returns in 48 hours the patches need to be inspected to ensure that the testing technique is adequate.

• As patches are removed their sites of application should be marked in order to identify the locations of particular allergens.
### Patch Test Scoring

**Table 15.2 International Grading System for patch tests.**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>+/-</td>
<td>Doubtful reaction, faint macular erythema</td>
</tr>
<tr>
<td>+</td>
<td>Weak, non-vesicular reaction with erythema, infiltration and papules</td>
</tr>
<tr>
<td>++</td>
<td>Strong, vesicular reaction with erythema, infiltration and papules</td>
</tr>
<tr>
<td>+++</td>
<td>Spreading bullous reaction</td>
</tr>
<tr>
<td>-</td>
<td>Negative reaction</td>
</tr>
<tr>
<td>IR</td>
<td>Irritant reaction</td>
</tr>
</tbody>
</table>

• A positive patch test reaction to nickel. This is an example of a 3+ reaction.
Patch Testing

• Patient again asked to keep back dry until second reading, done from 72 hours to 1 week after the initial application of the patches

• This delayed reading is necessary due to patch test responses to some allergens such as gold having a delayed reaction
Relevance of patch tests

- Past relevance
- Previous relevance
  - possible
  - probable
  - certain
- No relevance
Treatment and Patient Education

- Once allergens are positively identified, patient should be given written information on all of these chemicals.

- Patient should be instructed on how to read labels on old or new products to avoid future exposure.
Treatment of ACD

- Involves identification of causative allergens

- Clear the dermatitis with topical, or if necessary systemic corticosteroids

- Complete and prolonged clearing can take up to 6 weeks or more, even when allergens are being avoided
Mathias’ criteria for occupational CD

• Is the clinical appearance consistent with CD?
• Are there workplace exposures to potential cutaneous irritants or allergens?
• Is the anatomic distribution of dermatitis consistent with the form of cutaneous exposure in relation to job task?
Mathias’ criteria for occupational CD

- Is the temporal relationship between exposure and onset consistent with contact dermatitis?
- Are nonoccupational exposures excluded as likely causes?
- Does removal from exposure lead to improvement of dermatitis?
Mathias’ criteria for occupational CD

• Do patch tests or provocation tests implicate a specific workplace exposure?

At least 4/7 criteria should be “yes”
ALLERGIC CONTACT DERMATITIS - INDUCTION

• Induction (sensitization) occurs if hapten is allergenic and/or topical dosage is large enough

• Approximately 2 weeks later person is allergic to the same hapten chemical
ALLERGIC CONTACT DERMATITIS - ELICITATION

- Hapten penetrates through stratum corneum of a sensitized individual
- A classical Type IV reaction ensues in the form of eczema/dermatitis
CLINICAL FEATURES OF OCCUPATIONAL SKIN DISEASE

• When did disease start?
• In which skin area was the first symptom?
• What is work technique?
• Free time, other works
• Cleaning measures
• Protection
• Vacation, holidays
CLINICAL FEATURES OF CONTACT DERMATITIS

- Skin disease starts on the area of contact
- Dorsal aspects of hands and fingers, volar aspects of arms
- Redness, edema -> blisters, ulcerations
- Itch, pain, heat, stinging
- Contact dermatitis heals after exposure is discontinued
CLINICAL FEATURES OF CONTACT URTICARIA

- Hives (edema) appear on sites of contact within minutes
- The hives disappear within 1-4 hours
- Mild: Only itching
- Severe: Systemic symptoms (anaphylaxis)
DIAGNOSTIC TESTS

- PATCH TESTS
- PRICK TESTS
- SCRATCH TEST
- OPEN TEST
- USAGE TEST
PATCH TESTS

• Diagnosis of allergic contact dermatitis
• Hapten (~0.001-20%) in vehicle
• Finn Chamber
• 48 h application on back
• Reading at 2 days, 4-5 days (7-9 days)
• ?+ (erythema), + (erythema, edema), ++ (+vesiculation), +++ (+ bulla), IR (irritation)
PRICK TESTS

• A drop of allergen placed on top of skin
• Skin broken with lancet
• Positive control histamine
• Negative control vehicle
• Positive reaction: at least 3 mm and histamine size
• Overall negative: Antihistamine
• Overall positive: Dermografismus