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CASE REPORT

Solvent Induced Cumulative Insult Irritant Contact Dermatitis through Glove Permeation: A Case-Report on the Chronic Occupational Skin Lesion

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ABSTRAK

Seorang pekerja makmal wanita muda mengalami gejala kulit kering, gatal dan mengelupas pada kedua-dua tangan. Sejarah pendedahan pekerjaan menyokong pendedahan yang kerap dan berpanjangan kepada pelbagai pelarut bahan kimia yang diiktiraf sebagai perengsa penyakit kulit pekerjaan. Amalan kerja yang tidak selamat dan cara penggunaan sarung tangan pelindung yang salah turut dikenalpasti. Diagnosis dermatitis kontak iritasi (ICD) disokong oleh faktor risiko dermatologi tempat kerja, ciri-ciri klinikal dan ujian patch kulit negatif yang tidak menjurus kepada tindak balas hipersensitif. Diagnosis telah disahkan dengan memenuhi kesemua Kriteria Mathias. Pengurusan penyakit kulit pekerjaan yang berkesan memerlukan kawalan pendedahan merangkumi program penjagaan tangan yang komprehensif pada peringkat individu, saringan dan pemeriksaan keadaan kulit, rujukan awal untuk penilaian kesihatan pekerjaan, program pendidikan dan latihan yang berkesan, serta penyediaan pelembap tangan oleh majikan. Sokongan return to work (RTW) dalam kalangan pekerja yang terjejas adalah penting bagi mengurangkan impak negatif terhadap prestasi kerja dan kualiti kehidupan.

Kata kunci: Dermatitis kontak iritasi; kronik; pelarut teraruh; penyakit pekerjaan; resapan sarung tangan

ABSTRACT

A young female laboratory worker presented with chronic cumulative skin lesion over hands. The occupational exposure history supported the prolonged and frequent exposure to multiple solvents which are recognised as work irritants,

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improper work practice and wrong use of protective glove. The diagnosis of Irritant Contact Dermatitis (ICD) was supported by workplace dermatology risk factors, clinical features, negative skin patch test to rule out hypersensitivity reaction and fulfilment of all seven Mathias Criteria. The effective management of occupational contact dermatitis requires practices change and exposure control. The comprehensive Hand Care Programs must be individualised and incorporate several important elements namely the skin care screening and surveillance, early referral for Occupational Health assessment, effective education and training programs and provision of hand moisturising products. The support of return to work (RTW) among the affected workers is of paramount important in order to minimise the negative impacts on their quality of work as well as home life.

Keywords: Chronic; glove permeation; irritant contact dermatitis; occupational; solvent induced

INTRODUCTION

Dermal exposure to hazardous agents can result in occupational skin disorder. The majority of occupational dermatoses are caused by wet work and work exposure to dermal irritating or sensitising chemicals (Greaves et al. 2018). Contact dermatitis are the most prevalent presentation and might pose a severe impact to the individual's work ability as well as the activities of daily livings (Jones & Horn 2014). This case illustrated the cumulative skin insult in a laboratory technician handling wet work; with chronic exposure to highly irritant solvents without adequate occupational safety and health measures. The effective prevention often requires comprehensive synchronised approach from the multidisciplinary team including the dermatologist, occupational physician, hygienist and full organisational commitment.

CASE PRESENTATION

A 28-year-old female who had been working for 2 years as contract-based research assistant in the research laboratory, presented with chronic skin lesions over bilateral hands, predominantly on right side and symptoms persisted for a eight months duration. Worker reported the skin lesions as redness and itchiness but later turned into painful skin peeling lesion with burning sensation.

Chronological of Symptoms and Complaint

She started working in the laboratory in December 2018, symptoms free for skin lesions prior to the job. The first symptoms appeared in June 2019, when she first noticed skin dryness, itchiness and rashes over dorsum both hands, predominantly over the right dorsum of the 5th digit. She did not seek for medical attention

and continued work exposure until February 2020, she presented in the occupational health clinic as the skin lesion progressively worsened when she noticed skin scaling, peeling, thickening with on and off and skin fissure formation which was painful. Symptoms were worsened in the mid of work week (Wednesday and Thursday) but improved during weekend or when she off work.

Employment History, Work Activity and Exposure

This was her second employment. She started her first job as a research assistant in a university for 26 months (2016-2018) and reported no exposure to any physical, chemical and biological hazard. Her job scope was computerised data management and compiled laboratory test reports in the office setting. She was then moved to current employment since December 2018, also as a research assistant however full time working in the laboratory setting. She worked from 8.00 am until 5.00 pm daily for five days a week, without shift rotation, occasionally working on an additional day during weekend, about twice in a month.

The laboratory was equipped for research on ecology of insects and biocontrol of insect pests; as well as maintaining an arthropod collection. Her daily task including direct handling of the insects and mites killing jar which makes her exposed to three main volatile solvents; diethyl ether, acetone and chloroform. For the preparation of liquid killing agent, she would have to pour the concentrated diethyl ether, acetone and chloroform without dilution, into the glass jar. Each jar was being filled with about 100-200 ml of the solvent. Occasionally, she soaked papers into the solvent before putting them into the jar. The tasks last for 4-5 hours per workday, while at the end of shift, she would have to clean the laboratory equipment with detergent for 30 minutes per workday. For the purpose of dermal protection, she wore rubber glove throughout all work processes, with occasional contact of solvent with the glove during while transferring the chemical agents. Worker informed that she worn the same pair of rubber gloves frequently to clean the laboratory equipment directly after the chemical agent preparation. Additionally, she complained of sweaty palm and dorsum inside the gloves after the long duration of work tasks. The average duration of wearing rubber glove on both hands was 4-5 hours per day. Upon further questioning on the Occupational Safety and Health measure in workplace, worker admitted she was not familiar with the Safety Data Sheet (SDS) of all three chemicals handled, and most of the time, she performed the laboratory tasks alone without co-workers and supervision from the laboratory manager. She was also unsure of the occupational hygiene survey or risk assessment that had been conducted in her work unit. She had been given briefing and talk on laboratory and chemical safety during induction however has never been arranged for safe chemical handling training.

Non Occupational Causality

In order to rule out the atopic dermatitis, worker has never developed single episode of asthma or hay fever, rhinitis, conjunctivitis and eczema. Besides that, family atopy has been denied. She did not involve in other part time job; or other exposure to the irritants. Furthermore, she also denied of household activities, hobbies or recreational activities that brought her into contact with the chemicals or breakdown products. She was unsure of the environmental pollution around the residential area and never practice over-the-counter skin care prescription treatments.

Physical Examination and Clinical Investigations

Upon examination, the skin lesion only confined to bilateral hands, more prominent on the right dorsum, especially on the metacarpal phalangeal joint and Proximal interphalangeal joint (Figure 1), and medial aspect of dorsum (Figure 2). No lesion found on other body part. The glazed, dry, parched and scalded appearance of the epidermis suggestive of chronic lesion. No redness, erythema and vesiculation. The scaly lesion slightly swollen and mild tenderness upon palpation. Hyperkeratosis and healing fissuring were seen.

She was referred for Patch Test in the dermatology clinic and shown negative results towards latex, detergent and the solvents, this ruled out allergic contact dermatitis (ACD). The provisional diagnosis was irritant contact dermatitis (ICD).

DISCUSSION

Upon diagnosed with ICD, worker has been prescribed by dermatologist with high potency topical corticosteroid in view of the persistent and chronic dermatitis lesions. She was also being advised for regular emollient application especially after the contact with the irritant. The case was notified as occupational dermatoses. She was

FIGURE 1: Glazed, dry and scalded epidermis observed on the dorsum of right hand, prominent over the metacarpophalangeal joints and proximal interphalangeal joints

FIGURE 2: Hyperkeratosis and healing fissuring suggestive of chronic and cumulative insult on the medial surface of right hand

immediately restricted from the existing work task to cease the exposure. Job modification was facilitated by employer along with the counselling on future choices of career. She was also given education on the workplace exposure and appropriate protection, retrained on safe working procedure, personal protective equipment (PPE) usage, appropriate skin practices and compliance to treatment. The ongoing and effective communication between the physician, occupational health professional and worker, was established to detect early recurrence and support successful return to work (RTW).

Over 90% of cases of occupational dermatosis appear as contact dermatitis, which is the most common presenting symptom (Sasseville 2008). Contact dermatitis is defined as skin inflammation, typically eczematous in nature and induced by external irritant exposure (causing ICD) or allergen (causing ACD). ICD is more common than ACD and has a worse prognosis (Jones & Horn 2014). Both types of contact dermatitis have distinct pathophysiological. ICD is a non-immunological and non-specific skin reaction when an irritant causing direct damage to the epidermal skin cells of contact. On the other hand, ACD is an adaptive, Type IV, delayed and cell mediated immune response toward chemicals penetrating the skin, which first causing sensitisation upon first exposure, followed by elicitation during re-exposure (Houle et al. 2021). In this case, the worker developed first skin symptoms after assigned to the workplace that known to have the dermatology risk factors. The known causative agents at workplace including both of the allergen (rubber) and irritant (solvent and detergent). However, several clinical justifications justified the provisional diagnosis of ICD, namely (i) the anatomical lesion consistent with the site of contact; (ii) repeated and chronic exposure resulted in dry, hyperkeratosis lesion and painful fissure. ACD was ruled out due to (i) absent of erythematous, vesiculated and itchy lesions; (ii) negative skin patch test which excluded the presence of delayed hypersensitivity reaction in respond to allergen. When the contact allergen is not detected in the gold standard patch testing, the diagnosis might then be mostly ICD, given that anyone can develop ICD following sufficient exposure to an irritant, although susceptibility varies among individuals (Bains et al. 2019).

The determination of work relatedness and establishing of disease causality is essential in order to confirm the provisional diagnosis of occupational dermatoses (Greaves et al. 2018). The relevant determinants including (i) disease evidence; (ii) epidemiological data; (iii) evidence of exposure; (iv) other relevant factors; (v) validity of evidence; and (vi) evaluations and conclusion (American Medical Association 2013). The occupational cumulative exposure to irritants (multiple solvent and detergent) and inappropriate use of skin protective equipment of latex gloves supported the occupational diagnosis. The Mathias Criteria (Mathias 1989) had outlined seven important criteria in

order to evaluate the causal relationship between contact dermatitis and occupation, in which at least four out of seven criteria must be fulfilled. For the present case, all criteria were fulfilled (Table 1). Being a useful tool to generate occupational causations of contact dermatitis, De Carvallo et al. (2012) reported the excellent validity and diagnostic accuracy of Mathias Criteria, which had 100% sensitivity, high specificity (98.90%), positive predictive value (92.31%) and negative predictive value (100%).

The most common exposure that results in the greatest number of occupational ICDs in absolute terms is wet work (Jacobsen et al. 2022). In the workplace, acute ICD often occur as a result of poor work habit, mishandling of acute irritants as well as the failure to identify work irritant. Additionally, repeated insult with weak irritant especially among the susceptible individual may cause chronic ICD, or more appropriately the cumulative insult ICD (Koh & Seng 2001). The clinical presentation of this case highly suggestive of chronic dermatitis in which one of the characteristics is the duration from first exposure until the first symptoms might be up to months or years, depending on the nature of irritant, magnitude of exposure and the host susceptibility. In contrast to ICD, the skin lesions in ACD typically noticed 36-48 hours post contact with allergen (Houle et al. 2021).

Two significant risk factors of ICD had been recognised for this worker, namely, direct handling of highly irritant solvents and had rubber gloves on, both with huge magnitude of exposure (frequent up to at least 4 hours daily which was at least 20 hours per week). PPE is used as a preventive measure to limit the contact with occupational irritants and allergens however it might be the major source of the occupational dermatoses, through the development of a contact allergy to PPEs' components; or causing ICD through the mechanism of pressure, sweat and friction. Prolonged rubber glove wearing will create occlusion therefore prevent evaporation from the skin surface and lead to moisture accumulation over hands. The prolonged occlusion was defined as wearing gloves more than two hours or

TABLE 1: Establishing diagnosis of occupational dermatitis using Mathias Criteria

Criteria	Fulfillment
1. Is the clinical appearance consistent with contact dermatitis?	Yes
2. Are there workplace exposures to potential cutaneous irritants or allergens?	Yes
3. Is the anatomic distribution of dermatitis consistent with the form of cutaneous exposure in relation to the job task?	Yes
4. Is the temporal relationship between exposure and onset consistent with contact dermatitis?	Yes
5. Are non-occupational exposures excluded as likely causes?	Yes
6. Does avoiding exposure lead to improvement of the dermatitis?	Yes
7. Do patch tests or provocation tests implicate a specific workplace exposure?	Negative patch test ruled out ACD

the change of gloves more than 20 times day (Houle et al. 2021). Additionally the induction of ICD can be facilitated by the elevated temperature which cause sweating (Antonov et al. 2013). The risk of subsequent skin penetration by irritants or allergens is heightened soon after the breaching of the skin barrier.

Management of occupational contact dermatitis requires practices change in the work setting with the aim to minimise the exposure to the causative agents and at the same time improve skin care practices. Prior to the work exposure, as early as at the time of hire, it is the duty of employer to ensure all workers are educated, trained and familiarised with the nature of hazard, alert on the skin (dermal irritant) notation documented on safety data sheet of chemical; as well as the use of nitrile glove specific for the contact with hazardous chemicals instead of rubber glove. The successful RTW is highly supported by the effective communication between physician, employer and worker. Ongoing dermal monitoring must follow the RTW due to its ability to detect early recurrence (Chen et al. 2016).

The workplace "Hand Care Program" had been identified as the key measure to maintain and promote healthy, intact skin which is the first line defence against colonisation and infection (Teichmann et al. 2006) The comprehensive Hand Care Programs must incorporate several important elements: the skin care screening and surveillance, early referral for Occupational Health assessment, effective training and educational programs, provision of hand moisturising products such as emollient (Public health Ontario 2009). The topmost in the program is skin screening to identify all workers at risk for OCD via the administration of a medical questionnaire. The Nordic Occupational Skin Questionnaire (NOSQ) was developed to survey the occupational skin conditions and environmental exposures. Through the availability of skin care resources such as moisturiser or emollient; organisational involvement, training and occupational skin intervention programmes may ensure their effectiveness (Zack et al. 2017). The hand care products are crucial in preventing OCD, as they will restore the function of the stratum corneum to maintain skin integrity via water absorption and redistribution.

CONCLUSION

The wet exposure to irritants, improper use of protective glove and inappropriate work practices are the main contributors of the development of occupational ICD. Complete healing only expected with cessation or minimisation of exposure, while continuous yet unchanged exposure is the driving factor of poor prognosis. Therefore, workplace prevention and management must be individualised in order to support Return to Work among the affected workers and minimise the negative impacts on their quality of work as well as home life.

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