

Contact dermatitis caused by tulips: identification of contact sensitizers in tulip workers of Kashmir Valley in North India

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Summary

Background. Tulip, belonging to the genus *Tulipa* and family Liliaceae, is a spring-blooming perennial that grows from bulbs. Owing to manual handling, contact dermatitis can occur in professionals at any stage of the growth cycle of the tulip plant.

Objectives. To determine the clinical pattern of contact dermatitis resulting from tulip plant cultivation, and to assess contact allergy in workers coming into contact with this plant.

Methods. One hundred and sixty-four tulip workers were screened, and 48 patients with suspected contact dermatitis were patch tested with 39 allergens, including haptens from the Indian baseline series, a plant series, and extracts from different parts of the tulip plant.

Results. Thirty-nine positive patch test reactions were observed in 21 patients. Seventeen patients showed positive reactions to either α -methylene- γ -butyrolactone or to tulip plant extract. Clinical relevance was observed for 13 of 17 positive patch test reactions.

Conclusions. Contact dermatitis is an important health hazard in workers dealing with tulip bulbs. Further studies to identify and isolate other possible tulip allergens, and to quantify the amounts of allergens in different parts of the tulip plant, are recommended.

Key words: bulb dermatitis; contact dermatitis; epidemiology; occupational contact dermatitis; patch test; tulip.

Tulip, a premier ornamental flower with a long history of cultivation, is a spring-blooming perennial that grows from bulbs. It belongs to the genus *Tulipa* and family Liliaceae. Tulips originate from central Asia, and tulip production has increased worldwide, owing to expansion of its cultivation into new areas; tulips are presently grown

from southwestern Europe to North Africa and Central Asia (1). The fully developed tulip plant is composed of a bulb with roots and a flowering shoot, consisting of a stem, leaves, and one or more flowers (2). The tulip flower has colourful petals forming a cup at the top, and at the base there are almond-shaped small leaves called sepals. Petals and sepals together are known as tepals, and form the perianth of the tulip flower. Inside the flower there are six stamens and one pistil; each stamen typically consists of a pollen-containing anther and a filament.

The annual growth and developmental cycle of a flowering tulip requires much manual handling. The bulbs are taken out in June or July, and are peeled to remove the daughter bulbs, which are inspected and packed in August and September before they are planted in late

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September to early November. December to March is the wintering period, after which the mother bulb flowers and daughter bulb enlarge. The flower is removed from the stem, mostly manually or by machine, in April or at the beginning of May (3). Owing to manual handling, sensitization can occur at any stage of the growth cycle of the tulip plant in workers who come into contact with this plant. Contact dermatitis caused by tulip plants has already been reported in the literature (4–31). Since the description of ‘tulip finger’ by Bertwistle (31) in 1935, several studies have addressed this subject; however, they are mostly case reports and reviews.

We aimed to perform a cross-sectional, epidemiological study to examine the prevalence of sensitization and the clinical patterns of contact dermatitis resulting from tulip plant cultivation.

Materials and Methods

This cross-sectional descriptive study was conducted by the Department of Dermatology, Government Medical College Srinagar in collaboration with the Department of Extension Education, Sher-e-Kashmir University of Agricultural Sciences and Technology.

The study population included 164 employees of the agricultural department who primarily dealt with the handling of tulip bulbs and flowers. The demographic profile of the workers was documented in terms of a detailed history of the exact nature and duration of work, any skin disease (past or present), evolution of lesions, aggravating factors, any history of atopy or hyperhidrosis, and any treatment received. A detailed skin examination was performed in each worker, with an emphasis on the morphology and distribution of lesions, and the predominant areas of involvement.

Patch testing was performed with the Indian baseline series, a plant series, and extracts from different parts of the tulip plant, which included bulb, roots, stem, leaves, tepals, and stamens. The Indian baseline series with 20 haptens (Table S1), approved by the Contact & Occupational Dermatitis Forum of India and obtained from Systopic Laboratories, New Delhi, Delhi, India, was used in the study. The plant series was obtained from Chemotechnique Diagnostic, Vellinge, Sweden (marketed by Systopic Laboratories in India), and included allergens such as α -methylene- γ -butyrolactone, diallyl disulfide, propolis, and Compositae allergens. A total of 39 haptens were applied to the upper back of each patient using Finn Chambers[®], and patch test reading and interpretation were performed according to the criteria of the ICDRG on day (D) 2 and D4 (32). An assessment of the relevance of each positive patch test reaction to the patient's presenting dermatitis was made. To rule out any irritant reactions



Fig. 1. Tulip finger: involvement of the tip of thumb and index finger in a tulip worker.

to tulip plant extracts, patch tests with these were also performed in 20 healthy controls.

The tulip plant extract was prepared according to the method recommended by Hjorth and Wilkinson (27). An extract of each part was prepared by shaking with acetone (80% in aq.) for 90 min. After vacuum evaporation, the extract was kept in a desiccator. One per cent of the extract in 70% ethanol was used for patch testing. All workers were patch tested with the same batch of extract prepared from a single tulip cultivar over a period of 3 days. Fifteen microlitres of extract obtained from different parts of the tulip plant was applied with a micropipette for patch testing.

Results

Among the 164 workers who were initially screened, 48 workers (29.3%) were clinically suspected of having contact dermatitis, whereas the others did not show any clinical signs of eczema. Of the 48 workers with contact dermatitis, 46 (96%) were males whereas only 2 were females. Itching was the most common symptom, being noted in 39 (81%) patients. A history of atopy and palmo-plantar hyperhidrosis was observed in 6 workers (12.5%) and 4 workers (8.3%), respectively. Hand eczema was the most common clinical pattern identified. The pattern of the dermatitis corresponded to the area of hands coming into contact with the tulip plant, and was symmetrical in most cases. The tip of the thumb and the index finger were most frequently involved (Fig. 1). Most of the cases

Table 1. Positive patch test reactions to a plant series, tulip extracts, and the Indian baseline series

Allergen	No. of positive reactions
Plant series	20
α -Methylene- γ -butyrolactone	15
Sesquiterpene lactone mix	3
Diallyl disulfide	1
Parthenolide	1
Tulip extract	14
Indian baseline series	5
Potassium dichromate	2
-Phenylenediamine	1
Nickel sulfate	1
Colophonium	1

had involvement of the hands without any other body surface area being affected; however, spread to other areas, which included the forearms, face, legs, and abdomen, was observed in 9 (18.7%) workers. The morphology of the lesions varied according to the phase of dermatitis. Erythema, papulovesicles, erosions, oozing and crusting were observed during the acute stage, whereas, during the chronic stages, lichenification, fissures and hyperpigmentation were the most common morphological patterns seen.

Tables 1 and 2 show a summary of the patch test results. A total of 39 positive reactions were observed in 21 (43.8%) workers (Table 1). Seventeen of these 21 patients showed positive reactions either to α -methylene- γ -butyrolactone present in the plant series or to tulip plant (bulb) extract (Table 2). Among these 17 patients, 12 showed positive reactions to both α -methylene- γ -butyrolactone and to tulip extract, 3 showed positive reactions to α -methylene- γ -butyrolactone only, and 2 showed positive reactions to tulip plant (bulb) extract only. Interestingly, positive patch test reactions to tulip bulb extract in both of these patients were clinically relevant. Positive clinical relevance (past or current) was observed for 13 of 17 positive patch test reactions (Table 2). For the remaining reactions, the relevance could not be established with certainty, as the patients could not correlate their skin condition with the handling of the tulip plant. No positive reactions were observed in the 20 healthy controls patch tested with the tulip plant extract.

Discussion

Contact dermatitis caused by plants or plant products is a frequent observation, and represents approximately 5–10% of patients attending dermatologic clinics for

dermatitis (33). Occupational and non-occupational exposure can cause plant dermatitis, the former being common in florists, gardeners, horticulturists, foresters, woodworkers, farmers, and cooks, and the latter in hobby gardeners, housewives, and in all those who are likely to come into contact with plant material with the potential to cause contact dermatitis (34, 35). Bulbous plants (plant/flower growing from a bulb) mostly require manual handling during all stages of growth, and present problems as a result of continuous contact with different parts of the plant containing different profiles of sensitizers. Tulips, because of their long history of cultivation, have proved particularly complex in terms of the development of contact dermatitis (4–31).

Our study, as one of the few worksite-based studies, found clinical evidence of eczema in 29.3% of the tulip workers, which is comparable to the findings of a study conducted by Bruynzeel et al. with 103 bulb growers, in which minor signs of dermatitis were reported in 30% of the workers (16). However, our results showed a lower prevalence of eczema caused by the tulip plant than other studies in the literature. According to Bertwistle, 85% of workers are at risk of developing tulip fingers (31). Klaschka et al. found 8 of 12 nursery workers who were affected (29), and van der Werff (36) estimated that 40% of workers were affected. The lower prevalence in our study population could be attributable to the use of protective gloves by some workers. Also, the allergen content may depend on the tulip variety, the tulip cultivar, and the growing conditions: tulips grown in India may differ from tulips grown in Europe. Hjorth considered the percentage of tulip sensitivity in Denmark to be 4% (27), but this may be an underestimation of the exact prevalence, as many affected persons do not visit the doctor.

The clinical features of tulip contact dermatitis evaluated in those who are occupationally sensitized are best recognized in the literature as 'tulip fingers', which represent a severely fissured, hyperkeratotic dermatitis, at times accompanied by painful paronychia, involving the pulp of the first three fingers, which may develop after many years of recurrent seasonal work (31). In our study too, we noticed patients with tulip fingers primarily affecting the first three fingers, as shown in Fig. 1. However, most of the dermatitis cases in our study group were bilateral, involving the thumb, index finger, and thenar aspect of non-dominant hand as well, demonstrating that dermatitis does not always correspond to the preferred hand of the worker. This finding can be attributed to the fact that the tulip bulbs contain a tough outer tectum that is usually held by the non-dominant hand, resulting in damage to the skin. This friction and trauma may be the major

Table 2. Results of patch testing and characteristics of the 17 patients who tested positive for tulip allergen

Sex	Clinical pattern	Plant series and tulip plant extract	Patch test reading	Relevance	Indian baseline series
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Current	–
		Sesquiterpene lactone mix	+		
		Tulip extract	+		
M	Hand eczema	α -Methylene- γ -butyrolactone	++	Unknown	–
		Tulip extract	+		
M	Hand eczema plus face	α -Methylene- γ -butyrolactone	+	Current	–
		Tulip extract	+		
F	Hand eczema	α -Methylene- γ -butyrolactone	++	Old	Nickel
		Tulip extract	+		
M	Hand eczema plus forearm	α -Methylene- γ -butyrolactone	+	Current	–
		Tulip extract	+		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Current	Potassium dichromate
		Tulip extract	+		
M	Hand eczema, forearm, and face	α -Methylene- γ -butyrolactone	+	Unknown	–
		Diallyl disulfide	++		
		Tulip extract	–		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Current	–
		Tulip extract	–		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Old	–
		Sesquiterpene lactone mix	+		
		Tulip extract	+		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Old	–
		Tulip extract	+		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Unknown	–
		Tulip extract	+		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Unknown	–
		Tulip extract	+		
M	Hand eczema, face, forearm, and scalp	α -Methylene- γ -butyrolactone	–	Current	–
		Tulip extract	++		
M	Hand eczema plus forearm	α -Methylene- γ -butyrolactone	+	Old	–
		Tulip extract	–		
M	Hand eczema	α -Methylene- γ -butyrolactone	–	Current	–
		Tulip extract	+		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Current	–
		Tulip extract	+		
M	Hand eczema	α -Methylene- γ -butyrolactone	+	Old	–
		Tulip extract	+		

F, female; M, male.

source of primary sensitization to the allergen found in the epidermis of the bulb scales.

We also observed that tulip fingers of the non-dominant hand were usually more extensive in those who handle the bulbs for peeling, and less pronounced in those who only sort the bulbs and prepare them for shipping, or those who cut or pick the flowers. This finding can be explained by more mechanical injury of the non-dominant hand in which the bulb is held firmly during peeling. Also, the content of the allergen has been found to diminish rapidly immediately before harvesting in the outermost bulb scale, which subsequently becomes inert. However, the allergen remains present in the second

and subsequent scales, even after harvesting and during storage of the bulbs (27).

Interestingly, the clinical picture of tulip contact dermatitis depends on the season and the stage in which patient is seen. Most workers in our study developed dermatitis during contact with the bulb, especially during the season in which the bulbs were dug out, peeled, and packed for storage. Some workers developed dermatitis during the flowering period, when the flowers were cut. Besides allergic contact dermatitis, other side-effects of this ornamental plant reported so far include airborne contact dermatitis (22), chronic actinic dermatitis, and asthma and rhinoconjunctivitis (11). However, we did not encounter any such patient in our study sample.

In our study, 12 workers reacted positively to both α -methylene- γ -butyrolactone and to tulip bulb extract, indicating definite sensitization with the tulip plant, as tulipalin A (α -methylene- γ -butyrolactone) is the main antigen responsible for contact dermatitis. However, we did not observe any positive reactions to extracts from other parts of the tulip plant. This finding can be attributed to the higher concentration of allergen in the bulbs than in other parts of the tulip plant, which can be quantified by chromatography. However, in our study, we did not estimate the quantities of allergen in the extracts obtained from different parts of the tulip plant; further studies are recommended for quantification.

Two workers in our study group reacted positively to tulip bulb extract only, and for both of these workers the positive patch test reactions were clinically relevant. This finding raised the suspicion of other allergens being responsible for contact dermatitis in these workers, as the possibility of irritant reactions had been ruled out by patch testing of controls. Tulipalin B is another known tulip allergen that has been suggested to cause contact dermatitis (37). In addition, other allergens, such as tuliposide D and F, have been isolated, and these may contribute to the allergenic properties of tulips (10). Also, the possibility of cross-reaction between tulip extract and garlic needs to be ruled out, as both of them belong to the same plant family (Liliaceae). Gas chromatographic

analyses have indicated the presence in garlic extracts of tuliposide B, which is also present in tulip bulbs (24). We therefore recommend further studies to determine the exact chemical composition of the tulip plant, which was beyond the scope of the present study.

We conclude that contact dermatitis is an important health hazard in workers dealing with tulip bulbs, and that they are at risk of sensitization from the tulip allergens. The patch test reaction profile of workers in our study suggests a need for further studies to identify and isolate other tulip allergens. Moreover, the quantities of allergens in different parts of the tulip plant can be variable, and may be assessed by means of chromatographic studies.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Indian baseline series recommended by Contact and Occupational Dermatitis Forum of India (Systopic).

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Table S1: Indian Standard Series antigens recommended by Contact and Occupational Dermatitis Forum of India (Systopic)

Allergens	Concentration, %
Vaseline	100.0
Wool alcohols	30.0
<i>Myroxylon pereirae</i> (balsam of Peru)	25.0
Formaldehyde	1.1
Mercaptobenzothiazole	2.0
Potassium dichromate	0.5
Nickel sulfate	5.0
Cobalt chloride	1.0
Colophonium	20.0
Epoxy resin	1.0
Paraben mix	15.0
p-Phenylenediamine	1.0
Parthenium	0.1
Neomycin sulfate	20.0
Benzocaine	5.0
Chlorocresol	1.0
Fragrance mix I	8.0
Thiuram mix	1.0
Nitrofurazone	1.0
Black rubber mix	0.6