Original Article

Characteristics of cosmetic dermatitis in China: a meta-analysis

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Abstract: Background: Cosmetic dermatitis (CD) refers to abnormal physiological changes in the skin or mucous membrane due to improper use of cosmetics. Objective: To analyze the characteristics of CD in China in last 15 years. Methods: Using “cosmetic dermatitis”, “cosmetics-related diseases”, and “cosmetics adverse effects” as key words to search literatures published from 2000 to 2015. Open Meta software was used to process comprehensive analysis of data. Results: The most commonly type of CD was contact dermatitis (87.4%). In contact dermatitis patients, allergic dermatitis accounted for 59.9%. Patch tests were positive in 54.4% cases. Highly allergic substances included: spices, preservatives, dyes, heavy metals, and excipients. 36.2% patients had previous histories of allergies. Poor-quality cosmetics related CD took up 14.2%. Conclusions: The main type of CD is contact dermatitis. Spices and preservatives are most commonly seen allergens in cosmetics. Customers with previous allergy histories are more prone to cosmetic dermatology.

Keywords: Cosmetic dermatitis, cosmetics, allergic substance, patch test

Introduction

Cosmetic dermatitis (CD) refers to abnormal physiological changes in the skin or mucous membrane due to improper use of cosmetics. Commonly seen manifestations include: skin redness, pimples, pigmentation, depigmentation, and hair loss etc. [1, 2]. People choose cosmetics to protect their skins, beautify appearance, and to improve living quality; however, CD is utterly counterproductive by affecting the appearance, leading to low self-esteem, causing depression, and undermining people’s social activities and quality of life [3, 4].

With the continuous improvement of living standards and the increasing pursuit of beauty, more and more people choose to use cosmetics in their daily lives [5], and the incidence of CD has been increasing to be a common clinical disease. Majority of CD patients are 20-40 years old females. The most commonly seen CD is contact dermatitis. Other types of skin lesions include abnormal pigmentation, acne-like lesions, photosensitive dermatitis, hair damage and nail damage. Studies found spices, preservatives, and heavy metals, etc. [6-8] are common allergic ingredients in cosmetics.

CD has complex etiology, and can be results of interactions between internal factors (heredity, diet, stress etc.) and external factors (climate, chemicals, and pollution etc.) [9]. Complete mechanism of CD has not been clear yet, while most scholars believe that cosmetic contact dermatitis is an inflammatory reaction of the skin or mucous membrane when contact with exogenous cosmetic allergens. Cosmetics
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Photosensitive dermatitis is a reaction due to the light-sensitive material in cosmetics exposed to ultraviolet light, becoming allergic substances. Cosmetic acne-like lesions are caused by sebum excretion disorder, during to pores blocking by cosmetics.

Recently, as China develops fast economically, the number of people using cosmetics increases year by year, so is the number of CD patients. At present, although there are some articles on CD, but no evidence-based medicine analysis was made. Therefore, we retrospectively analyzed the reports focused on CD in China from 2000 to 2015, in terms of gender, clinical manifestation, patch tests, allergens, poor quality cosmetics and allergy history.

Methods

Document retrieval

Using cosmetic dermatitis, cosmetic dermatitis, cosmetics-related diseases, and cosmetics adverse effects as keywords to search in data bases as the Chinese National Knowledge Infrastructure (CNKI), Chinese Biology Medical Literature Database (CBM), VIP Database, and Wan Fang Med Online for all published literature from January 2000 to April 2015, including dissertations, conference papers and so on.

Inclusion criteria

All included documents match the following conditions: 1) subjects of study were Chinese patients diagnosed with CD; 2) published in 2000-2015; 3) subtype analysis (including gender, cosmetic dermatology classification, patch test analysis, allergens, poor-quality product or allergies, etc.) data are complete; 4) most-recently published literature was chosen if there were repeated publication. All documents were carefully reviewed by two independent investigators, according to the inclusion criteria.

Data extraction

After eliminating duplicate documents, two investigators collected and evaluated data independently. Basic information extracted as follows: first author, year of publication, the total number of cases, the number of male and female, the number of cases of certain disease subtype, patch test results, the number of cases of poor-quality products caused allergies, and allergy history. When collected results did not match, a third party assisted auditing.

Statistical analysis

Open Meta software was used to analyze all included studies, to calculate the results of pooled estimates, 95% confidence interval (CI), and P values. Also, bias analysis and sensitivity analysis were included. Heterogeneity among studies was examined by the inconsistency index ($I^2$) test. If the heterogeneity between studies was small ($I^2<50\%$), the fixed-effect model was used to calculate the statistical values, otherwise a random effects model was used.

Results

Literature search results

A total of 1925 literatures were found, and a final of 51 papers were included. Inclusion process is shown in Figure 1. The general information of included literatures is listed in Table 1.

Meta-analysis results

Male and female incidence ratio: Gender information was reported in 45 studies (a total of 13216 patients). Male patients accounted for
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Table 1. General information of included studies

<table>
<thead>
<tr>
<th>Studies</th>
<th>Year</th>
<th>Total Case</th>
<th>Sex</th>
<th>CD</th>
<th>Patch test</th>
<th>I²</th>
<th>H²</th>
</tr>
</thead>
<tbody>
<tr>
<td>M¹</td>
<td>F²</td>
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</tr>
</tbody>
</table>

1: Male; 2: Female; 3: Classification of diseases; 4: Classification of contact dermatitis; 5: With questionable cosmetics; 6: Standard kits; 7: Irregular products; 8: History of allergies; D: Precise data.

8.3% [95% CI (0.053 to 0.074), P<0.001], while female patients accounted for 91.7% [95% CI (0.903 to 0.930), P<0.001] (Forest plots were not presented).

CD sub-type analysis: In 25 studies, a total of 10571 patients were reported in CD subtypes. We excluded three studies by sensitivity analysis, and a total of 5401 patients were included in the rest 22 studies. Analysis results showed that contact dermatitis account CD for 87.4% of DC, abnormal pigmentation 4.7%, acne-like lesions 3.1%, photosensitive dermatitis 1.0%, hair damage 0.8%, nail damage 0.8%, others 0.1% (Figure 2) (Forest plots were not presented).

Sub-types of contact dermatology: In 14 studies, a total of 1597 patients were reported in contact dermatology sub-types. Analysis showed: Irritant dermatitis accounted for 40.1% [95% CI (0.298 to 0.504), P<0.001]. Allergic dermatitis accounted for 59.9% [95% CI (0.496 to 0.702), P<0.001] (Forest plots were not presented).

Positive rate of patch test for suspicious cosmetic: In 25 studies, a total of 5745 patients were reported to have brought suspicious cosmetics for patch test. Results showed patch tests positive rate was 54.4% [95% CI (0.471 to 0.618), P<0.001] (Figure 3).

Allergens analysis: In 6 studies, standard series of antigen kits were used to test patients’ allergens. Results showed that highly allergic substances included: spices, aromatic mixture, p-phenylenediamine, thimerosal, nikkel sulfate, formaldehyde, cobalt chloride, imidazolidinyl urea, and parabens etc. (Table 2).

Allergy history analysis: In 4 studies, 874 patients’ allergy histories...
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Analysis results showed that 36.2% patients had an allergy history [95% CI (0.330 to 0.393), P=0.338] (Figure 4).

Poor-quality products

In 19 studies, 645 of 5942 patients were reported to use poor-quality cosmetics, accounting for 14.2% [95% CI (0.110 to 0.174), P<0.001] (Figure 5).

Publication bias analysis: Open Meta software was used to draw funnel plots for assessing the possibility of publication bias. For summary estimate of female incidence ratio, cosmetic dermatology subtypes, contact dermatitis subtypes, suspicious cosmetics patch test positive rate, poor-quality cosmetics and allergy histories, no significant publication biases were found during to symmetrical plots. However, funnel plots of male incidence ratio, CD subtypes, and poor-quality cosmetics ratio were not symmetrical, indicating possible publication bias. (funnel plots are not presented for there are too many of them).

Sensitivity analysis: Open Meta software was applied to do sensitivity analysis for all included studies in each indicator. No individual study was found having excessive influence on the pooled effect. (data not presented).

Discussion

As economy improves, people are using more and more cosmetics to pursue beauty; however, these cosmetics may be harmful if people are exposed
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Table 2. Standard Series antigen kit patch test results

<table>
<thead>
<tr>
<th>Studies</th>
<th>Standards</th>
<th>High allergens</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 Jin (2002)</td>
<td>Peking University First Hospital</td>
<td>Perfumery¹, Imidazolidinyl urea², Parabens²</td>
</tr>
<tr>
<td>16 Xu (2003)</td>
<td>Nanjing Corning Medical Development Corporation</td>
<td>Aromatic mixture¹, Cobalt chloride³, Nickel sulfate⁴</td>
</tr>
<tr>
<td>25 Liu (2005)</td>
<td>Beijing Medical University</td>
<td>Aromatic mixture¹, P-phenylenediamine⁵, Formaldehyde³</td>
</tr>
<tr>
<td>45 Wang (2009)</td>
<td>Beijing Yuan Kang Medical Corporation</td>
<td>Thimerosal², Nickel sulfate⁶, Aromatic mixture¹</td>
</tr>
<tr>
<td>49 Feng (2010)</td>
<td>Affiliated Hospital of Nanjing Medical University</td>
<td>Aromatic mixture¹, P-phenylenediamine⁵, Formaldehyde³</td>
</tr>
<tr>
<td>59 Lan (2013)</td>
<td>Ruimin cosmetics kit C-1000</td>
<td>Span-83⁵, Kathon CG², AMO alcohol⁶</td>
</tr>
</tbody>
</table>

1. perfumery; 2. antiseptic; 3. hair dye; 4. heavy metal; 5. vehicle/emulsifier/surfactant.

Figure 4. Allergy history analysis: Forest plots showed 36.2% patients had allergy histories [$I^2=11\%$, 95% CI (0.330 to 0.393), $P=0.338$], therefore the fix effects model was used as the pooling method.

In this study, female patients of CD took up 91.7%, while male patients took up 8.3%. Although most CD patients are females in China, still there are a certain amount of male patients. Therefore, history of cosmetics use should not be ignored for male patients in dermatological clinics.

The subtype proportion of CD differs in different areas. This study showed that the major types of CD were contact dermatitis in China, followed by abnormal pigmentation, acne-like lesions, photosensitive dermatitis, hair damage and nail damage. Alani JI reported, in the United States, the most commonly seen CD were also contact dermatitis, but followed by hair damage and nail damage [61]. Different habits of using cosmetics, environment, and economic situation may be the reasons for regional differences. Furthermore, we found that 59.9% of contact dermatitis patients are allergic dermatitis. So when treating these patients, physicians should adequately assess the subtypes in order to provide more suitable treatment.

In this study, suspicious cosmetic patch test positive rate was 36.2% in 52 studies. The random effect model was used.

Figure 5. Poor-quality products caused CD ratio: forest plots showed that poor-quality products caused CD accounted for 14.2% of all allergic cosmetics [$I^2=96\%$, 95% CI (0.110 to 0.174), $P<0.001$]. The random effect model was used.

Suspicious cosmetic patch test is supposed to be an important evidence of CD. In this study, suspicious cosmetic patch test positive rate was...
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55.1%. Low positive rate may be caused by: ① cosmetic sellers were reluctant to provide cosmetics; ② patients were reluctant to go to hospitals repeatedly; ③ after patients got refund or compensation, they refused to take more tests [60]. It is not hard to diagnose cosmetic contact dermatitis, but when CDs present as photosensitive dermatitis, acne-like lesions, skin pigmentation abnormalities and other clinical manifestations, diagnosis of CD can be tricky. Delayed diagnosis and treatment may result in further progress of disease. Suspicious cosmetic patch test can provide effective reference for the diagnosis of such diseases.

Positive result of patch test can help diagnose CD, and further cosmetic standard series antigen patch test may help to find cosmetics specific allergens, so as to further prevent/treat such disease. In this study, there were six different Antigen kit used to detect allergens, and we summarized the most commonly seen allergens (Table 2). Results showed that in China, the most common allergens were spices and preservatives, possibly because the wide use of spices and preservatives in Chinese cosmetics [63, 64].

Allergic constitution of patients may increase the risk of CD. There were four studies reported histories of CD patients. Meta-analysis found that 36.2% of CD patients had a history of allergy for drug, food and/or alcohol. These results suggest that patients with allergy histories should be more careful for selecting and using cosmetics.

In addition, we found that poor-quality cosmetics (Labeling without health permits, manufacturer name and address, or valid identification) took up 12.8% of all CD. These cosmetics may contain excessive heavy metals, unknown substances, or even toxic substances, which make them more likely to cause CD than high-quality cosmetics do.

Publication bias analysis results showed that female incidence ratio, contact dermatitis subtypes, suspicious cosmetic patch test positive rate, and sensitizing drug analysis had no significant publication bias; male incidence ratio, CD subtypes and poor-quality cosmetics ratio analysis had certain publication bias. Fortunately, sensitivity analysis found these biases had no significant effect on the final combined effect, so the results are basically reliable and stable.

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Disclosure of conflict of interest

None.

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