EFFECTS OF MINERALS AND OTHER CONTACTANTS ON HUMANS AND ITS RELATION WITH SKIN DISEASES

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ABSTRACT

Objective: To find out the effect of minerals and other contactants on humans and its association with various allergic skin diseases by performing patch test.

Study design: Descriptive/cross sectional study .

Place and Duration of study: This study was conducted at Biochemistry Department Nowshera Medical College, Nowshera from March 2017 to March 2018.

Material & Method: The Standard Series consisting of 22 minerals and allergen substances were applied using IQ chamber in a group of 100 patients (75 females and 25 males) with suspected ACD who came to DHQ Hospital &Qazi Hussain Ahmed Medical Complex Nowshera from March 2017 to March 2018. The tests were read after 48, 72 and 96 hours.

Results: A total of 90 patients (21 males and 69 females) showed positivity to one or more allergens. There were no statistically significant differences between the sensitization rates in males and that in females. Nickel was the commonest allergen in women, with 30 out of 75(40 %) women showing positive reactions of being sensitive to it. In men, black rubber was the predominant allergen with 11of 25(44%) reacting to it. Eczema was the commonest clinical pattern in 55 patients, followed by contact dermatitis in 34 patients, urticaria in 7 patients, actinic dermatitis in 4 patients and melasma in 2 patients. The maximum numbers of positive reactions (52 %) were recorded in the age range of 21 to 40 years. The most frequent sensitizers were nickel sulfate 34 %, black rubber 33%, potassium dichromate 29%, cobalt chloride 27%,and aromatic mixtures 18%. According to the localization of Allergic Contact Dermatitis, hands, as the most common site, were involved in 41% cases, followed by the face in 21% cases.

Conclusion: Nickel sulfate, potassium dichromate, cobalt chloride and black rubber mixtures are the most common contactingminerals and allergens.

Keywords: Minerals, allergic contact dermatitis, allergen, eczema, patch test, systemic contact dermatitis.

INTRODUCTION

As human life becomes increasingly intricate, our skin is disclosed to an ever-increasing spectrum of chemical and biological products. Unavoidably, the incidence of allergic sensitization is displaying a steady rise. Dermatologists use the terms “dermatitis” and “eczema” reciprocally to illustrate a varied pattern of inflammation which, when acute, is represented by erythema and vesiculation, and, when chronic, by dryness, fissuring and lichenification.

Contact Dermatitis has been acknowledged since age-old times and has been present throughout humankind’s history. There are articles and statement of intense itching after contact with trees (pines), reactions to some contactants were suspected in some cases of dermatitis in the nineteenth century, even before the term “allergy” was invented by von Pirquet in 1906. JozefJadassohn is considered as the father of patch testing[1].

Patch testing is a fabulous procedure carried out by dermatology clinicians. It can help the referring doctor to find out whether skin condition is caused by

an allergy to substances (these substances are called allergens) which come into contact with skin, such as products at home, at work or in leisure activities.

Patch testing is indicated, if the history and the clinical presentation show one or more risk factors for dermatitis. The patch test is the only decent and trustworthy methodthe gold standardfor diagnosing ACD, and its suitable performance and analysis require considerable experience[2,3]. Aims of the patch test are to recreate in scaled down the clinical eczematous dermatitis by administering allergens under occlusion on intact skin of patients having suspected contact dermatitis.

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Patch testing is a biological test, and as all biological tests, it depends on many objective variables that may affect its efficacy and lawfulness. Furthermore, as all medical procedures, it is also accountable to possible mistakes and errors. While medical error reporting has enhanced in current years, the quality of error reporting that might be used for deterrent purposes in the medical profession is still far below the standard found in navigation[4].

The purpose of patch test is to detect contact allergy. It is performed by applying a suspected substance in a standardized fashion and in the correct concentration to a normal human skin. If an eczematous response is elicited, the person probably has a contact allergy to the tested substance.

MATERIAL AND METHODS

Prospectively, 105 consecutive patients suspected of dermatitis and eczema attending DHQ Hospital &Qazi Hussain Ahmed Medical Complex Nowshera were patch tested in Biochemistry Department, Nowshera Medical College Nowshera during Mrch 2017 to March 2018.

Inclusion criteria were as follows:

1. Informed consent from the patient.
2. No history of receiving systemic steroids (equivalent to 15mg/day prednisolone or more), immunosuppressive medications, anti-histamine medicationswithin one week, or topical application of large amounts (potentially equivalent to 15 mg prednisolone per day)at the test site within 1 previous weeks.
3. Exclusion of pregnancy and breast feeding (for females).

Five enrollees were excluded from the study because their information were unsatisfactory, three patients did not attend the prearranged sessions, and elastic tapes were too early peeled off in two patients. Finally, 100 patients were included in statistical analysis.

Each participant was requested to avoid taking a bath, physical exercises, sweating, and lying on the back until the tapes were in place. A questionnaire including demographic information and clinical findings was recorded for each patient. Then, 22 minerals and allergen substances were applied using IQ chamber on the patient's upper back and the test site was marked by indelible ink. After two days (48hrs), the tapes were removed, the test site was examined and read for the first time and photographed, and the results were recorded in a check list. The second examination was performed on the 3rd day (72hrs), and the same routine was applied. Some special cases also need to be examined on the 4th day (96hrs) because of late reactions. The patch test reactions were recorded and interpreted according to the international contact dermatitis research group criteria (ICDRG).

Demographic information, and clinical and test data were analyzed using SPSS 11.5. Patient characteristics were provided as descriptive statistic indices. Analytic studies were performed with Mann-Whitney U test and KrusKal-Wallis tests. Furthermore, differences in proportions were investigated by Chi square test. $P<0.05$ was considered statistically significant.

RESULTS

Age of these 100 patients ranges from 13 to 80 with a median of 37 years. There were 25 males and 75 females. A total of 90 patients (21 males and 69 females) showed positivity to one or more allergens. There were no statistically significant differences between the sensitization rates in males and that in females.

Important demographic characteristics of the patients according to the MOHLFA index are shown in Table 1. Nickel was the commonest allergen in women, with 30 out of 75(40 %) women showing positive reactions of being sensitive to it. In men Black rubber was the predominant allergen with 11out of 25(44%) reacting to it.Eczema was the commonest clinical pattern in 55 patients, followed by contact dermatitis in 34 patients, urticaria in 7 patients, actinic dermatitis in 4 patients, while melasma in 2 patients.

Positive reactions were noted to all the allergens tested except Marquardt 15 for which no patients reacted positively. The maximum numbers of positive reactions (52 %) were recorded in the age range of 21 to 40 years. The most frequent sensitizers were nickel sulfate 34 %, black rubber 33%, potassium dichromate 29%, cobalt chloride 27%, , and aromatic mixtures 18%.

A higher rate of patch test positivity (55%) was observed in patients with eczema who showed positivity to 18 different allergens. According to the localization of dermatitis, hands, as the most common site, were involved in 41% cases, followed by the face in 21 % cases.Moreover 21% of the patients had a personal history of atopy whereas 28% had a family history of atopy.

Table 1: Demographic characteristics of the patients according to the MOAHLFA index

Moahlfa index	Frequency
M (Male)	25 (25%)
O (Occupation)	35 (35%)
A (Atopic dermatitis)	18 (18%)
H (Hand involvement)	51 (51%)
L (Leg involvement)	31 (31%)
F (Face involvement)	24 (24%)
A (Age>40)	51 (51%)

Table 2: The positive rates of allergens between different genders(Individually):

Allergens	Male (Positive rate)	Female (Positive rate)	X^2	p
cobalt chloride	28.0	73.3	16.355	<0.001
Sulfhydryl mixture	4.0	3.8	0.07	0.790
Imidazolidinyl urea mixture	0.0	1.3	-	0.750
Phenylenediamine substrate	8.0	13.3	0.126	0.477
N-cyclohexyl-sulfur phthalic esters	8.0	9.3	0.41	0.840
Potassium dichromate	28.0	29.3	0.016	0.866
(EDA) Ethylenediamine	4.0	3.8	0.07	0.790
Rosin	20.0	14.7	0.099	0.753
Formaldehyde	8.0	6.7	0.051	0.821
Epoxy resin	4.0	6.7	0.236	0.627
Bromine nitrate propylene glycol	0.0	1.3	-	0.750
Thiuram mixture	0.0	2.7	-	0.561
benzene mixture	4.0	8.0	0.051	0.821
Nickel sulfate	16.0	40.0	4.813	0.028
Sesquiterpene lactones Mixture	4.0	8.0	0.051	0.821
Aromatic mixtures	20.0	17.3	0.09	0.764
Cl+Me-(isothiazole)	20.0	16.0	0.024	0.878
Black rubber mixtures	44.0	29.3	1.824	0.177
Kabbah mixture	0.0	5.3	0.347	0.556
Marquardt 15	0.0	0.0	-	-

Distribution of positive reactions to allergen according to sex is demonstrated in Table 2. Among the reactors, 28% displayed reaction to one, 26% to two, 11% to three, 11% to four substances, 6% to five substances, 5% to six substances and 3% to seven substances. Overall, 90 positive reactions were demonstrated to allergens.

Cobalt positivity was associated in all cases with concurrent positivity to potassium dichromate (in 11 patients), nickel (in 10 patients) or both potassium dichromate and nickel (in 3 patients).In metal allergic patients, 17(60.8%) of patients showing positivity to nickel had relevance to the current dermatitis.

In our study the positive rates in age groups (above and below 35 years) are not significantly different (p=0.504). The positive rates between different gender are not significantly different on all of allergens (p>0.05) except for nickel (p=0.022) and cobalt chloride (p<0.001).While positive rates of different diseases are significantly different (p<0.001). The comparison of eczema with contact dermatitis (p=0.003) and other diseases (urticaria, actinic dermatitis and melasma separately) are significantly different (p<0.001).

DISCUSSION

The aim of this study was to evaluate the importance of relation of patch test with related skin diseases due to exposure to minerals and other contactants. Patch tests are diagnostic tools used for the purpose of identification of the etiologic agent(s) of dermatitis and eczema.Allergic contact dermatitis is a hypersensitivity reaction to an external agent developing after contact with allergen. History as well as physical examination, although of unusual importance, is ambiguous in definitive diagnosis because of the diversification of allergens in the environment[5]. Previous studies have analyzed that early diagnosis of allergic contact dermatitis by patch test had led to a better quality of life, facilitate treatment responsiveness, and decreased treatment expenses. Furthermore, recognizing the etiologic agent and try to avoiding it, might prevent progression toward chronic non-remittable stages of the disease[6]. Still, patch test is famous to be the most trust worthy test to diagnose dermatitis/eczema and recognize its etiologic agent[7].

When the skin comes in contact with different external agents,a vast range of reactions are possible, including hyper and hypopigmentation, acne, atrophy, urticaria, photo-allergic and phototoxic reactions and eczema. Eczema might be either irritant (80%) or allergic (20%)[8]. Allergic contact dermatitis is a hypersensitivity reaction to an external agent which appears in a short time after contact with an allergen substance.

In our study, eczema was the commonest clinical

pattern (in 55 patients) followed by contact dermatitis in 34 patients, urticaria in 7 patients, actinic dermatitis in 4 patients, while melasma in 2 patients. The frequency rate of eczema is higher than contact dermatitis.

In our study there was no statistically significant differences in the sensitization rates between males and females ($p=0.215$). In contrast, many earlier studies have shown higher rates of patch test positivity in females[9,10]and some in males[11]. Most of this disparity between the sexes can be accounted for by the high rates of positivity to nickel in women because of alloy, electro such as earrings, watch, eyeglasses frames, hand bags, necklace usage etc. This trend was also observed in our patients with almost 88% (30 out of 34) of nickel positive patients being women. Yet, nickel has been reported to be the most common allergen in the majority of studies[12,13].

In our study positive rates between different genders are significantly differenton Nickel sulfate ($p<0.022$) while the highest prevalence was reported in the age groups of 15-40 years (22 cases, 64%). As well, Firooz et al postulated a significant relationship between nickel sensitivity and age younger than 40 years[14].

The gender difference for cobalt chloride ($p<0.001$) as we observed in our study, we considered that women more contact with stained glass, metal and ceramic jewelry in which contains cobalt.

In our study, nickel sulfate and potassium dichromate, each positive in 34% (34/100)and 29% (29/100) respectively were identified as the most common allergens. When in fact nickel sulfate has been identified as the most common allergen followed by potassium dichromate in many other studies from different countries[7,13,15].

Delayed type hypersensitivity reactions to nickel, cobalt, and potassium dichromate have been realized to be related to each other, nevertheless, the range of this relationship and the external factors that may affect these relationships have not yet been fully investigated. For decades the metal ions nickel and (VI) chromate have been widely recognized as important contact allergens[16].

In our study as well as in study conducted by Shamseddini et al from Iran[17] women showed significantly higher rates of nickel sensitivity as compare to men. Nickel sensitization is more common in women, mostly because of cheap jewelry, when in fact dichromate sensitization involve men more often[18]. In contradiction, most of the sensitization to cobalt, even though frequent in patients of both sexes, is considered of unclear relevance, and individual reactions to cobalt are rare. Relatively, contact allergy to cobalt is often accompanied by sensitization to nickel, chromate or even entirely unrelated allergens-like rubber additives[19]. In our study, cobalt positivity was associated in all cases with concurrent positivity to potassium dichromate (in 11 patients), nickel (in 10 patients) or both potassium dichromate and nickel (in 3 patients).

Contact dermatitis is encountered by external skin exposure to an allergen, but sometimes a systemically administered allergen may reach the skin and remain concentrated there with the help of the circulatory system, leading to the systemic contact dermatitis (SCD). Metals such as nickel, cobalt, chromium, and zinc are ubiquitary in our environment. Metal allergy may result in allergic contact dermatitis and also systemic contact dermatitis. Dietary nickel or cobalt ingestion may cause systemic reactions, such as hand dermatitis or generalized eczematous reactions. Systemic contact dermatitis (SCD) is an inflammatory skin condition that is known to occur with exposure to foods, drugs, and dental metals. A variety of types of skin eruptions have been reported, including flares of previous patch test sites, symmetrical flexural and intertriginous exanthema, exfoliative erythroderma, and extensive dermatitis[20].

CONCLUSION

To conclude, patch testing at Department of Biochemistry Nowshera Medical College, Nowshera has acknowledged that the commonest minerals and other allergens in our patient's population are nickel, black rubber, potassium dichromate and cobalt chloride, while the most common diseases encountered by these allergen are eczema and contact dermatitis.In view of the differences in clinical patterns, positivity rates are also reported. We have an obligation it to our patients to clarify the epidemiology of this important problem. Various geographic areas represent different causative agents of contact dermatitis, modifying standard patch test series in each region with attention to its allergen prevalence might be a tolerable and cost effective approach for more appropriate therapeutic strategies and preventive measures. A multicentric study from all the major geographic areas of the country is the need of time to facilitate further studies in this matter.

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