

A SURVEY OF ALLERGIC CONTACT DERMATITIS AMONG HAIRDRESSERS

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Summary

The study aimed to investigate the relationship between the professional environment and hypersensitivity reactions to various contact allergens, the features of the clinical course, and the type of allergic contact dermatitis (ACD) in 35 hairdressers. The analysis was based on data on length of professional experience, localization of rashes, clinical diagnosis and allergens, and the cause of positive reactions in patch testing. Skin changes most often affect the hands, palms, face, and neck. The frequency of ACD diagnosed was 46%, followed by dyshidrotic eczema (DE) - 34%. The highest percentage of contact dermatitis (68%) was seen in the upper extremities, followed by dermatitis of the face and hands (26%). Of the patients investigated, 34% had a history of illness up to 3 years. A negative correlation was found between professional experience and “hand eczema” ($p=0.005$). Patch tests showed that the most frequent positive reactions were to Nickel (II) sulfate hexahydrate (Nickel, 15 times) and p-Phenylenediamine (PPD, 14 times). These contact allergens are directly correlated with hand eczema. We compared the results with those published in the literature.

Keywords: contact allergy, hairdressers, Nickel, para-phenylenediamine.

Introduction

Contact allergy (contact sensitization) affects about 25% of the population in Europe. It is a form of delayed type of hypersensitivity. From a clinical point of view, after sensitization with a particular contact allergen, a subsequent exposure leads to a clinically presented acute, subacute, or chronic ACD with different skin localization and rashes. It is an indisputable fact that the ACD of the hands, especially in the area of the palms and fingers, has the highest frequency [1,2]. The „gold standard“ in diagnosing contact allergy

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includes epicutaneous tests (patch tests) for determining hypersensitivity to various allergens related to consumption or the work environment of the persons, such as metals, paints, varnishes and resins, smells, preservatives, cosmetics, foods, plants, medicines, and many more [3]. The hairdressing profession is defined as a risk for ACD due to the regular contact with various chemical irritants – detergents, disinfectants, metal tools for hair cutting, varnishes, oxidizers, and dyes for coloring and curling hair, preservatives and fragrances, disposable gloves, etc. [4].

These facts motivated us to investigate the nature of ACD among hairdressers and the most common allergens that cause contact allergy in these professionals.

Aim and tasks of the study

We aimed to investigate the relationship between the professional environment and hypersensitivity reactions to various contact allergens, the features of the clinical course, and the type of allergic contact dermatitis (ACD) in hairdressers.

The following tasks were set for implementation:

- To analyze the contact allergy in the patch-tested persons, dividing them by gender, age, length of professional occupation, and diagnostic groups, and determine the type of ACD based on the localization of the pathological skin changes.
- To analyze the distribution of allergens, the cause of allergic contact dermatitis, and determine occupational-related sensitizers in hairdressers
- To characterize the features of the clinical course of ACD in hairdressers and establish the cross-linked reactions of allergens from the applied series patch tests.

Material and methods

Materials

The study involved 44 hairdressers - 5 men and 39 women between 21 and 54 years old (mean age 35.32 ± 6.79). The group was selected over seven years (2014-2020) in two dermatological centers – The University Clinic for Skin and Venereal Diseases in Pleven and Euroderma

Clinic - Sofia. All of them actively sought consultation with a dermatologist because of skin rashes.

The survey covered 35 of them (average age of 34.43 ± 7.36), all with positive patch tests. Five women with negative patch tests and four women with contact dermatitis of the hands from gel-lack on the hands but tested negative to the allergens from the applied European Baseline Series (S-1000) and Hairdressing (H-1000) series were excluded from the study.

Methods

A registration form valid throughout the country was prepared for the purposes of the epidemiological analysis. The form was filled out by the doctor. It included a passport part, anamnestic data, localization of rashes in 23 areas, the patient's professional experience, contact with possible irritants, the patient's hobby, and the results from allergy testing. They were distributed by sex, age, professional experience, diagnostic group, and localization of the rash. The persons examined were divided into two age groups – under 40 and 40 and over.

Clinical method (data from the anamnesis and dermatological status)

The clinical-morphological characteristics of allergic contact dermatitis (acute, subacute, and chronic ACD/eczema) were studied. The results were interpreted according to the clinical picture, and the patients were grouped into the different diagnostic subtypes of ACD – dermatitis/eczema (the terms are synonymous), atopic dermatitis (AD), dyshidrotic eczema (DE), other types of eczema. Based on the topographical characteristics of the exanthema in the positive individuals, ACD was classified as: healthy (without clinical dermatitis signs), ACD of the hands, ACD of the face, and ACD of the hands and face.

Allergology methods (epicutaneous testing, patch-tests)

Epicutaneous testing for the diagnosis of contact allergy was performed using patch tests according to the testing guidelines of ESCD (European Society of Contact Dermatitis) and ICDRG (International Contact Dermatitis

Research Group). The European baseline series S-1000 with 30 allergens and the H-1000 specialized for hairdressers (Hairdressing) with 36 allergens were used. We used aluminum chambers 8 mm (Thaloderma, Varna, Bulgaria) attached to a hypoallergenic adhesive material (Micropore, 3M) for application on the skin for 48 hours on the back of the subjects. The results were reported on the 48th, 72nd hour, and the 7th day (with intensive positive reaction/s) and were interpreted according to the ICDRG criteria [5, 6].

Statistics

The information was entered and processed with the statistical package IBM SPSS Statistics 23.0.0. Some of it was processed with Statgraphics Plus for Windows and EXCEL computer programs. The results are described using tables, graphs, and numerical values (percentages, coefficients, average values, standard deviation, etc.), and $p < 0.05$ was chosen as the level of significance at which the null hypothesis is rejected. Attached are descriptions of qualitative and quantitative variables, parametric and non-parametric methods of hypothesis testing, variation, and correlation analysis.

Ethical aspects

The study was conducted following the national and international requirements for clinical studies, including the preservation of the anonymity of the participants and the non-disclosure of their personal information. Each participant signed an informed consent form before the start of the study. The volunteers were told they could withdraw from the study at any time without giving reasons.

Results

Thirty-five positive individuals (5 men and 30 women, aged 21 to 54, mean age of 34.43 ± 7.36 years) were tested with the European Baseline Series S-1000 (applied 30 times) and Hairdressing H-1000 (used six times). The data from the dermatological status of hairdressers showed that upper extremities were most often affected (hands, palms, and fingers), followed by the face and neck. Usually, the involvement of different topographical areas in one patient made

it possible to determine the type of dermatitis as eczema of the hands, of the hands and face, or the face only.

Table 1. Localization of pathological skin changes in 35 hairdressers

Zones	Patients (n)	Percent
Face	9	25.7%
Scalp	1	2.9%
Neck	7	20.0%
Palms	22	62.9%
Fingers, nails	7	20.0%
Hands	22	62.9%
Torso	6	17.1%
Feet	1	2.9%

The distribution by age groups, professional experience, type of eczema, diagnosis, and disease duration was examined with descriptive statistics. Young hairdressers predominated – 27 (77%) were under 40. Five (14.3%) had up to 1 year of work experience; eight (22.9%) had been in the profession between 1 to 3 years and 6 to 10 years. Twenty hairdressers (57.1%) had work experience of up to 3 years. The type of dermatitis was determined based on the topographical localization of the rash. The highest frequency was that of dermatitis of the hands - 24 patients (68.6%), of whom 21 had a history of the disease up to 5 years. Dermatitis of the face and hands ranked second - 9 patients (25.7%). One patient presented with incipient facial dermatitis, and one had no clinical manifestation of disease, despite a positive reaction on patch testing. The most frequently recorded diagnosis was ACD (45.7%) and DE on the palms and fingers (34.3%). One atopic dermatitis (2.9%) and six other forms of dermatitis (17%) were also observed. From a medical and occupational point of view, ACD of the hands and DE were two forms of hand dermatitis. The disease had a history of 0 to 3 years in 54%, and 3 to 5 years in 26% of the sample of the allergic coiffeurs, and 57% had professional experience of up to 5 years.

There was a statistically significant difference in the distribution of diagnoses of different types of dermatitis as follows: of 24 cases of hand dermatitis, 58.3% were diagnosed with ACD, and 37.5% were with ED, while nine hairdressers, 33% with hand-face dermatitis



Figure 1. Chronic hand eczema of 38 years old hairdresser with seven years of professional experience and four-year duration of eczema (*own photo archive*)

were with DE and 33% - with another diagnosis ($p=0.033$, $\chi^2=18.22$, $df\ 9$).

The bivariate correlation between the independent “professional experience” and the dependent “hand eczema” was statistically significant with a negative correlation. This correlation indicated that dermatitis values increased in the initial years of practice (21 of them had developed hand eczema to year 5 in this case) and decreased with longer working experience ($r= -0.469$, $p=0.005$, $N=35$).

We applied patch testing with S-1000 (with 30 allergens), and the H-1000 specialized for the profession (with 36 allergens) to study contact allergy. There were 51 positive reactions to various sensitizers from the S-1000 and 29 positive to H-1000.

The highest frequency was found for Nickel (16 times; in one person, the test was positive in the application of both series – 42.8%) and p-Phenylenediamine (14 times, 40%). The tests were positive in 15 cases of eczema on the hands

and 8 cases of dermatitis on the face and hands. When touching the hands, 54% of patients were positive for PPD versus 15.4% negative. The distribution of PPD when upper limbs were affected was 50:50, and when the hands were not affected - 6:1 (Fisher’s Exact Test $p=0.034$). The distribution according to the types of dermatitis of the cases with positive and negative reactions to Nickel and PPD showed a significant difference only for PPD ($p=0.049$, $\chi^2=7.86$, $df\ 3$).

The distribution of cases with positive and negative reactions to Nickel and PPD in diagnostic groups showed no significant statistical difference.

The following cross-reactivity and polyallergy were observed: Nickel*Cobalt – 4 times, PPD*Nickel*Cobalt – 2 times, PPD*IPPD – 2 times, PPD*Toluene-2,5-diamine sulfate*Ammonium thioglycolate*Ammonium persulfate*m-Aminophenol*p-Aminophenol – 3 times, PPD*Peru Balsam*Sesquiterpenum mix*Fragrance mix II – 1 time.

Table 2. Frequency of top sensitizers, cause of contact allergy in 35 hairdressers

Series	Allergens	Number	Percent
S-1000 applied 30 times	para-Phenylenediamine	9	30%
	Cobalt	6	20%
	Nickel	13	43%
	IPPD	3	10%
	Balsam Peru	3	10%
	Methylizothiazolinone	3	10%
H-1000 applied 6 times	PARA-PHENYLENE DIAMINE	5	83%
	TOLUENE DIAMINE-SULFATE	3	50%
	AMMONIUM THIOLYCOLATE	3	50%
	AMMONIUM_PERSULFATE	3	50%
	NICKEL	3	50%

Discussion

From an epidemiological point of view, hairdressers under 40 predominated (77%), the average age was 34.43 ± 7.36 , and those with professional experience up to 5 years were 57%. Men were 14.23%, and women were 85.77%. The highest incidence was that of contact dermatitis on the upper extremities (68%), followed by dermatitis on the face and hands (26%). Of the patients we studied, 34% had a disease history of up to 3 years (17.1% with a history of up to 1 year), and the number of sensitized individuals decreased with the length of work experience ($p=0.005$). In 2011, Lysdal et al. reported a large population-based study conducted in Denmark. Seven thousand eight hundred forty individuals who acquired a hairdressing license between 1985 and 2007 were included, and 5,324 individuals were included in the analysis, divided into two groups: practitioners ($n=2918$) and those who left the profession ($n=2321$). The objectives of the research were different from ours, but among currently working persons, there are data in the Danish register close to ours - 5% men and 95% women; the average age is 36.4 years; 77.2% are aged 22-42; with a history of hand eczema up to 1 year are 22.3% [7]. A frequency of hand eczema with a history of up to one year amounting to 18% was also reported by the Swedish team of Lind et al. [8]. We compared the frequency of positive reactions to the top 5 allergens among the 35 hairdressers with data from analyses published over the last 25 years on the frequency of contact sensitization in the profession in different parts of the world.

The variability of the indicated data proves the specifics of the professional and environmental data in different parts of the world, detergents, disinfectants, soaps with different compositions, shampoos, gels, hair dyes and varnishes, fragrances and perfumes, etc. [9]. Despite this variability, the high frequency of contact allergy to Nickel and PPD, as well as the uniform distribution of ammonium persulfate and toluene 2-5-diamine, was demonstrated among hairdressers [10, 11, 12].

According to the Scientific Committee for Consumer Protection in Europe, about 100 different chemical ingredients are allowed for use in hair dyes. The strongest sensitizers are 5 substances – paraphenylenediamine (PPD), toluene-2,5-diamine, resorcinol, m-aminophenol and p-aminophenol [13]. The most common and best-known component is PPD (black dye). First described by Hofmann in 1863, it has been used in hair dyes since the late 19th century. PPD has been part of the standard epicutaneous testing series ever since 1939. To this day, it remains a preferred ingredient in many products for its longer-lasting nature and imparts the black, naturally occurring pigmentation to hair after application [14, 15]. These facts put the practitioners of the hairdressing profession and their clients at risk of developing ACD, most often on the hands and face [4, 16].

Nickel is a metal with a very high allergenic risk; contact allergy to it is the most common worldwide. For this reason, the importance of Nickel as an occupational allergen in hairdressing is controversial. Metal sensitization is also associated with non-professional sources,

Table 3. Comparative analysis of data on occupationally-related hypersensitivity to allergens from series S-1000 and H-1000

References	n	Nickel %	Cobalt %	Katon %	PPD %	APS %	TDA %
[21] Van Der Walle (1993)	103	30	6	1	5	8	-
[22] Park et al. (2006)	61	37	34	-	21	-	-
[3] Krecisz et al. (2011)	133	30	6	1	5	8	-
[18] Warshaw et al. (2012)	432	30	-	-	53	-	-
[23] Schwensen et al. (2013)	398	22	5	2	10	10	5
[24] Carøe et al. (2016)	187	5	1	2	14	19	11
Our results (2020)	35	42	23	8.5	40	8.5	8.5

PPD – p-phenylenediamine; APS - Ammonium persulfate; TDA - Toluene-2.5-diamine

such as jewelry, watches, metal buckles and buttons, piercings, mobile phones, etc. [17, 18].

At the same time, cross-reactions can occur to all compounds with an amino group in the para position of the benzene ring: sulfonamides, sulfonylureas; some photoprotective screens based on para-aminobenzoic acid; preparations based on para-aminosalicylic acid, benzocaine, paracaine, and tetracaine (among other local anesthetics from this group); textile dyes – dispersed orange, dispersed yellow, and dispersed blue; p-toluene diamines; aminophenols; 2-nitro-4 phenylenediamine [16, 19]. Also, one should consider the fact that work-related ACD therapy with systemic and local steroids, as well as with H1-blockers, has a short-term effect and is often ineffective. This requires education of the risk groups and the introduction of prevention programs to reduce absenteeism from work and ensure good quality of life. In therapy, using barrier creams to restore the skin barrier is recommended [4, 20].

Conclusion

Hair dyes are a constant concern of the dermatological community due to their potential to cause contact dermatitis. Allergy to the PPD component of hair dyes mainly affects the face, scalp, neck, and hands. It suggests the development of occupationally induced allergic contact dermatitis in professionally engaged hairdressers and barbers. At the same time, cross-reactivity with other aromatic amines, sensitization to nickel and cobalt, detergents, disinfectants, oxidants, solvents, perfumes, and preservatives should be considered.

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