Metal contact dermatitis: Prevalence of sensitization to nickel, cobalt and chromium*

*Dermatite de contato por metais: prevalência de sensibilização ao níquel, cobalto e cromo**

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Abstract: BACKGROUND: Metal contact dermatitis (nickel, cobalt and chromium) is a common dermatosis among several population groups.
OBJECTIVE: To describe the individuals with metal contact dermatitis in the group studied, to determine the prevalence of skin sensitization by nickel, cobalt and chromium, to verify the positive test combinations among these three substances and to compare our results with the literature.
PATIENTS AND METHODS: Patch test was performed in 1208 patients with a presumptive diagnosis of contact dermatitis. Those with positive reactions to metals were selected.
RESULTS: Out of the total sample, 404 (33.5 %) patients had at least one positive reaction to nickel and/or cobalt and/or chromium. There were 487 positive reactions to metals (48% of all positive reactions). Most patients were female (72 %) and white (54%), aged 40-49 years old (25%) and cleaning services workers (59%). Among the 404 patients, 329 (81.5%) had positive reactions to only one metal; in that, 60% were positive to nickel, 13% to chromium and 8.5% to cobalt. Approximately 18.5% had positive reactions to two or three metals and the association of nickel and cobalt was the most frequently observed.
CONCLUSIONS: The frequency of positive reactions to metals was 48%, mainly in 40-49 year-old white women. Most patients were sensitive to only one metal and the dermatosis was not related to the occupation. The data obtained are in accordance with other studies published.
Keywords: Cobalt; Chromium; Dermatitis, contact; Metals; Nickel.

Resumo: *FUNDAMENTOS: Dermatite de contato (DC) por metais é dermatose comum em diversos grupos populacionais.*
OBJETIVOS: Caracterizar o grupo com DC ao níquel, cromo e cobalto na população estudada, determinar a prevalência da sensibilização aos mesmos, verificar as combinações de testes positivos e comparar com a literatura.
CASUÍSTICAS E MÉTODOS: Foram realizados testes epicutâneos em 1.208 pacientes com hipótese diagnóstica de DC. Selecionaram-se aqueles com testes positivos aos metais.
RESULTADOS: Obtiveram-se 404 pacientes (33,5% da amostra) com pelo menos um teste positivo ao níquel e/ou cobalto e/ou cromo. Foram 487 testes positivos a metais, correspondendo a 48% de todos os testes positivos. A maioria dos pacientes era do sexo feminino (72%), de cor branca (54%), com idade entre 40 e 49 anos (25%) empregada na área de limpeza (59%). Dos 404, 329 (81,5%) foram positivos a apenas um tipo de metal, sendo 60% com teste positivo ao níquel, 13% ao cromo e 8,5% ao cobalto. Cerca de 18,5% apresentaram testes positivos a dois ou três metais, sendo a associação níquel/cobalto a mais comum.
CONCLUSÕES: A sensibilização aos metais foi de 48%, entre os testes positivos e ocorreu principalmente em mulheres da cor branca, na faixa etária de 40 a 49 anos e sem correlação ocupacional. A maioria apresentou sensibilização a apenas um metal. Esses dados são semelhantes aos de outros trabalhos já publicados.
Palavras-chave: Cobalto; Cromo; Dermatite de contato; Metais, níquel.

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INTRODUÇÃO

Nickel, cobalt and chromium are the metals most commonly responsible for metal contact dermatitis. Sensitization by these components may or may not be related to occupation. Positive reactions for these metals are mainly due to cosensitization, owing to simultaneous exposure to materials that contain the elements in their make-up.[1-3]

In the literature searched for this study there was no report on the behavior of metal sensitization in the Brazilian population.

The main objectives of this study were thus: 1) to determine the prevalence of sensitization to nickel, cobalt and chromium among Brazilians with a presumptive diagnosis of contact dermatitis, seen at a healthcare service, from 1995 to 2002; 2) to describe the subgroup with metal contact dermatitis; 3) to verify combinations of positive reactions among these three components; and 4) to compare the results obtained with results in the literature.

PATIENTS AND METHODS

From 1995 to 2002, patch tests were carried out on1208 patients with a presumptive diagnosis of contact dermatitis referred to the Allergy and Phototherapy Sector of the Dermatology Clinic of the Santa Casa Hospital, Sao Paulo.

The patients were submitted to the patch test series proposed by the Brazilian Contact Dermatitis Research Group,[4] manufactured by FDA-Allergenic and comprising 30 elements (Chart 1).

The tests were read 48 and 96 hours later in compliance with the criteria adopted by the Group and by the International Contact Dermatitis Research Group - ICDRG, in 1981.[5]

The data obtained were added to a protocol drawn up on EPI-INFO 6.4. to compile the results.

RESULTS

In all, 1009 tests were positive for different compounds, among the 1208 patients tested, with 487 positive reactions to metals in 404 patients. Thus, 48% of positive tests were nickel, chromium or cobalt-related; the average was 1.2 positive reactions per patient (Chart 2).

Distribution of patients by sex is shown in Table 1 and by skin color in Table 2. There were 113 men (28% of cases) and 291 women (72%). There were 218 white persons (54%), 70 black persons (17%), 108 brown-skinned persons (27%) and eight yellow-skinned persons (2%).

Table 3 shows distribution by age. There were 36 patients (9%) aged 10-19; 78 (19%) aged 20-29; 94 (23.5%) aged 30-39; 101 (25%) aged 40-49; 53 (13%) aged 50-59; and 42 (10.5%) aged 60 or over.

CHART 1: Substances used in standard series

Nº de ordem	Elemento
1	Anthraquinone
2	Balsam of Peru
3	Benzocaine
4	Potassium dichromate
5	P-tert butylphenol
6	Carba mix
7	Cobalt chloride
8	Colophony
9	Ethylenediamine
10	Formaldehyde
11	Hydroquinone
12	Irgasan
13	Kathon CG
14	Lanolin
15	Mercapto mix
16	Neomycin
17	Nitrofurazone
18	Paraben mix
19	Paraphenylenediamine
20	Fragrance mix
21	PPD mix
22	Promethazine
23	Propylene glycol
24	Quaternium-15
25	Quinoline-mix
26	Epoxy resin
27	Nickel sulfate
28	Turpentine
29	Thimerosal
30	Thiuram mix

Table 4 shows the location of the dermatosis. The condition presented most frequently on the hands - 151 cases (37.5%); followed by the cephalic segment - 125 (31%); upper limbs not including the hands - 121 (30%); lower limbs not including the feet - 89 (22%); feet - 47 (12%); abdomen - 32 (8%); and trunk - eight (2%). The total number of locations was 573 with an average of 1.4 locations per patient.

Table 5 shows the occupations of patients testing positive for metals. Most worked in the cleaning segment, including housewives, totaling 239, corresponding to 59% of cases. This total was followed by 35 building workers (9%); 35 office workers/students (9%); 33 healthcare workers (8%); 15 mechanics/steel workers (4%); 14 shop assistants/salespersons (3%); 11 hairdressers (3%); eight tailors/garment makers (2%); four joiners (1%); and four farm hands (1%). Six patients (1%) reported no professional activity at the time of the contact tests. Additionally, 154 (39%) reported the appearance or worsening of the dermatosis in con-

CHART 2: Distribution of the 1208 patients by patch test reactions (Dermatology Clinic of the Santa Casa Hospital, Sao Paulo, 1995-2002)

Number of patients tested	1208
Number of positive reactions	1009
Number of patients presenting positive reactions to metals	404
Number of positive reactions to metals	478

TABLE 1: Distribution of the 404 patients with positive reactions to metals by sex (Dermatology Clinic of the Santa Casa Hospital, Sao Paulo, 1995-2002)

Sex	N	%
Male	113	28
Female	291	72
Total	404	100

TABLE 2: Distribution of the 404 patients with positive reactions to metals by skin color (Dermatology Clinic of the Santa Casa Hospital, Sao Paulo, 1995-2002).

Skin Color	N	%
White	218	54
Black	70	17
Brown-skinned	108	27
Yellow-skinned	8	2
Total	404	100

TABLE 3: Distribution of the 404 patients with positive reactions to metals by age (Dermatology Clinic of the Santa Casa Hospital, Sao Paulo, 1995-2002).

Age (years)	N	%
10-19	36	9
20-29	78	19
30-39	94	23,5
40-49	101	25
50-59	53	13
Over 60	42	10,5
Total	404	100

nection with professional activity, while 250 (61%) made no such association.

Table 6 shows positive reactions relating to isolated metals or associations between them. Among the 404 patients who tested positive for metals, 329 (81.5%) were sensitive to only one of the metals tested: 243 patients (60%) were nickel-sensitive; 52 (13%) were chromium-sensitive. and 34 (8.5%) were cobalt-sensitive. In regard to associations of these metals, 75 (18.5%) had more than one positive reaction: eight patients (2%) tested positive for nickel and chromium; 39 (9.5%) tested positive for nickel and cobalt; 20 (5%) tested positive for chromium and cobalt; and eight patients (2%) tested positive for all three components.

Table 7 shows in statistically significant fashion that nickel presented the highest sensitization prevalence in isolation, compared to the other metals. However, cobalt showed the highest rate of positive reactions when associated with chromium and nick (X^2=82,41; p<0,00001).

DISCUSSION

In the present study, 33.5% of patients presented one or more positive reactions for the metals, corresponding to 48% of all the positive test results. In other populations with similar profiles that have been studied, nickel, chromium and cobalt are the major sensitizers,[6-9] with chromium being most frequent in men, and nickel in women.[8,10] In the present study, 78% were women, which probably led to nickel being the substance with the highest number of positive reactions.

Thus, in regard to the prevalence of sensitization and sex, the results are similar to those of earlier publications.

As to age, all age ranges were represented, with 48.5% of patients in the 20-49 year-old age group, corresponding to the most economically productive sector of the Brazilian population, which is therefore the segment most exposed to sensitization.

In regard to location of the contact dermatitis, the data obtained match those of a previous study in this population,[4] in which the most common locations for metal contact dermatitis are also the hands, face and upper limbs.

The majority of patients (59%) worked in professions related to cleaning, including housewives. In the case of approximately 322 patients (83%), their professional activities were linked to wet work (cleaning services workers, builders, painters, hairdressers, etc). Metals in cleaning products have

Table 4: Distribution of the 404 patients with positive reactions to metals by location of the dermatosis (Dermatology Clinic of the Santa Casa Hospital, Sao Paulo, 1995-2002).

Location	N	%
Upper limbs	121	30
Lower limbs	89	22
Hands	151	37,5
Feet	47	11,5
Face	125	31
Chest	8	2
Abdomen	32	8
Total	573	100

been reported as powerful triggering or perpetuating agents in contact dermatitis caused by metals.[11] Work in moist conditions associated to exposure to metals favored sensitization in 39% of patients. Cleaning workers are related to all types of metals owing to their contact with nickel and chromium as well as cosensitization through cobalt.

The major sensitizer was nickel, occurring in 243 patients as the single sensitizer, and in 55 in association with chromium and cobalt. Nickel was statistically significant in relation to cobalt, which presented a higher frequency of sensitization when associated to nickel or chromium. Concomitant sensitization to metals occurs through cosensitization; in other words, through exposure to materials with different metals in their composition. Several studies have shown absence of cross-reactions to nickel, chromium and cobalt.[8,12,13]

Sensitization to cobalt occurs mainly through the presence of this metal in materials that also contain chromium and nickel, which explains why sensitization to cobalt is more common in association with other metals, as in the present study.

In some European countries such as Denmark, standards have been introduced in recent years to reduce sensitization to chromium and nickel. The addition of ferrous sulfate to cement to reduce the amount of trivalent chromium has already proved effective in reducing the incidence of cement-induced contact dermatitis.[14] Mandatory use, especially in jewelry and body piercings, of metals that liberate smaller quantities of nickel has already resulted in lower rates of nickel sensitization in recent years.[15-17] The role of new behaviors favoring metals allergies must be highlighted. Massimiliano et al.[15] published an article describing two patients with nickel-induced allergic dermatitis triggered by mobile telephones. Matilla et al.[16] reported an increase in the incidence of allergy to

Table 5: Distribution of the 404 patients with positive reactions to metals by occupation (Dermatology Clinic of the Santa Casa Hospital, Sao Paulo, 1995-2002).

Occupation	N	%
Cleaning services	239	59
Builder/Painter	35	9
Secretary/Student	35	9
Healthcare services	33	8
Mechanic/Steel worker	15	4
Shop assistant/Sales person	14	3
Hairdresser	11	3
Tailor/Garment maker	8	2
Joiner	4	1
Farm hand	4	1
Not given	6	1
Total	404	100

TABLE 6: Sensitization rate to different metals among the 404 positive patients (Dermatology Clinic of the Santa Casa Hospital, São Paulo, 1995-2002).

Positive reactions	N	%
Nickel	243	60
Chromium	52	13
Cobalt	34	8,5
Nickel and chromium	8	2
Nickel and cobalt	39	9,5
Chromium and cobalt	20	5
Nickel, chromium and cobalt	8	2
Total	404	100

TABLE 7: Incidence of sensitization to nickel, chromium and cobalt in isolation or in association (Dermatology Clinic of the Santa Casa Hospital, Sao Paulo, 1995-2002).

	Isolated sensitization	Associated sensitization	Total
Nickel	243	55	298
Cobalt	34	67	101
Chromium	52	36	88

$X^2=82,41$ $p<0,00000$

nickel, especially in women, between 1985 and 1995, associated with the use of jewelry and body piercings. Erlich et al.[17] suggested an increase in nickel sensitization owing to greater use of body piercings.

CONCLUSION

To sum up, in the group that was investigated, metal contact dermatitis showed a similar frequency to that in other reported studies, accounting for 48% of positive reactions. Approximately 33.5% of the population under examination showed sensitization to metals, above all white women in the 40-49 age range. In 39% of patients the dermatosis was associated with their occupation. The majority showed sensitization to only one type of metal. Sensitization to cobalt was most common when associated with a positive reaction to nickel.

All the data obtained are similar to those of other populations studied, showing that, in Brazil, the group that was studied had similar characteristics in relation to sensitization to metals.

Continuation of the study will in future enable assessment of other factors that may interfere in the incidence of this type of dermatosis in the whole population. ❑

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