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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.
GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.
ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman** (**Кириллица**), ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ,რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

Содержание:

OCCUPATIONAL ALLERGIC DERMATITIS IN METALWORKERS

Pere Sanz-Gallen*, Inmaculada Herrera-Mozo, Beatriz Calvo-Cerrada, Albert Sanz-Ribas, Gabriel Martí-Amengual.

Unit of Occupational Medicine and Toxicology, Faculty of Medicine and Health Sciences, University of Barcelona, Spain.

Abstract.

Background: Allergic contact dermatitis is a common inflammatory skin condition triggered by exposure to specific allergens on metallurgy.

Objectives: To describe ten cases of occupational contact dermatitis in metalworkers, focusing on clinical presentation, latency, allergen identification, and patch test results.

Methodology: Ten workers (seven men and three women), primarily mechanics, welders, and foundry workers, presented with dermatitis mainly affecting their hands, forearms, neck, and face were studied.

Results: Patch testing demonstrated a high prevalence of sensitization to metals, particularly cobalt chloride and nickel sulphate, often with severe reactions and frequent co-sensitization. Other metals, such as vanadium and potassium dichromate, were less common but clinically relevant in specific occupational contexts. In several cases, additional sensitization to additives in cutting oils was identified, indicating exposure to multiple allergens in industrial settings. Latency periods varied considerably, from a few months to several decades, with shorter latencies observed in individuals with a history of contact allergy. Complete remission was achieved primarily after a job change, while partial improvement was observed with the use of personal protective equipment and medical monitoring.

Conclusions: These findings underscore the crucial role of occupational exposure to metals and industrial fluids in the development of contact dermatitis and emphasize that effective allergen avoidance, including job modification, when necessary, remains the most effective strategy for managing the condition in affected workers.

Key words. Occupational dermatitis contact, metalworkers, metals, cutting oils.

Introduction.

Metallurgy is the industry of manufacturing useful objects based on the shaping and processing of metals. It includes cutting, joining, and forming processes, and encompasses a wide variety of work activities, such as welding, forging, machining, assembly, etc. Metalworkers have an increased risk of occupational contact dermatitis, primarily on their hands, due to repeated exposure to allergens and skin irritants in the workplace [1,2]. The most common exposures involve oils, greases, metals, leather gloves, rubber materials, and metalworking fluids (MMFs). MMFs and their components have been extensively studied and are considered one of the most common causes of allergic contact dermatitis in metalworkers, especially those who work with metals, such as lathe operators, machinists, milling machine operators, etc. [3,4].

Allergic contact dermatitis (ACD) is a common inflammatory skin condition triggered by exposure to specific allergens. It is also the most common cause of occupational dermatitis [5,6].

Cobalt is used in the aluminium-nickel-cobalt alloy for the manufacture of magnets.

The production of non-magnetic cobalt-based alloys accounts for approximately 50% of the world's cobalt mining production each year. These alloys are suitable for extreme working conditions because they combine toughness, strength, hardness, and corrosion resistance. Therefore, they are commonly used in steels resistant to heat, corrosion, or wear from friction.

Their range of applications includes tools of all kinds, steel wires for resistance bands in radial tires, and discs for cutting and polishing metals, as well as minor uses in alloys for the manufacture of prostheses.

The mixture of cobalt and tungsten carbide is especially hard (90 to 95% of the hardness of diamond). It is used for cutting parts of metal saws, drills, and drill bits.

Nickel stands out as one of the most prevalent allergens, both in occupational and non-occupational settings [7,8].

The widespread use of this metal in a broad range of consumer products, from jewelry and clothing to electronic devices, food, medical devices, and industrial components, significantly increases the risk of exposure, sensitization, and the development of these dermatoses, making it difficult to interpret and identify the underlying cause of the allergic reaction at the time of patient observation [5,8].

Hexavalent chromium compounds are widely used in industry for their anti-corrosive properties, hardness, and durability, and are found primarily in the chromite processing, electroplating, paint, pigment, soldering, ferroalloy, fungicide, and corrosion inhibitor industries [9,10]. Vanadium is a soft, ductile metal used in some alloys.

Sensitivity to this metal has been linked, in some cases, to loosening of dentures, as patients have reported eczema or pruritus near the metal-to-metal junction, a finding supported by positive results from in vivo studies [11-13]. Cases have also been described in workers who handled steel [14].

Skin contact allergies in metalworkers are primarily due to metals and additives in cutting and drilling oils, such as biocides and other substances. The aim of this study was to describe ten cases of allergic contact dermatitis in metalworking industry workers.

Materials and Methods.

We performed a descriptive study about ten cases of contact dermatitis in metalworkers including variables such as sex, age, job position, seniority, allergic history, clinical location of dermatitis and latency period. To determine whether this dermatitis was irritant or allergic, skin tests were performed using the standard test battery following the guidelines of the Spanish Research Group on Contact Dermatitis and Cutaneous Allergy (GEIDAC) of the Spanish Academy of Dermatology (Table 1), which is based on the epidemiology and case mix of

Table 1. *Patch-testing application the criteria of GEIDAC.*

Allergen battery of cutting and drilling oils	Metal battery	Anti-oxidant battery	**Other allergens**
Abietic acid 10%. Cetylstearyl alcohol (Lanette N) 20%. Amerchol L101 50%. p-Aminoazobenzene (Solvent Yellow 1, CI 11000) 1%. Chloroxylenol 1%. Chlorocresol 1%. Chloroacetamide 0.2%. Dichlorophene 0.5%. Phenoxyethanol 1%. Tricresyl phosphate 5%. Hydrazine sulfate 1%. Bioban CS 1135 1%. Bioban CS 1246 1%. Bioban P 1487 1%. Benzoisothiazolinone (Proxel) 0.1%. Benzotriazole 1%. Propylene Glycol 20%. Triclosan 2%. Triethanolamine (Trolamine) 2.5%. Bronopol (2-Bromo-2-nitropropane-1,3-diol) 0.5%. Dibromomethylglutaronitrile (MDBGN) 0.1%. Trichlorocarbanilide 1%. Coconut diethanolamide (Cocamide DEA) 0.5%. Isopropyl myristate 10%. Dipentene (d-Limonellum) 2%. Monoethanolamine 2%).	Copper oxide 5%. Cobalt chloride 1%. Potassium dichromate 0.5%. Zinc 2.5%. Ammoniacal mercury chloride (Mercury chloramide) 1%. Nickel sulfate 5%. Cadmium 1%. Mercury chloride 0.1%. Palladium chloride 1%. Sodium thiosulfate 2%. Silver nitrate 1%. Ammonium tetrachloroplatinate 0.25%. Copper sulfate 0.25%. Copper sulfate 1%. Titanium 1%. Titanium 5%. Vanadium 0.1%. Vanadium 1%. Vanadium 2.5%. Niobium 0.5%. Aluminium chloride 2%. Iron chloride 2%. Molybdenum 0.5%. Manganese 1%. Aluminium chloride.	BHA 2%. BHT 2%. Tert Butylhydroquinone 1%. Dodecyl gallate 0.3%. Octyl gallate 0.3%. Propyl gallate 0.5%. Sodium metabisulfite 1%).	Isothiazolone preservatives (Kathon CG 100 ppm, Benzoisothiazolone 0.1%, Octylisothiazolone 0.025%). **dyes and pigments**: p-aminoazobenzene. p-aminophenol. Disperse Blue 3 (C.I.61505). Disperse Orange 1 (CI 11080). Disperse Orange 3 (CI 11005). Disperse Red 1 (CI 11110). Disperse Yellow 3 (CI11855). Disperse Yellow 9 (CI10375). Eosin. Bright. lack 0.1%. Amaranth 0.1%. Blue patent. Bismarck Brown R 0.50%. **rubber additives** (PPD mixture) 1%. PPDA 1%. Thiuram mixture 1%. Mercapto mixture 2%. Mercaptobenzotriazole 2%. thioureas (dibutyl, diethyl, diphenyl, ethylenethiourea) 1%. diphenylguanidine 1%. diaminodiphenylmethane 0.5%. ethylenediamine 1%. ethenamine 1%.

Table 2. *Reading criteria of the ICDRG [16].*

Symbol	Morphology	Assessment
_	No reaction	Negative reaction
?+	Faint erythema only	Doubtful reaction
+	Erythema, infiltration, possibly papules	Weak positive reaction
++	Erythema, infiltration, papules, vesicles	Strong positive reaction
+++	Intense erythema, infiltrate, coalescing vesicles	Extreme positive reaction
IR	Various morphologies	Irritant reaction

Table 3. *Description of the then cases of allergic dermatitis to metals in metallurgical industry workers.*

Case	Sex	Age	Job position	Seniority (years)	Allergy history	Clinical location of dermatitis	Latency period
1	F	24	Automotive worker	3	None	Dermatitis on neck and face.	30 months.
2	F	42	Automotive industry mechanic	1	Contact eczema from costume jewellery.	Itching and rash on face, neck, arms and hands.	6 months.
3	F	40	Metal coatings (galvanising)	2	Contact eczema from costume jewellery	Dermatitis and oedema on hands.	3 months.
4	M	57	Automotive maintenance	40	None	Dermatitis on hands (Figure nº 1)	35 years.
5	M	46	Steel foundry	2	Dermatitis on hands due to cement.	Dermatitis and oedema on hands (Figure nº 2)	3 months.
6	M	60	Steel foundry	10	None	Itching and rash on arms, trunk and body.	10 years
7	M	54	Automotive industry mechanic	14	None	Dermatitis on hands	11 years
8	M	41	Welder and metal polisher	22	None	Dermatits on neck and face.	20 years
9	M	57	Steel welder	40	None	Dermatitis on forearms.	39 years
10	M	44	Automotive industry mechanic	5	None	Dermatitis on hands.	4 years

Table 4. *Results of Epicutaneous tests with allergens from the patients' work environment (readings at 48 and 96 hours) and the evolution of the patients after diagnosis.*

Case	Positive results for metals in patch tests (48 and 96 hours)	Positive results for additives in cutting and drilling oils in patch tests (48 and 96 hours)	Evolution
1	Cobalt chloride +++ Nickel sulphate ++	Negative	Remission after change of job.
2	Cobalt chloride ++ Nickel sulphate ++	Negative	Remission after change of job.
3	Cobalt chloride +++ Nickel sulphate ++ Vanadium ++	Negative	Improvement with PPE and medical control.
4	Vanadium ++	Negative	Improvement with PPE and medical control
5	Nickel sulphate +++ Potassium dichromate +++ Vanadium + Iron chloride +	Negative	Change of job position.
6	Cobalt chloride + Nickel sulphate +	Negative	Change of job position
7	Cobalt chloride +++ Potassium dichromate +++	Aminoazobenzene +. MDBGN + Propylene glycol +	Change of job position.
8	Cobalt chloride +	Aminoazobenzene +.	Change of job position
9	Cobalt chloride +	Negative	Improvement with PPE and medical control
10	Cobalt chloride ++ Nickel sulphate ++	-Cetylstearyl alcohol +++ -Aminoazobenzene +++ -Benzotriazole +++ -Abietic acid ++ -Propylene glycol ++ -Benzoisothiazolinone +++	Change of job position

Figure 1. *Dermatitis on both hands in an automotive industry maintenance worker.*

Figure 2. *Dermatitis and oedema of both hands in a steel foundry worker.*

our environment [15]. Their guidelines are similar to those of the International Contact Dermatitis Research Group (ICDRG).9). The evaluation of the effects according to the results obtained from the patch tests at 48 and 96 hours (D2, D4) is described in Table 2 [16]. Patch tests readings with allergens from the patients' work environment and other substances of occupational origin, as well as the evolution of the patients, were taken at 48 hours (D2) and 96 hours (D4).

Results.

The characteristics of the workers based on the information collected and patch tests are shown in Tables 3 and 4.

Characteristics of workers studied:

The characteristics of the workers based on the information collected are shown in Table 3. The cases predominantly affected male workers (7 men and three women) and the age range was broad (24–60 years). Ten workers were analysed (seven men and three women). Primarily mechanics, welders, and foundry workers, presented with dermatitis mainly affecting their hands, forearms, neck, and face. Three workers presented allergic history and latency periods varied considerably, from a few months to several decades, with shorter latencies observed in individuals with a history of contact allergy clinical location of dermatitis, latency period, positive results for metals from patch tests with allergens from the patients' work environment (readings at 48 and 96 hours) and other substances of occupational origin, as well as the evolution of the patients.

Most worked in occupations related to the automotive or metal processing industries, including mechanics, welders, foundry workers, and electroplating personnel, all with frequent exposure to metals, chemicals, oils, and cement. The hands, forearms, neck, and face were the most affected areas, consistent with areas of direct occupational exposure.

A history of contact allergy to costume jewellery was reported in two female cases, both with short latency periods (3–6 months), suggesting that prior sensitization to metals may accelerate the onset of occupational dermatitis. In contrast, most workers without a known allergy history had longer latency periods, ranging from several years to decades. The latency period varied considerably, from 3 months to 39 years, and appeared to be influenced by both allergy history and duration of exposure.

Clinically, hand dermatitis was the most frequent presentation. More generalized or extensive involvement (arms, trunk, and body) was observed in cases with longer exposures.

Patch tests results:

The patch tests results with allergens from the patients' work environment (readings at 48 and 96 hours) and the evolution of the patients are described in Table 4.

A high frequency of metal sensitization was observed through patch testing in this case series, particularly cobalt chloride and nickel sulphate, often with severe reactions and frequent co-sensitization. Other metals, such as vanadium and potassium dichromate, were less common but clinically relevant in specific occupational contexts.

In several cases, additional sensitization to additives in cutting and drilling oils was identified, indicating exposure to multiple allergens in industrial settings. Complete remission was achieved primarily after a job change, while partial improvement was observed with the use of personal protective equipment and medical monitoring.

Patch tests revealed metal sensitization with high frequency in this case series, particularly to cobalt chloride and nickel sulfate, which were the most frequently positive allergens. Cobalt sensitization was observed in most cases, often with intense reactions (++ to +++), either alone or in combination with nickel.

Nickel sulfate was also commonly positive, especially in cases with intense reactions (+++), reinforcing its recognized importance as an occupational and non-occupational contact allergen. Vanadium and potassium dichromate were detected less frequently but showed significant clinical relevance in certain cases, especially in workers exposed to metal alloys, where dichromate reactions were intense (+++).

Sensitivity to ferrous chloride was infrequent and weak, suggesting a minor contributing role. Only in case 5 is a weakly positive response to iron chloride observed, both in D2 (+) and in D4 (+).

Conversely, potassium dichromate was associated with severe reactions and required job modification, consistent with its known high allergenic potential in industrial settings.

Patch testing for non-metallic allergens was negative in most cases; however, several workers showed positive reactions to components of cutting oils, such as aminoazobenzene, MDBGN, benzotriazole, benzoisothiazolinone, propylene glycol, and abietic acid. These findings indicate multiple sensitization in some workers, particularly those with prolonged exposure to industrial fluids.

Regarding clinical outcomes, the results were closely related to exposure control.

Complete remission was primarily achieved after a job change, indicating that avoiding contact with allergens was crucial for disease resolution. Partial improvement was observed in cases where exposure was reduced through the use of personal protective equipment (PPE) and medical surveillance, suggesting that while protective measures may mitigate symptoms, they may be insufficient in the presence of intense sensitization.

Discussion.

The development of allergic contact dermatitis (ACD) in the metallurgical industry is a complex process where the work environment acts as a catalyst for sensitization. The skin barrier in metalworkers is frequently compromised by repetitive micro-trauma, abrasions, and the chronic use of aggressive industrial soaps and degreasers that strip the skin of its natural lipid layer [17]. The cases predominantly affected male workers (7/10), reflecting the male predominance in these industries.

According to current literature, the role of the microenvironment at the skin surface appears to be critical. Sweat, characterized by an acidic pH, has been reported to promote the corrosion of metallic micro-particles deposited on the skin. This chemical reaction facilitates the release and ionization of metals such as Ni^{2+} and Co^{2+}, making them bioavailable for penetration through the stratum corneum [18]. Once these ions enter the epidermis, they act as haptens, binding to endogenous proteins to form full antigens capable of triggering a T-cell-mediated Type IV delayed hypersensitivity response [19]. This proposed mechanism from prior studies could explain why areas such as the neck or arms—where friction and perspiration are frequent—are affected, even when primary contact occurs on the hands.

This synergistic effect of the industrial environment is particularly evident in the case of cobalt and nickel. Although nickel sensitivity is more common than cobalt sensitivity, the two are frequently associated in metalworkers due to their simultaneous release from alloys under the corrosive conditions described above. In this context, Rystedt and Fischer reported that one-quarter of nickel-sensitive patients developed cobalt allergy, and patients with simultaneous nickel and cobalt allergies present with more severe dyshidrotic eczema [20].

Cobalt is found in various materials. Hard metal is manufactured by a powder metallurgy process in which approximately 90% tungsten carbide, small amounts of other metal carbides, and polyethylene glycol are mixed with approximately 10% metallic cobalt, which is used as a binder. Hard metal manufacturing involves pressing, forming, sintering, polishing, and etching or color marking. Inhalation exposure to cobalt can cause cobalt-related asthma. Hard metalworkers may experience coughing, wheezing, and shortness of breath, which typically improve over weekends and holidays [21]. Localized contact dermatitis has also been reported due to occupational exposure to cobalt in the hard metals industry [22-24].

Nickel is the most common cause of allergic contact dermatitis, predominantly affecting women. It is mainly due to early contact with jewellery and clothing containing this metal, or other skin contact with nickel-containing objects. However, occupational exposure should not be overlooked. In fact, nickel-related allergic contact dermatitis is one of the most common occupational dermatoses, affecting workers in various sectors due to continuous exposure to this allergen in the workplace, as it is a metal frequently found in industrial and occupational products [6,8,25].

In the workplace, repeated exposure to nickel can lead to its deposition in the skin, which can cause chronic eczema and allergic contact dermatitis [7,26]. According to some published studies, the prevalence of occupational nickel dermatitis can reach up to 12% of all cases of occupational contact dermatitis [27].

The carcinogenic effects of nickel compounds are well known, affecting the lungs and nasal passages [28].

The hexavalent chromium compounds are sensitizers of skin and lung [29].

Chronic exposure to hexavalent chromium compounds can cause ulcerations and perforations of the nasal septum. In a study of 2,869 shipyard welders in Korea, found eleven cases of nasal septum perforation with no previous history of trauma, surgery, diseases or medication use which could explain these perforations [30].

Chronic exposure can also cause respiratory disorders, which may take the form of bronchitis, pneumonia, decreased pulmonary function or pneumoconiosis [31-33]. Furthermore, hexavalent chromium is an occupational carcinogen associated with lung cancer and sinus and nasal cancer. The International Agency for Research on Cancer (IARC) has concluded that there is sufficient evidence in humans to confirm the carcinogenicity of hexavalent chromium compounds as encountered in chromate production, chromate pigment production and chromium plating industries [34,35].

Vanadium is present in the alloys used in medical devices (dental implants, prostheses, etc.). Other sources of exposure, such as jewellery, tattoos, and metal tools, should also be considered.

Garcia-Nunez et al. [14] reported a case of allergic contact dermatitis caused by vanadium in a steel manufacturing worker.

Iron is a typical component of industrial products containing metals, particularly steel alloys. Furthermore, iron oxide pigments are components of tattoo inks and permanent makeup. Cases of occupational allergic contact dermatitis to iron have been reported among enamellers, toolmakers, and steel welders [36].

The persistence of these dermatoses across different metallic exposures despite the use of personal protective equipment (PPE) warrants careful analysis. Based on evidence reported in the literature, this phenomenon may result from direct and unintended effects of the protective equipment itself. Previous studies have demonstrated that, although gloves serve as the primary defensive barrier, their improper use can lead to the so-called "occlusive effect." If metallic particles (such as nickel, cobalt, chromium, or vanadium) or industrial fluids contaminate the inner surface of gloves, the resulting occlusion increases skin temperature and perspiration. These conditions maintain the acidic pH that facilitates metal ionization [18] and enhance the permeability of the stratum corneum, thereby potentially increasing allergen penetration. This mechanism, described in prior studies, may explain why some workers in our series showed only partial improvement despite the use of standard PPE.

Metalworkers use cutting oils whose components, such as aminoazobenzene, propylene glycol, dibromomethylglutaronitrile, and isothiazolones, among other substances, are responsible for a wide range of dermatological contact allergies [2,3,38-40], in addition to the metals already mentioned, such as cobalt, chromium, nickel, and vanadium, among others. Therefore, the main efforts should be focused on controlling exposure to these substances.

Conclusion.

This case series highlights that allergic contact dermatitis remains a significant occupational health problem in the metalworking industry, primarily due to exposure to metals and metallurgical fluids. Cobalt chloride and nickel sulphate were found to be the most frequent and clinically relevant allergens, often producing strong patch test reactions and, in several cases, co-sensitization. Vanadium and potassium dichromate, although less prevalent, showed clear relevance in specific work environments and were associated with severe or persistent dermatitis.

According to current evidence, the development of these dermatoses results not exclusively from direct contact but from a complex interplay between the industrial environment and the worker's skin biology. Theoretical models proposed in the literature suggest that disruption of the skin barrier by aggressive industrial cleansers and micro-trauma, together with the corrosive effect of acidic sweat on metal particles, may create a high-risk scenario for ion penetration and subsequent sensitization. This mechanism could account for the clinical observation that dermatitis often extends beyond the hands to areas such as the neck and face, where friction and perspiration are more pronounced.

The wide variability in latency periods, ranging from a few months to several decades, suggests that both prior sensitization and cumulative exposure play a significant role in the development of the disease. Workers with pre-existing metal allergies tended to develop occupational dermatitis more rapidly, while prolonged exposure over many years was associated with chronic and, in some cases, more extensive clinical presentations.

The components of cutting oils contributed to multiple sensitizations in some workers, underscoring the multifactorial nature of occupational dermatitis in metalworking environments. This reinforces the need to evaluate not only metals but also auxiliary substances such as biocides, preservatives, and additives in metalworking fluids during patch testing.

From a clinical and preventative perspective, avoiding the causative allergen was the most effective intervention. Complete remission was primarily achieved after a job change, while partial improvement was observed with reduced exposure through the use of personal protective equipment and medical monitoring. These findings emphasize that in cases of severe sensitization, protective measures alone may be insufficient, probably related to the paradoxical "occlusive effect" of gloves reported in the literature—where sweat and trapped metallic particles can actually accelerate ionization and skin penetration, potentially hindering full recovery.

Early identification of sensitization, strict control of exposure, specific health surveillance and, when necessary, reinforce the use of personal protective equipment or job modification are key strategies for preventing chronic diseases, reducing morbidity, and improving long-term outcomes for metalworkers.

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