

Dermatite de Contacto Ocupacional por Resina Epóxi no Centro de Portugal

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RESUMO – Introdução: A dermatite de contacto alérgica ocupacional é uma doença ocupacional muito comum e os produtos químicos epóxi estão entre as suas principais causas. O objetivo deste estudo foi caracterizar os doentes com reações positivas à resina epóxi nos testes epicutâneos realizados no Centro Hospitalar e Universitário de Coimbra entre 2012 e 2018, e comparar com os resultados obtidos entre 1999 e 2008 na mesma instituição. **Material e Métodos:** Realizámos uma análise retrospectiva dos resultados dos testes epicutâneos realizados entre 2012 e 2018 e identificámos os doentes com reações positivas à resina epóxi de bisfenol A testada a 1% em vaselina na série básica. Caracterizámos os seus dados demográficos e clínicos, avaliamos a relevância do resultado, as fontes de exposição à resina epóxi com particular atenção às fontes ocupacionais, outras reações positivas, e o impacto dos resultados dos testes no âmbito ocupacional destes trabalhadores. Por último, comparámos estes resultados com os de um estudo anterior realizado no mesmo hospital entre 1999 e 2008. **Resultados:** Dos 2363 doentes submetidos a testes epicutâneos no período de 2012-2018, foram encontrados 23 doentes (0,97%) que desenvolveram alergia de contacto à resina epóxi. Em 22 casos identificámos uma exposição ocupacional relevante: nove na indústria da construção civil, nove trabalhadores em fábrica de turbinas para energia eólica, dois em fábricas de fibra de vidro, um numa fábrica de produtos químicos e um numa estação de tratamento de águas residuais. Um dos 23 doentes era professor e não tinha exposição ocupacional relevante. Destes 22 trabalhadores, nove (39,1%) apresentavam lesões tanto nas mãos como do tipo aerotransportada, enquanto que oito (34,8%) apresentavam lesões exclusivamente nas mãos e cinco (21,7%) apenas do tipo aerotransportada. Quatro dos 23 (17,4%) reagiram exclusivamente à resina epóxi, e 11 dos 18 testados (61,1%) reagiram também ao hexanodioldiglicidil éter a 0,25% em vaselina. A evicção da exposição resultou numa melhoria significativa dos sintomas. Em comparação com o período analisado previamente (1999-2008), não houve mudanças epidemiológicas significativas, além de um discreto aumento na frequência das reações à resina epóxi e da sua principal fonte de exposição. **Conclusão:** A prevalência da dermatite de contacto alérgica à resina epóxi aumentou ligeiramente neste Centro Português, o que poderá estar relacionado com o surgimento de uma nova fábrica de turbinas para produção de energia eólica nesta região. Este alergénio continua a causar quase exclusivamente dermatites ocupacionais, tanto nas mãos, do tipo *airborne*, ou ambas.

PALAVRAS-CHAVE – Compostos de Epóxi; Dermatite Alérgica de Contato; Dermatite Ocupacional; Exposição Ocupacional; Resinas Epóxi.

Occupational Allergic Contact Dermatitis Caused by Epoxy Resin in the Centre of Portugal

ABSTRACT – Introduction: Occupational allergic contact dermatitis is a very common occupational disease and epoxy resins are among its main causes. The aim of this study was to characterize patients with positive patch test reactions to epoxy resin detected in the Coimbra Hospital and University Center between 2012 and 2018 and compare with the results of patients patch tested be-

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tween 1999 and 2008 at the same Institution. **Material and Methods:** Within a retrospective analysis of the files of patients with positive patch test reactions (1+ or more intense) to epoxy resin of bisfenol A tested at 1% pet. within the baseline series between 2012 and 2018, we characterized demographic and clinical data of reactive patients, evaluated the relevance of the reaction, sources of exposure to epoxy resin with particular attention to occupational exposures, other positive reactions and the impact of the results of the tests in the work conditions of these patients. Lastly, we compared these results with a previous study performed in the same Hospital between 1999 and 2008. **Results:** Among 2363 patch tested patients during the study period we found 23 patients (0.97%), 17 males and six females, who developed contact allergy to epoxy resins. In 22 cases we identified a relevant occupational exposure: nine from construction industry; nine workers from wind-mill turbines factory for eolic energy; two from fiberglass factories; one from a chemical factory and one from a wastewater treatment plant. In one patient (a teacher) no relevance was found. Of these 22 workers, nine (39.1%) had both hand and airborne lesions, while eight (34.8%) had lesions exclusively on the hands and five (21.7%) had predominately airborne dermatitis. Four of the 23 (17.4%) reacted exclusively to the epoxy resin, and 11 of 18 (61.1%) also reacted to 0.25% hexanediol diglycidyl ether. Avoidance resulted in a significant improvement of symptoms. Compared to the previous period (1999-2008), there are no significative changes apart from a slight increase in the frequency of the allergic reactions to epoxy resins and its main source of exposure. **Conclusion:** The prevalence of allergic contact dermatitis to epoxy resin has slightly increased in this Portuguese Center mostly due to workers from wind-mill turbines factory for eolic energy, a recent industry implanted in this region. This allergen still causes almost exclusively occupational dermatitis, either hand, airborne, or both.

KEYWORDS – Dermatitis, Allergic Contact; Epoxy Compounds; Epoxy Resins; Occupational Exposure

INTRODUCTION

Epoxy resin made by combining epichlorohydrin and diglycidylether of bisphenol A or F is used as adhesive, glue, coating, encapsulation, casting materials, sealants and binders. It is a frequent cause of occupational allergic contact dermatitis (ACD), often airborne, due to epoxy resin itself or to its hardeners or diluents. ACD occurs mostly in construction industry, aerospace and recreational industries where resins and fibers are combined to produce complex composite structures. More recently epoxy resin systems have also been introduced in three-dimensional (3D) printing, which has become a new source of epoxy resin sensitization.¹

Epoxy resins are amongst the most common occupational skin sensitizers in industrialized countries,^{2,3} affecting workers who handle unhardened epoxy resin. The hands and face are predominantly affected, and the face and neck are primarily involved through airborne exposure.³ Contact dermatitis substantially alters the social life of patients and affects their daily work productivity.⁴

The aim of this study was to characterize patients with positive patch test reactions to epoxy resin detected in the Coimbra Hospital and University Center (CHUC) between 2012 and 2018 and compare with the results of positive patch tested patients diagnosed between 1999 and 2008 at the same institution.

METHODS

Data for this study were obtained from the database of the Dermatology Department of Coimbra Hospital and University Center. We performed a retrospective analysis of the files of all patients patch tested during 7 years between 2012 and 2018 and identified patients with positive patch test reactions (1+ or more intense) to epoxy resin of bisfenol A tested at 1% pet. within the baseline series. We

characterized demographic and clinical data of reactive patients, evaluated the relevance of the reaction, sources of exposure to epoxy resin, with particular attention to occupational exposures, as well as other positive reactions within the baseline series and the series of epoxy chemicals (Chemotechnique Diagnostics®, Vellinge, Sweden).

We compared these results with a previous similar study from the same Hospital performed between 1999 and 2008.⁵

RESULTS

Between 2012 and 2018, among 2363 patch tested patients (654 males and 1709 females) we identified 23 patients (0.97%) with positive patch tests (PT), three with a 1+, 19 with a 2+ and 1 with 3+ reaction. There were 17 (73.9%) males and six (26.1%) females aged between 19 and 60 years (mean age of 37.4 years \pm 0.1); five patients (21.7%) have an atopic background with history of asthma and one (4.3%) has reported previous allergic contact dermatitis to chromium and nickel.

One of the 23 patients with facial dermatitis and a generalized eruption was a high school teacher with no identified relevant occupational or other source of exposure that might explain reactivity to epoxy resin. Actually, this patient was retested 3 years later and reactivity to epoxy resin was lost. The other 22 positive PT reactions were considered relevant and we could identify an occupational source of exposure with direct relation with the dermatitis: nine in construction industry; nine workers in a wind-mill turbines factory for eolic energy; two in fiberglass factories; one in a chemical factory and one in a wastewater treatment plant.

In these 22 cases, hand and airborne dermatitis (face, neck and arms involvement) occurred in nine (40.9%) patients, whereas exclusive hand dermatitis occurred in eight

patients (36.4%) and predominant *airborne* dermatitis was found in five (22.7%) patients. In what regards clinical presentation to the source of exposure, exuberant hand and *airborne* dermatitis occurred in nine patients (39.1%): four from construction industry, four from wind-mill turbines factory, one from fiberglass factory. Exclusive hand involvement was observed in eight patients (34.8%): five workers from construction industry and two from wind-mill turbines factory and one in a wastewater treatment plant. *Airborne* dermatitis was found in five patients (21.7%): three from wind-mill turbines factory for eolic energy, one from a chemical factory and one from a fiberglass factory.

Symptoms appeared between 1 month and 3 years in patients from wind-mill turbines factory for eolic energy, even though, as we could observe in a local visit to the working plant, workers had good individual protective equipment (2 pairs of gloves, complete protective suits with helmets and filters for the face) that were regularly changed, and general measures like ventilation were locally implemented. Nevertheless, epoxy resin was used everywhere in the plant and contact through this equipment or during its removal could not be excluded. In workers from construction industry symptoms began between 4 months and 30 years. The patient from wastewater treatment plant referred that symptoms appeared 3 years after beginning work in this area. The workers from the fiberglass factory referred an evolution approximately within 1 year, whereas evolution was unknown in the patient working in the chemical factory.

Eighteen out of these 22 patients were also tested with epoxy resin components: 11 out of 18 (61.1%) also reacted to hexanediol diglycidyl ether at 0.25% pet., three with a 1+, seven with a 2+ and one with 3+ reaction. None reacted to the epoxy hardener isophorone diamine or other amines.

Four out of 23 (17.4%) patients reacted exclusively to epoxy resin within the baseline series, whereas in 11 patients we observed positive reactions to other allergens within baseline series, mostly to methylchloroisothiazolinone/methylisothiazolinone (MCI/MI) at 0.02%/200 ppm, observed in four patients (17.4%).

Due to persistence of the dermatitis, three (13%) patients had to change to a completely different area of work, with a significant improvement of symptoms. Five (21.7%) patients remained in the same workplace however they were moved to another workstation, also improving their dermatitis. Patients who kept their workplace and workstation (6 - 26%) maintained lesions even under precautions and treatment with topical corticosteroids. Eight (34.8%) patients were lost to follow-up.

In the previous study performed in the same Institution, which included 2440 patients patch tested during 10 years (1999-2008), 24 patients (0.90%) reacted positively to epoxy resin (18 males and 6 females) with a mean age of 39.4 years. 17/24 patients (70.8%) were considered relevant, representing 69.7% of all patch tested patients. All

relevant cases (17) were work-related: 10 patients from construction industry, two patients from chemical factories, one from a bicycle factory, two from a pathology laboratory, one worker from naval painting and 1 was a handicraft jewelry worker. Four workers (23.5%) also reacted to isophorone diamine and no patient reacted to the diluent hexanediol diglycidyl ether. *Airborne* dermatitis was found in nine (52.9%) workers whereas hand dermatitis was found in eight (47.1%) (Table 1).

DISCUSSION

Comparing the two periods of the study we found that contact allergy to epoxy resin affected individuals of a similar age (39.4 and 37.4 years) with a similar male predominance. There was a slight increase in the frequency of allergic reactions in the last years (from 0.90% in 1999-2008 to 0.97% in 2012-2018), especially in the number and percent of relevant reactions (from 70.8% to 95.7%). We observed also a change in its main source of exposure (9/22 workers from wind-mill turbines factory for eolic energy in the recent period, comparing to none in the previous years).

Actually, with the recent implantation of a new big plan for producing wind-mill turbines for eolic energy in our region a large number of workers with hand and *airborne* dermatitis was observed in the past few years, despite the implementation of adequate individual and general protection measures as we could observe during a visit to the working place. The high sensitizing potency of epoxy resins and its permeation through gloves and equipment as well as some individual relaxation on the use of protective devices explains the high frequency of ACD, despite relatively appropriate working conditions.^{6,7} Although wind-mill turbine industry was responsible for largest increase in the number of cases in this latter period, the construction sector maintains a large number of patients with ACD to epoxy resin. In both periods symptoms were involving hand, face, neck and arms, both due to direct contact exposure (hand dermatitis) and from *airborne* exposure, which may be more difficult to prevent in the occupational setting. A change of job or of the workstation allowed improvement of the dermatitis, although many patients preferred to keep on working using protective devices, still with some dermatitis partially handled with topical treatment.

In what regards other positive and relevant PT reactions, in the more recent study, 11 of 18 cases (61.1%) had reactivity to hexanediol glycidyl ether, a diluent used to decrease viscosity of the resin, more frequently associated with *airborne* dermatitis due to its high volatility. In contrast, in the previous study we only observed reactions to amines used as epoxy hardeners (isophorone diamine), probably due to the different setting where ACD occurred. Reactive diluents and hardeners have been considered the most probable causes of *airborne* symptoms, because they are more volatile than diglycidyl ether of bisphenol A resin.⁸

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Table 1 - Comparison of the results of the two studies done in Coimbra Hospital and University Centre at different periods (2012-2018 versus 1999-2008).

| | 2012-2018 | 1999-2008 |
|--|------------------------|------------------------|
| Epidemiology | | |
| Reactivity to Epoxy resin | 23/2363 (0.97%) | 24/2440 (0.90%) |
| % males | 17/23 (73.9%) | 18/24 (75%) |
| Mean age (years) | 37.4 | 39.4 |
| Relevant cases (n - %) % from total | 22/23 (95.7%) 0.93% | 17/24 (70.8%) 0.69% |
| Occupational (n) | 22 | 17 |
| Wind-mill turbines factory for eolic energy | 9 | 0 |
| Construction industry | 9 | 10 |
| Factory workers | 3 | 3 |
| Wastewater treatment plant | 1 | 0 |
| Pathology laboratory workers | 0 | 2 |
| Naval painting workers | 0 | 1 |
| Handicraft jewelry workers | 0 | 1 |
| Location of the dermatitis | | |
| Airborne + hand dermatitis | 9 (40.9%) | --- |
| Predominantly airborne | 5 (22.7%) | 9 |
| Hand dermatitis | 8 (36.4%) | 8 |
| Other positive reactions | | |
| Hexanediol diglycidyl ether | 11/18 (61.1%) | 0 |
| Isophorone diamine | 0 | 4/17 (24%) |

CONCLUSION

The frequency of occupational allergic contact dermatitis to epoxy resin in this Region of Portugal is still < 1% among patch tested patients, although it has slightly increased in the last years due to the big factory for wind-mill production.

We may conclude that even with all the measures implemented to prevent occupational exposure to epoxy resins (education, medical examination, voluntary agreements

between employers and workers, modification of workplace tasks or appropriate personal and collective protective equipment), they may have not been effective enough to protect against skin sensitization to this potent allergen. Most often, a worker sensitized to epoxy resin will have to move to a completely different area or change to a different workplace or occupation to avoid further exposure to the offending allergen.⁹

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Confidencialidade dos dados: Os autores declaram ter seguido os protocolos da sua instituição acerca da publicação dos dados de doentes.

Proteção de pessoas e animais: Os autores declaram que os procedimentos seguidos estavam de acordo com os regulamentos estabelecidos pelos responsáveis da Comissão de Investigação Clínica e Ética e de acordo com a Declaração de Helsínquia da Associação Médica Mundial.

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