



Case Report

Lethal cardiotoxicity from quaternary ammonium compounds contained in an unguarded household detergent at a psychiatric facility



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ABSTRACT

Here, referred for the first time in literature, we present the forensic case of death, with suicidal intent, following ingestion of a conspicuous amount of quaternary ammonium compounds contained in an unguarded bottle of household detergent. The deceased person was a young female patient at a psychiatric facility; the cause of death was acute heart failure due to spotty infiltration of neutrophils, lymphocytes and plasma cells in the myocardial tissue, observable in the course of toxic myocarditis. The dominant pathogenetic factors involved are direct damage of myocardial cells and a superimposed immune response extending to the epicardial perivascular spaces. This rare form of acute myocarditis has never been previously described. Moreover, this fatal event emphasizes the need for planned clinical risk-management measures and for guidelines to prevent future adverse events of this kind in psychiatric facilities.

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1. Introduction

Quaternary ammonium compounds (QACs) are salts of quaternary ammonium cations (*quats*), which are positively charged polyatomic ions with a NR^+_4 , R being an alkyl or aryl group [1]. QACs are commonly used as detergents, disinfectants, sanitizing or antistatic agents, surfactants, fabric softeners, phase transfer catalysts, osmolytes and plant growth retardants [2]. However, they can also have adverse effects on health. Risks range from: mild skin or respiratory irritation; nausea and vomiting; severe caustic burns on the skin and gastrointestinal lining, depending on concentration; convulsions, hypotension, coma and death [2]. Furthermore, they are thought to be the chemicals responsible for anaphylactic reactions that occur with the administration of neuromuscular blocking drugs during general anaesthesia [3]. In this regard, quaternium-15 is the single chemical most often tested positive in cases of allergic contact

dermatitis of the hands [4]. Heretofore, QAC toxicology has not been completely elucidated, and our intent is to draw attention to their selective cardiotoxicity.

2. Case report

A 26-year-old woman, a known drug dependent and affected by chronic hepatitis C for several years, was admitted to a psychiatric facility for rehabilitation therapy consisting of psychiatric support and methadone. Moreover, she had suffered since adolescence from symptoms of borderline personality disorder, such as to require continuous use of anxiolytic and antipsychotic drug therapy, always well tolerated. During her stay in the unit, the patient ingested 500 ml of a commercial household detergent (Tayform[®]), containing QACs at pH 7. The bottle was left unguarded in the laundry. Following the attempted suicide by ingestion, an ambulance was called and the patient was taken to the nearest emergency unit. At admission, the patient's general and neurological conditions were good. Significantly, the laboratory tests and electrocardiogram revealed no variations from values registered on previous checks. No acute digestive or abdominal signs were present; the patient denied her consent

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to stomach pumping or gastric lavage and to further endoscopic investigations (only simethicone was orally administered according to the standard protocols). During hospitalization, she suffered from psychotic imbalances and it was decided to increase the daily dose of benzodiazepines and antipsychotics. Despite a temperature peak of 38 °C the night before, the patient was discharged 60 h after admission. She died at home 12 h from discharge. An autopsy was ordered by the judicial authority following an official complaint by the patient's parents.

3. Pathological findings

3.1. Gross examination

The heart was discovered soft in consistency with all chambers dilated; there was no evidence of valve disease. The pericardium and epicardium appeared opaque, while the proper ventricular myocardium was brownish in hue. The coronary arteries were patent; no thrombosis was evident. Both lungs were seriously edematous, exuding frothy fluid at incision. The gastro-esophageal mucosa appeared erythematous and hyperaemic, while the liver was characterized by a yellowish-reddish colour.

3.2. Histology

Histology revealed spots of myocardial damage characterized by degenerated and disrupted fibres. Both around and inside these spots, an infiltrate of neutrophils, lymphocytes and plasma cells was readily detectable, without, however, evidence of eosinophils or activated fibroblasts (Fig. 1). In the epicardium, the adipocytes were surrounded by the same inflammatory cells; a perivascular infiltration of neutrophils, lymphocytes and plasma cells was also detected (Fig. 1). On both lungs, histology confirmed a scenario typical in cases of acute pulmonary edema (Fig. 2). The epithelium

of the gastro-esophageal mucosa revealed areas of erosion with necrotic foci, all of which were surrounded by neutrophils, lymphocytes and plasma cells (Fig. 3). The liver was involved by a chronic hepatopathy (Fig. 4), at stage III Ishak [5]. No lesions were observed in the other abdominal organs, kidneys included, where the microvascular network was within the norm. A final autopsic diagnosis of acute pulmonary edema from acute heart failure secondary to myocarditis was rendered.

3.3. Toxicology

The post-mortem toxicology on blood, urine, bile and gastric contents highlighted the presence of several drugs, such as methadone, diazepam, delorazepam, aripipazole, clotiapine, haloperidol, trazodone, viminal, all in amounts referable to therapeutic doses. In detail, their blood concentrations were: methadone 0.14 mg/L, diazepam 0.004 mg/L, delorazepam 0.05 mg/L, aripipazole 0.03 mg/L, clotiapine 0.11 mg/L, haloperidol 0.001 mg/L, trazodone 0.04 mg/L, viminal 0.002 mg/L. The urinary concentrations of the above mentioned drugs were: methadone 3.52 mg/L, diazepam <0.001 mg/L, delorazepam <0.001 mg/L, aripipazole <0.001 mg/L, clotiapine 2.91 mg/L, haloperidol 0.01 mg/L, trazodone 1.30 mg/L, viminal 0.02 mg/L. The related gastric contents were: methadone 7.5 mg/L, diazepam <0.001 mg/L, delorazepam 0.18 mg/L, aripipazole 1.51 mg/L, clotiapine 5.73 mg/L, haloperidol 0.03 mg/L, trazodone 0.04 mg/L, viminal 0.14 mg/L. Therefore, the two main psychoactive drugs used to compensate the last psychotic imbalances were aripipazole and clotiapine. Cocaine was not found in any of the examined biological fluid (blood, urine, bile and gastric contents). Its presence was revealed only by the drug test on the hair, and this positive result was attributed to previous intake, not in the days before death, occurred at the end of November 2013. Assuming that the hair has an average speed of growth of about 1 cm per month and that,

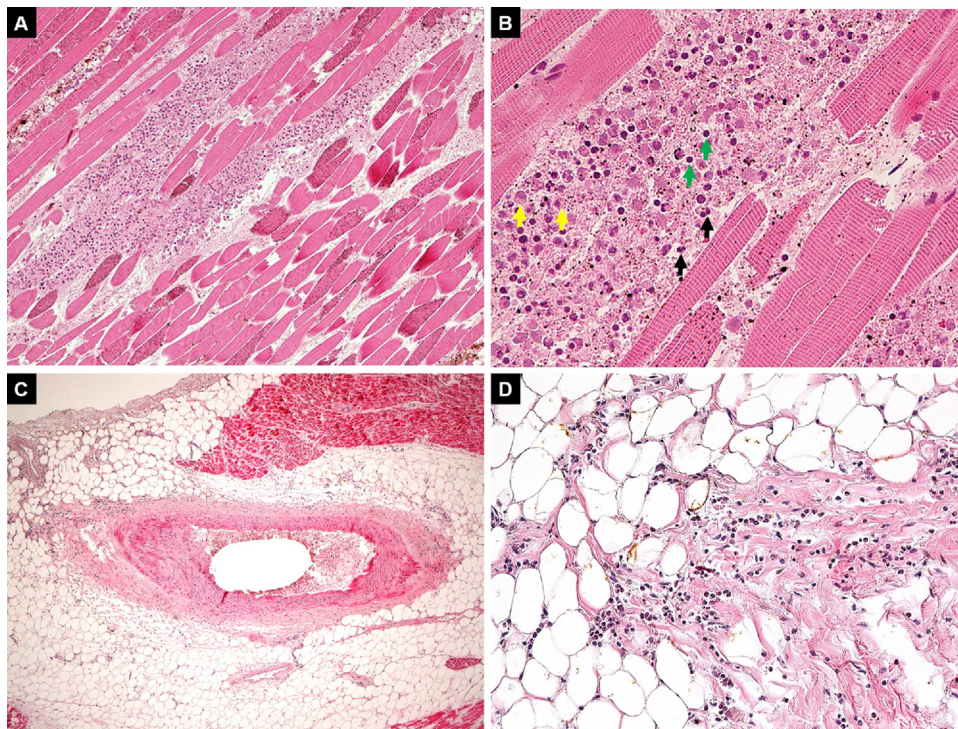


Fig. 1. The myocardium is focally infiltrated by inflammatory cells with disruption of some muscle fibers (A, H&E, $\times 10$). Among the inflammatory cells, neutrophils (black arrows), lymphocytes (green arrows) and plasma cells (yellow arrows) can be recognized (B, H&E, $\times 40$). The inflammation also involves the pericoronary space (C, H&E, $\times 5$) and the adipose tissue of the epicardium (D, H&E, $\times 20$). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

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