CASE REPORT

Hydrazine inhalation hepatotoxicity

Yung Hsiang Kao¹, C. H. Chong², W. T. Ng³ and D. Lim⁴

Abstract
Hydrazine is a hazardous chemical commonly used as a reactant in rocket and jet fuel cells. Animal studies have demonstrated hepatic changes after hydrazine inhalation. Human case reports of hydrazine inhalation hepatotoxicity are rare. We report a case of mild hepatotoxicity following brief hydrazine vapour inhalation in a healthy young man, which resolved completely on expectant management.

Key words Hepatotoxicity; hydrazine; inhalation; management; transaminitis.

Introduction

Hydrazine is a chemical which is commonly used as a reactant in rocket and jet fuel cells [1,2]. It is a hazardous material, and humans with either acute or chronic hydrazine exposure are at risk of developing serious health complications including cancer [3]. Hepatic changes due to hydrazine inhalation have been demonstrated in animal studies [3]. Human cases of hydrazine inhalation liver toxicity are rare, with only two reported cases since 1971 [4–6]. We report a case of mild hepatotoxicity following brief hydrazine vapour inhalation in a healthy young man, which resolved completely on expectant management.

Case report

In March 2005, while performing routine servicing of a jet aircraft in an open and well-ventilated hangar, a suspicious fluid was found leaking out of a fuel cell containing hydrazine as a mixture of 70% N₂H₄ and 30% water by weight. Suspecting a hydrazine leak, a 31-year-old Chinese male aircraft technician proceeded to test the fluid with a piece of indicator paper. He was wearing normal boots and coveralls, and held the indicator paper wearing simple, clinical-examination-type latex gloves. There was no physical contact with the fluid at any time, and he did not notice any suspicious ammonia-like odour. The indicator paper showed that the leaking fluid was hydrazine, and the entire hangar was immediately evacuated of all personnel. There were six other personnel in the hangar who were all standing more than 1 m away from the leaking fuel cell. The duration from the discovery of the leak to the evacuation of the hangar was approximately 10 min.

Neither the aircraft technician nor the other personnel in the hangar experienced any immediate symptoms, but 30 min later the aircraft technician complained of a mild headache and slight dizziness. This resolved after a few hours of rest, and he had no other symptoms. Following workplace protocol, the aircraft technician and the other six personnel in the affected hangar were sent to a nearby medical centre to be reviewed by a doctor. The medical evaluation involved history taking, general physical examination and laboratory investigations which included a liver function test. The clinical examinations for all seven personnel were normal. However, the laboratory investigations, which were done 5 h after discovery of the leak, showed that the aircraft technician had developed mild transaminitis. He remained relatively comfortable apart from the initial headache and dizziness. These abnormal findings were attributed to inhaled hydrazine vapour from the leaking hydrazine fuel cell. Laboratory investigations for the other six personnel were normal. The ambient temperature was estimated to be around 26°C. The concentration of hydrazine vapour at the affected hangar was not measured.

The hydrazine leak in the hangar was promptly removed by a specialized decontamination team, and the main method of decontamination was to dilute the leakage with large quantities of water and flushed to a safe, open area. Larger hydrazine spills are managed in a similar way.

The aircraft technician was followed up with regular liver function tests to monitor the trend of hepatotoxicity.
The rise and fall of transaminitis is shown in Table 1. By Day 28, the transaminitis had resolved completely. During this period, he complained of a mild headache with slight non-vertiginous dizziness on Days 10 and 14. These symptoms resolved with reassurance and rest. On Day 7, he developed an urticarial rash on his lower limbs, which subsided with oral anti-histamine. Throughout the period of transaminitis he did not have any typical symptoms of hepatitis such as lethargy, malaise, abdominal pain or nausea. Prior to the exposure, the aircraft technician was in good health. He did not consume alcohol regularly, and was HBsAg negative. There was also no other clinical or biochemical evidence to suggest that his liver enzymes could be deranged by other causes.

For the other six personnel who were screened for possible hydrazine toxicity, a liver function test was repeated for each of them within a week post-exposure. The tests showed no evidence of transaminitis, and there were also no clinical signs or symptoms suggesting hydrazine toxicity.

**Discussion**

Hydrazine is a simple diamine and powerful reducing agent. Comstock et al. observed liver damage in groups of rats exposed to hydrazine vapours, and Sotaniemi et al. described a fatal case of hydrazine inhalation toxicity where the patient developed liver degeneration and necrosis [1,4,7]. In vitro studies performed on rat hepatocytes suggest that the acute cytotoxicity caused by hydrazine is primarily mediated through the induction of oxidative stress, due to an increase in generation of reactive oxygen species and the depletion of reduced glutathione [8].

Hydrazine vapour is readily absorbed through the lungs [3]. The Occupational Safety and Health Administration exposure limit for hydrazine (N₂H₄) is 1 ppm (1.3 mg/m³) as a time-weighted average concentration over 8 h. The National Institute for Occupational Safety and Health recommends an exposure limit of 0.03 ppm (0.04 mg/m³) as a ceiling concentration for 2 h [9].

This case report demonstrates the reversibility of mild hydrazine hepatotoxicity, and offers insight into the recovery time following brief hydrazine vapour exposure. As shown in Table 1, the transaminitis had worsened from Day 0 to Day 3, and reached its peak from Day 4 to Day 6. His liver function improved slowly after Day 6, and returned to normal levels by Day 28. This observation is consistent with another case of hydrazine inhalation hepatotoxicity reported by Kirklin et al. in 1976, in which the abnormal liver biochemistry resolved in 5 weeks after treatment with pyridoxine [6].

Recommendations for post-exposure monitoring can be drawn from this incident. Medical practitioners treating patients who were exposed to hydrazine under similar circumstances should expect the hepatotoxicity to peak by Day 6, and thus monitor them more closely during this period. As evident in this case report, clinical signs and symptoms may be unreliable in detecting worsening cases of mild hydrazine hepatotoxicity.

Transaminitis was detected in the aircraft technician just 5 h post-exposure. However, the lack of human exposure data in medical literature makes it difficult to comment on whether a rapid rise in transaminases is typical of human hydrazine inhalation hepatotoxicity. Nevertheless, this case report highlights the importance of having a rigorous workplace protocol for the immediate screening of workers after occupational exposure to hydrazine, even if the exposed workers have little or no acute symptoms. It may be beneficial for industries handling hydrazine to perform routine pre-employment liver function testing for its workers, to establish a baseline record for future reference.

In addition to liver damage, hydrazine is also known to affect the skin and central nervous system [3]. However, in this case, we were unable to conclude if the headache, dizziness and urticaria were attributable to hydrazine exposure or if these symptoms were simply coincidental and unrelated.

**References**


