



Plain abdominal radiography: A powerful tool to prognosticate outcome in patients with zinc phosphide poisoning



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ARTICLE INFORMATION

Article history:

Received 7 March 2014

Received in revised form

27 May 2014

Accepted 2 June 2014

AIM: To evaluate the clinical features of zinc phosphide poisoning and to investigate whether outcome could be prognosticated based on abdominal radiography on presentation.

MATERIALS AND METHODS: All zinc phosphide-poisoned patients who were referred to Loghman-Hakim Hospital between March 2011 and September 2013 were retrospectively reviewed. Data regarding patients' demographic characteristics, characteristics of the poisoning, abdominal radiography results, and patients' outcome were recorded.

RESULTS: In 102 patients, the most common presenting signs/symptoms were nausea and vomiting (60%). Four patients died and another seven had developed complications during their hospitalization (metabolic acidosis, liver abnormalities, or acute renal failure). Nineteen patients had radio-opaque abdominal radiographs, nine of whom had died or developed complications ($p = 0.001$). Plain abdominal radiography had a sensitivity and specificity of 81% and 89% in predicting the patients' death or further development of complications. The positive and negative predictive values were 47% and 97%, respectively.

CONCLUSION: Plain abdominal radiography is a very good tool for prognostication in patients with zinc phosphide poisoning. Immediate abdominal radiography can help stratify patients into high- or low-risk groups and determine treatment strategies.

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Introduction

Zinc phosphide (ZP) is an inorganic compound used as a rodenticide and insecticide. It is a grey–black powder with an odour similar to garlic.¹ ZP is used to fumigate grain-

storage facilities. Toxicity due to ZP is due to the phosphine production in acidic conditions.² It accounts for up to 20% of deaths due to insecticides and rodenticides in some countries.³ No such statistics from Iran exist; however, sporadic deaths from ZP poisoning have been reported. Phosphine release causes disruption of the mitochondrial system by blockage of the cytochrome oxidase C as well as lipid peroxidation due to generation of the free radicals.^{4,5} The toxicity manifests with nausea, vomiting, abdominal pain, tachypnoea, hyperpnoea, dyspnoea, cough, chest tightness, acute lung injury, tachycardia, hypotension,

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dysrhythmia, loss of consciousness, seizure, coma, hepatic failure, metabolic acidosis, and electrolyte and blood sugar abnormalities.⁶

There may be a significant delay in the onset of symptoms following ingestion of insecticides, and it has been suggested that the patient be admitted and followed for at least 72 h.⁶ However, this may not be feasible in many centres. Patients may consider themselves to be healthy and self-discharge from the healthcare facility only to become symptomatic later. In addition, keeping a healthy patient in the hospital for 3 days imposes high costs to the patient and the healthcare system. Decreasing this observation time by excluding patients with a better prognosis or those whose toxicity will not progress may decrease the medical care costs and prevent hospitalization complications in patients without toxicity signs and symptoms or those with milder toxicities.

Zinc is a radio-opaque metal, which may enable the visualization of this toxic material.^{7,8} The aim of the present study was to investigate whether the outcome of ZP-poisoned patients could be prognosticated using abdominal radiography upon presentation.

Materials and methods

All ZP-poisoned patients referred to Loghman-Hakim Hospital between March 2011 and September 2013 were retrospectively reviewed. Those with plain abdominal radiographs available in their files were included. In these patients, abdominal radiography had been performed to rule out radio-opaque material due to arsenic- or thallium-containing rodenticides. Patients whose radiographs were not available or abdominal radiography had not been requested and patients with baseline hepatic, respiratory, kidney, and metabolic diseases were excluded. Data regarding patients' demographic characteristics (age, gender), characteristics of the poisoning (amount of the toxin ingested, time elapsed between ingestion and hospital presentation, signs and symptoms on presentation, vital signs, arterial blood gas analysis, and laboratory tests), abdominal radiography results, and patients' outcome were recorded. All radiographs were evaluated by a single radiologist blind to the study and considered to be positive if radio-opaque material was detected in them. The relation between positive radiography and the patients' outcome (death versus recovery) and later development of metabolic (metabolic acidosis), hepatic [abnormal liver function tests or increased prothrombin time (PT) and international normalized ratio (INR)], and renal complications (renal failure) was examined. Metabolic acidosis was defined as $\text{pH} < 7.35$ and a bicarbonate < 19 meq/l. However, only those with moderate to severe metabolic acidosis ($\text{pH} < 7.2$, bicarbonate < 15 meq/l),^{9,10} were considered to have significant metabolic complications. Aspartate transaminase (AST) and alanine transaminase (ALT) greater than two times the normal upper limit were considered as abnormal liver function tests (> 80 IU/l). The PT and INR were checked and reported to be abnormal if the PT was > 13 s and the INR

was > 1.3 (according to the kits available). Acute renal failure was defined as absolute increase in serum creatinine of ≥ 0.3 mg/dl, percentage increase in serum creatinine of $\geq 50\%$, or reduction in urine output, defined as < 0.5 ml/kg/h for more than 6 h.¹¹ The data were analysed using Social Package for Statistical Sciences (SPSS, IBM Incorporations, Chicago, Ill, USA) software version 17 and by the application of *t*-test, chi square test, and Mann–Whitney *U*-test. A *p*-value < 0.05 was considered to be statistically significant. Helsinki declaration on ethical principles of medical research was noted and the study was approved by the local ethics committee.

Results

A total of 163 ZP-poisoned patients were referred during the study period. They were admitted and kept in the hospital for at least 72 h. Of them, 103 (mean age 29.6 ± 11.1 years, range 15–74 years) had radiography notes in their files and were retrospectively evaluated. One patient was later excluded because he had been referred 1 week after the consumption of the ZP and his acidosis mainly involved the respiratory system. It was assumed that he might have overdosed an opioid and, therefore, this patient was excluded from further evaluations. Sixty-three (61.2%) were male. All had intentionally ingested the powder to attempt suicide. The mean amount of the ZP powder ingested was 63.1 ± 48.7 g (range 6.8–218.4 g). Mean time elapsed between ingestion of the toxin and hospital presentation was 4.8 ± 4.6 h (range 0.2–24 h). One case almost immediately referred to hospital (10 min after ingestion of the ZP) due to the fear of dying. The most common signs and symptoms on presentation were nausea and vomiting (65%), abdominal pain (31.9%), dizziness (20.4%), diarrhoea (9.2%), and decreased level of consciousness (9.2%). Eight patients were referred with headache and another eight had agitation and chest pain (four patients each; 3.9%). Weakness and dyspnoea were observed in two (1.9%) and one (1%) patients, respectively.

Mean vital signs and laboratory tests on presentation are shown in Table 1. Mean parameters of the patients' first, second, and third arterial blood gases analyses (ABGs) are depicted in Table 2. The ABGs were taken with 8–12 h intervals. In eight patients, the PT, partial thromboplastin time (PTT), and INR were normal on presentation but subsequently increased (reaching a mean of 19.8 ± 3.7 , 32.4 ± 6.1 , and 2.4 ± 0.8 , respectively). In 13 patients, the ABG progressively deteriorated, two of whom died. In total, four patients died (4/102 mortality of 3.9%) due to the complications of toxicity; one due to acute renal failure, one due to hepatic failure, and two due to severe acidosis and hypotension.

Nineteen patients had radio-opaque material evident from their abdominal radiographs (Fig 1). All four patients who died had positive radiography. The other five in this group experienced further complications (acidosis, abnormal liver function tests, and acute renal failure; $p=0.001$). Two patients experienced complications despite a normal initial abdominal radiography examination. Plain

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