

## Utility of Silver Nitrate Test for Post-Mortem Diagnosis of Aluminum Phosphide Poisoning

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### ABSTRACT

**Background:** Intoxication with aluminum phosphide has been prevalent in Iran recently. Lab confirmation of the poisoning is needed in clinical and post-mortem settings. Present study was conducted to determine efficiency and validity of silver nitrate test for detection of aluminum phosphide in samples.

**Methods:** Information about dead patients with history of aluminum phosphide poisoning referred for medicolegal autopsy was collected during 18 months. Their relationships with result of silver nitrate test was assessed statistically.

**Results:** 24 patients were studied. Silver nitrate test on samples of intra-abdominal organs was positive in 75% of autopsies, while the test on gastric content was positive in 50%. Relationship between number of ingested tablets and silver nitrate test was statistically significant ( $p$  value=0.017).

**Conclusion:** Results of present study showed that silver nitrate test can be used as a preliminary method for evaluation of patients or dead bodies suspected to be intoxicated with ALP. However, even negative result of silver nitrate test would not preclude ALP poisoning and more definitive quantitative tests such as HS-GC should be ordered, if feasible.

**Keywords:** Aluminum Phosphide, Diagnosis, Intoxication, Silver Nitrate, Test.

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### INTRODUCTION

Intoxication with pesticides is a worldwide health problem, particularly in developing countries. It causes more than 300,000 deaths annually, mainly after intoxication with organophosphates, organochlorines and aluminum Phosphide (1). Aluminum phosphide (ALP) is an effective and economical pesticide (2). It is an inorganic solid substance with dark grey or yellow crystals. Its melting point is more than 1000°C. It is heavier than water. It reacts with water, produces phosphine, a highly toxic gas (3-5). Phosphine is an appropriate protective factor according to international biological protocols. It is widely used for protection of crops, grains,

and commodities because of its effectiveness, wide accessibility, and low cost (6). Phosphine, also named hydrogen Phosphide and celphos, is a colorless, flammable and explosive gas with rotten fish or garlic odor. Its molecular weight is 34 g/mol with melting point -133.5 °C and boiling point -87.5 °C (7,8).

Recently ALP in form of 3 grams tablet contains 1680 mg aluminum phosphide and 1320 mg ammonium carbonate is widely used for suicidal attempts by Iranian youths (9-14). It poses a new health dilemma. Ingestion of only one-fourth tablet is lethal. There are reports of death after ingestion of 150-500 mg ALP (15-17). Its LD50 is estimated to be

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20 mg/kg (18). ALP poisoning creates multi-organ failure and variable clinical presentations (19).

Routinely chemical tests are used for confirmation of the intoxication, if patient's history or clinical presentation is warranted. Qualitative tests are used for verification of presence of phosphine in blood, breath, gastric contents, and other tissues and quantitative tests are used for determination of severity or prognosis of poisoning (8,16). There are qualitative (such as colorimetry), quantitative (for example GC, ETAAs, and ICP-MS) and semi-quantitative (potentiometry) methods for detection of ALP in the samples (2,8,19,20). Colorimetric methods such as silver nitrate test can be performed on gastric aspirate, exhaled breath, and non-biologic samples. If a paper immersed with silver nitrate is kept in contact with a questioned sample contained ALP or phosphine, it would turn black (2,21,22).

Silver nitrate test is performed in autopsy ward of Iranian legal medicine organization for cases suspected to die after ALP intoxication. But how much can actually rely on results of the test? Present study was conducted to determine efficiency and validity of the test.

## MATERIALS AND METHODS

During 18 months, from Sep.2009 to Jan. 2011 all dead bodies that referred to autopsy ward of Iranian legal medicine organization for medicolegal autopsy with history of ALP poisoning were included in the study. Information about chief complaint, vital signs, clinical presentation, dose and route of ingestion, demographic characteristics, lab findings, duration of hospital admission were extracted from hospital records of the patients. Findings in autopsy of the patients include macroscopic and histopathologic findings as well as result of silver nitrate test on gastric content and intra-abdominal tissues, and GC and TLC tests for detection of other poisons and drugs in the biologic samples were recorded too. The collected

data were analyzed using SPSS software version 16.0.

## RESULTS

24 patients with above mentioned criteria were included in the study include 8 (33.3%) males and 16 females. 5 patients had history of previous psychiatric problem; while 4 had previous suicidal attempts and one was drug abuser. All but one had been intoxicated after suicidal attempts. Mean number of ingested tablet was  $1.29 \pm 0.54$  (1-3 tablets). Mean age of the patients was  $24.12 \pm 10.41$  (14-66 years old). The most common symptom after arrival to the hospital was nausea and vomiting.

The autopsies had been performed within 48 hours after death. Body decomposition had not occurred at the time of autopsy. Silver nitrate test on samples of intra-abdominal organs was positive in 75% of autopsies, while the test on gastric content was positive in 50%. Mean number of ingested tablet was  $1.43 \pm 0.62$  in autopsies with positive silver nitrate test on samples of intra-abdominal organs. Patients with negative silver nitrate test on samples of intra-abdominal organs had ingested only one tablet of ALP.

Relationship between number of ingested tablets and silver nitrate test was statistically significant ( $p$  value=0.017). There were no statistically significant relationships between other evaluated parameters with result of silver nitrate test.

## DISCUSSION

Results of present study showed that silver nitrate test can be used as a preliminary method for evaluation of patients or dead bodies suspected to be intoxicated with ALP.

Various studies have suggested that if fresh tablets of ALP have been responsible for the intoxication, sensitivity of silver nitrate test reaches to 100% for samples of gastric contents and 50% for samples of exhaled breaths (23,24). Efficiency of the test is estimated 90% (8).

However we reach the sensitivity 75 and 50 percent for post-mortem samples from intra-abdominal organs and gastric content respectively. It should not be forgotten that negative silver nitrate test do not rule out ALP poisoning, particularly in post-mortem settings.

## CONCLUSION

Silver nitrate test can be used as a preliminary test for assessment of likelihood of ALP poisoning. Nevertheless, if patient's history, clinical presentation, and autopsy findings were highly suggestive of ALP poisoning, even negative result of silver nitrate test would not preclude ALP poisoning and more definitive quantitative tests such as HS-GC should be ordered, if feasible (2,20,25,26).

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