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Case Report

Right ventricular thrombus in a child with aluminum phosphide poisoning: A case report and review of the literature

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Abstract

Background: Aluminum phosphide (ALP) is a highly toxic inorganic compound used as a rodenticide, insecticide, and fumigant for stored cereal grains. Sometimes it uses for suicidal or criminal purposes, due to the low cost and availability of this tablet.Cardiovascular involvement is common and is the leading cause of death in these patients, but intra-cardiac thrombosis is rare and more common in the left ventricle following left ventricular dysfunction. The aim of our work was to describe an atypical manifestation of cardiovascular involvement of ALP poisoning.

Case presentation: We report a case of an ALP-poisoned child, with the uncommon complications of mobile right ventricular thrombus who has been treated successfully with systemic thrombolysis. An eleven year- old boy who referred to us with unstable hemodynamic status after suicidal ingestion of 3 grams ALP tablet. To the best of our knowledge, he is the first case of right ventricular thrombosis in the setting of ALP poisoning in the English literature.

Conclusion: In this ALP-poisoned child case, systemic thrombolysis along with conservative management could save the child from a non-reported complication of ALP.

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1. Introduction

ALP is a chemical that is often used as a pesticide in the grain storage including rice. In some countries, this pill is easily available in herbal shops. In most cases it is consumed with the intention of committing suicide. In extreme cases, ALP poisoning can lead to death. The cause of death is often cardiovascular involvement due to phosphine gas and toxic myocarditis resulting in cardiogenic shock (1). Treatment of ALP poisoning is very difficult due to the lack of specific antidotes and is based on supportive cares (2).

Intra-cardiac thrombosis is rare and has been reported in limited reports in the left ventricle following heart failure with reduced ejection fraction (EF) and in the inferior vena cava, where it is protruded to right atrium in patients with ALP poisoning (3, 4). Here we report an uncommon cardiovascular complication in a child patient. Although, the controversial treatment strategies in this case is a subject of debate and there is no consensus on it.

2. Case report

An eleven-year-old boy was referred to us after suicidal ingestion of a 3-gram ALP tablet (known as rice tablet in Iran), 10 hours post-ingestion. He has been intubated by Emergency Medical Service (EMS) due to unstable hemodynamic. Vital signs on arrival to the hospital were: blood pressure: 70/50 mmHg, heart rate: 136 beats/minute, respiratory rate: 35/minute and oxygen saturation of 93%. Bilateral lung examination was normal, and pupils were mydriasis and reactive to light. The peripheral pulses of the limbs were poorly palpable.

Initial supportive care was started and the treatment was continued with bicarbonate, high dose epinephrine infusion, L–carnitine, calcium gluconate, magnesium and high dose insulin infusion to achieve a hyperinsulin euglycemia (with glucose and potassium). The laboratory data of the patient on arrival is shown in **Table 1**.

Table 1. Patient's on-arrival laboratory testsoncentrations.

Parameters (unit)	Results	Normal range
WBC (cell/mm^3)	27000	4800-10800
Neut	71%	
Lymph	29%	
PLT (cell/mm^3)	413000	150000-450000
Hgb (gr/dL)	14	13.5-17.5
MCV (FL)	84	80-100
CPK (U/L)	125	25-195
CKMB (U/L)	23	<24
Venous Blood Gas:		
pH	7.144	7.31-7.44
pCO2 (mmHg)	42.6	38-52
pO2 (mmHg)	73.6	24-40
HCO3 (mEq/L)	14.3	22-28
LDH (U/L)	634	Up to 746
Urea (mg/dL)	18	15-36
Creatinine (mg/dL)	0/9	0.5-1
Sodium (mEq/L)	143	135-145
Potassium (mEq/L)	3.4	3.5-5.1
AST (U/L)	21	Up to 43
ALT (U/L)	6	Up t0 40
Calcium (mg/dL)	7.5	8.7-11
Phosphorus (mg/dL)	5.2	3.2-5.7
Magnesium (mg/dL)	2.5	1.9-2.5
FDP (mcg/mL)	10	<0.35
D-Dimer (mcg/mL)	2.3	<0.4
Fibrinogen (mg/dL)	396	200-400

WBC: White Blood Cell, Neut: neutrophil, Lymph: lymphocyte, PLT: platelet, Hgb: Hemoglobin, CPK: Creatine phosphokinase, CK-MB: Creatine kinase-MB, LDH: Lactate Dehydrogenase, AST: Aspartate transaminase, ALT: Alanine transaminase, FDP: Fibrin Degradation Product

After the initial treatment, the patient clinical condition improved and blood pressure (BP) reached to 100/60 mmHg. On the second day of hospitalization, the patient had fever due to aspiration pneumonia (skin temperature: 39º centigrade). Patient's ESR (56 mm/hr) and CRP (24 mg/L) was elevated.

Urine analysis, stool exam and chest X-ray (CXR) was normal and covid-19 PCR was negative. Empirical antibiotics including ceftazidime were started. Blood and urine cultures were negative.

Due to unilateral edema in right upper extremity, Doppler ultrasound performed and deep vein thrombosis (DVT) was confirmed in radial and cubital veins. Heparin was started with a therapeutic dose of 20 unit/kg/hr. Cardiology consultation and echocardiography were done due to low BP and electrocardiogram (ECG) abnormalities (**Figure 1**).

Echocardiography showed severe LV (left ventricular) dysfunction [ejection fraction (EF): 25%], moderate right ventricular (RV) dysfunction, TAPSE (tricuspid annular plane systolic excursion): 1.3 cm, and a large (2.5 cm) mobile thrombus in RV attached to chordae tendineae (**Figure 2**).

Coagulation profiles were sent to investigate the possible thrombophilia.

Surgical thrombectomy or catheter directed thrombectomy was not possible for the patient due to lack of enough facility in our hospital and also unstable hemodynamics and critical clinical condition. That made the patient's transfer very risky. The patient was treated with Alteplase infusion at a dose of 0.03 mg/kg/h for 12 hours and during the treatment with Alteplase the dose of heparin was reduced by half (10 units/kg/h). PT (prothrombin time), PTT (partial thromboplastin time) and CBC (complete blood count) tests were performed every 6 hours and the results were within acceptable level.

Twelve hours post Alteplase infusion, the patient's platelet count dropped to 54,000/mm^3. There was no clinical evidence of bleeding, decreased hemoglobin or changes in level of consciousness (the patient was conscious but he was sedated because of intubation). Due to thrombocytopenia less than 100,000, Alteplase infusion stopped, and the treatment continued with heparin infusion at full dose of 20 unit/kg/hr. PTT was within the therapeutic range. After 24 hours, the patient underwent echocardiography again. In addition to complete lysis of RV thrombus, the EF level also improved slightly and reached to 30%. Hemodynamic status improved and BP increased to

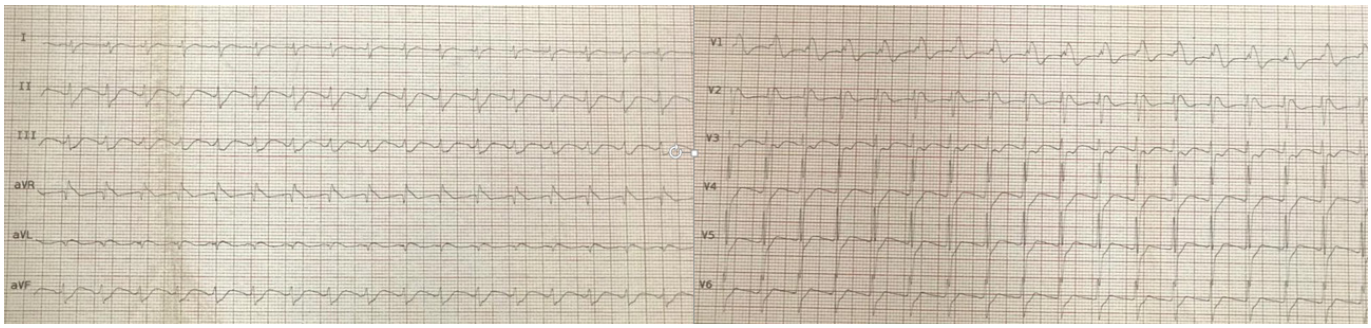

Figure 1. Electrocardiogram of the patient. Note wide QRS complex and abnormal ST-T changes.

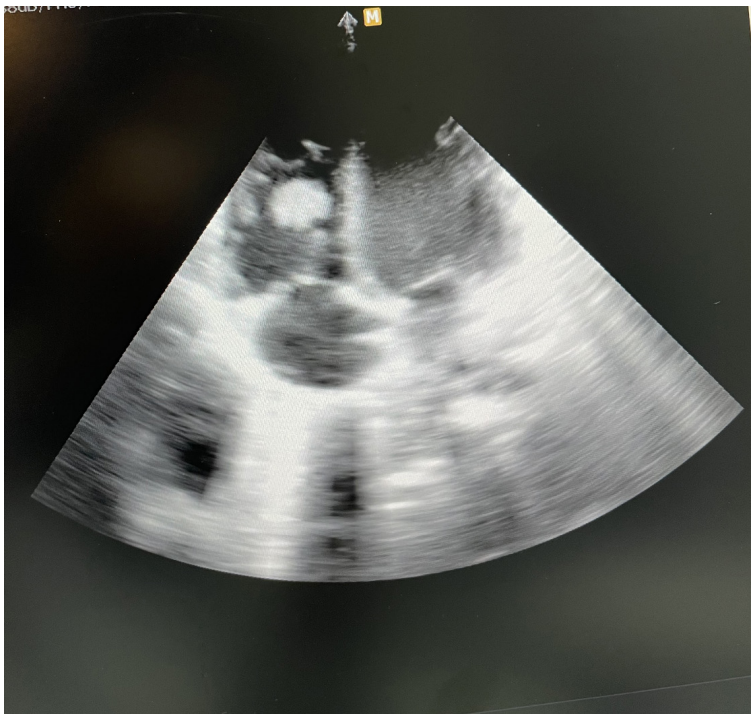

Figure 2. Transthoracic echocardiography: Large right ventricular thrombosis (white arrow).

120/70 mmHg and inotrope discontinued. The platelet counts gradually increased and eventually reached to the normal value, and clinical status improved in the consecutive days. Coagulation profile of the patient showed no hyper-coagulopathy state.

On the fifth day of hospitalization, the patient was extubated. Patient's EF had reached to 45% and RV function improved. There was no evidence of previous DVT on color Doppler ultrasound of the right upper limb. Finally, the patient was treated with oral rivaroxaban and discharged on day 12.

3.Discussion

In this report, we present a child with suicidal ALP poisoning and large RV thrombosis who was treated successfully with systemic thrombolysis. Cardiac involvement in ALP poisoning is prevalent. Myocardial damage reported in 60-100 % of patients (3). Thrombotic complications were reported in some case reports which may be due to myocardial and vascular damage in ALP poisoning (3-5). Intra-cardiac thrombosis is a rare complication in ALP poisoning and were reported in some adult case reports (3, 4). As far as we know this is the first case of child poisoning with suicidal ALP poisoning and RV thrombosis. All of the previous reports have presented in patients with thrombus formation in left ventricle (LV) with severe systolic LV dysfunction. RV thrombosis may be in transit from deep vein thrombosis or develop in the right ventricle (6, 7). More than 90% of patients with RV thrombosis have concomitant pulmonary thromboembolism (PTE) (8). Mortality reported to be as high as 27-45% if poisoned cases treated appropriately and up to 100% in untreated patients,

while PTE mortality is 2.5% in patients without RV thrombosis (6). RV thrombus needs an emergent action and the delay may lead to hemodynamic instability by embolization of another thrombus into pulmonary arteries (7, 9, 10). There are four treatment options for RV thrombosis in the literature include anticoagulation, thrombolysis, surgical thrombectomy and percutaneous interventional embolectomy (11). The best treatment approach is in debate and there is no clear guideline (6). Results of various studies are conflicting. In 2016, Barrios D et al. reported no significant mortality and benefit using thrombolysis fallowed by anticoagulation versus anticoagulation alone (12). Their study was not randomized clinical trial (RCT) and only 70 of 325 patients took thrombolytic. Lack of difference in mortality in their results may be due to possible selection of thrombolysis for more high risk patients. Also an old meta-analysis by Kinney et al. in 1989 considered small survival benefit for anticoagulation alone against surgery and thrombolysis. However all of their patients had not concomitant PTE (13).

Most recent studies have reported that thrombolysis and surgery may benefit more than anticoagulation alone. Athappan et al. in 2015 reported 37% mortality rate in patients who had been treated with anticoagulation alone compared to 18% and 13% mortality rate in surgery and thrombolysis groups respectively (10).

It seems that surgical thrombectomy is theoretically the most definite and classic management of RV thrombosis but surgery is an invasive procedure and not available in many centers (9, 10). Some guidelines recommend surgical thrombectomy when thrombolysis is contraindicated or ineffective (14).

Thrombolysis is a simple, rapid and effective treatment, in which it may be administered bedside and doesn't need patient's transfer or special equipment (9). In several case reports, right heart thrombus was managed successfully with thrombolysis (15-18). Some other studies observed the efficacy and safety of thrombolysis in the management of RV thrombosis (8, 9). The main concern about thrombolysis is thrombus dislodgement and embolization to pulmonary arteries (19). But it is an unsubstantiated concern (10) and there is no definite report about this phenomenon. Athappan et al. in 2015 reported no thrombus dislodgement in 122 patients with RV thrombosis who were treated with thrombolysis (10). In the previous studies a low-dose (0.01-0.06 mg/kg/hr, max 2mg/hr) alteplase infusion and a high-dose (0.1-0.5mg/kg/hr max 2mg/hr) alteplase regimen have been described. Low-dose therapy shows equivalent efficacy to high-dose regimens, considering the advantage and potentially less risk of bleeding at lower doses (20). In this patient, the therapeutic effect of low- dose alteplase without bleeding was observed.

Some reports reported the successful treatment of RV thrombus with percutaneous interventional procedures (21). But this therapeutic approach needs special equipment and expertise. Thrombolysis seems to be an appropriate treatment in most patients and surgical thrombectomy and percutaneous interventional procedures are recommended in patients with contraindications of thrombolysis or ineffective thrombolysis. Anticoagulation alone may be considered in selected stable patients who have higher risk of bleeding (22, 23).

4. Conclusion

Right ventricular thrombosis may be seen in ALP poisoning and may be treated by systemic thrombolysis along with conservative management. Randomized clinical trials are needed to determine the best therapeutic approach in patients with right ventricular thrombosis. In this ALP-poisoned child case, systemic thrombolysis along with conservative management could save the child from a non-reported complication of ALP.

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Conflict of interest

The authors declare that they have no conflict of interest.

Ethical Approval:

This study is In accordance with Helsinki declaration and waived from ethical clearance due to retrospective nature of the study.

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