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CASE REPORT

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Acute naphthalene toxicity following ingestion of mothballs and ethyl alcohol: a case report.

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ABSTRACT

Naphthalene poisoning is an uncommon poisoning due to its pungent smell, taste, insolubility in water, and poor absorption from the gut following exposure to naphthalene-containing compounds such as mothballs. Paradichlorobenzene has been reported to dissolve more quickly in alcohol. Within a period of 48-96 hours following naphthalene mothball exposure patient presents with acute onset of non-bloody bilious vomiting, dark brown urine and watery diarrhoea. We present a diagnostic and therapeutic challenge while treating a 27 years old male admitted to the intensive care unit with features of acute naphthalene-toxicity, methemoglobinemia and acute kidney injury following accidental ingestion of mothballs and ethyl alcohol. His vital signs at the time of intensive care unit admission included fever, tachycardia, and hypotension, and his laboratory workup demonstrates hyperbilirubinemia with indirect predominance, hemolytic anaemia, methemoglobinemia, and renal dysfunction. Treatment options include supportive care, red cell transfusion, ascorbic acid, methylene blue, and N-acetylcysteine. The importance of obtaining a careful history and clinical findings is of paramount importance, especially in making the right diagnosis and a successful outcome largely depends on it.

KEY WORDS: Naphthalene balls, mothballs, ethyl alcohol, toxicity, intensive care unit.

INTRODUCTION

Naphthalene is a bicyclic aromatic hydrocarbon ($C_{10}H_8$). Although the International Agency for Research on Cancer classifies naphthalene as a group 2B carcinogen (possibly carcinogenic to humans), it is commonly used in mothballs in developing countries [1]. The lethal dose and concentration of naphthalene are not exactly known. According to published literature, the probable oral lethal dose for adults may range from 5 to 15 g [2]. However, another study found one male who survived after ingesting around 60 g of mothballs [3]. Naphthalene, an ingredient in mothballs, is well absorbed following ingestion, dermal contact, or inhalation. Acute symptoms of naphthalene poisoning include headaches, nausea, vomiting, diarrhoea, and lethargy. Naphthalene poisoning typically induces prolonged hemolytic anaemia and hemoglobinuria [4]. In literature, case reports of death following naphthalene poisoning are uncommon. In this case report, we describe a case of acute Naphthalene toxicity following ingestion of mothballs and ethyl alcohol with methemoglobinemia and acute kidney injury.

CASE REPORT

PATIENT INFORMATION: A 27-year-old male patient was admitted to the emergency department with a chief complaint of Black coloured stool, haematuria, Vomiting, Blurring of vision, and Fever for the last 2-3 days. He has an alleged history of 6-7 naphthalene moth balls intake 72 hours before emergency admission. Before taking moth balls , patient has consumed 50 ml of ethyl alcohol (40% v/v).

CLINICAL FINDINGS: Apart from a History of alcohol intake he has no other history of co-existing co-morbidities on initial workup. At admission Pallor: ++, Temp: 39 °C, Glasgow coma score (GCS): 15/15, Heart Rate (HR): 119 bpm, Non-invasive Blood Pressure (NIBP): 98/60 mm Hg, Respiratory rate (RR): 13/min. Systemic examination was normal. He was not on any routine medications. Abdominal examination was normal, and other systemic examination was unremarkable.

DIAGNOSTIC ASSESSMENT: Initial Arterial blood gas (ABG) obtained showed features of acute respiratory alkalosis P_h 7.49, PCO_2 26, PO_2 145, HCO_3 19.8, Lactate 1.5, Hb 4.7.

THERAPEUTIC INTERVENTION: The patient was further investigated and managed accordingly. The patient received an Infusion of Pantoprazole (5 mg/hr), intravenous fluids (IV) Fluids, and other supportive measures were started and an Upper GI endoscopy was planned after the patient's initial stabilization by the gastroenterology team.

On the same day, the patient received 2 units of Packed red blood cells (PRBC) and 4 Units of Fresh Frozen Plasma (FFP) because of severe anaemia and Coagulopathy.At the time of intensive care unit (ICU) admission, the diagnosis of acute Naphthalene toxicity with intravascular hemolysis with Multiorgan Failure was made. The patient received an infusion of Vitamin-C 1 amp (500 mg) IV 8 hourly, 2 doses of Methylene blue (60 mg) in 50 ml of an aqueous water solution over 30-45 minutes, and an Infusion of N-acetyl cysteine (NAC) 9 grams in 250 ml dextrose normal saline (DNS) over one hour followed by 6 grams in 500 ml DNS

over the next 23 hours followed by 6 grams in 1000 ml DNS over the next 48 hours at a rate of 23.7 ml/hour. The poor prognosis of the patient clinical condition was also explained. Nephrology opinion were sent because of suspected acute kidney injury (AKI) in view of deranged serum Creatinine and decreased Urine-output. Injection of Vitamin K, and Syrup Sucralfate 10 ml 8 hourly were continued. Initially, antibiotics like Ceftriaxone and Levofloxacin were started empirically but later on it was escalated to Injection of Doripenem 500 mg IV BD and Injection of Metronidazole 500 mg IV 8 hourly added based on local antibiogram policy. The clear liquid was allowed, and normal saline was started at a rate of 100 ml/Hour, Plan was to transfuse another unit of PRBC, and further monitoring of vitals and input-output charting was advised. On the day of ICU admission (Day-1) ophthalmology opinion was taken with the following findings normal visual acuity in both eyes, normal anterior segment, normal pupillary response, and no macular oedema and Roths spot were seen. Meanwhile, 2-D echocardiography (ECHO) showed Normal ECHO findings with > 60% LVEF and he tested negative for the malarial parasite, COVID-19 antigen Test, Dengue fever NS-1 antigen, and Typhoid IG-M (Positive for Typhi-dot IG-G) and Non-contrast computed tomography scan-Kidney urinary bladder (NCCT-KUB): Showed bilateral normal Kidney with no cortical necrosis changes. Heparin-free hemodialysis with 2 L of ultrafiltrate removal was advised and One unit of PRBC transfusion because of the rising trend of serum creatinine on the next day (Day-2). The patient was kept on oxygen at a rate between 7-12 L/min using a high-flow oxygen mask for maintenance of oxygenation.

On Day 2 of ICU admission because of tachypnea and shortness of breath patient was kept on a non-invasive mode Continuous Positive Airway Pressure (CPAP) of ventilation for maintenance of oxygenation and ventilation (IPAP 12 cm H_2O, PEEP 8 cm H_2O, and FiO_2 80-90 %). Presence of bilateral fine crepitation and Chest X-ray findings of bilateral pulmonary oedema, diagnosis of Transfusion-related lung injury (TRALI) was made and continuation of Non-invasive ventilation (NIV) with an infusion of Furosemide at a rate of 2.1 ml/hour and nebulization of asthalin and N acetylcysteine was added. Injection of clindamycin 600 mg 8 hourly was added and total parenteral nutrition (TPN) at a rate of 70 ml/hour, and N-acetyl cysteine infusion @ 20.3 ml/hour was continued.

On Day 3 injection metronidazole, tranexamic acid, and NAC nebulization were stopped and an injection of hydrocortisone 100 mg 8 hourly was added. On Day 4, the third session of Heparin-free Hemodialysis was completed, and 2500 ml of ultrafiltrate and two units of PRBC were transfused. A total of 7 units of PRBC and 4 units of FFP + 2L/day+2L/day+2.5L/day= 6.5 Litres of ultrafiltrate were removed on three consecutive days. Chest physiotherapy and incentive spirometry was continued. On Day 5, the fourth session of Heparin-free Hemodialysis was done.

FOLLOW UP AND OUTCOMES: The patient gradually started to improve and the shortness of breath was resolved patient was maintaining oxygenation on room air with stable vitals. The patient then shifted to HDU (High Dependency Unit) on day 9th and he was discharged on the 10th day after hospital admission. Table 1 showed daily ABG trends and Table 2 show the progress of laboratory parameters during ICU stay.

Table 1. Daily ABG Trends.

Arterial Blood Gas (ABG)		Day-1	Day-2 Morning	Day-2 Evening	Day-3 Morning	Day-3 Evening	Day-4 Morning	Day-4 Evening	Day-5 Morning	Day-5 Evening	Day-6 Morning	Day-6 Evening	Day-7 Morning	Day-7 Evening	Day-8	Day-9
Parameters	Normal Range	Room Air	NRBM 7 L/min	NRBM 10 L/min	NRBM 10 L/min	NRBM 12 L/min	CPAP PS 12 PEEP 8 FiO_2 90%	CPAP PS 12 PEEP 8 FiO_2 70%	CPAP PS 12 PEEP 6 FiO_2 60%	CPAP PS 12 PEEP 8 FiO_2 90%	CPAP PS 12 PEEP 8 FiO_2 60%	CPAP PS 10 PEEP 6 FiO_2 40%	CPAP PS 10 PEEP 6 FiO_2 40%	CPAP PS 9 PEEP 6 FiO_2 40%	FM 5 L/min	NP 2 L/min
PH	7.35-7.45	7.49	7.45	7.45	7.39	7.45	7.40	7.47	7.47	7.48	7.42	7.43	7.40	7.44	7.39	7.45
PO_2 (mm Hg)	80-100	145	72	240	58	43	62	55	57	149	100	131	120	127	98	84
PCO_2 (mmHg)	35-45	26	16	37	30	31	33	33	37	39	43	34	30	33	35	34
HCO_3 (mmol/L)	22-24	19.8	11.1	25.7	18.2	21.5	20.4	24	26.9	29	27.9	22.6	18.6	22.4	22.5	23.6
Lactate (mmol/L)	0.6-1.2	1.5	6.1	2	1.9	1.9	2.7	3.3	1.8.	1.2	1.1	0.9	1.4	0.9	0.7	0.9

NRBM: Non rebreathing face mask; CPAP: Continuous positive airway pressure (cm H_2O); PS: Pressure Support (cm H_2O);
PEEP: Positive end expiratory pressure (cm H_2O); FiO_2:Fractional inspired oxygen concentration; FM: Face mask; NP: Nasal Prong

Table 2. Daily trends of hematological and biochemical Investigations.

Test Name	Normal Range	Day -1	Day-2	Day-3	Day-4	Day-5	Day-6	Day-7	Day-8	Day-9
Hb (gram/dl)	12-15 g/dL	3	5.9	6.3	6.8	7.1	6.2	8.6	9.3	9.8
TLC (cells/mm3)	(4-10) x $10^3/\mu L$	10,540	18,250	18,620	13,860	11,900	9550	10,530	9800	11,650
Platelet Count (cells/mm3)	(150-450) x $10^3/\mu L$	1,11,000	1,16,5000	1,44,000	1,23,000	1,07,000	77,000	1,06,000	1,38,000	2,15,000
PT	< 14 second	24.98	23.37	21.97	21.65	21.50	18.40	21.18	19.98	20.21
INR	0.8-1.0	1.74	1.68	1.52	1.50	1.48	1.30	1.46	1.38	1.41
Bilirubin Total (mg/dl)	0.3-1.2 Direct < 0.3 Indirect < 1	5.4 Direct: 2.30 Indirect: 3.10	9.8 Direct: 5.50 Indirect: 4.30	9.4 Direct: 5.2 Indirect: 4.2	9.0 Direct: 4.5 Indirect: 4.5	8.7 Direct: 4.4 Indirect: 4.3	4.5 Direct: 2.20 Indirect: 2.30	2.50 Direct: 1.10 Indirect: 1.40	1.50 Direct: 1.10 Indirect: 0.40	0.90 Direct: 0.50 Indirect: 0.40
SGPT (U/L)	13-40	17	75	73	68	65	55	35	20	18
SGOT (U/L)	< 37	109	248	252	256	235	140	85	45	26
Creatinine (mg/dl)	0.7-1.3	3.90	5.80	7.50	6.50	5.8	3.8	3.1	2.65	1.23
Urea (mg/dl)	13-43	151	223.7	270.7	206.8	143.7	126.1	118.4	112.9	88.2
Sodium (mmol/L)	135-145	141	143.8	146.8	144.7	139.6	138.4	134.5	136.4	135.8
Potassium(mmol/L)	3.5-5	5.2	4.8	4.6	3.7	3.8	3.8	3.4	3.7	3.6
FBS mg/dl	90-110	117	156	138	135	180	138	126	104	110
LDH (U/L)	230-460	2996	3100	3236	2599	1747	1381	851	642	604
Met-hemoglobin Assay (%)	0-2	9.9	9.6	6.9	6.0	4.7	3.4	3.0	2.8	1.2

TLC: Total leucocyte count; SGOT: Serum glutamic oxaloacetic transaminase; SGPT: Serum glutamic-pyruvic transaminase;
PT: Prothrombin time; INR: International normalized ratio; LDH: Lactate dehydrogenase FBS: Fasting blood sugar

DISCUSSION

Naphthalene mothballs are commonly used in households. It has rarely been an agent of poisoning worldwide [5]. Severe haemolysis from naphthalene poisoning is rare and can be a challenge to clinicians. Naphthalene is almost insoluble in water but is soluble in benzene, toluene, ether, and several other organic solvents [6]. Paradichlorobenzene has been reported to dissolve more quickly in alcohol [7] In our case patient consumed ethyl alcohol and then ingested 6-7 naphthalene balls (Paradichlorobenzene) and after one hour patient complained of vomiting, pain abdomen, blurring of vision and other toxic symptoms. Studies have demonstrated that toxic manifestations of naphthalene may be due to the enhanced production of free oxygen radicals, resulting in lipid peroxidation and deoxyribonucleic acid damage [8]. Ascorbic acid acts as a free radical scavenger and hence may be useful in this situation [9]. Haemolysis occurs particularly in patients with G6PD deficiency, who have a low tolerance to oxidative stress. Renal failure as a complication of naphthalene-induced haemolysis and haemoglobinuria has been reported [10]. Methaemoglobinaemia commonly occurs in naphthalene poisoning, however, in our case no Methaemoglobinaemia was present as the co-oximetry test was normal.

Kundra TS et al. reported a case of a 29-year-old girl who ingested 8 mothballs, and presented two days later with haemolysis and methaemoglobinaemia [11]. She was given intravenous methylene blue, N-acetylcysteine and ascorbic acid, besides supportive treatment. Uthuman AAA. et al. reported a case of a 33-year-old Sri Lankan woman after the self-ingestion of 15 naphthalene balls presented with intravascular hemolysis without features of pigment nephropathy or methemoglobinemia and was symptomatically managed with blood transfusion and adequate hydration [12]. Ekambaram S. et al. reported a 2 years old child with naphthalene-induced acute severe hemolytic anaemia with acute kidney injury from accidental ingestion of naphthalene balls [13]. Hassan KS et al. reported a case of severe hemolysis due to G6PD deficiency manifesting as methemoglobinemia in a 70-year-old Omani male who was never known to have any previous hemolytic episodes or previously diagnosed with G6PD deficiency [14]. Karthick CA et al. describe a case of naphthalene poisoning in a 2-year-old boy with rare manifestations of metabolic acidosis, methemoglobinemia and hemolytic anaemia which was managed successfully with red blood cell transfusion, IV methylene blue and sodium bicarbonate [15]. Volney G. et al. reported a case of naphthalene toxicity in a 20-year-old autistic male, who improved with supportive care, red blood cell transfusion, and ascorbic acid [16].

CONCLUSIONS

Naphthalene toxicity requires a high level of suspicion if exposure is unknown. Exact guidelines for the treatment of naphthalene poisoning based on the mode and severity of toxicity are unknown. Treatment includes supportive care, with intravenous hydration, respiratory and blood pressure support, and possibly renal replacement therapy.

SUPPLEMENTARY INFORMATION

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Informed Consent Statement: *Informed consent was obtained from all subjects involved in the study.*
Data Availability Statement: *The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.*
Conflicts of Interest: *The authors declare no conflicts of interest.*

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