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CASE REPORT

Acute Intravascular Hemolysis and Methemoglobinemia Following Naphthalene Ball Poisoning

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Abstract Naphthalene ($C_{10}H_8$) is a natural component of fossil fuels such as petroleum, diesel and coal. The common consumer products made from naphthalene are moth repellents, in the form of mothballs or crystals, and toilet deodorant blocks. Major toxic effects of naphthalene are due to precipitation of acute intravascular hemolysis. Very few cases of naphthalene poisoning and its effects have been reported from India. We report a case of accidental naphthalene poisoning, who presented with intravascular hemolysis and methemoglobinemia.

Keywords Methemoglobinemia · Naphthalene · Intravascular hemolysis · Methylene blue

Naphthalene ($C_{10}H_8$) is a natural component of fossil fuels such as petroleum, diesel and coal. The major commercial use of naphthalene is to make other chemicals used in making polyvinyl chloride plastics. The common consumer products made from naphthalene are moth repellents, in the form of mothballs or crystals, and toilet deodorant blocks. It is also used for making dyes, resins, leather tanning agents, and the insecticide carbaryl [1]. Naphthalene itself is a strong oxidizing agent, leading to formation of free oxygen radicals, which in turn cause erythrocyte membrane damage. It also leads to depletion of glutathione, a major reducing agent which protects erythrocyte from damaging effects of various oxidants [1]. Major toxic effects of naphthalene are due to precipitation of acute intravascular hemolysis. Naphthalene poisoning has been commonly reported in children who accidently suck or chew the moth balls [1, 2]. Very few cases of naphthalene poisoning and its effects have been reported from India [3]. We report a case of accidental naphthalene poisoning, who presented with intravascular hemolysis and methemoglobinemia.

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Case Report

A 14 years old boy, known case of Autism with generalized seizures on sodium valproate, was brought by his parents 36 h after suspected accidental consumption of unknown quantity of naphthalene balls. He had 3–4 episodes of non-projectile, bilious vomiting with typical odour and pieces of naphthalene balls which were noticed by his mother in the vomitus. Following this episode he passed dark cola colored urine and he was brought to the emergency services of our hospital. On examination he was afebrile, with heart rate of 120/min, respiratory rate 34/min and blood pressure 122/78 mmHg. He was pale, icteric and had central cyanosis (Fig. 1). Oxygen saturation (SpO_2) was 86 % on pulse oximeter which rose marginally to 88 % with oxygen supplementation without any breathlessness. There were no petechiae, purpura or any other rash. His neurological examination revealed autistic features with moderate mental impairment. Other systemic examination was essentially normal. Urinary catheterisation collected dark-brown urine (Fig. 2), which tested positive for blood on dipstick. The urine microscopy did not reveal significant red blood cells (RBC) content or casts, suggesting haemoglobinuria. Provisional diagnosis of haemolysis, haemoglobinuria and possibly methaemoglobinaemia secondary to naphthalene toxicity was made.

His hemoglobin (Hb) was 9.1 gm/dL, total WBC count 16,000 cells/mm^3, platelet count of 195,000 cells/mm^3. Peripheral smear showed hemolysis as evidenced by the

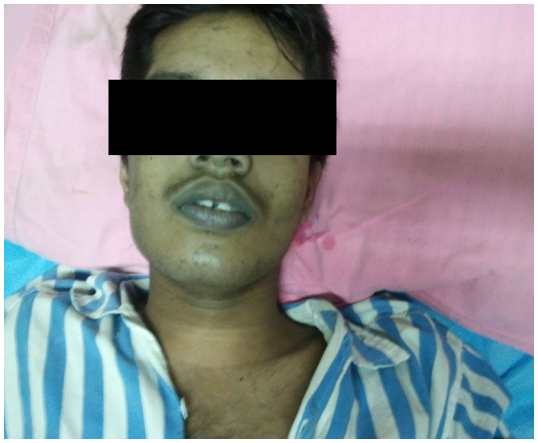

Fig. 1 *Bluish* discoloration of lips, signifying cyanosis. (Color figure online)

Fig. 2 *Dark brown* urine collected by catheterisation. (Color figure online)

presence of nRBCs, spherocytes and fragmented RBCs with reticulocyte count of 2.4 %. His total bilirubin was 3.9 mg/dL, with the indirect fraction measuring 2.1 mg/dL. His LDH levels were markedly raised to 2,544 IU/L. His liver enzymes, renal functions and coagulation profile were all normal. Arterial blood gas analysis (ABG) revealed pH of 7.45, pO_2 108 mmHg, pCO_2 34.4 mmHg and HCO_3 23.2 mmol/L. Methemoglobin levels were estimated in whole blood by spectrophotometry which showed levels of 12 % (normal 0.00–2.00 %) His G6PD levels were within normal limits.

He was started on oxygen inhalation, intravenous (IV) fluids, forced alkaline diuresis to maintain alkaline pH > 7.0, ascorbic acid 500 mg once daily, N-acetylcysteine 600 mg three times daily, and blood component support (3 units of packed RBCs over 0–4 days). IV methylene blue was given at a dose of 1 mg/kg (50 mg) and repeated after 1 h for 2 days. He was continued on

Table 1 Progression of Hb and biochemical parameters during admission

Day of admission	Day 1	Day 2	Day 3	Day 4	Day 5	Day 7
Hb (gm/dL)	9.1	8.3	8.9	6.5	9.2	9.7
Blood urea (mg/dL)	41	37	35	22	15	15
Serum bilirubin (mg/dL)	3.9	4.2	4.2	3.0	1.4	1.0
Serum LDH (IU/L)	2,544	3,080	3,719	2,171	1,035	
Methemoglobin (%)	12				1.2	

anti-epileptic drugs. His Hb level fell to 6.5 gm/dL over next 3 days with bilirubin rising to 4.1 mg/dL. However, his renal functions remained normal with good urine output. There was no UGI bleed. He improved subsequently, with improvement in oxygen saturation and normalization of Hb and other biochemical parameters (Table 1). His urine progressively cleared from dark brown to clear urine. He was finally discharged on day 7 of admission.

Discussion

Naphthalene balls are commonly used in Indian households as moth repellants or toilet deodorant blocks. Naphthalene is a bicyclic aromatic hydrocarbon with a molecular weight of 128 ($C_{10}H_8$). It is poorly soluble in water, and one mothball (depending on size) can contain between 0.5–5 g of naphthalene [4]. The clinical consequences of naphthalene ingestion may include headache, vomiting, diarrhoea, abdominal pain, fever and altered mental status [5]. Most significant toxicity of naphthalene, though is hematologic. Usual order of events, occurring as early as 0–1 day after exposure is intravascular hemolysis leading to sharp fall in hemoglobin [3] as was seen in our patient. Patients may develop acute oliguric renal failure due to hemoglobinuria and dehydration [2, 3]. Neurological complications usually occur within 3–4 days and are due to cerebral anoxia [5]. Majority of the cases have been reported in young children with accidental exposure to naphthalene balls [6]. Accidental poisoning with naphthalene occurs much more commonly than is reported in biomedical literature [7]. In 1989 there were 2,300 reported ingestion of naphthalene ball by children under the age of 6 in United States alone [8]. Toddlers may mistake naphthalene balls for candy and may present with severe hemolysis [8].Though most common route for exposure is by ingestion, several cases of toxicity have resulted by inhalation and dermal exposure too [3]. Several factors predispose patients to the serious effects of naphthalene toxicity for example hemolysis following inhalation was reported in 21 newborns exposed to blankets and clothing that had been stored with

naphthalene mothballs during summer [9]. Newborns are especially susceptible to hemolysis as they are unable to conjugate naphthalene metabolites effectively. Glucose-6-phosphate dehydrogenase (G6PD) levels decide the severity of hemolysis with disastrous consequences in patients with G6PD deficiency [3]. There is a wide variability in reaction to exposure dose of naphthalene which largely depends on age of the patient and G6PD status, with toxic effects being reported after ingestion of single moth ball (0.5 gm) also [3].

Role of gastric lavage is doubtful as in most of the patients, time and quantity of ingestion is not known. It is largely unhelpful if patient is brought after 2 h. Milk or fatty meals which may facilitate naphthalene absorption should be avoided for the following 2–3 h [3]. Hemolysis is indicated by drop in hematocrit, presence of reticulocytosis, spherocytes and Heinz bodies on peripheral smear, along with rise in unconjugated serum bilirubin and lactate dehydrogenase (LDH) levels. Our patient had reticulocytosis, reticulocytosis, spherocytosis without evidence of Heinz bodies on peripheral smear. Screening for hemolysis should continue for at least 1 week after exposure. Judicious use of intravenous fluids and urine alkalinisation may prevent renal failure due to tubular precipitation of hemoglobin as seen in our case. If fulminant toxicity occurs, blood transfusions may be necessary as was done in our patient. Presence of cyanosis with normal oxygen saturation on ABG is an indicator of methemoglobinemia. Treatment with methylene blue should be started without delay in such patients. Before administering methylene blue though G6PD levels should be ascertained as methylene blue itself can precipitate severe hemolysis (through the development of Heinz bodies) and can cause paradoxical methaemoglobinemia in G6PD deficient patients [10]. In severe cases with massive intravascular hemolysis double volume exchange transfusion can be life saving [11].

In conclusion naphthalene toxicity can lead to severe intravascular hemolysis and methemoglobinemia. Due to wide use of naphthalene balls in our households, physicians should be aware of potentially disastrous consequences of the exposure.

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