



Dermatological Manifestations of Magnesium and Thermite Poisoning

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Thermite is a metal powder and metal oxide mixture that is pyrotechnic. Thermite conducts an exothermic decrease oxidation process (redox) when inflamed by the heat or chemical reaction. Burning thermite or magnesium produces predominantly thermal injury that may be considered identical to deep partial- or full-thickness thermal burns. While exposure to incendiary metals can occur in many settings, serious burns are most likely to result from industrial or military incidents. The main cause of thermal damage in combustion thermite or magnesium is the identical to the profound burning thermal burning of partial or total thickness. Thermite incendiaries can create several tiny, deep, dispersed molten iron burns. Local anesthetic may make this feasible. Outcomes and complications of incendiary metal burns are similar to other thermal injuries. In this paper we overview magnesium and thermite poisoning dermatologically and their management.

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1. INTRODUCTION

At 632°C, magnesium, a white silvery metal of 24.32, is ignited and burned at 1981°C with its combustion product, magnesium oxide (MgO). Metallic magnesium may fire during an exothermic process in order to create Mg (OH)₂ and hydrogen, for example. In combination with water, hydrogen and oxygen are released [1].

Thermite is a metal powder and metal oxide mixture that is pyrotechnic. Thermite conducts an exothermic decrease oxidation process (redox) when inflamed by the heat or chemical reaction. Although most varieties are not explosives, brief heat and high temperature splashes can occur in a small area. Its effect is comparable to other combustion-oxidizing agents, such as black powder [2]. The powder is made of aluminium and metal oxide, like iron. When ignited or heated, the chemical combination of aluminium and oxygen generates a huge quantity of heat. The reaction temperature of 4.400° F (2.400° C) is estimated [3].

There are two main forms of metal burns: magnesium-based and thermite/thermal burnt. Fire metals are generally found in military or industrial environments, but can even be met in other applications since magnesium shavings are commonly used as a fire-start technique such as for camping, sparking or fireworks [4].

Thermite or magnesium combustion mostly causes thermal injuries which are regarded equivalent to deep thermal or partial burns of full thickness (see Emergent Management of Thermal Burns). Thermite burns may lead to several tiny deep burns containing dispersed molten iron. These particles should be promptly refreshed and eliminated with water. With local anaesthetic, this may be accomplished. Residual particles (magnesium particularly) can also cause chemical eye, skin, and breathing tract damage [5].

In a tiny enclosed area, such as a military vehicle assaulted by a thermal grenade, if exposure to incendiary metals takes place, the intake of hot gases can lead to thermal damage to the respiratory tissue. The tissue fluid allows magnesium particles to react to produce a strong basis for magnesium hydroxide. This strong base can cause alkaline burning in magnesium particles that are not combusted. When the magnesium is burning, it may combine with water

to produce extremely inflammable hydrogen gas (H₂). For certain magnesium burns, water isn't a suggested consumption agent [6].

2. THERMITE

The very high temperatures that are created and the tremendous difficulty of suppressing a response after it is begun thermite usage are dangerous. Throughout the reaction, little streams of molten iron can travel significant distances and melt through metal containers, encountering their content. Flammable metals with relatively low boiling spots like zinc (which boils at 907°C at a temperature of approximately 1370°C below that of thermite burns) might possibly spray heated boiling metal heavily into the air when they are close to a heat reaction [7]. There are numerous uses for thermite reactions. It is not an explosion; instead it works by exhibiting extremely high temperatures in a very tiny region. Intense heat focussed on a tiny location may both be utilised by melting metal from the components, and by infusing molten metal from the thermite reaction itself via metal or welded metal components [8]. In the case of thick steel sections such as locomotive axle frames, thermite may be utilised for repair by welding the piece without removing the component from its place of installation. For fast cutting or soldering of steel like rail tracks thermite can be utilized, without the need for sophisticated or heavy equipment. Deficiencies like slags and voids (holes) are commonly found in such welded joints, therefore much attention is needed to effectively run the process [9].

Armed forces often utilize thermite hand grenades and charges both in the function of the anti-material and in partial destruction of equipment; these are usual if time is not available for safer or thorough techniques. It can be used to kill cryptographic equipment in an emergency if it is in risk of being seized by hostile soldiers. Since ordinary iron thermite is hard to ignite, burns with nearly no flame and has a tiny action radius, standard heat thermite is rarely employed as a fire component on its own. An increase in the amount of gas reaction products in a thermite mixture enhances the thermite transfer rate (and therefore damage) of that particular thermite blend [10].

Defective artillery pieces are a typical military application for thermit, for instance near Pointe

du Hoc, Normandy since the Second World War. In case of silence required to an operation, Thermite can constantly deactivate artillery pieces without using explosive charges. You may achieve this by putting an armoured thermite grenade into the breach, and then close it fast, welding the breach shut and making it difficult to load the weapon. In the barrel of the gun, the grenade is alternatively released into the gun, which causes the weapon to fire. It is hazardous. Thermite can also solder the gun's crossing and lifting mechanism, making proper aiming quite difficult [11].

3. MAGNESIUM

Elemental magnesium is a lightweight gray-white metal, 2/3 of the aluminium density. The lowest melting temperature (923 K (1, 202° F)) is in magnesium and the lowest boiling point is 1,363 K (1,994° F). Magnesium is the 11th largest element in the human body in bulk and is required for all cells and about 300 enzymes. The ions of magnesium interact with ATP, DNA and RNA polyphosphates. Hundreds of enzymes need to work with magnesium ions. Magnesium compounds are used medicinally for aberrant neuronal stimulation or blood vessel spasm under circumstances such as eclampsia and for antacids (e.g. magnesium milk) as a frequent laxative [12].

Magnesium is quite highly flammable, above all if it is powdered or shaved in thin strips, but in mass or mass it is not easy to ignite. Fire and magnesium alloy flamm temperatures can exceed 3,100°C, even with the fire height generally lower than 300 mm (12in) above the burning metal. Once lit, the combustion in nitrogen (magnesium nitride formation), carbon dioxide (magnetic oxide, magnesium carbon) and water continues, causing the extinction of such flames is difficult (forming magnesium oxide and hydrogen, which also combusts due to heat in the presence of additional oxygen) [13].

Following iron and aluminium, magnesium is the third most widely utilised structural metal. In the order: aluminium alloys, die-casting (alloyed with zinc), removal of sulphur in iron and steel manufacturing and titanium manufacture in the Kroll process, are major uses of magnesium. In lightweight materials and alloys, magnesium is employed. For instance, it possesses an exceptionally high specific strength when injected with nanoparticles of silicon carbide [14].

4. MANIFESTATIONS OF POISONING AND MANAGEMENT

The main cause of thermal damage in combustion thermite or magnesium is the identical to the profound burning thermal burning of partial or total thickness. Thermite incendiaries can create several tiny, deep, dispersed molten iron burns. These particles should be refrigerated and removed immediately with water. Local anaesthetic may make this feasible. Residual particles (magnesium in particular) can potentially cause chemical eye, skin and respiratory system injuries. In a tiny enclosed area, such as a military vehicle assaulted by a thermal grenade, if exposure to incendiary metals takes place, the intake of hot gases can lead to thermal damage to the respiratory tissue. The tissue fluid allows magnesium particles to react to produce a strong basis for magnesium hydroxide. This strong base can cause alkaline burning in magnesium particles that are not combusted. When the magnesium is burning, it may combine with water to produce extremely inflammable hydrogen gas (H₂). For these magnesium burns, water is not a suggested drill agent [15].

It is typically clear from the history that the exposure is characterised by the patient or the rescuer describing conditions leading to thermite or magnesium fire exposures. If a patient has burn injuries and has no history, consider magnesium exposure, thermite exposure, or other dangerous substances. Patients with substantial cutaneous burns require vigorous resuscitation according to a formula, such as the resuscitation of Parkland, and urine output monitoring and other key indicators [16].

Initial treatment should involve mechanical removal, if necessary, of any unbranded particles, including wound debridement. Do not flush with water until particles are taken away when particles are present. Use large quantities to quickly wash away leftover magnesium before the following chemical reaction might hurt if water is needed for burning or other cleaning. The region can be submerged or covered with mineral oil to inhibit the burning particles that cannot readily be removed [17].

Provide conventional thermal burning methods for treating burns. Standard assistance for ABCs including, if necessary, intubation and fluid recovery. Cover with dry, sterile or burn-specific treatments the burning regions. Avoid the danger

of hypothermia for broad regions of moist dressings. If the patient's hemodynamic state permits, narcotic analgesia may be beneficial. The treatment of other thermal burns is same in hospital and generally requires topical antibiotics (for example silver sulfadiazine) and operative debridements. Skin grafts may be needed; life support measures may be required Institute [5,6].

The ambulatory treatment is the same as the treatment of other thermal burns. Usual follow-up treatment should be provided to patients by a doctor knowledgeable in burn management. Dressing, topical antibiotics, analgesia and grafting might be used in the treatment. Cycloplegic drops are used to decrease ciliary muscle spasm and relieve discomfort in the outpatient treatment for UV keratitis. To reduce the risk of subsequent infection, topical antibiotics, drops or ointments should be given. In addition, thorough follow-up should take place within 24 hours with an ophthalmologist [18].

The main medicines used are resuscitation fluids, breathing supportive oxygen, tetanus prophylactic, and analgesic. Follow conventional thermal burn injury treatment procedures. Antibiotic therapy may be necessary using intravenous or oral medicines or topical medications (e.g. silver sulfadiazine). UV keratitis treatment consists of ophthalmologic antibiotics and medicines for oral or intravenous discomfort [19].

5. THERMITE OR MAGNESIUM BURNS

Patients with significant dermal burns require aggressive fluid resuscitation, following a formula, such as the Parkland burn resuscitation guidelines, and require monitoring of urinary output and other vital signs. [20].

Thermite burns can deposit molten iron in tissue resulting in very extensive localized tissue damage. Clinicians should assume that these burns are deep partial- or full-thickness until proven otherwise. Magnesium particles can react with tissue fluid to produce magnesium dihydroxide, which produces an alkali chemical burn in addition to direct thermal effects. Retained magnesium particles in skin may produce a lesion that mimics gas gangrene, with tissue necrosis and intra-tissue gas bubbles due to hydrogen gas formed from the same reaction [21].

Inhalation of magnesium dust or magnesium oxide smoke can produce respiratory irritation with potential signs and symptoms as nasal catarrh, productive cough, pneumonitis, including metal fume fever, hypoxia and tachypnea and airway burns (eg, edema, charring) or lung burns, with potential airway obstruction, wheezes or crackles are found on lung examination [22].

6. CONCLUSION

The main cause of thermal damage in combustion thermite or magnesium is the identical to the profound burning thermal burning of partial or total thickness. While exposure to fire metals can happen in many places, severe burns are most frequently due to industrial or military events. The major source of thermal damage in combustion thermite or magnesium is that of deep, partial or complete combustion thermal burning. Thermite fires may produce numerous small, deep, scattered molten burns of iron. This can be made achievable via local anaesthetics. The results of incendiary metal burnings and their consequences are comparable to other thermal wounds.

CONSENT

It's not applicable.

ETHICAL APPROVAL

It's not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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