

Treatment of yellow phosphorus skin burns with silver nitrate instead of copper sulfate

by Song Zong-yue,¹ Lu Yao-ping,² Gu Xue-qí²

SONG ZY, LU YP, GU XQ. Treatment of yellow phosphorus skin burns with silver nitrate instead of copper sulfate. *Scand J Work Environ Health* 11 (1985): suppl 4, 33. The authors recommend the application of silver nitrate solution for the treatment of yellow phosphorus skin burns instead of the traditionally used copper sulfate solution. The latter may cause copper poisoning if absorbed through damaged skin. Silver nitrate treatment has been successfully applied in 13 cases of phosphorus burns.

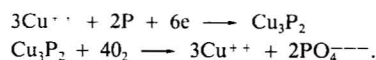
Key terms: external treatment.

Yellow phosphorus is used in industry in many parts of the world for manufacturing pesticides and other products. Workers in unsafe processes may suffer severe skin burns by contact with melted yellow phosphorus. Copper sulfate solution has traditionally been used externally to treat skin burns caused by yellow phosphorus. Recently it was reported that serious adverse effects can follow the application of copper sulfate solution on burnt skin. The evidence is illustrated by the following case report (1):

A male patient, aged 41 years, was admitted with second-degree skin burns caused by melted yellow phosphorus on the lower extremities, on an area of about 7 % of the body surface. After the wound was rinsed and cleaned with water, a 0.4 % copper sulfate solution was applied immediately to the burned area, which was then covered with a gauze pad wet with the same solution. After this treatment, however, and contrary to what had been anticipated, the condition of the patient worsened during the night. He developed nausea and vomiting, hematuria, jaundice, and hepatomegaly. Finally the patient died of acute renal failure on the 11th day. Experimental and clinical studies were carried out to determine the cause of death. These showed that the absorption of copper ion caused hemolysis resulting in the death of the patient.

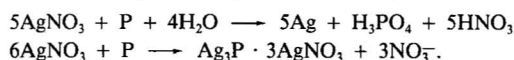
In the treatment of skin damage due to contamination by yellow phosphorus, the prevention of further burning due to phosphorus oxidation is of primary importance.

In general, a 2—5 % copper sulfate solution is conventionally used. The reaction would be as follows:



The granules of Cu_3P_2 are black and they easily decompose; they should therefore be removed as soon as possible, before spontaneous combustion starts

again. The copper ion (Cu^{++}) is absorbed into the bloodstream, where it reacts with different anions. Consequently hemolysis of red blood cells occurs. If 1—3 % silver nitrate is used instead of copper sulfate, copper poisoning can be avoided (2). The possible mechanism is explained by the following reactions:



The silver granules produced by the reaction precipitate onto the surface of the phosphorus and form a thin layer which isolates the phosphorus from oxygen and prevents its further combustion. In this way yellow phosphorus can remain nonflammable for six months or longer, even when exposed to air.

Although silver nitrate may also be absorbed into the body, silver ions react in the blood and tissue fluid with chlorine ions to form silver chloride, which will not cause hemolysis. Furthermore, silver poisoning has never been observed after such application.

We therefore consider silver nitrate to be safer than copper sulfate as an external treatment for melted yellow phosphorus burns. Other symptomatic therapeutic measures, such as a wet compress with 3—5 % sodium bicarbonate solution following silver nitrate application, should also be used.

Since 1978 this improved treatment has been successfully applied in 13 cases. The most seriously affected patient had 15 % of his body surface burned. One-third of the cases had third-degree burns. Other merits of this treatment are smaller scars and the absence of abnormalities of other clinical laboratory tests.

References

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¹ Institute of Occupational Diseases, Zibo, Shan-Dong Province, People's Republic of China.

² Department of Occupational Health, Shanghai First Medical College, 138 Yi Xue Yuan Road, Shanghai 200032, People's Republic of China.