Ind J Clin Biochem (Jan-Mar 2013) 28(1):71–73
DOI 10.1007/s12291-012-0235-6

ORIGINAL ARTICLE

Eye Cosmetic 'Surma': Hidden Threats of Lead Poisoning

K. Goswami

Received: 8 November 2011 / Accepted: 5 June 2012 / Published online: 2 August 2012

Abstract Traditional eye cosmetics 'Surma' use is a popular practice. A total 34 'Surma' samples of black, brown, orange, grey and white were collected and analysed for the presence of lead. High lead levels were detected in all samples except white colour 'Surma'. Blood lead concentrations were measured in 93 children, of whom 69 used 'Surma' regularly. The mean blood lead concentration of 'Surma' users was found to be 29.6 ± 10.2 μg/100 ml; where as non user's value was 4.9 ± 0.8 μg/100 ml. Also, the low haemoglobin levels were observed in the users (10.2 ± 1.4 g/100 ml). In conclusion, the use of 'Surma' is associated with high blood lead concentration with significant reduction of haemoglobin levels. For better quality of life, the use of lead free 'Surma' is suggested.

Keywords Surma · Lead poisoning · Haemoglobinopathy

Introduction

Environmental exposure to lead can be hazardous to human health and is particularly dangerous for children because of their immature neurological system. Children may show behavioural problem or even reduced mental capacity at low exposures to lead [1]. Lead poisoning is a global problem, considered to be the most important environmental disease in children [2]. Pregnant women and children under 6 years of age absorb lead in the highest quantities, and even low levels of lead exposure are considered hazardous to pregnant women [3].

K. Goswami (✉)
Department of Pathology, ESIC Hospital & Occupational Disease Centre (EZ), DH Road, Kolkata 700104, India
e-mail: krishnajyoti@rediffmail.com

Surma, an ore that is mined and ground into a powder, has been used for centuries as a cosmetic and to ward off evil. Manufacturing is not regulated and lead content varies greatly, from 16 to 70 % [3]. Many women also apply 'Surma' to their infant's faces, uninformed about its potential damage to every organ system in the body.

A study of kohl manufactured in Egypt and India found that a third of the samples studied contained lead while the remaining two-thirds contained amorphous carbon, zincite cuprite, goethite, elemental silicon or talc, haematite, aluminium, and organic compounds [3].

The 'Surma' (eye cosmetic) use as eye liner is a popular practice and people firmly believe that it is safe to use. The name 'Surma' derives from the Urdu word for antimony, as its major constituent was antimony sulphide, recently due to scarcity of antimony sulphide, lead sulphide has been used [3]. The 'Surma' is traditionally applied to the conjunctival surfaces rather than to the outside of the eyelids with the help of a metal applicator; used to streak eye powder across the eyeball. Its use is cosmetic and medicinal. It is used to stop bleeding and after circumcision for hygienic measures. When a person uses 'Surma', it can get on to the hands and the user may ingest the lead through hand-to-mouth contact. Some lead may also be absorbed through the eyes. There are fair chances of "Cosmetic Plumbism". However, on the other hand antimony sulphide has been found to induce DNA strand lesions but not DNA protein crosslink [4]. Fumes and melting antimony cause dermatoses and skin lesions [5]. It is difficult for users of this product to tell the difference between safe and dangerous; even "Surma" may contain high level of lead, but is not mentioned as an ingredients on the label. Also, it is still readily available all over the country.

Paediatricians recommend that baby's eyes should be kept free from any application as it can lead to watery eyes,

itchiness, and even allergies and infections [3]. Also, when *kajal* or *surma* is washed off during a bath it passes down through the nasolacrimal duct, which is a small opening between the eyes and the nose. This is a very tiny opening and the duct is also very narrow. Therefore, the *kajal* or *surma* can block it, causing partial or total occlusion.

Prolonged application may result in excessive lead storage in the body, affecting baby's brain and formation of marrow in his bones. Some experts also relate the regular use of *kajal* and *surma* to anaemia and convulsions [3].

Furthermore, the cornea or the pupil is very sensitive. Dirty fingers, sharp and uneven fingernails can hurt baby's eyes. Apart from the immediate pain and the discomfort, the baby may even lose his vision.

The aim of this study was to investigate the association between the use of 'Surma' and blood lead concentrations.

Materials and Methods

In total, 93 children who visited our hospital with various health problems needed a blood test as part of their management. With proper consent, venous blood samples were collected from each child in a heparinised vacuum blood collection tube, to estimate blood lead concentration. The 69 children used 'Surma' frequently on their eyes two or three times daily. The remaining 24 children never applied 'Surma', even on special occasions, who therefore served as controls. Also, 34 samples of 'Surma' ranges in colour from black, brown, orange, grey and white were collected from local market of different brands, including local manufacturer also.

For the quantitative determination of lead, both 'Surma' samples and whole heparinised blood was analysed by atomic absorption spectrophotometer (Perkin-Elmer, AAS 2380) by complexation of the lead with 2 % ammonium pyrrolidine dithiocarbamate and extraction into methyl isobutyl ketone. Constituents of the organic phase were measured at a 283.3 nm wave length with background correction and calibration, by standard addition [6]. The coefficient of variation of the method was 2 %. Haemoglobin was measured by cyanmethaemoglobin method [7, 8]. Both external and internal quality control was maintained, using quality control sera of Bio Rad, USA.

Data were analysed by Student's t test [9]. Result were deemed statistically significant where $p < 0.001$. Also, statistical analysis was conducted using SAS software [10].

Results

The findings were that few (about 5 %) 'Surma' sellers accepted that the ill health effects due to improper 'Surma' preparations. But, the mothers, regular user for several years believed that 'Surma' was good for eye health and a cosmetic also.

Table 1 The concentration of lead, in the 34 samples of 'Surma' collected from local market

Colour of 'Surma'	No. of samples	Lead concentration (%)
Black	7	31.63 ± 9.16
Brown	5	29.51 ± 7.51
Orange	9	32.13 ± 10.82
Grey	7	24.69 ± 6.76
White	6	0.64 ± 0.03

Values represent mean ± SD

Table 2 Distribution of blood lead and haemoglobin concentrations in the 93 children studied

Subject (no. of subjects)	Mean age (in year)	Sex		Blood lead concentration (μg/100 ml)	Haemoglobin (gm/100 ml)
		Male	Female		
'Surma' user (69)	6.7 ± 2.9	20	49	29.6 ± 10.2*	10.2 ± 1.4*
Control group (24)	6.4 ± 3.2	06	18	4.9 ± 0.8	14.5 ± 0.9

Reference haemoglobin levels for human subjects: 11.5–15.0 g/100 ml [8]

Values represent mean ± SD

* $p < 0.001$

The average lead content in 'Surma' from different colours in Table 1 and the results of the investigated parameters are depicted in Table 2.

To determine the presence of lead in 'Surma' 34 different samples of black, brown, orange, grey and white colours were analysed. High lead concentrations in all samples except white 'Surma' contained little or no lead. It is generally noticed that other samples contains lead sulphide and lead oxide.

In Table 2, shows the two groups were not significantly different in respect of the age and sex distributions and religion of the children. The mean blood lead concentration in the 24 children, who were non-user of 'Surma', as a control group was 4.9 ± 0.8 μg/100 ml. In the 69 children, who were users of 'Surma', some of which may not have contaminated by lead or partially contaminated, the mean blood lead concentration was 29.6 ± 10.2 μg/100 ml. The difference between these two groups were statistically significant ($p < 0.001$).

To understand the ill effect of 'Surma', blood showed a significant decreases in haemoglobin with increasing values of blood lead levels ($p < 0.001$) when compared with the group of 'Surma' user and control group. These results clearly demonstrate the association of raised blood lead levels with the reduction of haemoglobin. These findings

also support our previous publication [11], which clearly indicate that environmental lead interferes with haem synthesis, which leads to have low haemoglobin levels.

The non significant p value for lead clearly indicates that lead is found equally in black, brown, orange and grey colour 'Surma' samples. But the white colour 'Surma' samples was significantly lower ($p < 0.001$) compared with others.

Discussion

In the last two decades, evidence of the adverse health effects due to low level of lead exposure has increased the blood lead concentration. This is a matter of concern [1]. At present, the principal sources of lead exposure for children are paint, soil, dust, water, food, etc. New or a more obscure source is 'Surma' which may continue to be a risk and should be suspected in cases of lead poisoning. 'Surma' is used by adults as well as children of both sexes.

In this study, we found a close association between the use of 'Surma' and high blood lead concentration. Clearly, from these results, it appears unlikely that transcorneal transport is a contributory mechanism for absorption of lead. On the other hand, lead might be absorbed across the conjunctiva; lacrimation, eye rubbing and finger sucking are probably the route of ingestion. The 69 children, who are using 'Surma', 36 had blood lead concentrations of 38 μg/100 ml or above, although none of had evidence of lead toxicity. But, the blood analysis of regular 'Surma' users revealed a high blood lead concentration and relatively low haemoglobin levels, which is still health risk or warnings. The effect of lead on the haem biosynthetic pathways inhibits two major enzymes; namely, delta-aminolevunlinic acid dehydratase and ferrochelatase. Also, lead interferes with mitochondrial energy metabolism, which is necessary to reduce ferric iron to ferrous iron before insertion of iron into the porphyrin ring. When iron deficiency is present, ferrochelatase is more sensitive to these effects of lead and result is depression of haematopoiesis [11].

Special attention should be given to the possibility of unusual or unrecognized source of lead exposure and with close follow-up to ensure that a patient is responding appropriately to interventions. Also, to see why there is such a frank disbelief that the cosmetic can cause lead poisoning.

References

1. Goswami K. Environmental pollution of lead: an update review. Res J Chem Environ. 2001;5(1):75–9.
2. Goswami K, Bandyopadhya A, Banerjee SK, Bhattacharya B. Blood lead levels in the population in Calcutta. J Inst Chemists (India). 1999;71(6):211–2.
3. Al-Saleh I, Khalil MA, Taylor A. Lead, erythrocyte proto-porphyrin, and haematological parameters in normal maternal and umbilical cord blood from subjects of the Riyadh region, Saudi Arabia. Arch Environ Health. 1995;50:66–73.
4. Gebel T, Birkenkamp P, Luthin S, Dunkelberg H. Arsenic (III) but not antimony (III), induces DNA-protein cross links. Anticancer Res. 1998;18:4253–7.
5. White GP Jr, Mathias CG, Davin JS. Dermatitis in workers exposed to antimony in a melting process. J Occup Med. 1993;35:392–5.
6. Zinterhofer LJ, Jatlow PI, Fappiano A. Atomic absorption determination of lead in blood and urine in the presence of EDTA. J Lab Clin Med. 1971;78:664–74.
7. Drabkin DL, Austin JH. Spectrophotometric studies: spectrophotometric constant for common haemoglobin derivatives in human, dog and rabbit blood. J Biol Chem. 1932;98:719–33.
8. Lewis SM, Bain BJ, Bates I, Dacie JV. Dacie & Lewis, Practical haematology. 10th ed. Philadelphia: Churchill Livingstone/Elsevier; 2006. p. 26–31.
9. Chatterjee CC. Human physiology, vol II. India: Medical Allied Agency; 1983. p. 10–1.
10. SAS Institute, Inc. SAS Version 6.12. Cary: SAS Institute, Inc; 1996.
11. Goswami K, Bandyopadhyay A, Prasad O. Haematological alterations due to environmental lead exposure in an urban population. Asian J Microbiol Biotech Environ Sci. 2002;4(4):577–80.