Direct oxidant damage to red cells associated with propanil ingestion

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Introduction

Glucose-6-phosphate dehydrogenase (G6PD) deficient red cells haemolyse because of oxidant stress, as the protective mechanisms against such stress are compromised. Infections, drugs and toxins are known causes of haemolysis. Red cells with a normal G6PD too are known to haemolyse owing to oxidation of the haemoglobin molecule after exposure to chemicals which overwhelm the protective mechanisms against oxidative stress. Chlorates, bee and wasp bites, and spider bites cause direct oxidant damage to red cells (1,2,3). Arsine gas (4) lyses red cells by interacting with the sulphhydryl groups in the red cell membranes. Lead (5) interferes with the cation pump and damages the red cell membrane. Copper oxidises (6) intracellular glutathione, haemoglobin, NADPH (nicotinamide adenine dinucleotide phosphate) and inhibits G6PD, and other enzymes. Propanil, a weedicide used in paddy cultivation known to cause haemolysis in rats (7) because of direct oxidant damage. Haemolysis has been reported in two humans in a study of five Sri Lankans (8). However, the absence of G6PD deficiency was not proven in these patients. This case of direct oxidant damage to human red cells by propanil is the first one reported in the literature, in the absence of G6PD deficiency.

Figure 1. Contracted cells / ghost cells in direct oxidant damage to red cells in man due to propanil poisoning. Stain: Leishman stain. Magnification: $\times 40$.

Figure 2. Heinz bodies in the red cells. Stain: Methyl violet. Magnification: $\times 100$.

Case report

A 55-year old male, after an alcoholic binge, had used propanil in his tea instead of sugar. He had no significant illnesses in the past. The following morning he was admitted to hospital with cyanosis, an altered level of consciousness and vomiting. On examination he had central cyanosis. There were no other significant clinical findings.

The following laboratory results were found. Haemoglobin 6.7 g/dl, red cell count $1.86 \times 10^6/\mu\text{l}$, MCV 106 fl, MCH 35.1 pg, MCHC 32.9 g/l, reticulocyte count 27%, platelet count 200 000/ μl and white cell count 17 000/ μg l with

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neutrophils 82% and lymphocytes 18%. Blood picture: the red cells showed a marked polychromasia, numerous ghost cells, a few spherocytes and many nucleated red cells (Figure 1). The white cells showed a marked neutrophil leucocytosis with a left shift and toxic granulations. The platelets appeared normal in number and morphology. These findings were compatible with a haemolytic anaemia caused by oxidant stress to red cells. Supravital staining of the red cells with methyl violet revealed numerous Heinz bodies (Figure 2). Tests for unstable haemoglobins were negative. Serum methaemoglobin was positive. Brewer's test done after recovery from the acute haemolytic episode was normal. Urine haemoglobin was not present. Renal function tests at their worst were, blood urea 167 mg/dl, serum sodium 140 mmol/l, serum potassium 6 mmol/l, and serum creatinine was 566 µmol/l. The hepatic functions were: ALT 242 u/l, AST 527 u/l, total serum bilirubin 3.5 mg/dl, total serum proteins 7.6 g/l, serum albumin 3.7 g/l and serum globulin 3.9 g/l, and prothrombin time 15.9s (INR 1.2). He was treated with intravenous methylene blue, blood transfusions and haemodialysis, and recovered completely in one month.

Comment

Propanil induced direct oxidant stress to normal red cells in experimental rats is a well known phenomenon (7). Propanil has been reported to cause haemolysis in five Sri Lankans (8). However, in the Sri Lankan study the G6PD deficiency and the presence of unstable haemoglobin were

not excluded. In this patient G6PD deficiency and presence of unstable haemoglobin were excluded, and direct oxidant damage to red cells was established.

References

1. Beutler E. Williams Haematology: Haemolytic anaemia due to physical and chemical agents. 5th ed. New York: McGraw-Hill, 1995: 671-2.
2. Dacie JV. The haemolytic anaemias. New York: Grune & Stratton, 1967: 1091.
3. Monzon C, Miles J. Haemolytic anaemia following a wasp sting. *Journal of Paediatrics* 1980; **96**: 1039.
4. Jenkins GC, Ind JE, Kazantzis G, Owen R. Arsine poisoning: Massive haemolysis with minimal impairment of renal function. *BMJ* 1965; **2**: 78.
5. Vincent PC, Blackburn CRB. The effects of heavy metal ions on the human erythrocyte. I. Comparisons of action of several heavy metals. *Australian Journal of Experimental Biology and Medical Science* 1958; **36**: 471.
6. Fairbanks VF. Copper sulphate induced haemolytic anaemia. *Archives of Internal Medicine* 1967; **120**: 428.
7. Mcmillan DC, Bradshaw TP, Hinson JA, Jollow DJ. Role of metabolites in propanil induced haemolytic anaemia. *Applied Pharmacology* 1991; **110**: 70-8.
8. de Silva WA, Bodinayake CK. Propanil poisoning. *Ceylon Medical Journal* 1997; **42**: 81-4.