

BLOOD INDICES IN RELATION TO METHYL ALCOHOL TOXICITY IN RATS

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ABSTRACT

The effects of methyl alcohol toxicity on some blood indices in adult male rats were studied. Male albino rats were injected intraperitoneally with absolute methanol (4 ml/kg body weight). The data revealed a highly significant decrease in total erythrocyte and leucocyte counts concomitant with an increase in hematocrit, hemoglobin, mean cell volume and mean cell hemoglobin following methanol administration. It was concluded that blood indices, in particular mean corpuscular volume, may be used as a test to verify methanol toxicity.

INTRODUCTION

Although methanol poisoning is uncommon, its hazards are increasing due to its being a versatile fuel in energy-conscious societies. Metabolic acidosis, disturbed blood gases and an increased anion and osmolar gaps are the most apparent laboratory manifestations (Gilger and Potts, 1955; Potts, 1955; Clay *et al.*, 1975; McMartin *et al.*, 1975; Hayreh *et al.*, 1980; Jacobsen *et al.*, 1982; Sharpe *et al.*, 1982; Sejersted *et al.*, 1983).

In previous studies (El-Sayed *et al.*, 1989 a & b) on the effect of methanol in our laboratories, it was found that methanol induced hypoxia, acidosis, elevated anion gap and retinal changes in rats contrary to previous reports that stated that rodents were insensitive to methanol (Roe, 1955; Clay *et al.*, 1975; Makar and Tephly, 1976). As far as the authors are aware, very few investigators have studied the blood picture in methanol toxicity in man or animals. Thus in this study it is our aim to further elucidate the effect of methanol in regards some blood parameters in rats.

MATERIALS AND METHODS

Male albino rats were injected intra-peritoneally with 4 ml/kg body weight absolute methanol, a sublethal dose, as determined previously (El Sayed *et al.*, 1989 a). Control animals received an intraperitoneal injection of an equal volume of distilled water. Blood samples were drawn from the retro-orbital venous plexus while the animal was under light ether anaesthesia (Madway *et al.*, 1969). Total erythrocyte and leucocyte counts were determined in duplicate with a standard improved Neubauer hemocytometer. Hematocrit value (Hct) was determined by spinning capillary tubes of heparinized whole blood at 8000 rpm for 20 min. Hemoglobin content (Hb) was determined in duplicate by the Boehringer reagent kits, using a Perkin-Elmer Lambda/AUV/Vis spectrophotometer at 546 nm. Mean corpuscular volume (MCV), the volume of the average erythrocyte was calculated from RBC count and Hct; mean corpuscular hemoglobin (MCH), the weight of hemoglobin in the average erythrocyte, was calculated from RBC count and (Hb); and mean corpuscular hemoglobin concentration (MCHC), the percentage hemoglobin content of the packed cell volume of whole blood, was calculated from Hct and (Hb) (Seiverd, 1972).

RESULTS

Scrutiny of the blood cell counts of the injected rats revealed that the erythrocytes have a highly significant lower average 6 hrs postinjection than the control, reading its minimum value at 24 hrs postinjection. The same trend was seen in the leucocyte count, yet as early as 2 hrs postinjection with its minimum value at 6 hrs postinjection. Both values were then noticed to increase gradually to regain normal counts, although 2 weeks postinjection the leucocytes were still significantly higher (Table 1 and Fig.1) contrarily, disregarding the value obtained 24 hrs postinjection, the hematocrit value was noticed to significantly increase during the course of the experiment .

In the same manner the hemoglobin content increased significantly with the exception of the value obtained one week postinjection where the increase was insignificant (Table 1 and Fig. 1). Changes in MCV, MCH and MCHC in methanol treated rats are presented in Table 1 and Fig.2 illustrating significant increases in their values after methanol administration.

DISCUSSION

Total erythrocyte and leucocyte counts, mean cell hemoglobin and hematocrit values changed significantly ($P < 0.001$) when 4 ml/kg body weight methanol was injected intraperitoneally .

It was observed that there is an inverse correlation between red blood cell count and cell hemoglobin, the former decreasing while the latter increased. This is substantiated by the increased MCH observed in this study. Thus as some of the red blood cells were destroyed, the others enlarged and increased their hemoglobin concentration as indicated by the significant increase of the MCH and MCV. It has been reported by Becker (1983) that the MCV increased significantly in severe cases of methanol poisoning than in mild cases .

The decreased number of red blood cells could be a result of the ensuing acidosis associated with methanol toxicity reported in animals by Haskell *et al.* (1921), Loewy and Munzer (1923), Röe (1946) and El-Sayed *et al.* (1989 a) . Furthermore, it is worth mentioning that methyl alcohol has been characterized by Tyson and Schoenberg (1914) and Isaacs (1920) as a true hemotoxin as a result of which the number of red blood cells would also decrease.

From the two previous causes it follows that the decrease in number of red blood cells could be the cause of the hypoxic state found in methanol poisoning as reported by Benton and Calhoun (1953), Sharpe *et al.* (1982) and El-Sayed *et al.* (1989a), who explained all the degenerative changes observed in the different tissues on the basis that they were deprived of their nutrition and oxygen .

The increase of {Hct} is concomitant to the increase in MCV, which confirms the finding of Deb and Hart (1956) that an increase in {Hct} without an increase in the red cell count, indicates an increase in volume of the red blood cell.

Hannon and Young (1959) stated that in order for MCHC to increase, the hemoglobin content per cell must increase per unit volume of blood .

The increase in the MCH and MCV together with a decrease in red blood cell count indicates that the rate of destruction of red blood corpuscles exceeded the rate of production along with an increase in volume of these cells and an increase in the amount of hemoglobin per cell .

Thus, it may be concluded that there is an important association between methanol poisoning and the various blood indices, in particular the mean corpuscular volume .

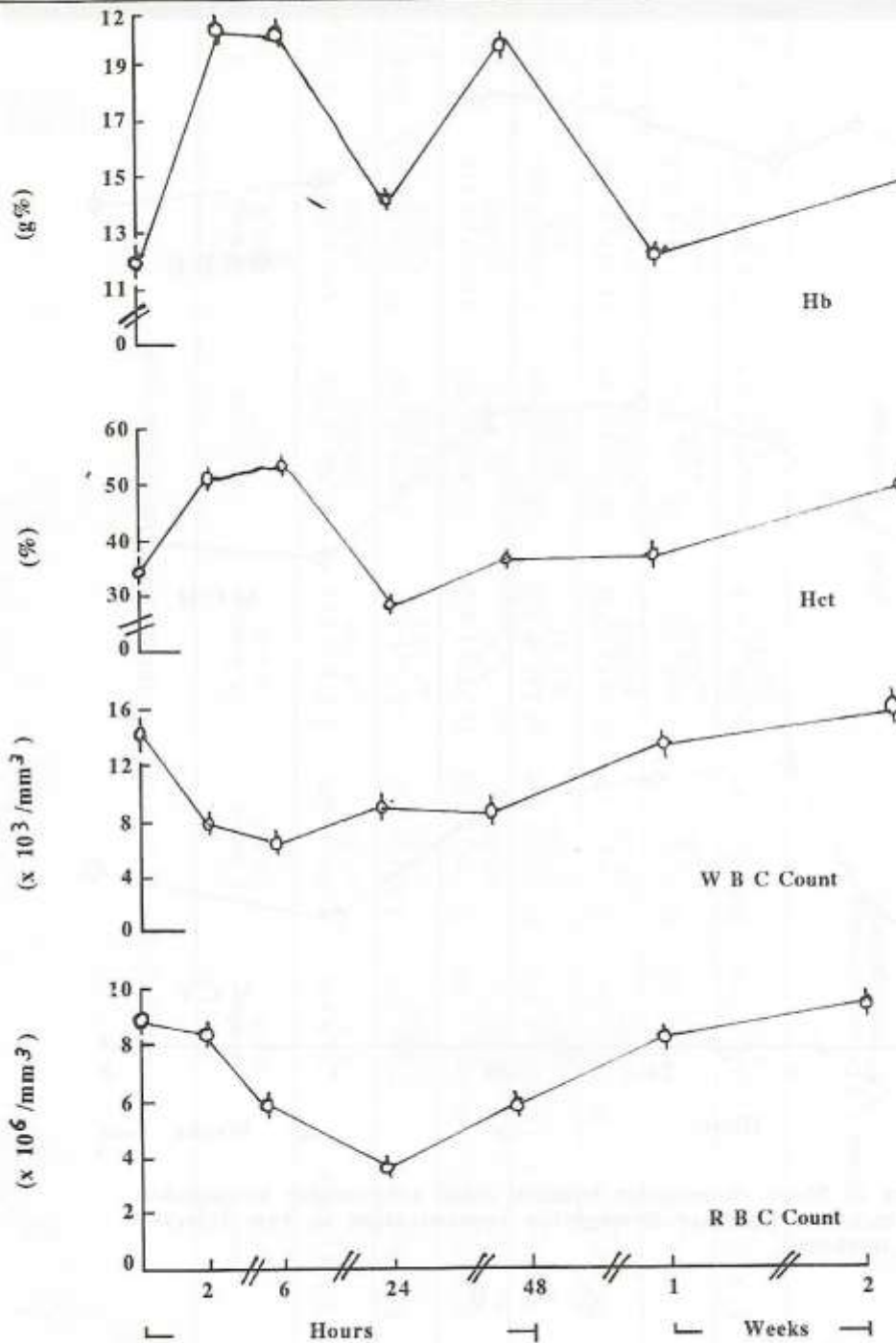


Figure 1: Red and white blood cell counts, hematocrit and hemoglobin values in rats injected with methanol.

$\diamond: \bar{x} \pm S D$

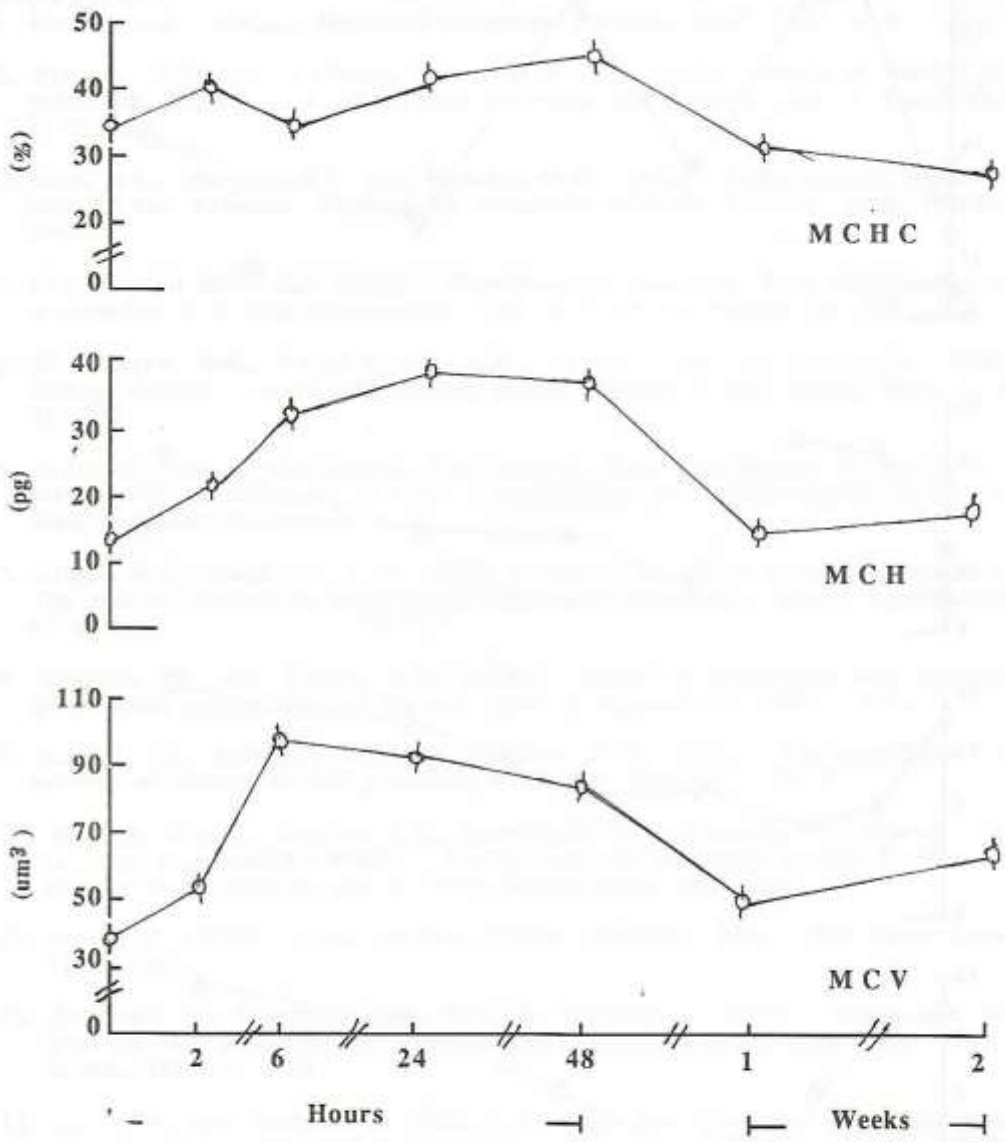


Figure 2: Mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration in rats injected with methanol.

$$\phi : \bar{x} \pm S D$$

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الثوابت الدموية وعلاقتها مع تسمم الكحول الميثيلي في الفئران

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تم دراسة تأثير تسمم الكحول الميثيلي على بعض الثوابت الدموية في ذكور الفئران وقد حققت ذكور الفئران البيضاء في الفشاء البريتوني بكحول ميثيلي (4 مل / كجم وزن جسم) وقد اوضحت النتائج انخفاض حاد في كرات الدم البيضاء والحمراء مع زيادة في الهيماتوكريت والهيموجلوبين ومتوسط حجم الخلية ومتوسط الهيموجلوبين في الخلية بعد الحقن .

وقد انتهى البحث الى اهمية الثوابت الدموية وخصوصاً متوسط حجم الخلية كدليل للتسمم الميثيلي .