Short Communications

The Mean Red Cell Volume in Diabetes Mellitus

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Summary. The Coulter mean red cell volume was found to be significantly elevated in a sample of 100 diabetic patients compared with 200 normal subjects (p < 0.01). There was no correlation between the mean red cell volume level and the type of diabetes, its method of treatment or degree of control as measured by random blood glucose and glycosylated haemoglobin levels.

Key words: Coulter mean red cell volume, diabetes, blood glucose, glycosylated haemoglobin.

In diabetic ketoacidosis a marked but transient elevation of the mean red cell volume (MCV), as measured by the Model S Coulter Counter, has been recently reported [1]. This change in MCV was reversed following correction of the hyperglycaemia and ketoacidotic state.

The Coulter MCV is a reliable and highly reproducible measurement based on cell interference of electrical conductivity and the principle that the amplitude of the voltage pulse is proportional to the volume of the individual cell producing it.

These observations prompted us to undertake a study of the Coulter MCV in a series of diabetic

patients and to determine whether any alteration, if detected, may be related to the type of diabetes, the method or adequacy of its control.

Materials and Methods

One hundred patients with established diabetes mellitus were selected from adults attending the Diabetic Outpatient Clinic. To eliminate factors which commonly alter the MCV, no patient was admitted to the study who had (a) anaemia (Hb < 12 g/dl in females and < 14 g/dl in males) or other blood disorder (b) liver or thyroid disease (c) a history of excessive alcohol intake or (d) who was receiving drugs other than antidiabetic agents.

All patients had a peripheral blood profile performed (Coulter Counter model S calibrated with Coulter 4C) on a venous sample (K_2 EDTA, 1 mg/ml as anticoagulant) within 4 h of venepuncture and a random plasma glucose determined by a glucose-oxidase method. In a further 15 diabetic patients (seven males; eight females), in whom the MCV ranged from 76 to 94 fl, haemoglobin Al_c (HbA_{1c}) was also measured by a semi-automated technique based on the furfuraldehyde/thiobarbituric acid reaction [2].

Results

The diabetic patients comprised 61 females and 39 males with a mean age of 53 years (range 21–79 years). The range and mean values for MCV are shown in Table 1.

Table 1. Coulter red blood cell mean corpuscular volume (MCV) values (fl) in diabetic and normal subjects, divided according to sex

	Males		Females		Total	
	Diabetic	Normal	Diabetic	Normal	Diabetic	Normal
No. of patients	39	100	61	100	100	200
Range of values (fl)	81-99	82-95	83–97	82-95	81-99	82-95
Mean	90.08	88.22	89.80	88.70	89.89	88.46
S. D.	3.837	3.60	3.636	3.75	3.684	3.685
P (t test)	< 0.02		> 0.05		< 0.01	

As shown, the MCV in the diabetic group is significantly greater than that in the control subjects. When separately analysed according to sex, the MCV of the male subgroup remained significantly increased (p < 0.02) but that of the females failed to obtain statistical significance (p > 0.05).

When the patients were categorised according to type of antidiabetic treatment – diet alone (14 patients), biguanide (15 patients), sulphonylurea (18 patients), combined biguanide/sylphonylurea (nine patients) and insulin (44 patients) – the MCV was not statistically different in any of the five groups.

No correlation was established between the MCV and plasma glucose level (mean 9.87 mmol/l, range: 3.4-25.4) in individual patients. Of the 15 patients in whom HbA_{1c} was determined (normal range: 4–7%), six had increased levels ranging from 8.1 to 11.8% indicating poor antidiabetic control during the previous 4–6 weeks. Three of these six patients were first referrals and had received no antidiabetic treatment. There was no correlation between the Coulter MCV and the HbA_{1c} levels.

Discussion

Current literature [3] does not recognise alterations in red cell diameter or volume among the peripheral blood changes in diabetes mellitus nor is diabetes cited as a cause of genuine or spurious red cell macrocytosis [4].

A careful search of the literature, however, reveals that in 1938, Mohr [5] reported that the MCV (derived from the centrifuged haematocrit and manual red cell count) was greater than normal (95 fl) in 14.3% of 42 uncomplicated diabetics and in 35% of 20 patients with diabetic ketoacidosis. He concluded that the increase in cell volume could not be attributed to acidosis *per se* nor was it related to the blood glucose level. These early findings support our recent and current observations which however remain unexplained.

Most surveys of normal populations including our own [6] have shown the Coulter MCV to be marginally but not significantly higher in females [7]. Conversely, the present study revealed the MCV to be higher in male than female diabetics. While studies [8, 9] of the effects of age on MCV have reported conflicting results, no such influence can be implicated in this patient series as the age distribution was very similar in both sexes.

Finally, our findings would appear to indicate that any alteration of the Coulter MCV in the uncomplicated diabetic state is unrelated to the type of diabetes, its form of treatment or its degree of control.

While the possible clinical and pathological significance of these preliminary findings continues to be the subject of our ongoing studies, it is hoped that this communication will stimulate other workers to confirm our results and explore further the red cell volume changes in diabetes and its complications.

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