Red Cell Volume and Plasma Sodium

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Dear Sir,

We read with interest the paper by Hsu et al. 'Bicarbonate hemodialysis: influence on plasma refilling and hemodynamic stability [Nephron 55:202–208 (1984)]. We note that the authors compute change in plasma volume from change in Hct. This assumes constant red cell volume (RCV). They state that no significant change was found in mean corpuscular volume (MCV) except for a small reduction during LoNaAc dialysis. They do not state how MCV was measured and we are concerned that methodological factors may have affected their results.

Change in red cell size might be expected when plasma osmolality is altered by a dialysis-induced change in plasma Na. If MCV is measured using the Coulter R or Coulter-SR counter – as is common practice – it should be noted that this involves dilution of an aliquot of blood in hundreds of times its volume with Isoton R, or Isoton-III R or a similar solution with a fixed and constant osmolality. A consequence of this is that any change in red cell size previously caused by the change in plasma osmolality will be reversed.

Use of mean cell hemoglobin concentration (MCHC = Hb concentration/Hct) avoids this problem. Hb concentration can be measured on an automated device and Hct by a direct microhematocrit method in which red cells remain in their own plasma.

In the course of our studies on fluid shifts on dialysis we have had occasion to compare the two methods. 4 patients were dialysed for 1½ on separate days using 3 different Na dialysate concentrations (154, 140, and 126 mmol/l) under conditions of no net ultrafiltration. Change in RCV was computed from MCV (measured on a Coulter-S counter) and also from MCHC using the formula:

$$RCV(t) = \frac{MCHC(0)}{MCHC(t)} RCV(0)$$

where RCV(t) = RCV at time t, RCV(0) = RCV at time 0, MCHC(t) = MCHC at time t, and MCHC(0) = MCHC

at time 0. Hct values for the computation of MCHC were the mean of 6–8 measurements (method of Pearson and Guthrie [1]). Mean results obtained from the 4 patients are presented below.

We conclude from the MCHC results that, as would be expected from theoretical considerations, red cells shrink when plasma Na is acutely elevated and swell when it is acutely lowered as a result of change in dialysate Na concentration. This is not shown by Coulter-S measurement of MCV which we conclude to be a methodological artefact. It follows that change in plasma volume cannot be calculated accurately from change in Hct when dialysate Na is altered significantly unless allowance is made for change in RCV.

R. Reference

1 Pearson

T.C.; Guthrie

D.L.: Trapped plasma in the microhematocrit. *Am. J. clin. Path.* 75:770–772 (1982).