Effect of Urine Osmolality on Urinary Red Cell Morphology

S.N.	Stephen N.	Turitzin ^a
C.	Carlos	Rotellar ^a
J.F.	James F.	Winchester ^a
R.C.	Robert C.	Mackow ^a
T.A.	Thomas A.	Rakowski ^a
J.J.	John J.	Pahira ^b

Georgetown University Medical Center ^aNephrology Division and ^bDivision of Urology, Washington, D.C., USA

Stephen N. Turitzin, MD, Georgetown University, Medical Center, Nephrology Division, 3800 Reservoir Road, Washington, DC 20007 (USA)

Dear Sir,

We have read with interest the article by De Caes-tecker et al. [1] on the localization of hematuria by red cell analyzers and phase contrast microscopy. We disagree with their conclusion that urine osmolality does not affect the urinary erythrocyte cell size distribution. Although this may be true for situations in which high urine osmolality is encountered, it is not the case for hypotonic urine.

As part of a larger study of urinary red cell morphology following extracorporeal shock wave lithotripsy [2], we examined erythrocyte size distributions in mixtures of blood and urine of different tonicities. We found that low urine osmolality substantially altered red cell size determined by cell counter.

Urine collected from a healthy male volunteer was diluted with varying proportions of distilled water to produce samples with a range of osmolalities from 68 to 758 mosm/kg. One hundred microliters of whole blood was mixed with 10 ml of each of these urine samples. After 30–60 min incubation, 50 μ l of each mixture were added to 25 ml of isotonic buffer for determination of cell size distributions and median cell volume using a cell counter (Electrozone/Celloscope Model 112 CLT, III.). Cell counts were made before and after addition of a lysing agent (Zapoglobinll, Coulter Electronics, Fla.) to eliminate counts due to nonerythrocyte debris. We found that above 210 mosm/kg osmolality had little effect on red cell size, but that below this value median cell volume fell. Figure 1 shows red cell size distributions in urine samples with osmolalities of 89, 140, and 247 mosm/kg. The mean median cell volume in eight urine samples with osmolalities between 68 and 201

- 89 mOsm/Kg
- * 140 mOsm/Kg
- 247 mOsm/Kg

Fig. 1. Cell size frequency distributions of erythrocytes incubated in urines of three different osmolalities.

mosm/kg was 46.6 ± 14.2 fl (mean $\pm$ SD), while the mean median red cell volume in ten urine samples with osmolalities between 228 and 758 mosm/kg was 101.1 ± 9.5 fl. This difference was

statistically significant ($p < 0.001$, Wilcoxon two-sample test). Phase-contrast microscopy revealed that this effect was due to the presence of red cell ghosts which were counted as small cells.

Our finding that urine osmolality affects red cell size distribution is at variance with previous reports [3,4] and that by De Caestecker et al. [1]. Shichiri et al. [3] and Fasset et al. [4] both stated that urine tonicity did not influence the urinary red cell morphology, although neither urine osmolality nor specific gravity were reported. The study of De Caestecker et al. [1] reports only the effect of hyperosmolar urine on the red cell size distribution.

Our study demonstrates that red cell lysis occurs at an urine osmolality less than 210 mosm/kg, producing a left shift in cell size distribution, with associated reduction in

Effect of Urine Osmolality on Urinary Red Cell Morphology

345

median cell volume as determined by a cell counter. These findings may be construed as indicating red cells of glomerular origin. In patients with renal failure, who are often isosthenuric, this might not be a problem. However, misleading results could be obtained when patients have very dilute urine leading to the erroneous diagnosis of renal parenchymal disease, when the source of the bleeding is extraglomerular. Such may be the case in patients with renal calculi for whom high fluid intake is often prescribed and this may explain the finding of Shichiri et al. [3] that patients with kidney stones often had a mixed glomerular and nonglomerular pattern.

In conclusion, we agree with De Caestecker et al. [1] that hyperosmolarity of the urine does not affect the urinary red cell morphology. However, our study shows that hypotonic urine has an important effect on the urinary erythrocyte cell size distribution. We also believe that when a cell counter is used to evaluate urinary red cell morphology, urine osmolality should be obtained and red cell size interpreted accordingly.

References

De Caestecker MP, Hall CL, Basterñeld PT, Smith JG: Localisation of haematuria by red cell analysers and phase contrast microscopy. *Nephron* 1989;52:170–173.

Turitzin SN, Rotellar C, Mackow RC, et al: Urinary erythrocyte morphology following extracorporeal shock wave lithotripsy. In preparation.

Shichiri M, Hosoda K, Nishio Y, Ogura M, Suenaga M, Saito H, Tomura S, Shiigai T: Red-cell-volume distribution curves in diagnosis of glomerular and non-glomerular haematuria. *Lancet* 1988;i:908–911.

Fasset RG, Horgan BA, Mathew TH: Detection of glomerular bleeding by phase-contrast microscopy. *Lancet* 1982;i:1432.