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Title : OSMOLAR EXCRETION, URINE OUTPUT AND CREATININE CLEARANCE

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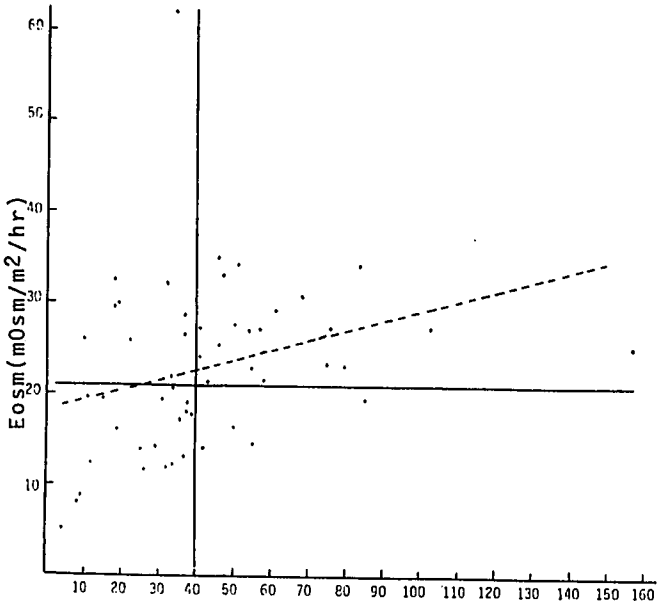
Introduction. Urine flow rate (U.O.) is the most commonly measured variable relevant to renal function in the operating room and intensive care unit (ICU). The lowest acceptable value for urine output (oliguria) is variously stated to be 400 ml/day (~17 ml/hr)[1], 10 ml/hr[2], 1 ml/kg/hr[3], 0.5 ml/kg/hr. These minimal values assume that: (1) urine is excreted with an osmolality of ~1mOsm/ml; (2) the daily osmotic load is about 12 mOsm/kg/day[3]. Ccr is an estimate of glomerular filtration rate (GFR) which is ultimately dependent on glomerular capillary pressure and renal blood flow. In acute situations, reductions in Ccr are due to disturbances in these determinants, which reflect an inadequate hemodynamic state, and, if allowed to persist, may cause acute renal failure. The purpose of this study was to define the correlation of creatinine clearance (Ccr) with U.O. and osmolar excretion (Eosm).

Methods. Twenty-five ICU patients (54 days of data) with indwelling bladder catheters, and who did not receive diuretics had daily serum and timed urine (~24 hours) samples analyzed for osmolality and creatinine. Body surface area (m^2), Ccr (ML/min/m^2), U.O. and Eosm were calculated. U.O. and Eosm were indexed to body weight (kg) and per m^2. The study was approved by the institution's research committee.

Results. U.O. (range:0.3-2.8 ml/kg/hr, 15-116ml/m^2/hr) did not correlate with Ccr (range:4-157ml/m^2/min; mean=43). On nine days U.O. was <0.75 ml/kg/hr: 3 had normal Ccr (>40); 2 severely reduced Ccr (≤12); 4 moderately reduced Ccr (13-39),($p>.1$)). On 4 days U.O. was<20 ml/m^2/hr, 2 with normal Ccr, 2 severely reduced; ($p>.1$). In contrast, Eosm<.5mOsm/hr/kg were found primarily in patients with Ccr<40 (16/20 observations, $p<.005$); ($r=.28$, $p<.05$). Similarly, Eosm/m^2/hr was significantly related to Ccr ($r=.312$, $p<.025$).

Eosm mOsm/hr/m^2	Ccr ml/min/m^2		ABNORMAL Ccr
	<40	≥40	%
<21	19	4	83
≥21	10	21	32
x^2 = 13.4634, $p<.0005$			



Discussion. There is a theoretical critical level of urine output which must be maintained if Ccr is normal. This value requires knowledge of both maximal urinary osmolality (Uosm) and the solute load to be excreted. If maximal Uosm is 1mOsm/ml and solute load is 0.5 mOsm/kg/hr, then minimal U.O. with maximal Uosm and normal Ccr will be 0.5 ml/kg/hr. By calculating Eosm, assumptions about Uosm are bypassed and U.O. is measured, leaving only the assumption of solute load. The correlation with Ccr improves as a consequence. We conclude: that Eosm/m^2/hr is a reflection of Ccr; that urine output as low as 16 ml/m^2/hr, (0.4 ml/kg/hr) is not; that Eosm<21mOsm/m^2/hr indicates a high probability of depressed Ccr; but, that Eosm > 21mOsm/m^2/hr does not assure a normal Ccr.

References.

1. Frazier HS: Evaluation and management of the oliguric patient. Chapt 18 in Skillman JJ, (ed.) Intensive Care. Boston: little Brown and Company, 1975.
2. Jones LW, Weil MH:Changes in urinary output and free water clearance in patients with acute circulatory failure (shock). J Urol 102:121-125, 69.
3. Jenkins MT, Giesecke AH, Johnson ER: The postoperative patient and his fluid and electrolyte requirements. Brit J Anaesth 47: 143-150, 75.