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 Title : TRACKING RENAL FUNCTION IN CRITICALLY ILL PATIENTS
 Authors : B. Shin, M.D., C.F. Mackenzie, M.B., F.F.A.R.C.S, J. Shah, M.D., M. Helrich, M.D.
 Affiliation: Department of Anesthesiology, University of Maryland, School of Medicine, Baltimore, Maryland 21201

Introduction. Urinary diagnostic indices such as urine/plasma (U/P) creatinine ratio <20, U/P osmolality ratio <1.1 and urinary sodium concentration >40 mEq/L have been used for diagnosing oliguric renal failure. Recently free water clearance (CH20), fractional excretion of filtered sodium (FENa) and creatinine clearance (Ccr) have all been advocated for tracking renal function (1,2). These indices, although useful in 90% of oliguric renal failure patients, have not been tested in critically ill patients who receive numerous therapeutic interventions which may alter the validity of these indices. This study was undertaken to evaluate prospectively several urinary indices which are commonly used for tracking renal function in critically ill patients.

Methods. Ninety-one consecutive post-operative and post-traumatic patients who were treated in the intensive care unit longer than two days were studied. Terminal patients and patients who received hyperosmolar fluids or drugs and diuretics were included so that a wide variety of clinical situations might be obtained. The following indices were measured or calculated for each patient daily for an average of 8 days: urinary sodium concentration, U/P osmolality ratio, CH20, Ccr, U/P creatinine ratio, and FENa (sodium clearance/Ccr in percent). Indices were correlated with each other on scatter diagrams and with the occurrence of multiple organ failure (MOF), renal failure, and death. MOF was defined as any dual combination of brain, lung, liver, kidney and wound healing dysfunction. Acute renal failure (ARF) was defined as serum creatinine >3.0 mg/dl, Ccr <20 ml/min and FENa >1.5 for more than two consecutive days.

Results. The occurrence of MOF and death increased linearly with decrease in Ccr (r = 0.94 Table 1). Ten of 13 patients who had Ccr <20 ml/min experienced ARF and the remaining three died within one day. Once Ccr fell below 20 ml/min, fatality rate was high despite aggressive therapy resulting in improvement of renal function.

Table 1: Values of Ccr and clinical course

Ccr, ml/min	patients	MOF	ARF	DEATH
0-20	13	13(100)	10(77)	9(69)
21-40	14	8(57)	0	4(29)
41-80	18	3(16)	0	2(11)
81-	37	0	0	1(3)

Values: the lowest values observed
 Parenthesis: percent

CH20 also correlated well with the incidence of MOF and death rate but not as well as Ccr. (Table 2)

Table 2: CH20 values and clinical course

CH20, ml/hour	PATIENTS	MOF	ARF	DEATH	
positive	0	11	10(91)	5(46)	6(55)
-1 -	-20	12	9(75)	5(42)	5(42)
-21 -	-50	7	2(29)	0	3(43)
-51 -	-300	41	2(5)	0	5(12)

CH20 values: the highest values observed
 Parenthesis: percent

No other indices correlated well with clinical findings. There were poor correlations between Ccr and CH20, Ccr and FENa, and CH20 and FENa. (Table 3). CH20 and FENa appear to be influenced by therapeutic interventions such as administration of fluid, electrolytes, diuretics or other drugs.

Table 3: Relationship between Ccr, CH20, FENa

Total patients with:	Ccr<20	CH20>-20	FENa>1.15
Ccr<20	13	12	11
CH20>-20	12	23	16
FENa>1.5	11	16	41
ARF	10	10	10

Values of blood urea nitrogen were high in all patients with Ccr <20ml/min but not in patients with CH20 >-20 ml/hour or FENa > 1.5. Peak values of blood urea nitrogen averaged 66±37 mg/dl in patients with Ccr < 20, 45±38 mg/dl in patients with CH20 >-20 and 35±32 mg/dl in patients with FENa >1.5. Eight of ten ARF patients were nonoliguric and the remaining two patients experienced only 2-6 days oliguria. **Comment:** Urinary diagnostic indices other than Ccr are influenced by therapeutic interventions so that they are not useful in critically ill patients. Ccr was not only the most sensitive clinical measurement in tracking renal function but also in predicting the development of MOF and prognosis of patients. CH20 values approaching positive values were also a sign of MOF although not as sensitive as Ccr. Ccr values decreasing below 40 ml/min should be a warning of developing MOF and ARF, requiring intervention to maintain optimum tissue perfusion.

References.

1. Miller TR et al: Urinary diagnostic indices in acute renal failure. *Ann Int Med* 89:47-50, 1978.
2. Shin B et al: Postoperative renal failure in trauma patients. *Anesthesiology* 51:3: 218-221, 1979.