

CASE 1—EVALUATION OF DECREASED URINE OUTPUT

A 74 year old male with a history of insulin dependent diabetes, hypertension, and a “cardiac problem” suffered a perforated bowel in late January and underwent emergency surgery for repair; an ileostomy was created. He remained in the intensive care unit, but was transferred to the regular ward in early March and was begun on oral food intake. On March 15, he was begun on Neutraphos supplements when his serum phosphate was noted to be low. Pathology was consulted on March 19 because of hyperkalemia; discontinuation of Neutraphos was suggested because of high potassium content. His renal function continued to deteriorate, and Pathology was consulted again on March 25; measurement of urine electrolytes and osmolality were recommended. Urine urea nitrogen was also measured on March 25 and was 315 mg/dL. The clinical differential diagnoses were acute tubular necrosis, dehydration, or adrenal insufficiency; what is the most likely diagnosis, based on the results presented? What is the significance of the urine osmolality? What further tests would be useful?

SPECIMEN	Na	K	Cl	CO ₂	BUN	Creatinine	Glucose	Osmolality
Mar 15	135	4.1	101	20	4	1.1	251	
Mar 19	127	7.4	97	22	31	1.7	241	
Mar 25	122	7.3	92	17	96	3.4	208	
Urine	<10	33.9	<15			173.0		434

The presence of decreased serum sodium and increased serum potassium in this case led the physicians to suspect the diagnosis of adrenal insufficiency. Because of loss of blood volume caused by sodium loss in the urine, this disease would produce a clinical picture of prerenal azotemia, with high BUN/creatinine ratio, as observed in this case. All three disorders would cause decreased urine output. Initially, based on the serum results, we suggested measurement of urine electrolytes and osmolality to further evaluate the likelihood of each disorder.

With ATN, the kidneys would not be able to conserve sodium or to concentrate the urine; both features were present in these urine chemistries. With adrenal insufficiency, dehydration is due to losses of sodium from the kidney, so that urine sodium should be increased. The low urine sodium rules out this diagnosis. This led us to conclude that prerenal azotemia was the most likely diagnosis in this case.

One problem which the clinicians had with this diagnosis was the relatively low urine osmolality. Most normal individuals should be able to produce much greater

concentration of the urine with maximal reabsorption of water under the influence of ADH. A recollection of the normal constituents of the urine will be instructive in explaining the observed results in this case. Recall that as urine passes through the tubules, most electrolyte is reabsorbed, while waste products such as urea are concentrated in the urine. When urine reaches the collecting ducts (where ADH acts), most solute is composed of urea and, to a lesser degree, sodium and creatinine. As ADH causes water reabsorption, the total solute concentration rises with urea becoming the most concentrated.

In this patient, urine urea nitrogen was only 315 mg/dL, which translates to only 112 mosm/kg. Normally, the ratio of urea to creatinine in urine averages approximately 10-15/1 (in mg/dL concentrations). In this patient, the ratio was less than 1.5/1. This low result is due to extreme malnutrition which was present in this patient. The cause for both the malnutrition and the dehydration were related to the patient's surgery. The patient had been slow to start eating again after his operation, and this caused significant loss of protein from his body. Sodium and water were being lost through the ileostomy which was created at the time of surgery.

We suggested measurement of stool volume, osmolality, and electrolyte concentration to document the amount of each being lost. Stool (ileostomy) losses were about 1.5 liter per day with a sodium concentration of 78 mmol/L. Administration of normal saline to the patient to make up for total losses plus the estimated deficit in body water resulted in normalization of all results within 5 days.