This patient’s disease falls under the general rubric of hyperkalemic renal tubular acidosis (RTA). Since proximal RTA is associated with hypokalemia, the location of this patient’s defect is the distal nephron. Hyperkalemic distal RTA can be divided into three types: aldosterone deficiency, aldosterone resistance, and voltage-dependent RTA. Voltage-dependent RTA results from a decreased capacity to reabsorb sodium in the collecting duct. This, in turn, reduces the lumen-negative potential difference in the tubule, which then reduces proton and potassium secretion. This defect is known to occur in patients with various sickle cell syndromes. This patient has SS disease and therefore might be expected to develop voltage-dependent RTA. This form of acidosis, however, is always associated with an inability to lower the urine pH appropriately during acidemia. This patient had a urine pH of 4.84 when mildly acidotic, a finding which effectively excludes voltage-dependent RTA. The remaining two syndromes are both associated with a normal ability to lower urine pH. The patient also has a history of lead toxicity. The interstitial nephritis of lead is associated with hyporeninemic hypoaldosteronism. The patient clearly had decreased renin and aldosterone levels. In order to conclusively demonstrate that this syndrome was the cause of his hyperkalemic metabolic acidosis, administration of aldosterone or other mineralocorticoid-like hormones should completely reverse his metabolic abnormalities. The available data do not completely exclude aldosterone resistance as the cause of this patient’s disorders. Two types of aldosterone resistance have been described. One is associated with profound salt wastage and hyperkalemic metabolic acidosis. This disorder is seen in very early childhood. Another form of aldosterone resistance has been described in adults which is associated with enhanced permeability of the distal nephron to chloride and is associated with salt retention. The absence of hypertension in this patient argues against this diagnosis. In order to make this diagnosis with finality, we would have to demonstrate that this patient did not respond to mineralocorticoid administration while on a high salt diet, but that he did respond normally, as regards potassium excretion, to the administration of sodium with a poorly reabsorbable anion, i.e., sulfate.

References

Answer to Question 2
Despite the history of vomiting and the virtual absence of chloride in the urine, there is little evidence that this patient had metabolic alkalosis. Bicarbonate concentration is very low. The hypochloremia can almost entirely be accounted for by the hemodilution, i.e., the degree of hypochloremia parallels the degree of hyponatremia. The low blood pH in the presence of any increased anion gap suggests metabolic acidosis. With a bicarbonate concentration of 12 mEq/l one would expect a blood pH considerably lower than the 7.36 observed were this a case of uncomplicated metabolic acidosis. The PCO2 of 18 mm Hg suggests the possibility that there is an associated respiratory alkalosis. The most likely cause of increased anion gap in metabolic acidosis in this patient is alcoholic ketoacidosis. This diagnosis is supported by the finding of a blood alcohol level of 78 mg/dl and trace ketones in the urine. Other causes of metabolic acidosis to be excluded include methanol, salicylates, ethylene glycol, paraldehyde, renal failure, and lactic acidosis. The establishment of a correct diagnosis in a patient such as this is essential, since methanol or ethylene glycol ingestion should be treated with alcohol while, obviously, a patient with alcoholic ketoacidosis should not be given alcohol. An additional piece of information helpful in the establishment of this diagnosis is the pattern of urinary electrolytes. This patient had 93 mEq/l of cation in his urine with only 2 mEq/l of chloride. His urine pH was 5.0. Thus, the cause of the urinary anion gap could not be attributed to a high urinary concentration of bicarbonate. Since there was no reason to think that large amounts of phosphate and sulfate were present in the urine, the anion gap could only be attributed to the presence of the salt of a weak organic acid such as ketoacids.

Another useful piece of laboratory information which should also point toward the diagnosis of alcoholic keto-acidosis is that the calculated osmolality was 227 while the measured was 234. Under ordinary circumstances, the calculated osmolality exceeds the measured osmolality. The observation of the reversal of this pattern suggests the presence of an osmotically active substance other than sodium, potassium, glucose, and urea. The presence of 17mosm/kg H2O of alcohol (78:4.6) identifies the cause of this reversal of calculated and measured osmolality. Bicarbonate was not administered to this patient since his blood pH was close to normal. Even when the blood pH is markedly reduced, bicarbonate should be administered sparingly since the salts of ketoacids represent potential bicarbonate. That is to say, when the generation of increased amounts of ketoacids ceases, these organic salts will be metabolized by the liver to bicarbonate. If large amounts of bicarbonate are given at the same time bicarbonate is regenerated, acute alkalemia may result. The cause of the patient’s respiratory alkalosis is not immediately apparent. It was likely the result of the central nervous system effect of hyponatremia. This is supported by the fact that the patient had a grand mal seizure shortly after arriving in the emergency room attributed to hyponatremia. The hyponatremia was doubtless the result of volume contraction secondary to vomiting and loss of sodium in the urine accompanying the excretion of beta-hydroxybutyrate and acetacetate. This impression is confirmed by the observation of hyponatremia rapidly corrected following the expansion of volume with iso-tonic saline.

References