CASE B—EVALUATION OF HYPONATREMIA

The supervisor in the stat laboratory noticed that the results on a patient in the operating room had changed significantly since the previous evening, as shown in the accompanying table. A repeat specimen gave the same results as that from the second specimen received, while a specimen from two days before agreed with the first specimen. Estimate the calculated osmolality and osmotic gap. What are the possible causes for these findings?

TIME	Na	K	Cl	CO2	BUN	Creatinine	Glucose	Osmolality
2/17, 6 pm	143	5.6	111	17	20	1.6	111	294
2/18, 3 pm	112	4.7	93	16	16	1.3	150	280

Discussion

In this case, there are several considerations. Comparing the results of the second specimen with the first, there is clearly a significant difference in sodium, chloride, and anion gap (anion gap was 15 in the first specimen but only 3 in the second specimen); healthy persons show little variation in these from day to day. There is a large osmotic gap of 42 in the second specimen but a gap of essentially zero in the first specimen. The relatively normal osmolality in the presence of a low sodium suggests the possibility of a specimen containing increased solids, such as protein or lipids. The specimen was not lipemic and preoperative serum protein and albumin were normal. Since excess protein is not administered to patients, these causes can be excluded. Additionally, the slightly lower osmolality indicates some change in total solute, which would not occur with altered protein or lipid. A second possibility is that the two specimens came from different individuals; however, two specimens on the day before surgery from this patient gave the same results, and a second specimen from the operating room had a sodium of 109. The third and, now, most likely, possibility is that the patient has received a hypotonic solution of a drug which is both osmotically active (diluting sodium and lowering osmolality slightly) and an unmeasured cation (lowering the anion gap). While several drugs such as mannitol are osmotically active, few are positively charged. The major candidate likely to cause this picture is the amino acid glycine.

Glycine solutions with relatively high osmolality (between 200 and 220) are commonly used as irrigation fluids during surgical resection of tissue from the bladder, prostate, or uterus. Such procedures are done using electrical cautery with visual inspection; washing the surface is necessary to allow the surgeon to visualize the abnormal tissue and prevent injury to normal tissues. Because the fluid must be infused into the organ under pressure, it could be absorbed through opened blood vessels. Water cannot be used, since its absorption would markedly lower osmolality and could cause hemolysis. Electrolyte solutions such as normal saline cannot be used because they conduct and diffuse electricity. For these reasons, glycine solutions have become the preferred irrigation fluid.

While removal of the lining of the uterus has been associated with absorption of small amounts of glycine, severe hyponatremia from glycine absorption usually occurs during TURP. In resecting the prostate, upwards of 60 liters of irrigation fluid can be used. If the surgeon accidentally cuts into a venous sinus (a large blood vessel in the prostate), many liters of fluid can be absorbed. While the patient is hyponatremic, this does not cause problems in itself, since osmolality is relatively normal. The large amount of fluid can cause edema of the lungs and can impair heart function. The glycine can, either by itself or through generation of ammonia, alter brain function and can even produce coma in cases of extensive absorption. The fall in the sodium provides evidence of the amount of fluid absorbed.

Between 5 and 10% of patients undergoing TURP absorb enough fluid to lower their serum sodium below 125. An osmotic gap proves the presence of glycine, and can be used after surgery to determine the rate of its clearance.