HOSPITAL PHYSICIAN®

INTERNAL MEDICINE BOARD REVIEW MANUAL

Case Studies in Hyponatremia

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Preface

During the past decade, internal medicine has become increasingly challenging. The challenge stems from the evolution of managed care and an associated emphasis on cost containment as well as quality. As a result, it is increasingly important to have and maintain board certification. In addition, some health maintenance organizations and other employers of physicians consider board certification essential for employment. The process of certification requires intensive residency training and successful completion of the American Board of Internal Medicine certification examination.

The *Hospital Physician Internal Medicine Board Review Manual* is a study guide intended to help candidates prepare for the written examination. The manual consists of four publications focusing on selected topics. Space will not permit an exhaustive review; however, Volume 10 targets several of the more commonly encountered conditions or topics in internal medicine. Included in this list are:

- Case Studies in Hyponatremia
- Approach to the Diabetic Foot
- Hypernatremia
- Case Studies in Nephrolithiasis
- Malabsorption Syndromes
- Valvular Heart Diseases
- Secondary Causes of Hypertension

Board examination candidates will find this manual to be a concise review of some of the essential and well-recognized aspects of these topics. The case-based format presents the information in a logical fashion, including clinical presentation, history, etiology, diagnosis, and treatment.

This manual has been developed without the involvement of or review by the American Board of Internal Medicine. It is based on the Series Editor's and Contributors' clinical experience, awareness of new developments in the field of internal medicine, and knowledge of basic components of education contained in our residency training program. The Editors wish all candidates success on the examination.

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Case Studies in Hyponatremia

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I. INTRODUCTION

Hyponatremia is an electrolyte abnormality that occurs when serum sodium levels decrease below 135 mEq/L.[1,2] This condition is common in the hospital population,[1,2] and its incidence may be as high as 15% to 20%. Although hyponatremia affects all races and both sexes equally, it is most commonly found in elderly persons because of the increased frequency of comorbidities that can lower serum sodium levels (eg, cardiac, hepatic, or renal failure).[3] In healthy individuals, hyponatremia does not develop unless water intake is greater than renal water excretion. It is essential to diagnose and treat hyponatremia because it can be fatal. Hypotonic hyponatremia is the most common form of hyponatremia. This article will review the presentations, diagnosis, complications, and treatment of hypotonic hyponatremia using 4 case patients.

II. DEFINITIONS

RENAL FUNCTION

Figure 1 illustrates the renal regulation of sodium and water. Because plasma osmolality is primarily determined by plasma sodium concentration, a true decrease in plasma sodium caused by water excess results in hypo-osmolality (< 280 mOsm/kg H_2O). Therefore, it is evident that water content relative to sodium can alter the plasma osmolality.[4] Most cases of hyponatremia are caused by impaired renal water excretion in the presence of continued water intake. Antidiuretic hormone (ADH) plays a very important role in the regulation of the extracellular volume status (**Figure 2**).[5] The important step in assessing patients with hyponatremia is to differentiate this disorder into the 3 major groups using serum osmolality (**Figure 3**).[6]

HYPONATREMIA

Pseudohyponatremia

Occasionally, plasma sodium is artifactually low in patients with severe hyperlipidemia or hyperproteinemia. Plasma is 93% water with 7% proteins and lipids. Reduction in sodium may result from displacement of plasma water by excess lipids or proteins. The measured serum osmolality is normal or elevated, but the calculated osmolality is low because of the artifactually low serum sodium; therefore, the osmolar gap is increased. This condition is called *pseudohyponatremia.* The patient is not symptomatic from the hyponatremia because osmolality is normal. No treatment is required for the low sodium concentration. Clinicians, however, need to be aware of the method used to determine serum sodium levels in their clinical laboratory. Serum sodium may be measured by indirect ion-specific electrodes. These assays are performed after diluting the sample, making the analysis subject to pseudohyponatremia because the sodium is falsely decreased when lipids are increased. This problem does not occur when a sodium electrode is used to measure the sodium concentration in an undiluted sample. Currently, the sodium electrode technique is in wide clinical use, and false-positive studies of pseudohyponatremia are especially rare.[7,8]

Isotonic Hyponatremia

Iso-osmotic or slightly hypo-osmotic hyponatremia can complicate transurethral resection of the prostate or bladder because large volumes of iso-osmotic (mannitol) or hypo-osmotic (sorbitol or glycine) bladder irrigation solution can be absorbed and result in marked dilutional hyponatremia, which can be associated with neurologic symptoms. The metabolism of sorbitol and glycine to carbon dioxide and water may lead to hypo-osmolality if accumulated fluid and solutes are not rapidly excreted.[8]

Hypertonic Hyponatremia

Severe hyperglycemia in uncontrolled diabetic patients also lowers the plasma sodium concentration. The sodium level is low because of transcellular shifting of water, but the measured serum osmolality is very high. Glucose is an effective osmole; the high glucose concentration causes water movement from the intracellular compartment to the extracellular compartment, thus