

Handbook of
RENAL
THERAPEUTICS

Handbook of RENAL THERAPEUTICS

Edited by
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Preface

This book started out as a "Manual." The idea was to offer straightforward instruction on how to handle patients in whom renal function is altered by intrinsic as well as systemic or extrarenal disease. While we have attempted to provide simple approaches to most conditions, we have gone beyond that and offer here more detailed description of pathophysiology, diagnosis and therapy. Thus, the "Manual" has become a *Handbook*. In so doing we hope we have widened the audience for which the book may be useful. As it now stands, we envision that students, house staff, nephrology trainees, nephrologists, primary-care physicians, and nurses of specialized units, interested in kidney-related disturbances and in alterations of the composition of the extracellular fluid, will benefit from reading the *Handbook*.

While providing a rational background for the treatments outlined, each author has attempted to narrate the reasons why such therapy is utilized. Frequently, the information is provided in tables and figures to which ready reference can be made. The flow-chart approach has also been utilized to illustrate pathophysiological sequence or steps in therapy. In most instances, the discussion of pathophysiology has been limited to what is widely accepted rather than treading into anything controversial, unless the nature of the problem or the nature of our knowledge is ambiguous.

The chapters are grouped by types of disturbances and by clinical conditions to make it easy to find information which can be applied to actual patients. The treatment of each condition has been highlighted for practical purposes.

The authors have had extensive experience in the fields which they cover. This experience comes, not only from practical knowledge, but also from their contributions to clinical investigation in each area.

Their approach to each subject has been to make information as readily accessible as possible. In this way, the *Handbook* can be consulted for bedside use with speed and efficiency.

I would like to thank the contributors and Anna Carmen Rivera, my outstanding secretary, for making this *Handbook* possible.

Manuel Martínez-Maldonado

San Juan, Puerto Rico

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Fluid and Electrolyte Disturbances

Hypo- and Hypernatremia

RALPH A. DeFRONZO and SAMUEL O. THIER

I. NORMAL PHYSIOLOGY OF URINARY DILUTION

The treatment of hyponatremia (serum sodium concentration less than 135 mEq/liter) is critically dependent on establishing the correct diagnosis. Fortunately, both the diagnosis and approach to therapy rest firmly on physiological principles. The presence of low serum sodium concentration indicates an excess of water relative to sodium and can occur in the face of increased, normal, or decreased total body sodium content. To maintain a normal serum sodium concentration, it is necessary for the kidney to excrete an amount of free water that is equal to the free water intake (minus insensible losses, about 400 ml/day). Therefore, to understand the pathophysiology of hyponatremia, it is important to review briefly free water generation by the kidney.

Normal urinary dilution depends on three factors (Fig. 1): (1) adequate delivery of solute to the distal diluting sites (ascending loop of Henle and early distal tubule); (2) functional intactness of the distal diluting sites so that sodium, along with chloride, can be removed at a point where the tubule is impermeable to water, thereby generating free water; and (3) suppression of antidiuretic hormone (ADH) so that any free water generated by the distal diluting sites will not be reabsorbed by the collecting duct.

Adequate sodium delivery to the distal nephron is in turn also dependent on three factors (Fig. 1, sites 1A, 1B, 1C): (1) adequate renal plasma flow;

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