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## **The Paradox of Aciduria in the Presence of Alkalosis Caused by Hypochloremia<sup>\*</sup>**

K. Keller Van Slyke and Everett Idris Evans

<sup>\*</sup>Presented at the Meeting of the American Surgical Association, Hot Springs, Virginia, March 25-27, 1947.

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## THE PARADOX OF ACIDURIA IN THE PRESENCE OF ALKALOSIS CAUSED BY HYPOCHLOREMIA\*

K. KELLER VAN SLYKE, M.D. AND EVERETT IDRIS EVANS, Ph.D., M.D.

WITH THE TECHNICAL ASSISTANCE OF MISS RACHEL LEWIS

RICHMOND, VIRGINIA

FROM THE SURGICAL RESEARCH LABORATORY, MEDICAL COLLEGE OF VIRGINIA, RICHMOND, VIRGINIA

THE PARADOX OF ACID URINE excretion in the presence of internal alkalosis caused by loss of gastric juice is a phenomenon that has been recognized by a few investigators especially interested in the acid-base balance, but remains unfamiliar to most physicians. In this day of sulfonamide therapy and whole blood transfusions, with the accompanying increasing frequency of occasions when alkalization of urine is considered desirable, it becomes pertinent to study the details of a condition in which a low urine pH does not indicate either the desirability or the safety of alkali administration.

An acid urine in the presence of internal alkalosis may be encountered whenever there is severe loss of gastric juice, as by vomiting or gastric suction. The paradoxical combination that results is a plasma of abnormally high pH and bicarbonate content, accompanied by a urine of low pH and practically no bicarbonate content.

The lost gastric juice contains both hydrochloric acid and chlorides of Na and K, chiefly Na.<sup>1,2</sup> Loss of the sodium chloride and its equivalent of water causes dehydration. Loss of the hydrochloric acid causes part of the remaining plasma sodium chloride to be replaced by sodium bicarbonate, causing alkalosis to complicate the chloride loss and dehydration. In this condition, there is such a great depletion of body sodium salts that the kidneys cease to excrete sodium as either chloride or bicarbonate, despite the excessive plasma concentration of the bicarbonate. Urine lacking bicarbonate is acid.<sup>3,4</sup> The condition encountered, therefore, is one in which an internal alkalosis, caused by loss of hydrochloric acid, is accompanied by excretion of acid urine.

As first noted by Haden and Orr in 1923,<sup>5</sup> bicarbonate administration in this condition is contraindicated because it increases the internal alkalosis and hastens the onset of tetany. If such a patient requires alkalization of the urine, the preferable means is infusion of sodium chloride solution; this corrects the dehydration, sodium, and chloride deficit, decreases the internal alkalosis, and, at the same time, permits excretion of an alkaline urine; for alleviation of the body's deficit of sodium salts allows their excretion to be resumed. Of the excreted salts, part are in the form of bicarbonate, excreted from the excess present in the body, so that the urine pH rises. Sodium

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