

An in vivo acid-base nomogram for clinical use

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Summary: An *in vivo* acid-base nomogram is presented. Its construction, limitations and usefulness in diagnosing acid-base disorders are discussed.

Résumé: Nomogramme acide-base *in vivo* utile en clinique

L'article décrit un nomogramme acide-base *in vivo* et passe en revue sa construction, ses limitations et son intérêt pour le diagnostic des troubles de l'équilibre acido-basique.

Nomograms have long been used in the assessment of acid-base disorders. Until recently most were constructed from data derived from the *in vitro* response of blood to perturbations of acid-base equilibrium.^{1,2} Schwartz and Relman³ recognized the limitations of the *in vitro* approach and suggested that knowledge of the response of intact individuals to single respiratory or metabolic disturbances would allow a more rational evaluation of acid-base disorders. *In vivo* response curves for both respiratory⁴⁻⁶ and metabolic⁷⁻¹² acid-base disorders have been developed by Schwartz and others. On the basis of these *in vivo* studies the author has constructed a clinically useful acid-base nomogram with limits described for single respiratory and single metabolic acid-base disturbances (Fig. 1).

On this nomogram PCO_2 (mm. Hg) is plotted on the abscissa and bicarbonate (mEq. per litre) on the ordinate. By adding pH isobars, given any two values of the three acid-base components, PCO_2 , pH and bicarbonate, the third value can be determined from the nomogram. Each pathological acid-

base disorder, together with the appropriate range of *in vivo* physiological compensation, is represented as a shaded band.*

Since the bands describing the various respiratory disorders⁴⁻⁶ represent 95% significance, the values of PCO_2 , pH and bicarbonate for 95% of all patients with a specific respiratory acid-base disturbance would be expected to fall within the limits of the band for that disturbance.

Bands for metabolic acidosis and alkalosis are available from several studies.⁷⁻¹² Rather than rely on any one of these, bands for metabolic acidosis and alkalosis were arbitrarily drawn

from a composite of the individual regression lines in these studies to encompass what appears to be a reasonable range (Fig. 2). On the basis of the available data, no clear separation between acute and chronic metabolic acid-base disorders can be made.

What do plots on the *in vivo* nomogram mean? Acid-base values falling within a band usually represent a single disturbance. However, occasionally such values represent a combination of acid-base disorders, a mixed disturb-

*For example, in simple acute respiratory alkalosis, the pathological alteration (decrease in PCO_2) is shown in relation to the range of physiological compensation (decrease in plasma bicarbonate) to be expected.

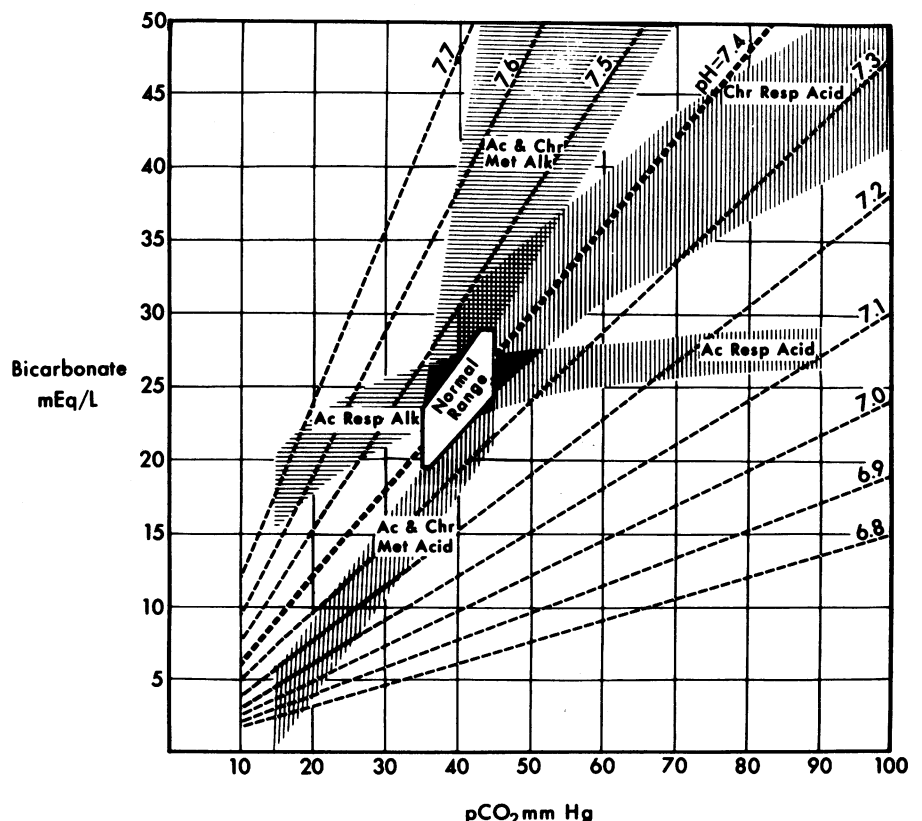


FIG. 1—*In vivo* nomogram showing bands for defining a single respiratory or metabolic acid-base disturbance.

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Dosage

Edema — 100 to 200 mg daily may be required initially to produce the desired response in severe cases of edema. When "dry" weight is reached, average maintenance doses of 100 mg daily should suffice.

50 to 100 mg daily will usually control mild to moderate cases of edema. Dosage level should be adjusted individually as it is often dependent on the patient's salt intake.

Hypertension — 100 mg daily will usually produce the desired response. Once reduction of blood pressure has been attained, mild cases are often controlled on 50 mg daily, while more severe cases may require a higher maintenance dosage. Dosage level should be adjusted individually as it is often dependent on the patient's salt intake.

Note: Divided doses are unnecessary and a single daily dose given in the morning with food is recommended.

The therapeutic effect of Hygroton occurs even without strict salt restriction and is well-sustained during continued use. Its saluretic effect is sufficiently distinct from that of other sulfonamide diuretics so that it may be employed successfully in a high proportion of patients who are intolerant of other agents or who become refractory to them.

Contraindications

Complete renal shutdown.


Precautions


Maintain moderate sodium intake, unless inadvisable, and consider dietary or other potassium supplement. Close observation should be maintained in the presence of cirrhosis, diabetes, gout and digitalis therapy. There is the possibility of hyperuricemia or hyperglycemia. As with any drug, Hygroton should not be used during the first trimester of pregnancy unless in the opinion of the prescribing physician, the potential benefits outweigh the possible risks.

Side Effects

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ance.⁵ On the other hand, acid-base values falling outside any band almost certainly represent at least two acid-base disturbances.

Most of the bands were derived from measurements on arterial blood. However, whether the blood is arterial, venous or arterialized is unimportant since differences in acid-base values in blood obtained from these three sources are small¹³ relative to the width of the band.

Personal experience has shown this nomogram to be useful for teaching acid-base physiology and for defining, assessing and treating acid-base disturbances in both children and adults. It is of particular value where the early recognition of the emergence of a mixed disturbance may be of critical importance to the clinical management. For example, a patient presenting with hyperventilation may be rapidly identified as having possible aspirin intoxication; comparison of the patient's blood acid-base measurements to the nomogram indicates that the plasma bicarbonate is too low for the degree of PCO₂ reduction seen with simple acute respiratory alkalosis.

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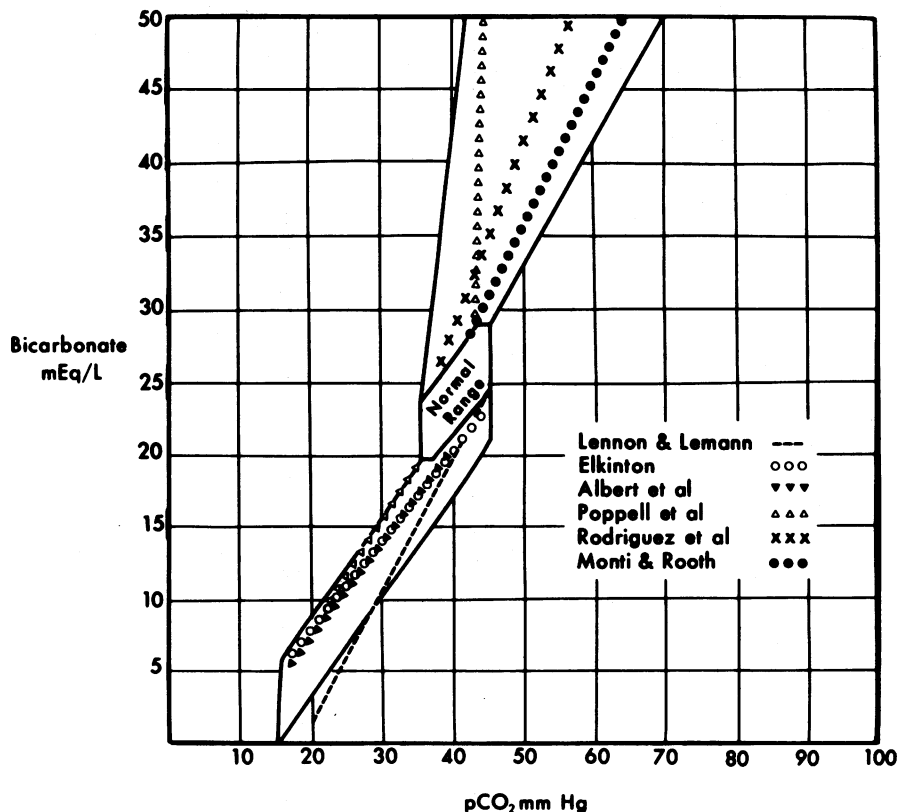


FIG. 2—Published regression lines⁷⁻¹² for acid-base response of man to metabolic acidosis and alkalosis shown in relation to the normal range and the proposed bands.