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Variations in alkali reserve and acid-base balance in tetany.

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The idea that tetany was a condition associated with alkalosis originated from the high figures for the CO_2 combining power of the blood obtained in tetany occasioned by gastric lavage and was strengthened by the statement that tetany may be accompanied by a pH as high as 7.8. As a result of work carried out here two years ago, the conclusion was reached that the variation in the pH to the alkaline side of normal need not necessarily be great, and that such a variation was undoubtedly followed by a fall to the acid side of the normal for the animal under observation.

To investigate changes in the acid-base balance by determining values for the pH, $[CO_2]$, $[H_2CO_3]$ and $[BHCO_3]$ of the blood, CO_2 dissociation curves were drawn for the blood of normal and thyroparathyroidectomized dogs, the determinations on the latter being made on the three consecutive days following the operation. The pH was calculated from the equilibration data by use of the Hasselbach formula and thus a curve approximately linear in character was obtained in which $[CO_2]$ was related to pH. The pH for the blood under consideration was then found by interpolation upon this curve of the total $[CO_2]$ value of the blood as drawn. To determine changes in the alkali reserve the value of the $[CO_2]$ for the blood as drawn was extrapolated to the value which would obtain at the CO_2 tension necessary to maintain the pH at the normal figure for the animal. From the value thus found the $[BHCO_3]$ was calculated,

$$[BHCO_3] = \frac{[CO_2] \times R}{(R + 1)}$$

R being equal to the ratio $[BHCO_3] : [H_2CO_3]$; the change in the base content of the blood then indicated the excess of base over acids other than H_2CO_3.

The results so far have been remarkably uniform and indicate that the form which the associated blood condition may assume depends largely upon the degree of the tetany produced. Within

the first twenty-four hours after the operation the condition is one of alkalosis; the pH rises on an average of 0.154, this being due to an uncompensated CO_2 deficit. This stage is marked by an absence of any of the signs of acute tetany, it may be regarded as a quiescent or primary phase of the disease, while the subsequent stage which is one of acidosis, marked as it is by definite tremor, violent spasmodic twitching of the muscles of the head and lower jaw, spasticity of leg muscles and rapid respiration, may be regarded as the acute phase, or the tetany proper.

The loss of base begins in the first stage and continues progressively throughout the second, while the loss of volatile acid, which is marked in the first stage far exceeding the loss of base, is partially recovered from and may either remain stationary or fall again with the development of acute tetany. The alkali reserve which may be increased in the first stage begins to fall with the onset of the acute condiiton and continues to fall rapidly until the death of the animal. The point at which the pH again reaches and passes the normal is indicated very approximately, in a graphic representation of these results, by the point at which the acid : base ratio again becomes balanced although on a lower level.

As an example of the results obtained, in which the changes in acid, base, and alkali reserve are presented as a percentage of the normal, the following table may be given:

Normal		Tetany 24 hrs.	Tetany 48 hrs.	Tetany 72 hrs.
pH	= 7.440	7.603	7.430	7.360
$BHCO_3$	= 16.830	26.15 per cent —	21.03 per cent —	36.20 per cent —
H_2CO_3	= 0.840	45.11 per cent —	9.54 per cent —	15.48 per cent —
Alk. res.	= N.	0.24 per cent +	24.90 per cent —	45.35 per cent —