

## Effect of Anoxemia on the Impermeability of the Stomach to Water.

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It has been known for a long time that practically no water is absorbed from the normal stomach, but that the small and large intestine are responsible for this function.

In an attempt to explain this difference certain theories have been advanced. Fischer<sup>1</sup> postulates that water absorption is influenced by the affinity of the colloids for water, and that the colloids of the blood have the greatest affinity for water when the blood is relatively most venous. Since the blood of the colon is relatively more venous than that of the small intestine, and since the stomach is the least venous of all, Fischer believes that venosity is correlated positively with water absorption.

Koehler, *et al.*,<sup>2</sup> showed that anoxemia is fundamentally acidotic, and that the pH of the blood can reach 6.7 during severe anoxemia. The carbon dioxide combining power can also fall as low as 9.8 volumes percent. This work has been confirmed by Van Liere and his coworkers, and by other investigators.<sup>3</sup>

It was felt that a study should be made of absorption of water from a stomach whose blood supply is increased in venosity. Anoxemia is an agent by which a significant increase in the venosity of the blood can be brought about.

During the course of other studies on the effects of anoxemia on gastro-intestinal function, the opportunity was exercised to study the effect of anoxemia on the absorption of water from the stomach. Barbitalized dogs and cats (220 mg. sodium barbital per kilo, intravenously) were used. Two animals were chosen as near the same age and weight as possible. One served as a control, while the other was subjected to anoxemia.

The stomach was exposed by a mid-line incision and the lower end of the esophagus was ligated. The stomach was washed out

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<sup>1</sup> Fischer, M. H., *The Physiology of Alimentation*, John Wiley and Sons, New York, 1907, p. 267.

<sup>2</sup> Koehler, A. E., Brunquist, E. H., and Loevenhart, A. S., *J. Biol. Chem.*, 1925, **64**, 313.

<sup>3</sup> Van Liere, E. J., David, N. A., and Lough, D. H., *Am. J. Physiol.*, 1936, **115**, 239.

with distilled water and the pylorus ligated. The ligatures were so placed that the isolated loop thus formed had virtually an intact blood supply. The stomach was then filled with a measured amount of distilled water at body temperature, taking care to avoid over-distension. The abdomen was closed and the animal kept warm.

The other animal was treated by an identical procedure, including the injection of exactly the same amount of water into the stomach. After the abdomen was closed this animal was placed in a respiratory chamber and was subjected to the desired degree of anoxemia. Partial pressures of oxygen of 117, 94, 80, 63, and 53 mm. of mercury were used. The normal pressure, of course, is 152 mm.

At the end of 3 hours the stomach was removed from each animal, slit open, and its contents carefully measured.

*Results.* Table I shows the amount of water absorbed in the normal animals and in those at the various degrees of anoxemia.

TABLE I.

| Partial Pressures<br>of Oxygen mms.<br>of Hg | No.<br>Animals | % Water<br>Absorbed | Variation from<br>Normal % |
|--|----------------|---------------------|----------------------------|
| 152  | 74             | 6.5                 |                            |
| 117  | 4              | 5.0                 | -1.5                       |
| 94   | 19             | 8.2                 | 1.7                        |
| 80   | 20             | 7.9                 | 1.4                        |
| 63   | 14             | 5.1                 | -1.4                       |
| 53   | 17             | 6.2                 | -0.3                       |
| Aver.  | 74             | 6.5                 | 0.0                        |

The normal animals absorbed 6.5%, and the extremes of variation in the experimental animals were 5.0 and 8.2, respectively. The average of all the experimental animals without reference to the degree of anoxemia was 6.5%, identical with the figure for the control animals.

Our findings in the control animals agree with the accepted dictum that comparatively little water is normally absorbed from the stomach of anesthetized animals. Six and one-half percent absorption over a period of 3 hours is surely not significant, for normally water would not encounter an obstruction at the pylorus such as was produced here, but would readily pass into the small intestine.

The findings of Koehler, *et al.*,<sup>2</sup> certainly show that anoxemia produces a condition in which the blood supply to all of the organs is increased in relative venosity. Starling<sup>4</sup> states, moreover, that the small intestine, less venous than the colon, is more efficient in water absorption.

<sup>4</sup> Starling, E. H., *Principles of Human Physiology*, Lea and Febiger, Philadelphia, 1936, p. 560.

The factor of secretion into the stomach as an influence on the amount of absorption can be ruled out, for it has been shown<sup>5</sup> that there is normally very little secretion in response to filling the stomach with water, and that even very severe anoxemia has but little influence on the small amount of secretion which is present.

As a further check on the importance of the blood supply to gastric absorption the control part of the experiment was repeated in 11 freshly killed animals. The average amount of absorption in these animals was 6.3%, a figure closely comparable with the normal figure for living animals.

In view of these findings, and since very severe degrees of anoxemia failed to influence the amount of absorption by the stomach we feel that some other factor than the venosity of the blood supply must be of prime importance in the failure of the stomach to absorb water.

*Summary.* Barbitalized cats and dogs were subjected to various degrees of anoxemia, the most severe being a partial pressure of oxygen of 53 mm. of mercury. This causes a distinct increase in the venosity of the blood. It was found that no degree of anoxemia compatible with life could have any appreciable influence on the amount of absorption from the stomach. It was also found that about as much water is absorbed from the stomach of a dead animal as from that of a living one.

From our findings, and related evidence from other workers previously quoted, it is concluded that some other factor than the venosity of the blood is of chief importance in the failure of the stomach to absorb water.

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#### Hepatic Circulation Time in Unanesthetized Dogs.

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No report on the rate of blood flow through the liver in unanesthetized dogs has been found in the literature. Since we have had available a number of animals angiotomized according to the tech-

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<sup>5</sup> Sleeth, C. K., and Van Liere, E. J., *PROC. SOC. EXP. BIOL. AND MED.*, 1937, **36**, 208.