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Hydrochloric Acid and Total Chlorine Content of Pure Gastric Juice Produced After Histamine Injection.

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The acid curve obtained from a fractional analysis of an ordinary test meal is at present in a stage of reinterpretation. This new interpretation is based on Boldyreff's theory about the automatic regulation of the acidity in the stomach.[1] Clinically this theory is being supported chiefly by work from Guy's Hospital (Bolton and Goodhart;[2] Baird, Campbell and Hern;[3] Ryle[4]). The chief point in the interpretation is that the total chlorides of the gastric content represent a true expression of the acid production in the stomach. The difference between the curve expressing the free hydrochloric acid and the total chloride curve, therefore, according to this theory represents the extent of neutralization of acid either by combining with protein or by neutralization with regurgitated alkaline duodenal content, particularly pancreatic juice. The value of this theory evidently depends upon several factors. One important point to be ascertained is whether in the pure gastric juice chlorides are present in other forms than HCl. Other analyses indicating a fair agreement between hydrochloric acid and total chlorides are not entirely satisfactory in this connection. Schoumow-Simanowsky,[6] for instance, used litmus as indicator in her titration for free acid, Rosemann[7] used phenolphthalein.

We have determined the total chlorides and the free hydrochloric acid of the gastric juice produced after subcutaneous histamine injection (Lim, Matheson and Schlapp[5]). We have used normal individuals as well as hospital patients. The standard dose of histamine has been three milligrams ergamine (Burroughs Wellcome). The stomach was first carefully washed out and emptied. Samples were withdrawn every fifteen minutes following the injection of the histamine. Dimethyl-amino-azobenzene was used as indicator in determining the free acid. Van Slyke's method was used for the chlorine determinations. On pure hydrochloric acid solutions identical figures were obtained by the two methods. Chart 1 is presented to indicate the close correspondence between the free acid and the total chlorides. Shaded portion represents limits for free HCl in 80 per cent of normal people. (Bennett and Ryle.[11]) Chart 2 shows all way through a greater difference between the free acid and the total

chlorides, the curves, however, being regular in shape. We believe this difference is due to combining of acid with mucus. Chart 3 shows marked and irregular neutralization by regurgitation. The regurgitation was here evidenced by the staining of the stomach content with bile.

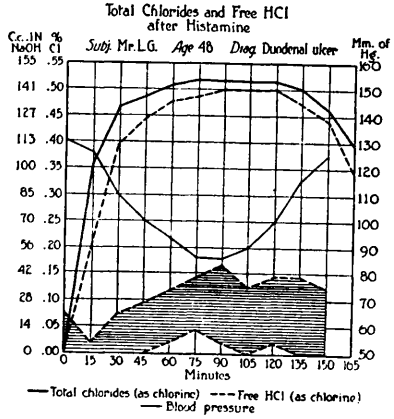

CHART 1.

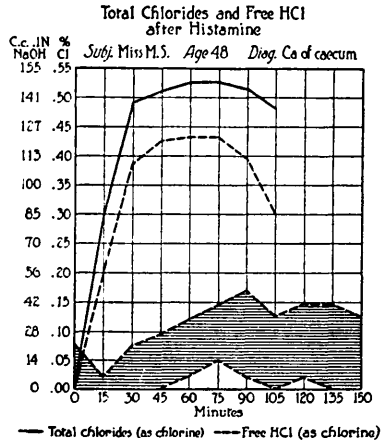

CHART 2.

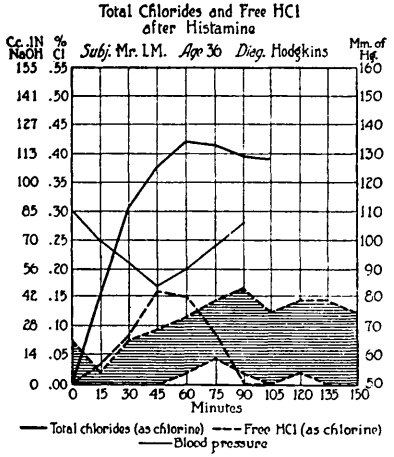

CHART 3.

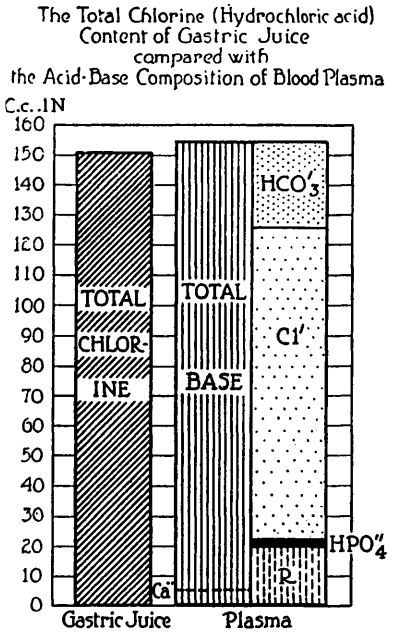

CHART 4.

From the close correspondence between the two curves in the first chart as well as from the same correspondence in other curves not reproduced in this preliminary report, we conclude that the normal stomach juice contains only insignificant amounts of chlorine, if any, in other forms than hydrochloric acid.

Attempts to correlate the total chlorides of the gastric juice with the chlorine content of the blood plasma failed to reveal any correlation, while there is an almost complete correlation between the highest chlorine figure obtained for the gastric juice and the total base of the blood plasma. (Chart 4, the plasma diagram from Gamble, Blackfan and Hamilton.[8]) This correlation is believed to be of definite significance. The gastric juice is therefore believed to fall in the same group of body secretions as milk and bile, this group having a depression of the freezing point not greater than that of the plasma, in this respect differing from the urine, where a concentration beyond the Δ of the plasma takes place. It is well known (Carlson[9]) that the fish shows a hydrochloric acid concentration in its gastric juice far above the concentration in mammals. This, however, does not break the rule since the freezing point depression of the plasma, and consequently the fixed base in the different species of fish, are correspondingly increased (for reference to the osmotic pressure in fish see Schmidt-Nielsen[10]).

This is a preliminary report.

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[1] Boldyreff, W., *Ergebnisse d. Physiol.*, 1911, xi, 121. and *Quart. J. Exp. Physiol.*, 1915, viii, 1.

[2] Bolton, Ch., and Goodhart, G. W., *The Lancet*, 1922, ccii, 420.

[3] Baird, M. McC., Campbell, J. M. H., and Hern, J. R. B., *Guy's Hosp. Rep.*, 1924, lxxiv, 23.

[4] Ryle, J. A., *The Lancet*, 1925, 583, 641, 687, 697, 754 (Goulstonian Lectures).

[5] Lim, R. K. S., Matheson, A. R., and Schlapp, W., *Edinburgh Med. J.*, 1923, July.

[6] Schoumow-Simanowsky, E. O., *Arch. Exp. Path. Pharmak.*, 1894, xxxiii, 336.

[7] Rosemann, R., *Arch. gesamte Physiol.*, 1907, cxviii, 467.

[8] Gamble, J. L., Blackfan, K. D., and Hamilton, B., *J. Clin. Invest.*, 1925, i, 359.

[9] Carlson, A. J., *Physiol. Rev.*, 1923, iii, 1.

[10] Schmidt-Nielsen, Signe and Sigval, *Kgl. Norske Videnskapers Selskaps Skrifter*, 1923, No. 1.

[11] Bennett, T. J., and Ryle, J. A., *Guy's Hospital Reports*, 1921, lxxi, 286.