A STUDY OF ACIDITY CURVES IN STOMACH CONTENTS

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The paper by Francis Thurmon, a student of Illinois College, Jacksonville, Ill., was introduced by Professor Isabel S. Smith of Illinois College, as follows:

Illinois College has a department of biology, and I who have the honor of occupying that settee am a botanist. We have, of course, men who are preparing for medicine. Through the kindness and under the direction of Dr. Frank Garm Norbury of the Norbury Sanatoriums, we are able in the excellent laboratories of those institutions to furnish our strongest prospective medical students a chance to do what is to them research in the latter part of their college course. Dr. Norbury is a loyal alumnus of Illinois College, has an A. M. from the University of Illinois, is a graduate of the Harvard Medical School, and while there was an assistant in the pathological laboratory. Before taking work with him these men have taken in Illinois College a year of zoology, invertebrate and vertebrate, a semester of histology, a semester of vertebrate embryology and two or three years of chemistry.

Besides the work which Mr. Thurmon will present, individual students are doing work on myleogenous leukemia, on anthrax isolated from a clinical case, studied by means of guinea pig cultures; on histological preparations from a case of sphlenic anaemia, the spleen having been removed at time of operation; on cancer of the oesophagus and inflammation of the spinal cord, removed at autopsies. Blood chemistry is often introduced.

I cannot tell you what an inspiration this is to these advanced zoology students. Thinking that this may be of assistance to other professors in small colleges, I have

asked Mr. Thurmon to present a piece of work done under Dr. Norbury's direction, "A Study of Acidity Curves in Stomach Contents." The Paper follows:

The method of gastric analysis clinically in vogue at present entails the feeding at a standard test meal, the partial removal of stomach contents at fifteen minute intervals over a period of 90-120 minutes, and the examination of the samples for: (1) Total acidity, (2) Free acidity, (3) Lactic acid, (4) Occult blood, (5) Bile, (6) Microscopical constituents.

OLD METHOD

The old method used until the introduction of the Rehfuss method of fractional analysis consisted of feeding of a standard test meal, the partial removal of complete stomach contents at the end of a one-hour period, and the analysis of the material so removed. That this was inaccurate has been proved through laboratory examination and is best explained by graphic representation.

Owing to the bulk of the stomach tube and the marked discomfort occasioned by its use, it was impossible to follow the complete cycle of digestion and to estimate the different changes step by step which took place in the stomach after the introduction of a definite stimulus such as various foods. At the end of one hour the entire stomach content was removed and examined. Chart 2 will suffice to show the fallacy of this method. Both curves represent the total acidity of two different cases. They show a vast variance by the fractional method; but by the old method, which called for the removal of complete stomach content at the end of one hour, one would readily suppose they were normal curves.

REHFUSS TUBE METHOD

Realizing the inadequacy of the procedure entailed in the old method, Dr. Martin E. Rehfuss devised an apparatus and procedure by which it is possible to follow the entire cycle of digestion without undue discomfort to the patient. It is the so-called "fractional method." The modified stomach tube (No. 12 French Tubing) is fitted with a metal tip. The tip is slotted with large perfora-

tions, the diameter of each being equivalent to the maximum bore of the tubing. The principle of the tube is entirely that of gravity, and the tip is sufficiently heavy to seek the lowest portion of the stomach. The instrument is inserted and left in the stomach for hours until the gastric cycle is completed. It is possible at any given moment to draw off any or all of the juice secreted in sufficient quantity to perform the necessary chemical examination.

METHOD

The patient is requested to drink no water at any time after the evening meal on the night previous to examination, and to eat nothing until after the test is complete. Usually he presents himself about 8 o'clock the following morning for removal of residium by means of the Rehfuss tube.

REMOVAL OF RESIDIUM

The swallowing of the tube may be accomplished without the aid of water. In obstinate cases where swallowing is difficult the process may be accomplished by coating the tube and tip with a thin film of petrolatum, and by placing the tip in the lower part of the pharynx, back of the tongue, and having the patient swallow. When the tube has reached the stomach (which has been determined by measurement) the contents are aspirated. A normal residium of large volume possessing a total acidity value of seventy or over may indicate ulcer.

THE TEST MEAL

Before making an analysis of stomach contents it is customary to introduce something into the stomach which will stimulate the gastric cells. The response to this stimulation is then measured clinically by the determination of total and free acidity in the stomach contents. The test meal most widely employed is the Ewald test meal, which consists of 2 pieces (35 grams) of toast and 8 ounces of tea or water. (The water meal is advised because it has the added advantage of enabling one to determine the presence of food rests, and to test more accurately for blood and bile.)

THE RETENTION MEAL

In order to obtain more information, if desired, regarding gastric motility than is furnished by the ordinary test meal, the patient may be fed a so-called retention meal. This meal is fed in place of the customary evening meal and contains substances readily detected. In the morning before breakfast the stomach contents are removed and examined for food rests. A normal stomach should give no evidence of food retention. A satisfactory retention meal consists of six raisins.

REMOVAL OF SAMPLES FOR ANALYSIS

At exactly fifteen minute intervals from the time the test meal is eaten until the stomach is empty, 10 c. c. samples of gastric contents are withdrawn from the stomach by means of aspiration.

EXAMINATION OF SAMPLES

The modern tendency among clinicians is to lay particular emphasis upon the value of free acidity and total acidity. The determination of presence or absence of occult blood, mucus, and food rests are also of importance. Microscopic examination may show remnants of food from previous meals, red blood corpuscles, pus cells, sarcinae, excessive number of yeast cells, bacteria, and definite abnormal cells in an abnormal ulcerating cancer, all of which are of diagnostic importance.

DETERMINATION OF FREE HYDROCHLORIC ACID

Principle—The indicator used is di-methyl-amino-azobenzene (Toeopfer's reagent.)

Procedure—Measure 10 c. c. of the gastric contents and introduce it into a clean 100 c. c. beaker. Add 2 drops of Toeopfer's reagent, and if free hydrochloric is present the solution will turn a visible pink (depth of color depending upon acid concentration.) Titrate with N/10 sodium hydroxide until the red color is replaced by an orange yellow. Take the burette reading and calculate for free acidity.

Calculation—The indicator used reacts only with free hydrochloric acid, hence the number of cubic centimeters of N/10 sodium hydroxide used indicates the volume necessary to neutralize the free hydrochloric acid of 10 c. c. of gastric juice. To determine the data for 100 c. c. of gastric juice multiply by 10. Occasionally in the fractional method it is not possible to obtain 10 c. c. of a specimen in one or more of the periods of aspiration. In this case use 5 c. c. of the gastric content and dilute to 10 c. c. with distilled water and proceed as above. Multiply the results by 2 because a 5 c. c. dilution was used. The latter procedure gives only approximate results, yet, an idea of the nature of the curve is determined.

TOTAL ACIDITY

Principle—The indicator used is phenolphthalein. Since the indicator reacts with mineral acids, organic acids, combined acids, and acid salts, the values obtained represent the total acidity of the solution.

Procedure—To the titrated solution used above add 2 drops of phenolphthalein and titrate with N/10 sodium hydroxide until a faint pink color is obtained and persists for about two minutes. Take the burette reading and calculate for total acidity.

Calculation—The number of cubic centimeters of N/10 sodium hydroxide used indicates the volume necessary to neutralize the total acidity of 10 c. c. of the solution. To determine the data necessary for 100 c. c. multiply by 10. (It is customary to express the acidity in values per 100 c. c.) This product of acidity represents the total acidity of 100 c. c. of the solution of that period.

OCCULT BLOOD

Guaiac method used: Introduce 1 c. c. of gastric contents into a 10 c. c. test tube and acidify with 1 or 2 drops of glacial acetic acid. From a previously prepared solution, consisting of a few Guaiac crystals and 95% alcohol (about 6 c. c. vol.), add to the gastric contents in equal

volume. To this add a similar amount of hydrogen peroxide and if chemic blood is present the solution will turn a distinct blue.

TYPES OF CURVES

Curves representing total acidity and free acidity of the periods during complete cycles of digestion have been made. The ordinate of the graph represents the degree of acidity and the abscissa of the graph represents the time periods.

1. Isosecretory type shows a steady rise, high point usually sustained for half an hour and then a gradual decline. The curve is usually steady and unbroken; its high point rounded and not abrupt and is to be found within the neighborhood of one hour. Chart No. 1.

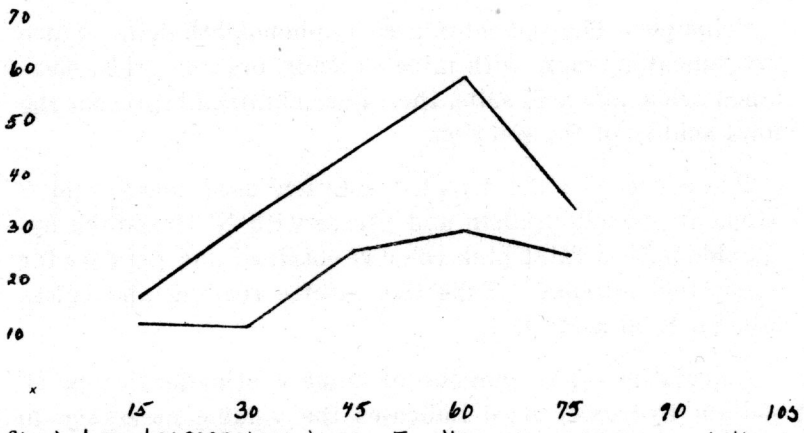

Chart 1.— Isosecretory type. Top line represents total acidity and lower line free acidity.

2. Hypersecretory type shows a rapid response to stimuli, rapid increase in acidity, high point from 70 to 100 or over, either abrupt or sustained, and a slow decline or none at all in the usual time. It is called the hypersecretory type because of the general tendency to assume exaggerated proportions. Chart No. 3.

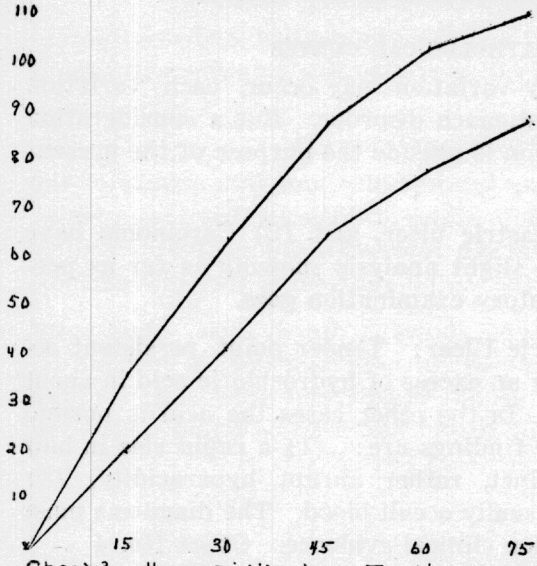

Chart 3. Hyperacidity type. Top line represents total acidity and lower line shows free acidity

Curves 1 and 2 are typical of the reaction of normal individuals when given an Ewald meal. A consideration of these curves from the examination of normal individuals indicates that there is no normal curve which will hold for all cases, but a normal curve may vary within certain well defined limits.

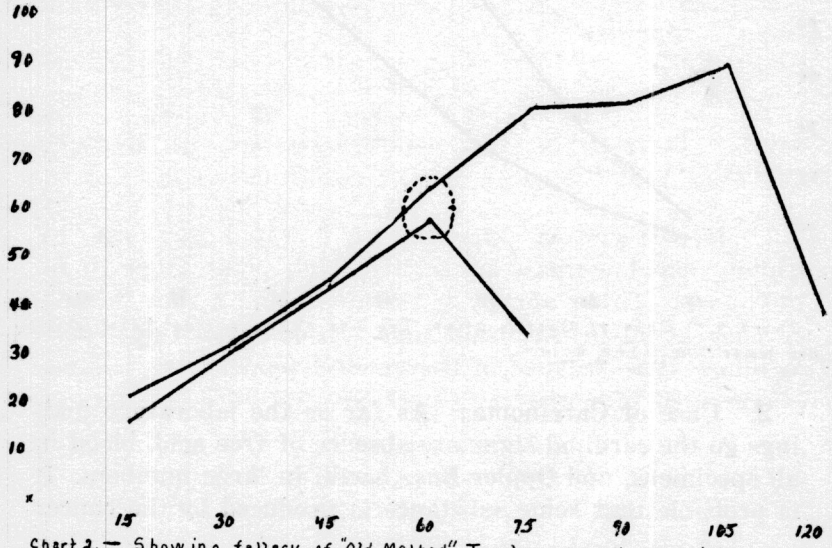

Chart 2.— Showing fallacy of "Old Method". Top line shows hyperacidity after the one hour period. Lower line represents a normal curve.

PATHOLOGICAL CURVES

Pathologically any variation may occur, each variation type typical of its stomach disorder. But a consideration of their interpretation is outside the purpose of the present paper.

Charts of (1) Gastric ulcer, and (2) Carcinoma have been prepared with slight analysis showing as far as possible how the laboratory examination goes.

1. Case of Gastric Ulcer: Tender point, persistent occult blood. There is an excess of hydrochloric acid in about one-half the cases. In the other cases the acid is normal or diminished. The findings are: (1) a rapid rise in half an hour, (2) distinct, rather abrupt hyperacidity, (3) rapid decline, (4) usually occult blood. The diagnosis must be based largely upon clinical evidence. Chart No. 4

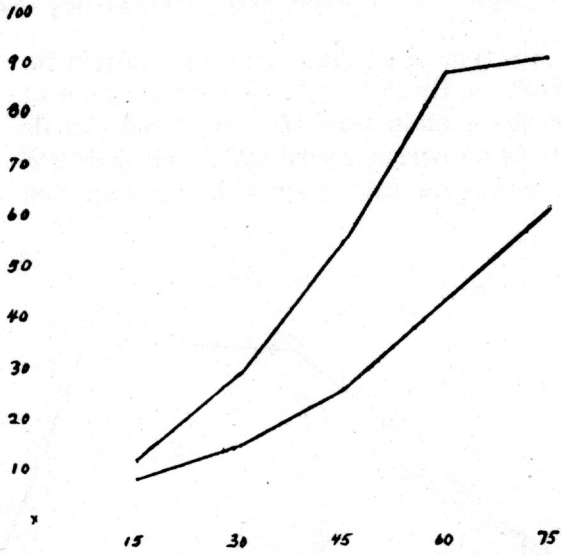

Chart 4 — Case of Gastric Ulcer: Top line representing total acidity and lower line free acidity

2. Case of Carcinoma: As far as the laboratory findings go the cardinal signs are absence of free acid, blood in all specimens, and Oppler-Boas bacilli in large numbers. It is probable that some substance is produced by the cancer

which neutralizes the free acid. Also carcinoma seems to furnish a favorable medium for growth of Oppler-Boas bacilli. Chart No. 5.

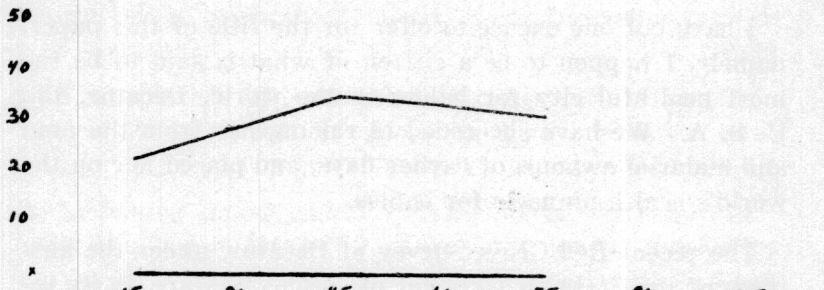

Chart 5.— Case of Carcinoma: showing free acidity equating zero (lower line.), and low total acidity (top line).

CONCLUSION

1. Gastric juice in healthy normal individuals shows no specific curve, but types of curve can be found which are named isosecretory and hypersecretory.

2. The pathological significance arises when a curve shows any marked deviation from the recognized standard.

The most typical curves have been chosen from a group of one hundred fifteen cases examined. It has not been my purpose to offer a complete interpretation in this study of acidity curves, so much as it has been my aim to show how they serve as a means of aiding in diagnosis, and to represent some of the possibilities open for advanced study during a "Liberal Arts Course."

Bibliography: (1) Practical Physiological Chemistry. Hawk. (2) The Journal of the American Medical Association, Vol. 63, Nos. 1, 2. Vol. 64, No. 21. Vol. 65, No. 12.