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NITRATE OF SILVER IN HYPERCHLORHYDRIA.¹

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My experience with hyperchlorhydria has been in nervous temperaments, although not always nervous according to the popular acceptance of the term. In some cases, especially those with atony or gastrectasia, mucus has been present in considerable amount, but the burden of proof would rest heavily on one attempting to prove them other than neuroses. In particular, I recall a heavy drinker who presented the clinical picture of gastric catarrh, except that there was a history of burning pain coming on some time after meals but relieved by food. It was not very troublesome just at that time. The man had been treated for alcoholic gastritis in a hospital some months previously, but since then had been totally abstinent.

One hour after 30 grammes of bread and 300 c. c. of water had been given, free HCl was .18 per cent. and total acidity .25 per cent. The greenish contents contained much mucus. Twenty-five c. c. of filtrate required over five hours to dissolve .05 gramme of the white of hard-boiled egg at 40° C. Two days later an analysis gave the same results. Lavage sharpened the appetite, improved the catarrhal symptoms, and increased the burning. One week from the first analysis an examination under identical conditions gave 145 c. c. of contents, slightly greenish in color, with considerable mucus. Free HCl, .241 per cent.; total acidity, .31 per cent. Digestive test required three hours, the normal period. In other words, we were clearing up a gastric catarrh which obscured the usual condition, hyperchlorhydria.

The severity of subjective symptoms is not a reliable index of the degree of acidity in different cases nor in a given case at different times. It may be marked, and the acidity within normal limit. This points to hyperesthesia, which seems to be present in these cases. On the contrary, a great increase in the acidity is usually attended by a corresponding aggravation of symptoms.

In a given case, if the environment can be so controlled as to give the greatest nervous relaxation and avoid nervous tension, the prognosis is better. In short, to do the best for these sufferers, frequently one must treat them as neurasthenics. He must understand them, their history, their daily lives, so that he can assist them to live without unnecessary expenditure of nervous energy and encourage to healthy activities. How difficult this problem, where change of environment is impossible, is known to us all. On the whole, proteid diet has been most suitable, especially in bad cases. Raw eggs between meals have been very helpful in certain cases.

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We have found medicinal treatment discouraging as regards cure. Of local remedies, alkalies, bismuth and nitrate of silver have been tried. Of remedies intended to act through the nervous system, nux vomica and bromide. Nux vomica has seemed to decrease the percentage of acid in certain cases and improve the motility, but has increased the discomfort, except in one case, and there the result was quite brilliant. I will refer to the case briefly:

A man thirty-one years of age, with an excellent family history and past history, has been engaged in exacting mental work for several years. He occupies a very responsible position and has acquired the pernicious habit of devoting his meal times to mental work and, at the same time, satisfying completely a never-failing appetite. For three years a history of digestive disturbances. About an hour after taking food, especially at noon, he experienced a burning sensation, distention and belching, and most annoying of all, a sensation of weight, as if the stomach did not empty itself. This would last almost or quite to the next meal. Occasionally it would be present all the forenoon and recently several times late in the forenoon he has vomited his breakfast. Acid things and pastry increased the burning. Bowels irregular. Frequently a restless night. Lost much weight. Recently a trembling of the hands had annoyed him.

Physical examination.—Expression troubled and careworn. Chest, negative; abdomen prominent. Right kidney easily palpated. Stomach in normal position. Distended with CO₂ its lower border was one and one-quarter inch below umbilicus. Filled with water its lower limit was two and one-quarter inches below umbilicus. When slightly distended with gas or containing a small amount of water the stomach was considerably smaller, being markedly atonic but only moderately dilated.

Nux vomica was given and the dose gradually raised from 10 drops three times daily to 20. Habits, exercise and diet were regulated. Improvement was prompt. Treatment commenced early in May, and by August, when he started for a bicycling trip on the Continent, the gastric symptoms had nearly disappeared. At that time the stomach was empty six hours after a mixed meal given in the morning, although the salol test gave negative result at two hours and positive at thirty and a half hours. The acidity was moderately reduced under treatment, as judged from five analyses, and motor power improved. Early in September my patient wrote that there were no digestive symptoms, and to-day I received the same report.

From a practical point of view, control of subjective symptoms is the chief object of treatment. In this connection I wish to give a limited experience with nitrate of silver. I have not attempted a review of the literature on the subject. Riegel² recommends its trial in severe cases. It is to be given by mouth, or the stomach washed out with a solution (1-1,000), and this in turn followed by thorough washing with water. Nitrate of silver has been tried in three of my cases. In two, one-quarter grain in one-half ounce of distilled water was given twenty minutes before breakfast. One case is doing well. The other reported some improvement after two weeks, but it seemed as likely due to diet, regular exercise, and a more rational mode of living. From the fasting stomach in the morning I then obtained 10 c. c.

² Nothnagel's Sp. Path. und Ther., xvi.

of fluid with about .1 per cent. free HCl. The conversion of nitrate to chloride presumably caused the failure. Where there is continuous secretion of acid gastric juice thorough lavage should precede the administration of silver nitrate. This precaution is manifestly necessary, but I have not seen it mentioned. If lavage is impracticable we depend on bismuth and alkalis instead of silver nitrate. The neutralization of the acid instead of lavage will occur to everybody, but there is no means of judging the amount of alkali necessary. An excess of bicarbonate of soda, for instance, would convert the nitrate of silver into the oxide without local action, according to the equation: $\text{AgNO}_3 + \text{Na}_2\text{CO}_3 = \text{Ag}_2\text{CO}_3 + 2\text{NaNO}_3 = \text{Ag}_2\text{O} + \text{CO}_2 + 2\text{NaNO}_3$. Where the fasting stomach contains acid juice the equation, is, of course: $\text{AgNO}_3 + \text{HCl} = \text{AgCl} + \text{HNO}_3$, and in our experience the treatment fails.

Mrs. S., thirty-six years of age, consulted Dr. W. N. Bullard, December 6, 1898, and he kindly referred her to me.

F. H. Negative, except that three sisters have "weak stomachs."

P. H. In Massachusetts General Hospital nine years ago with pelvic abscess, and while there vomited blood during two days; was menstruating. Five years ago, Dr. H. O. Marcy removed the appendages for double pus tube. Recently Dr. Marcy kindly wrote me that he considered it a case of gastric ulcer. For a year after the operation she menstruated a little each month and then none for three years. In these nine years, and especially during the three when menstruation was absent, the patient vomited "coffee grounds" and bright blood frequently. The hematemesis occurred, so far as she could judge, when menstruation would naturally have occurred. Much of the past nine years has had heartburn and sour stomach. During an attack of hematemesis and the two or three preceding days, her stomach would feel as if it contained "live coals." For three or four years has drunk two cups of hot water morning and evening and vomited. It has given the greatest relief and she "couldn't get on without it." Food and tea relieve the burning pain. Very constipated. Eight weeks ago, menstruated one day, and for seven weeks the water vomited morning and evening contained "coffee grounds" and some bright blood. For a week, vomitus very acid, but not bloody. Burning continues. Not subject to epistaxis.

Physical examination. — Well developed, fairly nourished. Face, tongue and mucous membrane of mouth pale. Expression drawn. Pupillary and other reflexes normal. Repeated laryngoscopic examination failed to show any source of bleeding. Remainder of examination negative, except moderate epigastric tenderness with one very tender point in extreme left of epigastrium. This point had been tender whenever blood was raised. Lower border of stomach distended either with air or water reached a little below umbilicus. Position of stomach normal.

Analysis No. 1. — One and one-quarter hours after a test meal of bread 70 grammes, water 300 c. c., amount contents 150 c. c., containing a small amount of brown material assumed to be digested blood. No chemical test made and no blood corpuscles seen in microscopic examination. Free HCl, .15 per cent; total acidity, .27 per cent.

Patient was in bed three weeks on diet of peptonized milk and there was almost an absence of symptoms.

Milk was peptonized because otherwise it seemed to cause distress, and several times was vomited in thick curds. Also, it was hoped that more acid might be combined, as Professor Chittenden has shown to be the case with peptones. During the fourth week she commenced to sit up; burning pain with frequent headache returned; and, as formerly, she found temporary relief by drinking two cups of hot water morning and night and vomiting. During this week a thorough trial was given the "gastric sedative" mentioned in the article on this subject in the "American System of Practical Medicine," consisting of two parts, by weight, of cerium oxalate, four parts of bismuth subcarbonate, and eight parts of light carbonate of magnesium. The relief was so temporary that my patient pronounced its further administration useless and asked to be excused from bothering with it. The diet had been increased only by the whites of eggs.

January 7th. Tincture nux vomica was commenced in ten-drop doses and gradually increased.

January 8th. There commenced at noon an unusually severe attack, consisting of headache, gastric distress, a strangling sensation, vomiting, and occasional darting pains referred to the stomach. In the afternoon I siphoned out the remains of one-half glass of peptonized milk drunk two hours before, and then washed out the stomach thoroughly. There was no blood. The analysis was: Free HCl, .226 per cent.; total acidity, .387 per cent.

Until March 14th the headaches were frequent. The burning sensation was severe and persistent, being relieved temporarily by the hot water and by food. Raw eggs taken between meals gave temporary relief. By successive trials, the largest dose of nux vomica to be tolerated was determined. The maximum dose was reached gradually and maintained while practicable, as judged by the nervous symptoms. Then it was reduced gradually and gradually re-established after the unpleasant symptoms had disappeared. The gastric symptoms were not relieved by the nux vomica, while the patient was much more nervous than before its administration. The outlook seemed discouraging. The history of successive attacks of hematemesis during nine years, and the sharply localized point of tenderness, which had been the same in all attacks, pointed strongly to a recurrent ulcer. Vicarious menstruation could be excluded fairly after the seven weeks' duration of the last hematemesis. In view of the almost continuous suffering from acidity for nine years, I seriously considered the advisability of an exploratory operation with a view to excision of the ulcer scar.

In one of the medical journals, I noticed nitrate of silver recommended for gastric irritability with or without ulcer; one-fourth grain was to be administered in one-half ounce of distilled water twenty minutes before breakfast, or the stomach was to be washed out with a solution (1-1,000) and that followed by a thorough washing with water. (I regret that I am unable to give the reference. It was to some digestive work.) Already lavage had been substituted for drinking and vomiting hot water. After lavage each morning, with occasional omission of two or three days, one-fourth grain of silver nitrate in one-half ounce of distilled water was poured through the tube. At this time the gastric symptoms were overshadowed by a train of symptoms commencing some days before the administration of silver nitrate, namely, frequent desire to micturate and some pain. Twenty-four hours' amount

of urine was 18 ounces, and a few days later only 11 ounces. Later, what was apparently renal colic supervened. Patient was put to bed on milk diet. As the urine remained scanty in spite of diuretics, Dr. Ogden examined and reported no evidence of renal disease, confirming the result of my own analysis.

During the three weeks' confinement to bed lavage seemed impracticable, and as bromide was indicated for the patient's nervousness, it was pushed for a possible beneficial effect on the gastric symptoms. The latter were not improved, and April 15th lavage and silver were resumed, and, with an occasional precautionary omission, have been continued to date.

May 3d. Dr. Quackenboss ordered glasses for a moderate degree of hypermetropic astigmatism.

May 5th. One hour after bread, 35 grammes, water 300 c. c., the amount of stomach contents was 45 c. c. There was previous lavage. Free HCl, .248 per cent.; total acidity, .321 per cent.; 25 c. c. filtrate dissolved, .05 gramme of white of hard-boiled egg in three and one-sixth to three and one-half hours at 40° C.

At this time the symptoms were not very marked and steadily diminished, being absent during June, July, and until August 20th. For two months before the latter date all restrictions on diet were disregarded by the patient. She fairly revelled in fresh tomatoes with pepper, vinegar and salt, stewed tomatoes seasoned with pepper, pickles, sour apples and grapes. I never saw her so happy as one day after she had eaten, without symptoms, a boiled dinner and a sour apple. She gained in weight and spirits.

August 7th. The fasting stomach contained 30 c. c. of yellowish-green fluid, acid to litmus. Free HCl, absent; total acidity, .066 per cent. Bile absent. This was the usual amount of fluid removed in the morning before breakfast. A test meal of 30 grammes of bread and 300 c. c. of water was then given and in one and one-sixth hours 110 c. c. removed, not remarkable in appearance. Free HCl, .102 per cent.; total acidity, .219 per cent.; lactic acid, a trace; filtrate, erythrodextrin; microscopic, yeast and nothing else to note; digestive test, four hours, twenty-seven minutes, at 39° to 40°. The stomach, filled with water, reached to within one and three-fourths inches of the umbilicus, being decidedly smaller than in December. Also, in order to empty the stomach completely, it was necessary to pass the tube a less distance.

August 20th. Headache, nervous, tender breasts, a sleepless night. No gastric distress.

August 21st. Ate tomato soup for supper, vomited in the night, and in the morning washed from her stomach some of the soup. June 13th, in the morning, the stomach had contained banana eaten the previous evening. These were the only times that macroscopic remains of food were present before breakfast.

August 29th. The fasting stomach this morning contained one ounce of yellowish-green fluid and some mucus. No macroscopic food remains. Free HCl, .113 per cent.; total acidity, .212 per cent.; filtrate, no reaction with IKI; digestion, three and two-thirds hours. Microscopically, no blood, few starch grains, as shown by their appearance and behavior to IKI. No muscle fibres. Much pavement epithelium, one small clump of columnar epithelium, with quite frequently a polynuclear leucocyte and occasionally a salivary corpuscle.

August 29th. One hour after bread, 30 grammes,

water, 300 c. c., amount contents, 72 c. c. Appearance and odor not remarkable. Free HCl, .212 per cent.; total acidity, .277 per cent.; lactic acid, absent; filtrate, erythrodextrin; digestion, four hours. Microscopically, no blood, yeast not increased and nothing of importance.

September 16th. Patient reported that the acidity had been somewhat troublesome since August 20th, three weeks. Incidentally, she remarked that she felt some burning at that moment, and I allowed her to siphon out her stomach contents. Three hours previously she had eaten, among other things, fish chowder and stewed tomatoes. The amount was 88 c. c. Free HCl, .303 per cent.; total acidity, .526 per cent.; lactic acid, absent; digestion, four hours.

September 26th. Patient reported that the acidity was very troublesome from the 16th to the 22nd of September, but since then less troublesome. The dose of silver nitrate was increased from one-fourth grain to one-half grain September 20th. Marked amelioration of symptoms was noted by the 23rd, and three days later a return to one-fourth-grain dose seems justifiable. This morning two ounces of yellowish-green fluid was siphoned from the fasting stomach. Free HCl, .146 per cent.; total acidity, .248 per cent.; digestion, three and three-fourths hours; lavage to-night.

September 27th. Same amount of fluid and of same appearance. Gastric symptoms still improving. Free HCl, .19 per cent.; total acidity, .26 per cent.; digestion, three and one-half hours; lavage to night.

September 28th. Comfortable yesterday and perfectly comfortable this morning. Fasting stomach contained two ounces of colorless fluid. Free HCl, .314 per cent.; total acidity, .380 per cent.; digestion, three hours, fifty-two minutes. After lavage, gave test meal of bread, 30 grammes; water, 300 c. c. Amount of contents in one hour, 48 c. c. Free HCl, .27 per cent.; total acidity, .34 per cent.; filtrate, erythrodextrin; digestion, three and one-fourth hours; lavage at night omitted.

October 4th. Since last analysis not much discomfort. Yesterday patient ate roast lamb at 4 p. m. and lamb stew at 8.30 p. m. This morning, fasting stomach contained two ounces plus of yellowish-green fluid with more sediment than usual, but no macroscopic food remained. Free HCl, .242 per cent.; total acidity, .329 per cent. Microscopically, occasional striated muscle fibre and starch grain. No blood. Considerable pavement epithelium. Few yeast cells. Frequently a salivary corpuscle.

October 11th. Almost no discomfort since last analysis. Perfectly comfortable at present. Cold boiled ham and bread for supper yesterday. This morning, fasting stomach contained 10 c. c., acid to litmus, giving a faint brown with Congo-red paper; no reaction for free HCl. Total acidity, .095 per cent. Microscopically, no muscle fibre, rarely the remnant of a starch grain, as shown by IKI; frequently a polynuclear leucocyte, showing the entire cell, and a salivary corpuscle. Considerable pavement epithelium.

The case is apparently under control again, or quiescent.

The disadvantage of this form of treatment in the presence of continuous secretion is the necessity of using a stomach tube. In the case just reported lavage in the morning was done by the patient with

satisfaction. Also we must remember the possibility of argyria and omit occasionally.

Besides these three cases I have followed this treatment in a few cases in the practices of friends. So limited an experience is not convincing to me, but suggests the advisability of giving the treatment a thorough trial. Apparently it has markedly diminished the gastric sensitiveness in two of my cases, whether or no it has affected secretion of acid.

I trust that my experience may be supplemented by the favorable or unfavorable experience of others present, and may lead some to assist in determining the value of silver nitrate in hyperchlorhydria.

A SIMPLE METHOD FOR THE QUANTITATIVE ANALYSIS OF THE GASTRIC CONTENTS FOR USE IN CLINICAL WORK.

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IN my article upon the analysis of the gastric contents published two years ago in the JOURNAL, I suggested certain modifications of the Töpfer method of quantitative analysis of the contents, which was at that time the most practical method of analysis for use in clinical work.¹ These modifications were:

I. The addition of a second test for free hydrochloric acid which could be utilized at the same time as the dimethyl test of Töpfer and serve as a control test to ensure a more accurate record on this point.

II. The substitution of the Congo-red test for the alizarin test in the estimation of the total organic acids plus acid salts.² Experience had proven to me as well as to many others,³ that accurate readings with this dimethyl test and the alizarin test uncontrolled were in gastric contents often impossible and I sought by these modifications to remedy these weaknesses in the original Töpfer method. During the last two years I have succeeded by attending to these modifications in developing and approving by extended use a quantitative method of analysis, at the same time more accurate and more simple than the original method, or the method as first modified by me. The details of this new method are as follows:

I. *Total free HCl.*—Measure off five cubic centimetres of contents after shaking. To this five cubic centimetres of the unfiltered contents in a test tube add a few drops of Töpfer's reagent (a one-half-per-cent. alcoholic solution of dimethyl-amido-azo-benzol). If free hydrochloric acid is present, the mixture will assume a carmine-red color. As a rule, where the acid is present, one drop will give the clear red color. In some cases, however, the addition of three or four drops is necessary.

To this red mixture a decinormal solution of sodic hydrate is added by titration until the red color gives place to an orange or bright yellow color. The number of cubic centimetres of the soda solution necessary to bring about this result are then read off. By multiplying this number by .00365 gramme, the amount of free hydrochloric acid in the five cubic

centimetres of contents is obtained and from this record the grammes of free HCl per hundred (per cent.) or per thousand may be reckoned. As it is sometimes difficult to determine the exact point at which the red color disappears in this titration, it is well to control this test by another more delicate test for free HCl. When enough soda has been added to leave but a very faint red color in the mixture, a drop of the mixture should be mixed upon a white evaporating dish with a drop of a saturated alcoholic solution of 00 tropeolin, and the dish warmed (not heated intensely) over a flame. As long as such a mixture gives a purple color upon evaporation, the free hydrochloric acid in the contents is not yet neutralized. When the purple color fails the acid is neutralized. By thus depending upon the Töpfer test until near the end of the reaction and upon the tropeolin for the last steps, we obtain a very accurate quantitative estimation of the free hydrochloric acid.⁴ For rough work, for results within .01 per cent. of the accurate result, the Töpfer test suffices.

II. *Total free acids plus acid salts.*—To the same five-cubic-centimetre mixture of gastric contents in which the free hydrochloric acid has been neutralized continue to add the decinormal soda solution until a drop of the mixture fails to color Congo-red paper (paper prepared by dipping filter paper into a five-per-cent. aqueous solution of Congo red and drying). When the mixture fails to color the Congo paper, all the free acids, organic and mineral, also the acid salts (acid phosphates), are neutralized. By taking the record of the soda used up to this point the quantitative estimate of the total free acids plus acid salts in the contents can be obtained in the same manner as in the estimation of the total free HCl. If in performing this Congo test the reaction point is passed, the paper is turned a brighter red than its original color. It is thus easy to control the accuracy of this test.

III. *Total acidity.*—To the same five-cubic-centimetre mixture of contents in which the free hydrochloric acid and the other free acids and acid salts have in turn been neutralized add two drops of a one-per-cent. alcoholic solution of phenolphthalein. Continue to add the soda solution until a deep red color of maximum intensity is obtained. The appearance of the deep red color indicates the presence of an alkaline reaction, that is, that the neutralization of all the acid elements of the contents is accomplished. From the record of the soda solution used to accomplish this result we estimate the total acidity. Care must be observed in performing this last step of the estimation to develop the deepest red color which can be obtained. As long as the top of the mixture takes a deeper color after the addition of a drop of the soda than the rest of the mixture the end reaction has not been obtained.⁵

This analysis gives us a qualitative test for free hydrochloric acid, and a quantitative estimation of the total free hydrochloric acid, the total free acids plus acid salts, and the total acidity. By subtracting the total free HCl (I) from the total free acids plus salts (II) we obtain a quantitative estimate of the total organic acids plus acid salts (IV). By subtracting

⁴ The tropeolin test is used as it gives no color reaction with the Töpfer reagent; phenolphthalein gives a red color with this reagent even in the absence of free HCl.

⁵ Owing to mechanical obstruction some of the acid in the particles of contents is not at once neutralized by the acid, so that enough extra soda to give the deep red color combine with all the phenolphthalein is added to allow for this acid. Upon standing well stoppered, the mixture turns a paler red as the hidden acid is liberated.

¹ Boston Medical and Surgical Journal, November 25 and December 2, 1897.

² Töpfer: *Zeitschr. f. physiolog. Chemie*, 1894, Bd. xix, H. 1, S. 104.

³ Mohr: *Loc. cit.*, H. 6, S. 67; Hurl: *Archiv f. Verdauungskrankheiten*, Bd. II, H. 243; Strauss: *Deutsches Archiv f. klin. Med.*, Bd. lxvi, H. 1; Hewes: *Boston Medical and Surgical Journal*, November 25, 1897, p. 540.