CLINICAL PATHOLOGY IN GENERAL PRACTICE

TESTS OF GASTRIC FUNCTION

BY

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Tests of gastric function have a limited role in clinical medicine. Sometimes simple inspection and analysis of a sample of the gastric contents may contribute towards the diagnosis. A fractional test meal will demonstrate the response of the stomach to various secretagogues, and the varying curves may be associated with different clinical conditions.

Passing of a Stomach Tube

There is considerable individual variation in the ease with which a tube may be passed, but if carefully done a minimum of discomfort is caused. For most patients it is more comfortable to pass the tube through the nose than over the back of the throat. The nose may feel sensitive to the touch of the tube, but this is rarely uncomfortable, and once the tube is down the gullet there is little discomfort in the throat. Pharyngeal irritation may be uncomfortable when the tube has been swallowed over the back of the tongue and is constantly touching the soft palate. For performing fractional test meals the nasal route is preferable, but if a brief aspiration of the gastric contents is to be undertaken a small but fairly rigid oesophageal tube may be quickly passed through the mouth into the stomach. For performing a fractional test meal, a soft rubber Ryle tube, 42 in. (107 cm.) long, No. 12 French, is probably the most useful one to use. It has a small metal olive at the tip, with four holes between 1 and 5 in. (2.5 and 12.7 cm.) from the olive. Alternatively a Levine tube may be used. This is a round-tipped tube size 14 or 16 F. with four openings in the terminal 3 in. (7.6 cm.). The average distance from the teeth through the cardia is 18 in. (46 cm.), and from the cardia through the pylorus another 11 in. (28 cm.). The nasal route is 2 in. (5 cm.) longer than the oral route.

The tube is well lubricated with water and passed gently into the nostril. As soon as the tube reaches the nasopharynx the patient is encouraged to swallow continuously until the first ring has reached his nostril. He is then allowed a pause and told to breathe through his mouth, while the tube is slid gently down until the tip is well below the pool of gastric juice; in most patients this is about the level of the third ring marked on the tube. Gentle suction is then applied with a syringe. If no gastric contents are obtained, the position is adjusted and a little air is injected. For any research work it is important that the position of the tube should be checked radiologically, but this is seldom necessary in routine clinical studies. It should be appreciated that the tube may curl up in the fundus of the stomach and prevent proper samples being obtained.

Performance of a Gastric-function Test

The purpose of this test should be explained to the patient. He is instructed to have neither food nor drink after 10 p.m. the previous day, the test being carried out early on the following morning. It is best to have the patient sitting upright with his back well supported by a pillow. His nose is inspected to see which nostril is larger, and the tube, well wetted, is then inserted and gently passed as already described. The stomach is emptied and the volume of the residual fluid measured. The free end of the tube is then spigoted and firmly attached to the patient's cheek by strapping.

When the necessary stimulus has been given, samples of about 10 ml. are withdrawn every 30 minutes for two and a half hours. After each aspiration the syringe is

washed out with water and a little air is injected down the tube, then the spigot is replaced. One and half hours later gastric juice is tested with Töpfer's reagent, which turns red with acid, or with Congo-red paper, which turns blue if free acid is present. If no free acid is present then an injection of histamine, 0.5 mg., is given subcutaneously. The patient is warned that this will make him feel flushed and may give him a headache, and that there will be redness and irritation at the site of the injection. When the test is completed he is asked to depress his chin on his chest while the tube is withdrawn. Throughout the test he is instructed not to swallow saliva. He should be provided with a receptacle in which to spit. The following are the commonly used tests.

Gruel Test Meal.—This provides evidence of the response of the stomach to a normal food stimulus. Gruel has the advantage of being practically colourless and of such a consistence as not to block the tube. It is prepared by bringing to the boil four tablespoonfuls of breakfast oatmeal with a quart (one litre) of water and then simmering down to a pint (half a litre) and straining through muslin. It is advisable not to add sugar or salt, and on no account must milk be used, as it may effectively neutralize the acid secretion.

Alcohol and Histamine Test Meal.—This is used to demonstrate the presence or absence of achlorhydria. Fifty millilitres of 7% alcohol is given and specimens are taken every fifteen minutes for one hour. Histamine, 0.5 mg., is then given and two further specimens are obtained.

Histamine Test.—By repeated aspiration or by continuous suction it is possible to determine the volume of juice secreted in response to histamine injection; this provides a quantitative estimate of gastric secretory function. With the *Ilhre* technique* a secretion volume at the rate of 180 ml. an hour is taken as indicating hypersecretion. This test is carried out by injecting 0.1 mg. of histamine per 10 kg. body weight and using continuous suction for one hour after the injection. The maximum acid secretory response† may be estimated by injecting four times the normal body-weight dose of histamine. An antihistamine, such as mepyramine hydrogen maleate (100 mg.), should be injected intramuscularly 30 minutes before the histamine is given. This is to protect the patient against the systemic effects of histamine. Continuous suction is applied, and the secretion collected from one-quarter to three-quarters of an hour after the histamine injection is taken as the maximum secretory response. More than 600 mg. of hydrochloric acid an hour suggests hypersecretion.

Indications for Examination of the Gastric Contents

In problem cases with symptoms referable to the upper abdomen—for example, patients with epigastric pain, loss of weight, but with a normal barium meal report—an examination of the gastric contents may help to establish the diagnosis. Examination of fasting juice alone may reveal gross blood-staining from a carcinoma of the fundus, which is easily overlooked radiologically. Gross blood-staining of all specimens in a test meal, together with an offensive smell and a big difference between "free" and total acidity, is strong evidence of a neoplasm, whether or not there is achlorhydria, and a gastroscopy is indicated. If only a blood-staining resting juice is found, it is worth repeating the observation, for a carcinoma of the ampulla of Vater or head of the pancreas can cause bleeding which

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†Kay, A. W., *British Medical Journal*, 1953, 2, 77.

can be regurgitated back into the stomach. Again an excessive amount of fasting juice, together with a high-climbing curve, is suggestive of a duodenal ulcer which has been missed radiologically—a further x-ray examination is indicated. The odour of the gastric juice must always be noted. The normal pungent odour is lost with a fungating or ulcerating neoplasm, and also with a gastrocolic fistula, and the odour may be very unpleasant.

Another type of problem case is the patient with an anxiety state and abdominal symptoms in whom it is necessary to exclude organic disease. A patient with a physical lesion suffering pain will usually accept a test meal when this is suggested, but a functional dyspeptic commonly reacts vigorously against the suggestion; indeed, the reaction of the patient may be another piece of evidence for or against a physical lesion.

Carcinoma of the Stomach.—It is important to appreciate that a normal acid curve and sometimes a high-climbing curve may be found in patients with carcinoma, particularly in those with small pyloric tumours. At least one-third of the patients with carcinoma ventriculi diagnosed radiologically will have free acid present, but, as mentioned above, there may be a bigger difference than usual between the total and free acid levels. The others will have achlorhydria with a high total acidity but no free acid. If there is a radiological diagnosis of gastric neoplasm but the clinical picture does not fit the diagnosis, it is certainly worth arranging both a test meal and a gastroscopy. Sometimes an unnecessary laparotomy may be avoided.

Gastric Ulcer.—A test meal does not contribute usefully to the management of a patient with a gastric ulcer. If there is any doubt about the benign nature of the ulcer, a gastroscopy is required. Gastric ulcer patients may have high acid curves, but more usually they are normal or low. Absolute achlorhydria does not occur with active gastric ulceration, but it may need additional tests, such as a 24-hourly pH test or Kay's special histamine test to demonstrate this (see above).

Duodenal Ulcer.—A test meal is not indicated in the routine management of duodenal ulcer, but may reasonably be done if operation is indicated. A high basal secretion, together with a high level of acidity, may encourage the surgeon to undertake a full 70% resection. Alternatively, a low level of secretion which may sometimes be found may encourage a gastro-enterostomy and vagotomy in a poor-risk subject, and particularly in women, in whom this is still a reasonable surgical procedure.

Chronic Gastritis.—A test meal does not provide conclusive evidence of chronic gastritis, but a low acid curve will be found with an atrophic gastric mucosa. The gastric biopsy technique introduced by Wood and Doig* is a simple method of providing definite histological evidence of the state of the mucosa and gives better information than gastroscopy.

Addisonian Anaemia.—A histamine-fast achlorhydria is a reasonable requirement for clinching the diagnosis, but it is very likely that a "tubeless" test meal will eventually suffice. This depends on the release of quinine by acid from a quinonium resin and measurement of its excretion in the urine.†

Factors Influencing Gastric Secretion

Gastric secretion may be divided conveniently into two phases—the period of digestive secretion and the inter-digestive phase. The period of digestive secretion is that in response to meals, and this may be further divided into three phases; the psychic, the gastric, and the intestinal.

The *psychic secretion* is provoked by sight, smell, taste, and even the thought of food, and the secretion evoked is highly acid and rich in pepsin. Vagal section or large doses of atropine will abolish this phase, but it is difficult to measure this secretion in man. In practice, using gruel test meals, this mechanism plays a small and unimportant part.

In the *gastric phase* are three types of stimulating agents which provoke gastric secretory responses. Simple mechanical distension is one mechanism, and it has been shown conclusively that distension of the pyloric part of the stomach stimulates the secretion of hydrochloric acid by the parietal cells of the body and fundus of the stomach. How much of this plays a part in man is still open to question. This secretion can be produced even in a denervated pouch and provides proof of the existence of a hormone for gastric secretion, which is called "gastrin." The second mechanism for acid secretion is the chemical stimulation of the stomach by the products of digestion of food or by food substances themselves. These secretagogues are present in many foods, such as milk, meat, and meat extracts, and in the breakdown products of digestion of proteins. The normal gastric phase of secretion is partly dependent on an intact vagus innervation, and a marked decrease in response to secretory stimulants, such as food, alcohol, and histamine, occurs after a successful vagotomy. It has been suggested that the response of a secretagogue depends upon the basal level of acetylcholine production in the gastric mucosa and thus upon vagal activity. A third mechanism of secretion may depend on actual chemical irritation of the mucosa with liberation of histamine, and this may be the way in which alcohol stimulates gastric secretion.

The *intestinal stimulatory phase* of secretion does not appear to play a significant part in man. More important is the inhibitory effect on secretion and motility that arises from the presence of fat in the intestine, which stimulates the formation of an inhibitory hormone, enterogastrone.

Interpretation of Tests

At one time there was a tendency to relate dyspepsia either to an increased or to a decreased peptic secretion, and a diagnosis of hyperacidity or hypoacidity was regarded as conclusive. Unfortunately this is not so, for both high and low levels of acidity can be found in individuals who are free from digestive disorders. The terminology has been most misleading. Test meals measure a concentration of acidity and not the total output of acid secretion, so that *hyperacidity* is not necessarily synonymous with *hypersecretion*. The concentration of acid in the gastric contents depends on two variables—the amount of acid secreted and the rate of emptying of the stomach. With rapid emptying there may be little fluid left to dilute newly secreted acid, and the concentration may therefore be far higher than if the stomach had emptied more slowly but secreted at the same rate.

At the other end of the scale, the term "achlorhydria" can also be misleading. The limit of free acid is reached when Töpfer's reagent turns from red to yellow. This colour change occurs at pH 3.5, which is well above neutrality point at pH 7, and there is, in fact, a small amount of free acid left at pH 3.5. Normally, however, it is perfectly adequate to take pH 3.5 as indicating achlorhydria.

The secretory response to a test meal depends on the quantity and chemical nature of the food, and to a smaller extent on the enjoyment with which it is eaten. The products of digestion of protein, or even their watery extracts, are good stimulants. Starches, on the other hand, are poor secretagogues and their secretory effect is mainly due to distension of the stomach. Nevertheless, the starch test meal has a considerable advantage over a meat-extract meal. The stomach may give an average response to a gruel meal but a hyperresponse to meat extract or alcohol, and the latter would therefore fail to differentiate between a normally secreting stomach and the hypersecretory response associated with a duodenal ulcer. The gruel test meal is commonly used, but the alcohol and caffeine tests are sometimes used instead. Alternatively, the quantitative response to histamine may be measured.

When a gruel test meal is given and samples of gastric juice are taken every 15 minutes, there is an initial fall in acidity followed by a steady increase, with a gradual

**Med. J. Aust.*, 1952, 1, 593.

†Harkness, J., and Durant, J. A. (1953). *J. clin. Path.*, 6, 178.

fall after about one and a half to two hours. The initial fall is due to the dilution of the small initial secretion by the bulk of the meal. The increase in acid is often due to the mechanical stimulation of the gruel, which unlike many foods, such as milk, eggs, or meats, does not have any intrinsic secretagogic action.

Gastric secretion consists of two components: the parietal cell component—that is, hydrochloric acid—and an alkaline secretion from the pyloric glands which, together with mucus, lowers the final level of acidity. The fall in acidity commonly found at the end of a test meal is mainly due to this “non-parietal” secretion; regurgitation of bile and pancreatic juice plays a minor part. The exact mechanism of co-ordination between the acid and alkaline components of the gastric juice is not yet fully understood. There seems to be a normal “brake” mechanism which operates through the duodenum; when the pH reaches a certain level an inhibitory mechanism begins to come into action and depresses gastric acidity either by increasing the alkaline component or by decreasing the acid secretion, or both. With duodenal ulcer this “brake” mechanism may be lost, hence the high rising curve sometimes found.

The standard gruel test meal provides a number of points for consideration: first, the amount and appearance of the resting secretion; and, secondly, the shape of the curve, the level of acidity attained, and the approximate rate of emptying of the stomach. The curve is commonly plotted on a printed sheet which gives the limits of the so-called normal responses in a shaded area. It must be remembered that this so-called normal response merely represents the limits which account for 80% of symptom-free subjects. The remaining 20% of normals had either well-marked “hyperchlorhydria” or hypochlorhydria.

In a standard test meal it is customary to give histamine, 0.5 mg., after one and a half hours if there is no acid present in the stomach by then. Histamine is a powerful stimulus to acid production, but if there is no response to histamine it is still not conclusive evidence of the complete inability of the stomach to secrete acid. For example, in a patient with a histamine-fast achlorhydria and a gastric ulcer, it is possible to get copious free acid for many hours during the day when hourly samples are taken round the clock, yet the histamine response may have been repeatedly negative. The ordinary dose of histamine does not get all the parietal cells into action, and about four times the usual dose is required to do this, but a dose of this size can be given only when covered by an antihistamine drug. This technique does enable one to assess the “total secretory mass” of the gastric mucosa.

Conclusion

The standard test meal is, in practice, full of pitfalls and fallacies, and unless done with care by an interested observer will not justify the discomfort caused to the patient or the time taken in the laboratory. It has been said that the test meal is a much better test of the patient's endurance than of his gastric function. Gagging and retching may cause secretory inhibition and produce an apparent achlorhydria. Achlorhydria, with increased difference between the free and total acid, may be due to the gruel being made with milk or to the patient having had a meal before the test was started. The presence of flecks of blood is sometimes misinterpreted and may be merely due to the trauma of suction on the mucosa. A chemical test for blood is too sensitive and it is better to rely on naked-eye appearance. Appreciable blood-staining is usually significant. The end of the tube may sometimes slip back into the gullet or pass through into the duodenum. Nevertheless, when the test is done by someone with experience and sympathy, particularly if the nasal rather than the oral route is used, it can be made reasonably comfortable and the major difficulties can be avoided.

Next article on Clinical Pathology.—“Laboratory Investigation in the Hyperchromic Anaemias,” by Dr. John F. Wilkinson.

A SURVEY OF ST. ALFEGE'S HOSPITAL GERIATRIC UNIT FOR 1952

BY

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This geriatric unit is known as St. Alfege's Hospital II. It is situated in two separate blocks, each of three stories. Each floor consists of one ward divided into two—one for the bedridden, and the other for patients who are up and about. These arrangements have been made for the comfort of the patients and, more especially, to facilitate the work of the staff, particularly at night. The present bed establishment is 268—164 for women and 104 for men. As a considerable number of women patients are under 60 one ward is allotted to them together with diabetic patients. The same need does not arise in the case of male patients, but, on the other hand, there are more surgical and post-surgical cases, mainly due to urinary tract conditions (prostatic hypertrophy, cancer of the prostate, urinary retention, cystostomy), and therefore one ward is allotted to them. Male diabetics have a special ward.

Population Served

The area served by this hospital covers the boroughs of Greenwich and Deptford. According to the latest available figures the population is 170,000 (and therefore the present number of beds represents 1.6 per 1,000). If we regard 14% as being the geriatric group—that is, persons of pensionable age—this would amount to approximately 24,000, and therefore there are available 1.1 beds per 100 for the group.

It is well known that the social structure of the population is of great importance when assessing the number of beds required for elderly people. For instance, it is likely that a hospital situated in an upper-class residential area might require fewer beds than one in a working-class district. The population in our area consists almost entirely of weekly wage earners; most members of the family go out to work, and neighbourly help is therefore seldom readily available. Housing conditions are sometimes poor, with overcrowding. As a result of these circumstances there is often a heavy demand for hospital beds for old people. A large proportion of the population, mostly women, live alone, and the additional burdens which accompany winter may well bring their slender resources, already stretched to the utmost, to breaking-point, and compel them to seek hospital admission.

Admissions

During the year under review 300 women and 246 men were admitted. Requests for admission come from the following sources: General practitioners, acute wards of St. Alfege's and Miller Hospitals, the Emergency Bed Service, the medical officer of health, receiving-room, and other hospitals (teaching, cancer hospitals, etc.).

The procedure for the admission of patients put on the waiting-list by general practitioners is as follows.

In the late spring and through the summer, when the number of applications is not large, patients are admitted solely on their doctors' recommendations, because it is thought that even those patients who need residential rather than hospital accommodation will benefit from a stay in hospital before moving on to a local authority home.

Patients who are mentally deranged often benefit in the same way, but if after a period of observation their mental condition does not improve the advice of the consultant psychiatrist is sought. On his recommendation suitable patients can be transferred to Tooting Bec Mental Hospital,