CLINICAL PATHOLOGY IN GENERAL PRACTICE

CHEMICAL EXAMINATION OF THE FAECES

BY

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Blood in the stool traditionally is divided into visible and invisible, or occult. Visible new blood normally indicates lesions in the colon, rectum, or anal canal. Occult blood may be due to bleeding from any point in the alimentary canal from teeth to rectum, since it must not be forgotten that small amounts of blood from the colon or even rectum may be invisible if mixed into a semi-solid stool. The usual test for blood relies on the catalytic action of haemoglobin or haematin in oxidizing a suitable precursor (usually benzidine) to a highly coloured substance in the presence of excess of a peroxide. If the blood has had time for bacterial action to break off the iron fraction from the haematin this catalytic action is lost, but a pigment of the porphyrin type is formed which can be identified by spectroscopic examination. The use of the two tests together can be quite a useful guide to the amount and sometimes to the region of the bleeding. Being a simple, quick, and inexpensive test, it can be used to pick out, for example, from cases with persistent abdominal symptoms those which need far more lengthy and expensive investigations.

In order to obtain the maximum amount of information the patient should not take, for a least three days, pigmented foods such as meat, herring, or green-stuff, or laxatives of the senna or rhubarb type. He should be instructed to collect three consecutive stools. A sample of each one at least as big as a walnut is placed into a named and numbered container, which should be obtained from the nearest pathological laboratory—not in a jam-jar or paste-pot. The inferences that may be made are shown in the Table.

Inferences Drawn from Benzidine and Spectroscopic Tests

Benzidine Test	Spectroscopic Test		Inference
	Acid Haematin	Haemato-porphyrin	
Very strong positive	+++	0 to +	Severe haemorrhage, usually gastric or duodenal, but may be swallowed blood or of oesophageal origin
Strong positive	+	+	Fairly severe haemorrhage, probably gastric, oesophageal, or swallowed
" "	Trace or +	0 or trace	Less severe haemorrhage, probably gastric, oesophageal, or may be duodenal
Positive ..	0	+ or trace	Slight bleeding: duodenal or gastric ulcer. Ulceration, malignant or simple, of jejunum
" ..	0	0	Slight bleeding or ulceration, simple or malignant, of colon or ileum
Negative ..	0	Trace or +	Gastric ulcer, simple or malignant

Sources of bleeding in the mouth and upper and lower respiratory passages should be remembered, however. They would mimic gastric bleeding. Errors in feeding should not be forgotten and the finding of chlorophyll in the spectroscopic examination is useful, indicating insufficient preparation. It is rare, however, for any diet, especially in these days, to contain enough blood pigment to cause more than trace reactions. Excessive amounts of chlorophyll interfere with both the benzidine and the spectroscopic examinations, and trace reactions must be ignored. Medicinal iron, even if in sufficient amount to give a black stool, will not interfere with spectroscopic examination.

The serial examination of the stools of an ulcer patient under treatment can be a useful guide, since so long as any

blood is present, provided other sources of bleeding can be excluded, it is certain that the ulcer is not healed and unnecessary radiological examinations for ulcer craters can be avoided. It is essential that a suitable sensitive spectroscopic test is used as well as the benzidine test, especially if some degree of constipation is present.

Pigments

There are many pigments which may appear in a stool, and both food and drugs will affect the colour. Occasionally conditions permit the formation of red pigments which may make the unwary observer suspect the presence of blood. They often appear in a constipated stool which has a cover of mucus—the pigment seeping out of the stool tints the mucus red. Closer inspection is usually enough to expose the deception. A black stool, due to iron or bismuth or even charcoal biscuits, may be mistaken for the tarry black stool of melaena, but again careful inspection alone should reveal the difference. Apart from these the colours due to diet or drugs are unlikely to mislead one.

Bile and its Derivatives

Examination by simple inspection of the amount of brown pigment will give much information, and often it is not necessary to have laboratory help, but especially when the stools are soft and bulky an erroneous impression of absence of pigments may be given. As accurate information about the presence or absence of altered bile pigment is of great value in the differential diagnosis of jaundice, it is wise to confirm visual inspection by laboratory tests. In all but the neonate the excreted bile pigments are altered in the gut to stercobilin, a brown pigment responsible for most of the colour of the normal stool, or stercobilinogen. Stercobilinogen is a colourless substance easily altered to the brown coloured stercobilin but a potential source of error in simple visual inspection. Its presence can be inferred if the stool becomes brown on the surface on contact with air. There is no diagnostic value in distinguishing between the two forms of altered bile.

In complete obstruction with long-standing jaundice there may not be a complete absence of pigment. Slight traces will always be found if a sensitive method is used. The source of this pigment is from the jaundiced gut wall and its secretions.

In acute hepatitis there may be a great reduction of stercobilin, often reaching the same low level as complete obstruction, but this lasts only a short time and the first sign of recovery is the reappearance of stercobilin in the faeces. In haemolytic jaundice the amount of stercobilin is often increased.

In the neonate the diagnostic importance of the bile pigments in the stool is greater owing to the often misleading results of blood liver-function tests at this age. At first the pigment present is unaltered bile, but at some time between 4 and 16 weeks the pigment becomes stercobilin. It is important, therefore, in this age group to look for bile as well as stercobilin. The presence of visible traces of brown or green bile in congenital obliteration of the bile ducts can be misleading, but chemical examination will show that only a very small amount of pigment is actually present.

Digestive and Absorptive Functions

The normal stool varies in colour, consistence, and content of total solids within a wide range depending on diet, fluid balance, bowel habit, and other factors. The patient's

statement of a change having occurred, or the mother's that the stool differs from other children's, is of importance in that it directs attention to digestive or absorptive disturbances. Naked-eye inspection of the stool should not be omitted. It takes but little time and quite often gives useful information.

Before making an examination of the stool it is essential to know the nature of the diet. If possible a diet which is of normal composition for the age of the patient should be given. It is obviously useless to look for starch or meat in a patient living on a milk diet. Medicines, if taken, should be noted—for example, liquid paraffin, especially in emulsion—and it should not be forgotten that most dusting powders applied to infants contain much starch and must contaminate the stool.

Much useful information is obtained from a microscopical examination, but as bacterial and ferment action continue after the passage of the stool it should be examined as soon as possible. A thin film of faeces is made with two drops of Lugol's iodine and examined under the $\frac{3}{4}$ and $\frac{1}{4}$ objectives. Starch granules appear black; meat fibres appear brown and have the typical striations of muscle fibres. Fatty acids appear as fine needle-shaped crystals, a little longer than the diameter of a red cell, either singly or in sheaves. Fat globules are seen as clear spheres of varying sizes, often golden in colour, but are better seen in films stained with fat stains such as scharlach R or sudan III. All these constituents may appear in a normal stool in very small numbers, and a little experience is needed in interpreting the results; as a rough guide, in one high-power field there should not be more than one meat fibre or fat globule or starch granule. Fatty acid crystals are more frequent.

Carbohydrate

Carbohydrates are normally easily digested and absorbed and only traces—0.1 to 0.5%—are found in the stool. Very little help is obtained from chemical estimation of digestible carbohydrates, partly because they are so easily utilized by micro-organisms. Soluble sugars are almost completely absorbed during the passage through the gut, but starches, if not digested, may in part escape bacterial destruction and appear in the stool. Much gas can be evolved by bacterial digestion of starch, and faecal specimens have been known to blow out the cork or shatter the container if delayed in transit to the laboratory. A simple test for excess starch is to place a drop of iodine solution on the stool, if much starch is present a blue or blue-black stain is formed; if in less amount the microscope will reveal its presence. Starch may be present as amorphous material staining the whole stool, as small granules, or as granules inside a cellulose-covered cell. This last form indicates that raw or only partly cooked starch-containing vegetable foods have been taken—for example, unripe banana—and is not of much significance. Marked failure of digestion of starch occurs in pancreatic dysfunction, and less marked failure in coeliac disease and in so-called "starch dyspepsia," a condition often due to faulty dietary habits such as eating too much pastry. A tendency to pass bulky gassy stools with indefinite abdominal discomfort is an indication to look for this condition.

Protein

The easiest way to detect failure of protein digestion is to look for meat fibres. Usually protein is entirely absorbed—the average nitrogen content of the 24-hour stool in an adult on a normal diet is 1 g., and on a protein-free diet it is 0.75 g. The nitrogen is from bacteria and cell debris, and varies with the bulk of the stool to some extent. Collection of a representative 24-hour stool has certain difficulties owing to the irregular rate of emptying of the colon in many people. Accurate metabolic studies need an intelligent and co-operative patient. It is usually not practical in general practice to look for an increase in the nitrogen lost in the stools by analytical chemical tests. An increase in undigested meat fibres occurs typically in pancreatic deficiency,

but any condition giving rise to intestinal hurry may also cause them to appear. The stool is usually soft or semi-fluid and has a characteristic unpleasant Limburger-cheese-like smell.

Fat

The digestion of fat presents rather more of a problem, as from its nature it cannot be got into a soluble form in the gut. Detection of failure of fat absorption is, however, far from a simple task. After the age of 1 year the normal stool contains 10 to 25% of its dry weight as fatty material. Values over 35% are considered abnormal. About 2 to 5% represents metabolic fats—from the tissues or from bacterial bodies. About a quarter of the total fat is unaltered dietary fat and the balance is present as free fatty acid or calcium and magnesium soaps. The actual composition, however, does not always represent the digestive activity, since bacterial enzymes split the fat while the stool is retained in the colon and continue to act at a rate dependent on the temperature after the stool has been passed. Microscopical examination of a freshly passed stool gives more useful information about the capacity of the digestive juices to split fat than chemical analysis. On the other hand, except in extreme cases, it is not possible by microscopical examination, especially in children, to form any estimate of the total split fat present. Inspection of the stool can be useful. Obvious fat may be seen, but more often the stool has a metallic sheen, resembling aluminium paint, due to the presence of many fatty acid crystals. If the stool is pale, large, and bulky, excess of fat may be suspected, but chemical examination is needed to confirm it.

Estimation of the fat content of a single stool has only a limited value; in the infant it is useless, as many normal infants pass stools containing over 40% of fat. In coeliac disease, largely owing to generalized absorptive failure, the total fat may fall within the normal range and children with normal fat absorption can occasionally be found with a total stool fat between 35 and 40%. As, however, in domiciliary or out-patient work more accurate methods of collection are too difficult to carry out, the single stool examination has to suffice.* If a stool contains more than 35% fat there is a case for hospital investigation of the patient. The stool should be a representative one and an adequate sample should be sent. The waxed cardboard containers now obtainable from the nearest pathological laboratory should be at least half filled. During periods of acute diarrhoea misleading results may be obtained and it is better to postpone the investigation.

It is in children that the faecal fat estimations are most useful—in detecting coeliac disease and fibrocystic disease of the pancreas. In coeliac disease there is a generalized difficulty in digestion and absorption leading to wasting, with a large abdomen and large bulky offensive stools. In fibrocystic disease absorption is unimpaired but digestion is more severely affected than in coeliac disease. Microscopical examination often reveals this difference. It is also seen by the much higher total fat content of the fibrocystic stool, values of over 70% being not uncommon. In the adult, sprue resembles coeliac disease—disorders of the external secretions of the pancreas when they occur give a picture similar to fibrocystic disease, but disturbances of liver func-

*The accurate assessment of errors of fat absorption is done by placing the subject on a weighed diet containing an amount of fat representing some 30% of the total calories. Any unconsumed food is collected each day, and its fat content determined. After a few days a coloured marker (carmine or charcoal) is given at 7 a.m., and as soon as it appears in the stool collection of all stools passed is started. After four days a second marker is given, and a second four-day collection is started as soon as the second marker appears, and on the eighth day a third marker is given. When this appears in the stools the collection is stopped. The two four-day collections are separately analysed for their total fat, and the percentage fat absorption determined for each period, after allowing for any unconsumed fat. The two results are then averaged. Normally at least 95% of the fat consumed is absorbed, but a result is not considered abnormal unless it is under 90%. For protein absorption estimations a similar technique is used.

tion leading to gross reduction of bile will also produce failure of fat absorption without any evidence of other digestive errors.

Digestive disturbances attributed to fat by the sufferer are often met with. In those who do not respond to the usual common-sense remedies it would be worth while to seek by examination of the stool for evidence of a real abnormality.

Ferments

Some information can be obtained by searching for digestive ferments, a procedure complicated by the instability of digestive ferments and by the presence of active bacterial ferments. In practice the estimation of tryptic activity is the most reliable method. This must be done on a freshly passed specimen not more than four hours old. The value of the results depends somewhat on the technique used, the simple film method (see Appendix) being less in agreement with the clinical findings than the test-tube method. If there is digestion at a dilution of 1 in 100 or more it is probable that adequate pancreatic juice is being secreted. The converse, that if no digestion occurs at a dilution of 1 in 50 or less it suggests absence of pancreatic secretion, does not hold except in infants.

Appendix: Simple Chemical Tests

Blood: Benzidine Test.—Take a piece of stool about the size of a pea and emulsify with about 2 in. (5 cm.) of water in a test-tube. Boil and cool. Take a knife-point of benzidine and dissolve it in $\frac{1}{2}$ in. (1.25 cm.) of glacial acetic acid

Spectrographic appearance of (1) stercobilin in acid alcohol; (2) chlorophyll, weak; (3) chlorophyll, strong; (4) acid porphyrin; (5) acid porphyrin, weak solution; (6) acid haematin in diluted hydrochloric acid.

acid alcohol (1 ml. concentrated hydrochloric acid into 100 ml. absolute alcohol or industrial methylated spirit). Mix. Stand overnight. Filter. Examine with a hand spectroscope. The bands to be seen are shown in the Figure.

Bile.—Make a thin emulsion of the stool and mix with increasing amounts of Fouchet's reagent (trichloroacetic acid, 25 g.; distilled water, 100 ml.; 10% ferric chloride solution, 10 ml.)—not more than equal parts—either on a white tile or in a test-tube. A green or blue colour indicates bile.

Trypsin.—Make an emulsion of the stool with 1% crystalline sodium carbonate solution, about 1 in 10 dilution. Place one drop of the emulsion and one drop (as control) of the sodium carbonate solution on a dry radiographic film or photographic plate. Incubate 30 minutes at 37° C. (Keep moist by placing a sheet of wet filter paper just above the film.) Wash under the cold-water tap. If trypsin is present the coating of the film will be dissolved off and a clean round spot will be seen. The control will

only be slightly swollen up. Serial dilutions of the faeces can be made with the sodium carbonate solution and a semi-quantitative result obtained.

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RECRUITMENT OF MENTAL NURSES

A three-day conference on mental nursing, arranged by the Royal College of Nursing, opened on January 12. The subject taken in the first session was "Staffing: a Survey of the Present Position."

Dame ENID RUSSELL-SMITH, Under-Secretary, Ministry of Health, in an opening address, said that this was one of the most difficult problems in the National Health Service. Mental nursing had been caught up, though in greater degree than most, in the difficulties that beset every profession. Perhaps for the first time in our history we were running short of man- and woman-power, and this was hitting us particularly at the professional level. Nearly all occupations were becoming more difficult and more technical, less manual and more professional, and therefore making ever bigger demands on a comparatively limited age group. The matter for immediate concern was the inadequate number of those offering themselves as students for mental nursing. The problem was not so much how to attract all and sundry to mental nursing: it was how to attract more student nurses of the right calibre.

The High Wastage

In the Report of the Working Party on the Recruitment and Training of Nurses, Dame Enid continued, it was calculated that the rate of wastage among mental nurses was about 80%. Another later calculation on a different set of facts gave a wastage rate nearer to 65%. She thought the latter figure was more likely now to be true, because the former was calculated during the disturbance of the immediate post-war period. A good deal was known about the causes of wastage. Some of these, of course, were inevitable, but others were susceptible of remedy. First came family reasons, including marriage, but some married women nurses, as in other professions, returned to work after their children began to grow up. There was also wastage owing to some people who had originally shown promise turning out to be unsuitable. A third reason was bound up with questions of pay, but as an arbitration was pending that question could not be discussed profitably on this occasion. Other reasons related to conditions of work and to the teaching and training itself. If the training was too difficult a student was naturally discouraged, as also if it was too elementary. Careful selection of students must be made, but if this were done there must inevitably be, at least temporarily, a drop in numbers. The question was how to fill the gap until the training was rendered more attractive. The National Advisory Council of the Ministry of Labour believed that enrolled assistant nurses should be trained and employed in mental hospitals, but the Minister's Standing Mental Health Advisory Committee was against the employment of enrolled assistant nurses and favoured the continued employment of nursing assistants, possibly for many years to come, while recommending that such assistants should be systematically instructed in the tasks they were called upon to perform. The Confederation of Health Service Employees held that the only type of nurses employed in the mental nursing service should be qualified nurses and student nurses, but