

Diagnostic Tests in Gastroenterology

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London

CHAPMAN AND HALL MEDICAL

First published in 1989 by
Chapman and Hall Ltd
11 New Fetter Lane,
London EC4P 4EE

© 1989 Alistair D. Beattie

Typeset in 10 on 12pt Sabon by
EJS Chemical Composition, Bath

Printed in Great Britain at the
University Press, Cambridge

ISBN 0 412 27660 7

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British Library Cataloguing in Publication Data

Beattie, Alistair D.

Diagnostic tests in gastroenterology.

1. Gastrointestinal tract. Diagnosis.

I. Title.

616.3'3075

ISBN 0-412-27660-7

Preface

Diagnostic Tests in Gastroenterology has been written with the practising gastroenterologist in mind. It is not a textbook of intestinal disease but an anthology and manual of clinical and laboratory tests which may be required in the assessment of patients suffering from such diseases.

Careful selection has been necessary and certain tests have been deliberately excluded. Endoscopy which forms a large part of gastroenterological practice is fully described in a growing number of textbooks dedicated to that art and is not included in this book. Radiological techniques are excluded except for reference to their selection in preference to or as a complement to other methods of investigation. It is assumed that the gastroenterologist will have access to expert assistance in the performance and interpretation of X-rays. Biochemical and microbiological methods have not been described in detail if they are generally accepted as being universally available standard techniques. There is, however, variation in availability and described methods will not be required of every gastrointestinal laboratory.

Methods used in research studies have been included where they are generally accepted as being the standard method for assessment of a given problem. These tests are not essential for gastrointestinal practice but hopefully will be useful in some situations.

My grateful thanks are due to various colleagues for their help and encouragement and I should particularly like to acknowledge the advice of Dr G.P. Crean and the contribution of material by Dr W. Watson, Dr P. Morley, Dr M. Millar and Dr G.T. McCreath. My wife, Gillian, has been a great support throughout the preparation of the text. I am indebted to Mr Alexander Rodger, Mrs Kathleen Lindsay and Mr Laurence Bebbington for the considerable task of checking the references. Finally the typing of the manuscript has been done with skill and patience by Mrs Audrey Muldoon and Mrs Fiona McCallum and I am extremely grateful to them both.

A.D. Beattie

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Assessment of oesophageal symptoms

The investigation of heartburn, dysphagia and chest pain which may be of oesophageal origin presents the gastroenterologist with difficulties which may not always be resolved by radiology and endoscopy. In the majority of cases the barium swallow and endoscopy with biopsy will provide a sufficient basis on which to proceed to either definitive therapy or a trial of appropriate pharmacological agents but in a significant minority of patients it is necessary to use other tests to establish the pathophysiological nature of the illness. This is particularly so when surgery is contemplated.

The most specialized of these tests are oesophageal pH measurement and oesophageal manometry. These require a high measure of skill and experience and may be regarded by some as research techniques. This is incorrect because they have a clear role in diagnosis in a small number of patients and they should be accessible although not necessarily in every gastroenterology department.

The remainder of the oesophageal tests include acid perfusion tests for differentiation of oesophageal from other forms of chest pain, the mecholyl test used in association with manometry in the diagnosis of achalasia, the methylene blue test for the diagnosis of oesophageal reflux in children and oesophageal scintigraphy in the diagnosis of gastro-oesophageal reflux.

1.1 OESOPHAGEAL pH MEASUREMENT

Accurate measurement of oesophageal pH is possible with equipment which can be comfortably tolerated by patients over a period of 24 hours. Such measurement is not frequently required in clinical practice but it does constitute the most objective method of assessing both the presence and severity of gastro-oesophageal

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reflux. The method described here is that of De Meester *et al* [1] who have reviewed their experience in 393 patients with symptoms suggestive of oesophageal disease.

(a) Method

The electrodes used are a Beckman No. 39043 pH electrode or equivalent and a Beckman No. 40249 reference electrode. The nose is anaesthetized with 3% cocaine and the pH electrode is passed to a position about 5 cm above the upper portion of the distal oesophageal sphincter preferably located by preliminary motility studies. The reference electrode is firmly secured to the forearm by tape making sure that sufficient clear electrode jelly is applied to facilitate good electrical contact. An occlusive wrap is placed around the arm to produce sweating and this is then covered with a gauze bandage.

The pH probe and reference electrode are connected using an isolation module (e.g. Beckman No. 588485) to a pH meter and a strip chart recorder running at 10 cm per hour. The system should be standardized at pH values of 1.4, 4 and 7.

The patient is encouraged to take a normal diet but should avoid coffee and cigarettes because of their tendency to reduce lower oesophageal sphincter pressure. Pharmacological agents should also be avoided for the period of study unless considered essential because of other medical conditions. Liquids of pH less than 5 or greater than 6 should be avoided.

Patients are also asked to record symptoms such as heartburn, nausea, abdominal or chest pain with accurate timing of their occurrence. A chart is kept of all food and drink taken and changes of posture are recorded. If possible the patients should only adopt the recumbent posture during hours of sleep. The test is commonly used on a 24-hour basis but can be continued for up to 72 hours if desired.

Interpretation of the test is made on the basis of certain guidelines which may vary from centre to centre. De Meester *et al* [1] suggest that acid reflux should be defined as a fall in oesophageal pH to 4 or less and the number of such episodes and their duration recorded. They also calculated the proportion of time that the oesophagus was exposed to acid during the total time of the test and individually for the supine and erect positions. They also recorded the number of reflux episodes exceeding 5 min duration as a record of the ability of the oesophagus to clear acid.

(b) Normal values

As with many other tests, a scale of normal values must be compiled by each laboratory individually. In a series of 15 asymptomatic volunteers De Meester *et al* [1] found that the number of episodes of acid reflux should be less than 50 per 24 hours. The pH should be less than 4 for less than 6.3% of time spent in the upright position and less than 1.22% of time spent in the supine position. The number of reflux episodes of 5 min or more should not exceed three.

(c) Evaluation

The routine management of gastro-oesophageal reflux does not require 24 hour oesophageal pH monitoring and indeed it would be a gross misuse of resources to apply it to the majority of such patients. It is, however, a very useful means of assessing the patient with atypical symptoms where there may be confusion with angina pectoris or other non-oesophageal causes of chest pain. The relationship of symptoms to acid reflux can be studied in a much more detailed manner than that afforded by the relatively crude Bernstein test. Patients being assessed before or after oesophageal surgery can also be regarded as a group in whom useful clinical information is obtained from this test.

Safety is high and significant side-effects virtually unknown.

Cost is low after initial purchase of the equipment and a number of systems of relatively high capital cost incorporating computer analysis methods are now commercially available.

1.2 ACID PERFUSION TEST

Bernstein and Baker [2] described a test in which 0.1M hydrochloric acid was dripped into the oesophagus through an oesophageal tube to reproduce the pain of oesophageal disease and differentiate it from cardiac and other causes of chest pain. Over the years this has proved a useful and discriminating test of value to both gastroenterologists and cardiologists.

(a) Method

The test is carried out with the patient in a comfortable sitting position. A polyethylene tube is passed until its tip lies about 8 cm above the cardia of the stomach or 32 cm from the mouth. The tube is connected to two drip sets – one containing 0.9% NaCl and the

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other 0.1 mol/l HCl. A three-way tap allows instant changing from one solution to the other and is arranged in such a way that the patient is unaware of changes being made.

The saline solution is perfused for 10 min at a rate of 10 ml/min and at 20 ml/min for 5 minutes. Perfusion of hydrochloric acid follows at 10 ml/min for 15 minutes and 20 ml/min for 15 minutes. Symptoms are recorded throughout and if pain occurs 0.1 mol/l sodium bicarbonate is infused for rapid relief. In this circumstance it is essential to repeat the procedure for confirmation that the pain is causally related to the acid perfusion.

(b) Evaluation

The acid perfusion or 'Bernstein' test is generally accepted as useful in distinguishing cardiac chest pain from that caused by oesophageal disease. Bennett and Atkinson [3] reported a study of 15 healthy volunteers, 11 patients with angina pectoris, 29 with a clinical diagnosis of reflux oesophagitis and 22 with anterior chest pain of uncertain cause. All the patients in the reflux oesophagitis groups had normal electrocardiograms and all but five had endoscopic evidence of the condition. Typical pain was produced on acid perfusion in 28 of the 29 patients with oesophagitis and no patient with angina had a positive test although two on acid perfusion experienced a pain which was easily distinguishable from their angina. This corresponds to a false negative rate of 3% and a false positive rate of 0–7% depending on how the results are interpreted.

However, the usefulness of the test is probably confined to distinguishing cardiac from oesophageal pain. Spencer [4] reported positive tests in 18% of normals, 29% of patients with peptic ulcer and 67% of patients with gallstones. These high false positive rates suggest that considerable caution is required in the interpretation of acid perfusion tests in dyspeptic subjects.

1.3 METHYLENE BLUE TEST

Radiology and endoscopy are less useful in the diagnosis of gastro-oesophageal reflux in infants than in adults and the need may sometimes arise for a simple and safe test which can be used in this situation. The methylene blue test was described by Girardi *et al* [5] and was evaluated by them in 70 patients.

(a) Method

The patient is fasted overnight and a nasogastric tube is passed into the stomach through which 5 ml/kg body weight of methylene blue solution (1% in 0.1 mol/l HCl) is introduced. The tube is then withdrawn and sedation given.

A 2 mm diameter polyvinyl tube with several openings and a cotton thread contained along its length is then passed transnasally until the tip lies in the lower oesophagus.

The patient lies supine for two hours and then sits up while the tube is rapidly withdrawn. The cotton thread is removed and examined for staining with methylene blue. Staining occurs, in a positive test, opposite the openings along the length of the tube.

(b) Evaluation

Girardi *et al.* [5] using barium swallow evidence of reflux as a standard found 49 cases of reflux all of whom had a positive test. Three patients had a positive methylene blue test but negative radiology. Both sensitivity and specificity are therefore high although exact figures for these are meaningless in the absence of an absolute standard for positive reflux.

1.4 OESOPHAGEAL SCINTIGRAPHY

Oesophageal scintigraphy [6] was introduced as a means of assessing and quantifying gastro-oesophageal reflux in a non-invasive way. It has not been widely adopted because of the facility of detection by barium meal or endoscopy but the technique does offer some advantages and will therefore be described. The method described can be found in detail in Malmud and Fisher [7].

(a) Method

The fasting patient is placed in a supine position under a gamma camera using a diverging collimator with a window setting of 140 keV \pm 20%. Isotonic saline (300 ml) containing 100–300 mCi ^{99}Tc sulphur colloid is ingested and 30 s timed images are obtained.

Gastro-oesophageal reflux is computed using the formula:

$$R = [(E_1 - E_R) / G_o] \times 100$$

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where R = gastro-oesophageal reflux in per cent

E_1 = oesophageal counts at t_1

E_B = background oesophageal counts

G_0 = gastric counts at beginning of study

The amount of activity in oesophagus, stomach and background is determined by counting the scintillations within the outlined areas of interest using a light pen or a 64×64 cell grid on the oscilloscope face.

If no reflux is demonstrated, sensitivity may be increased by repeating the test 15 to 20 minutes after the ingestion of an additional 100–300 mCi ^{99}Tc sulphur colloid in 300 ml acidified orange juice containing 150 ml orange juice in 150 ml 0.1M HCl.

(b) Evaluation

The test has not been widely evaluated and probably represents an unnecessarily expensive approach to a simple problem. Malmud and Fisher [7] found the method to be more sensitive than any other diagnostic technique. Using simultaneous manometry as a standard they detected reflux in 27 out of 30 patients – a sensitivity of 90%. Specificity should be 100%.

The radiation dose is negligible and much less than that of conventional barium radiography.

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Tests of oesophageal motility

2.1 OESOPHAGEAL MANOMETRY

Barium swallow and endoscopy may fail to diagnose the cause of dysphagia and chest pain even in cases where clinical presentation is suggestive of oesophageal disease. The differential diagnosis between angina pectoris and chest pain of oesophageal origin may be unresolved by the electrocardiogram and effort test and both may either respond or fail to respond to drugs which are mainly thought of as coronary vasodilators. In such circumstances, oesophageal manometry may be of great value and while the technique may not necessarily be available in every hospital it should be accessible to patients who require it.

Manometry is mainly of value in motility disorders of the oesophagus and these can be subdivided as follows:

1. Primary oesophageal motility disorders
 - (a) achalasia
 - (b) diffuse oesophageal spasm
 - (c) hypertensive lower oesophageal sphincter
2. Secondary oesophageal motility disorders
 - (a) progressive systemic sclerosis
 - (b) diabetes mellitus
 - (c) Chagas' disease
 - (d) chronic idiopathic intestinal pseudo-obstruction

Indications for employing manometry may be approached in terms of suspicion of the above diagnoses although in practice it may be more realistic to think in terms of differential diagnosis of symptoms in which case dysphagia and chest pain will be the main indications after the more obvious causes of these symptoms have been excluded. There is little evidence that manometry is helpful in the differential diagnosis of heartburn.