Butterfat absorption – a valuable screening test in malabsorption

G.D. Harper, D.C. Wheeler¹ and A.C.B. Wicks²

North Devon District Hospital, Raleigh Park, Barnstaple, Devon EX31 4JB, ¹Royal Infirmary, Cardiff CF2 1SZ and ²Leicester General Hospital, Leicester LE5 4PW, UK

Summary: The diagnosis of intestinal malabsorption is difficult to make without the use of specific tests such as endoscopic retrograde cholangiopancreatography (ERCP) or duodenal biopsy which are invasive and potentially hazardous. Faecal fat estimation or C14 Triolein breath tests have limitations as screening tools are time consuming and expensive. The butterfat absorption test (BFAT) is, in contrast, a simple, quick and cheap test for fat malabsorption. We have assessed the performance of this test in a blinded retrospective study of all such procedures performed in a teaching hospital over an 8 year period.

One hundred and fourteen cases of suspected malabsorption had one or more butterfat tests. These were divided into absorbers and malabsorbers without knowledge of the butterfat test results.

We found the butterfat test to have a sensitivity of 88% and a specificity of 94% using a cut-off of 20 light-scattering intensity units to discriminate normal from abnormal tests. At this level, predictive values are 91% for a positive result and 92% for a negative. These results are similar to those reported with the C14 Triolein breath test and adjusted faecal fats.

We conclude that the butterfat test is a simple, cheap and effective screening test in the diagnosis of malabsorption.

Introduction

The diagnosis of malabsorption is currently based on a collection of non-specific symptoms, signs and blood tests which guide the physician to the appropriate specific investigations of duodenal or jejunal biopsy, small bowel enema, endoscopic retrograde cholangiopancreatography (ERCP) or pancreatic studies.¹ The latter are unpleasant, expensive in terms of medical time and resources, and are potentially hazardous. Thus there is a need for a reliable, cheap and quick screening test.

Fat malabsorption is present in over 75% of patients with coeliac disease and the majority of patients with pancreatic or overgrowth malabsorption. Tests for fat malabsorption remain the most commonly used screening tool. Faecal fat estimation requires a strict diet, collection of all stool over 3 days and, ideally, the use of markers to compensate for variations in intestinal transit time. Even when performed to all these criteria it remains unpleasant and time consuming, requiring hospitalization for reliable results.¹ The use of radio-labelled triglyceride absorption and subsequent breath test has been shown to be sensitive and very specific.^{2,3} It is, however, contraindicated in childhood and pregnancy, expensive and time consum-

ing, taking about 7 hours, and is not widely available. It is likely that many clinicians do without a screening test and proceed directly to specific investigations.

The butterfat absorption test (butterfat test) is, in contrast, quick, cheap, easy to perform and relatively pleasant for the patient. The equipment needed is present in all district general laboratories and the test is easy to perform as an outpatient. Despite the apparent advantages, very little published work has been performed to assess its value. We have performed a retrospective study of all the butterfat tests conducted at the Leicester General Hospital and compared the results with the final diagnosis in each case.

Patients and methods

We have used the butterfat test as our preliminary screening test for malabsorption in Leicester since 1980. It is a simple procedure performed both in the outpatient departments and on the wards. Patients are asked to fast from 22.00 hours the previous evening and, following a fasting blood sample, are given 1 g/kg body weight of butter on two slices of toast as a carbohydrate carrier. A second sample is then taken at 2 hours. The change in the light scattering intensity (LSI) of the serum measured

Correspondence: G. Harper, M.R.C.P.

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with a nephelometer is then calculated by simple subtraction.

In an earlier evaluation in our own department, the butterfat test was compared with faecal fat collections in 25 subjects with suspected malabsorption in whom a final diagnosis had been established. The two tests showed a fair and significant correlation ($r = 0.61$, $P < 0.01$). From these results it was decided that a change in LSI at 2 hours of over 40 units should be considered normal, less than 20 units abnormal and the range between 20 and 40 units borderline. This broadly agrees with a cut-off level of 20 units previously suggested.⁴

Data for the present study were gathered from a retrospective review of the case notes for all patients undergoing the butterfat test from 1980 to 1989. Patients were felt to be malabsorbing if they had a positive duodenal or jejunal biopsy, an abnormal ERCP or pancreatic function test, or an elevated faecal fat. Other clinical data considered were weight loss, response to treatment, steatorrhoea, folate and albumin levels and X-ray studies. Patients were excluded if the data were inadequate or conflicting, in the presence of severe underlying disease (including depression) unless fully investigated, and if suffering from giardiasis. The data were collected retrospectively by one of the authors (GDH). The absorption status for each case was assessed without knowledge of the patient's name or butterfat result. The specificity, sensitivity and predictive values were calculated for increments of five from 10 to 40 LSI units as a simple cut-off value and the value of a 'borderline' zone assessed.

Results

A total of 81 patients received a total of 97 butterfat tests. The characteristics of this population are shown in Table I. The main analysis is set out in Table II and the separation of the two groups is illustrated in Figure 1. As can be seen from the analysis, a simple cut-off value of 20 LSI units at or below which malabsorption is likely appears to give the best balance of sensitivity, specificity and predictive values. Even if repeat tests are included there is only a slight loss of accuracy overall.

If 20–30 units is taken as an equivocal range, five cases (6%) fall into this band. The net result as shown in Table II improves the tests' performance still further. Widening this band to an upper limit of 40 units has a negative effect and unnecessarily doubles the number of grey cases.

Of the patients with false negative results one had pancreatic and three coeliac malabsorption. The patient with pancreatic disease may have taken pancreatic enzyme replacement ('pancrex') and one of the coeliac patients may have already started a

Table I Characteristics of the patients and final diagnoses for those studied

Age (years)			
Mean		42.5	
Median		42.0	
Range		1.5–90	
SD		19.2	
Sex			
Male		35	
Female		46	
<hr/>			
	<i>Diagnoses</i>		
<i>Malabsorbers</i>		<i>Absorbers</i>	
<hr/>			
Coeliac disease	19	Irritable bowel	17
Pancreatic disease	11	Crohn's disease	2
Jejunal diverticulosis	2	Ulcerative colitis	1
Ileal resection	1	Diverticulosis	1
Total	33	Polyposis	1
		Dietary	6
		Food allergy	1
		Alcoholic	1
		No pathology	18
		Total	48

diet. One patient diagnosed as coeliac had only minimal villous atrophy which later became more florid. Of the patients with false positive tests, one had diabetes and two were suffering from nausea.

Discussion

In 1956, Gardiner *et al.* evaluated a test that involved chylomicron counting in their review of investigations for patients with tropical sprue.⁵ They gave a fixed 30 g fatty load (butter) on a suitable carbohydrate carrier (two slices of toast) and measured optical densities of serum thereafter. They demonstrated that in normal subjects serum optical density rose dramatically to peak at about 3 hours. In patients with sprue the optical density rose very slowly and at 5 hours the level attained was less than 30% of the normal peak. Other investigators have since corroborated these results,^{4,6,7} and suggested a cut-off level of 20 LSI units as an appropriate lower limit of normal.⁴ Despite this apparently useful separation, the test has not found widespread use. Indeed West² compared a selection of such tests against adjusted faecal fats and concluded that only the C14 triolein breath test performed well enough to be thought of as a true screening test.

We do not consider the conclusion of West *et al.* valid for two reasons. Firstly they used a standard test meal for all the tests with a fixed level of fat (60 g), and little or no butter. This is adequate for

Table II Sensitivity and specificity (95% confidence intervals) for the butterfat test using different cut-off values and diagnostic groups

Cut-off value (LSI)	Sensitivity (95% CI)	Specificity (95% CI)	Predictive value +	Predictive value -	Borderline
First tests (n = 81)					
10	61% (44-78)	94% (87-100)	87% (75-100)	78% (67-89)	-
20	88% (77-99)	94% (87-100)	91% (81-100)	92% (84-100)	-
30	91% (81-100)	86% (76-96)	83% (71-95)	93% (85-100)	-
20-30	91% (81-100)	93% (84-100)	91% (81-100)	93% (84-100)	6% (1-11)
20-40	91% (81-100)	92% (83-100)	91% (81-100)	92% (83-100)	12% (5-19)
All tests (n = 97)					
20	86% (76-96)	91% (83-99)	88% (78-98)	89% (81-97)	-
20-30	88% (79-98)	90% (82-98)	88% (87-98)	90% (82-98)	5% (1-9)
Working diagnoses					
First test (n = 97)					
20	86% (75-97)	93% (87-99)	89% (79-99)	92% (85-99)	-
20-30	89% (79-99)	93% (86-99)	89% (79-99)	93% (86-100)	9% (3-15)
All tests (n = 114)					
20	85% (75-95)	91% (84-98)	87% (77-97)	90% (83-97)	-
20-30	87% (77-97)	90% (83-97)	87% (77-97)	90% (83-97)	9% (4-14)

Figure 1 Butterfat test results for malabsorbers (median (95% CI) 5 (2-11)) and absorbers (median 76.5 (54-95)).

the radioisotope technique, but the determination of serum lipid changes is best achieved by titrating the dose of body weight and using sufficient carbohydrate as a carrier.⁴ Secondly they used the peak level of optical density as their discriminating measure and not the level at 2 hours. As Gardiner's work demonstrates, in patients with malabsorption, not only is the peak optical density reduced, but the rate of rise is much lower. We would suggest that a sample at 2 hours is more sensitive for both effects.

The butterfat test performs well when assessed to the criteria set down by Reigelman.⁸ It is simple to perform and measurement of the light scattering intensity is a quick, cheap and simple procedure performed on a nephelometer (cost approximately £1,500) or a fluorimeter (possessed by almost all hospital laboratories). The results are reproducible within and between both patients and observers, and closely reflect the observed rise in lipids.⁷ As we have shown, the diagnostic discrimination and predictive value of the butterfat test is excellent. The false positive results we found may represent poor gastric emptying or inadequate consumption of the test meal.

In our hands the butterfat test has proved a reliable screening test for fat malabsorption, performing as well as the radioisotope test and faecal fat collection with considerably less cost and inconvenience. We have shown that a simple cut-off level of 20 LSI units gives very good discrimination and the use of an equivocal range of 20-30 LSI can improve this further at little cost. Patients falling into this range could either have repeat tests or second line investigations as their clinical condition dictates.

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References

1. Russell, R.I. & Lee, F.D. Tests of small intestinal function. In: Russell, R.I. (ed.) *Clinics in Gastroenterology*. W.B. Saunders, London, 1978, pp. 277–317.
2. West, P.S., Levin, G.E., Griffin, G.E. & Maxwell, J.D. Comparison of simple screening tests for fat malabsorption. *Br Med J* 1981, **282**: 1501–1504.
3. Turner, J.M., Lawrence, S., Fellows, I.W., Johnson, I., Hill, P.G. & Holmes, G.K.T. [¹⁴C]-Triolein absorption: a useful test in the diagnosis of malabsorption. *Gut* 1987, **28**: 694–700.
4. Bentley, S.J., Eastham, R.D. & Lane, R.F. Oral butter fat test meal with serum nephelometry in suspected fat malabsorption. *J Clin Pathol* 1975, **28**: 80–81.
5. Gardiner, F.H., Santiago, E.P. & Bayamon, P.R. Oral absorption tolerance tests in tropical sprue. *Arch Intern Med* 1956, **98**: 467–473.
6. Penfold, W.A.F. & Keynes, W.M. Use of a standard fatty meal as a test of fat absorption. *Ann Surg* 1971, **173**: 157–163.
7. Osmon, K.L., Zinn, W.J. & Wharton, G.K. Comparison of turbidity with total lipid levels. *JAMA* 1957, **164**: 633–638.
8. Riegelman, R.K. *Studying a Study and Testing a Test*. Little, Brown and Co., Boston, 1981, pp. 119–140.