Relative Value of Tests for Intestinal Malabsorption

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SUMMARY

In the investigation of 79 patients to establish the presence or absence of intestinal malabsorption, the most accurate pointers to malabsorption were established. A good test should be abnormal in most patients with malabsorption, and be normal in normal patients. The investigations adhering nearest to these criteria were found to be jejunal biopsy, barium meal and follow-through, and Schilling and xylose tests. Stool fat estimation, glucose tolerance and vitamin A tolerance were less useful tests of malabsorption. There was no correlation between stool fat excretion and vitamin A tolerance.

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A battery of tests is required for the adequate investigation of malabsorption. This is largely because of the great length of the small intestine, and the variation in sites of absorption of different nutrients.[1] In addition, no single test is sufficiently reliable to be used as a screening test. In the series of 71 patients investigated and reported upon by us,[2] and 8 subsequent patients, it became apparent that certain of the tests utilised for the investigation of intestinal malabsorption were abnormal in a far greater percentage of patients than other tests. This prompted a further analysis of these tests.

METHODS

Seventy-nine patients were studied. Sixty-seven were patients referred with a clinical suspicion of malabsorption and 12 were Zulu control subjects. Each patient had a jejunal biopsy with the Carey capsule,[3] a barium follow-through examination of the small intestine with non-flocculating barium, a Schilling test for vitamin B_{12} absorption employing a 24-hour urine collection of ^{57}Co plus intrinsic factor,[4] a xylose excretion test[5] with a 5-hour urine collection after a 25-g dose; a glucose tolerance test, with 5 half-hour blood specimens after a 50-g oral dose; a 3-day stool collection for faecal fat,[6] and a vitamin A tolerance test[7] with blood taken at zero time and 4 hours after a 350 000-unit load of vitamin A in oil. Malabsorption was accepted to be present if the barium follow-through and/or jejunal biopsy were abnormal with at least two of the biochemical tests.

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RESULTS

The studies with the greatest discriminatory value in distinguishing malabsorption from normal were the barium

TABLE I. DISCRIMINATORY VALUE OF TESTS FOR MALABSORPTION

	Malabsorption					
Jejunal biopsy	Yes		No		X^2	*P*
Normal	6		25			
Abnormal	40	87%	0	0%	49,16	<0,0005
	46		25			
Barium follow-through						
Normal	8		25			
Abnormal	35	81%	0	0%	42,14	<0,0005
	43		25			
Schilling test						
Normal	7		21			
Abnormal	30	81%	3	12,5%†	27,36	<0,0005
	37		24			
Xylose excretion						
Normal	10		19			
Abnormal	30	75%	6	24%†	16,00	<0,0005
	40		25			
Stool fats						
Normal	18		19			
Abnormal	13	42%	1	5%†	8,36	<0,005
	31		20			
GTT*						
Normal	18		18			
Abnormal	22	55%	7	28%†	4,64	<0,05
	40		25			
Vitamin A tolerance						
Normal	17		11			
Abnormal	29	63	12	52%†	0,78	NS
	46		23			

* Glucose tolerance test.
† % false positive.

TABLE II. COMPARISON BETWEEN VITAMIN A TOLERANCE AND STOOL FATS

	Both vitamin A and stool fats abnormal			Both vitamin A and stool fats normal		
	Total No. of patients	Patients with malabsorption	Normal patients	Total No. of patients	Patients with malabsorption	Normal patients
Test in accordance	**11**	**10 (91%)**	**1**	**21**	**9 (43%)**	**12**
	Vitamin A normal and stool fats abnormal			Vitamin A abnormal and stool fats normal		
	Total No. of patients	Patients with malabsorption	Normal patients	Total No. of patients	Patients with malabsorption	Normal patients
Test in discordance	**8**	**8 (100%)**	**0**	**29**	**18 (62%)**	**11**

Normal values: vitamin rise > 180 μm in 4 h; stool fats <6 g/24 h.

follow-through (χ^2 42,14, $P<0,0005$) and the jejunal biopsy (χ^2 49,6 $P<0,0005$) (Table I). The features on the barium meal which were most valuable[2] were either a regular dilatation (28 patients), or alternating areas of dilatation and narrowing (7 patients). No patients without malabsorption in this series had an abnormal barium follow-through. Jejunal biopsy revealed partial villous atrophy in 40 of 46 patients with malabsorption[2] with a villous : crypt ratio of less than 1 : 1. No patients without malabsorption had an abnormal jejunal biopsy.

Of the 5 biochemical tests utilised, the best were the Schilling test of vitamin B_{12} absorption and the xylose excretion test (Table I). Thus the Schilling test with intrinsic factor was abnormal (less than 7% excretion in 24 hours) in 81% of patients with malabsorption, and only 12,5% of patients without malabsorption (χ^2 27,36, $P<$ 0,0005). Xylose excretion was abnormal (less than 4 g in 5 hours) in 75% of patients with malabsorption, and 24% of patients without malabsorption (χ^2 16,00, $P<0,005$). Stool fats and glucose tolerance tests were less helpful tests for malabsorption. The stool fat excretion was only abnormal (greater than 6 g/24 hours) in 42% of patients with malabsorption and was always evident on other studies as well. On the other hand, stool fats were abnormal in only 1 patient without malabsorption (5%) and this may have been a laboratory error. A χ^2 of 8,36 was obtained, which is significant at the 0,005 level.

Glucose tolerance was less useful, with errors in both malabsorption and normal groups. Glucose tolerance was abnormal (less than 40 mg/100 ml rise) in only 55% of patients with malabsorption, and 28% of patients without malabsorption (χ^2 4,64, $P<0,05$).

Vitamin A tolerance was useless in discriminating between malabsorption and normal. Although vitamin A tolerance was abnormal (less than 180 μm rise) in 73% of patients with malabsorption, it was also abnormal in 52% of patients without malabsorption (χ^2 0,78, NS). When vitamin A tolerance and stool fat were both abnormal, 10 of the 11 patients (91%) had malabsorption (Table II). When both vitamin A tolerance and stool fats were normal, 9 of the 21 patients (43%) had malabsorption, and 12 were normal. When the 2 tests were in discordance, where vitamin A tolerance was normal and stool fats were abnormal, all 8 patients had malabsorption. Where vitamin A tolerance was abnormal and stool fats were normal, 18 of the 29 patients (62%) had malabsorption and 11 patients were normal.

Absolute values for the 5 biochemical tests utilised, and the comparison between results obtained in patients with malabsorption and patients without malabsorption (by Student's *t*-test), are seen in Table III. All figures refer to means ±standard deviation. Schilling test excretion in 24 hours after a labelled dose was 5,0 ± 5,9% in 37 patients with malabsorption, and 13,5 ± 6,1% in 24 patients without malabsorption ($P<0,001$). Xylose excretion was 3,0 ±2,0 g/5 h in 40 patients with malabsorption, and 5,4 ±2,6 g/5 h in 25 patients without malabsorption ($P<$ 0,001). Stool fat excretion was 9,0 ±8,1 g/24 h in 31 patients with malabsorption, and 3,4 ±1,8 g/24 h in 20 patients without malabsorption ($P<0,001$). A mean rise

TABLE III. ABSOLUTE VALUES FOR TESTS

	Malabsorption		No malabsorption		
	No.	Mean ± SD	No.	Mean ± SD	*P*
Schilling test %/24 h	**37**	**5,0 ± 5,9**	**24**	**13,5 ± 6,1**	**<0,001**
Xylose excretion g/5 h	**40**	**3,0 ± 2,0**	**25**	**5,4 ± 2,6**	**<0,001**
Stool fats g/24 h	**31**	**9,0 ± 8,1**	**20**	**3,4 ± 1,8**	**<0,001**
GTT* mg/100 ml rise	**40**	**34,1 ± 24,9**	**25**	**61,2 ± 34,4**	**<0,01**
Vit. A. μm/ml rise	**46**	**240 ±288**	**23**	**480 ±415**	**NS**

* Glucose tolerance test.

of 34,1 ±24,9 mg/100 ml after a 50-g glucose dose was observed in 40 patients with malabsorption, and a mean rise of 61,2 ±34,4 mg/100 ml was observed in 25 patients without malabsorption ($P<0,01$). In the vitamin A tolerance test a rise of 240 ±288 units was observed in 46 patients with malabsorption, and a rise of 480 ±415 units was found in 23 patients without malabsorption (this was not significantly different). The percentage of abnormal tests in the major disease groups is shown in Table IV. Percentages of over 50% are underlined. There were fewer haematological abnormalities in the group with tuberculosis.

TABLE IV. PERCENTAGE OF ABNORMAL TESTS IN MAJOR DISEASE GROUPS

	TB	Crohn's	Tropical sprue	Giardiasis	Infective
Haematological					
Megaloblastic marrow	36	50	96	50	67
Low ser. folate (<3,6 pg/ml)	33	0	58	0	50
Low ser. B_{12} (<200 ng/ml)	33	50	54	0	0
Intestinal					
Jejunal biopsy (PVA)†	82	50	100	100	60
Barium follow-through	100	100	71	100	100
Stool fat>7 g/24 h	29	50	33	100	100
Glucose tolerance test <40 mg rise	29	50	67	100	0
Xylose<4 g in 5 h	63	0	79	100	67
Schilling test<7%	100	100	79	100	0
Hypo-albuminaemia <3,5 g/100 ml	100	100	42	50	67

* Shigella, Salmonella, diverticular disease of jejunum.
† Partial villous atrophy.

DISCUSSION

In the study of 79 patients to establish the presence or absence of malabsorption, it appeared that the tests with the greatest discriminatory value were the non-biochemical investigations, jejunal histology and barium follow-through examinations. These tests require a degree of subjective analysis. In an attempt to obviate this, the tests were read in a blind fashion, and their discriminatory value was confirmed.

Of the biochemical tests, by far the best were the Schilling test for vitamin B_{12} excretion and the xylose excretion test (Table I). As xylose is absorbed in the jejunum, and vitamin B_{12} in the terminal ileum,[1] these 2 tests are extremely useful as biochemical indicators of malabsorption. Significant renal disease was not present in our series, and urine collections were adequate.

Stool fat estimation was abnormal in only 42% of patients with established malabsorption, and occurred when other tests were also abnormal. It is conjectural whether stool fat excretion should be employed as a routine test for malabsorption except in certain circumstances. Even if renal function vitiates the use of xylose or Schilling tests, resort to blood estimations in these tests is possibly preferable to the tedium of stool fat estimation. In diseases of the jejunum, such as coeliac disease,[1] stool fat estimations are frequently normal. If documentation of patients is required for publication, stool fat estimations are necessary. In the investigation of maldigestion due to pancreatic disease, stool fat estimation before and after therapy is required because pancreatic enzyme replacement may be of therapeutic use.[8]

Vitamin A tolerance had no relation to stool fat excretion in this series. Vitamin A tolerance is abnormal or normal with such great frequency in patients with and without malabsorption that it has no value as an indication of malabsorption.

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REFERENCES

1. Booth, C. C. *in* Code, C. F. ed. (1968): *Handbook of Physiology*, Sect. 6, vol. III, p. 1524. Washington, D.C.: American Physiological Society.
2. Moshal, M. G., Hift, W., Kallichurum, S. and Pillay, K. (1973): S. Afr. Med. J., **47**, 1093.
3. Carey, J. G. jun. (1964): Gastroenterology, **46**, 550.
4. Schilling, R. F. (1953): J. Lab. Clin. Med., **42**, 860.
5. Sammons, H. G., Morgan, D. B., Frazer, A. C., Montgomery, R. D., Phillip, W. M. and Phillips, M. J. (1967): Gut, **8**, 348.
6. Van der Kamer, J. H., Huinnink, H. T. C. N. B. and Weyers, H. A. J. (1949): Biol. Chem., **177**, 347.
7. Adlers-Berg, D., Wang, C. I. and Bossack, E. T. (1957): J. Mt. Sinai Hosp., **24**, 206.
8. Marks, I. N., Bank, S. and Airth, E. M. (1963): Gut, **4**, 217.