
Clinical Topics

Costs of unnecessary tests

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British Medical Journal, 1979, 2, 21-24**Summary and conclusions**

The relative importance of the history, examination, and routine and special investigations has been assessed in the diagnosis and management of 630 medical outpatients. The history was the most important factor in both diagnosis and management in cardiovascular, neurological, respiratory, urinary, and other miscellaneous problems, and decided 56% of all diagnoses and 46% of all management. Examination findings were of more limited value, accounting for only 17% of diagnostic and 17% of management decisions overall. Routine haematology and urine examinations were of minimal value, contributing to less than 1% of all diagnoses. Special investigations decided most of the diagnoses and management in alimentary and endocrine problems, but were less helpful in problems affecting all other systems.

If a local survey in the Trent Region reflected the pattern of medical outpatient practice nationally, then £1.25 million could be saved annually if routine investigation was discontinued on all patients whose problem had already been diagnosed on the basis of the history and the clinical examination.

Introduction

The use of routine investigations in the medical outpatient department is widespread. The experienced doctor, however,

realises the limited value of such investigations and the importance of the clinical history and, less so, of the clinical examination in the diagnosis and management of patients. To try to measure the usefulness of the three basic clinical methods—history, examination, and investigation—a two-year study of medical outpatients was undertaken in a typical district general hospital serving a largely urban population of 225 000 people.

Patients and methods

All new patients referred by a general practitioner to a general medical clinic with a cardiological bias were included in the study. The new patient was examined at his first attendance by the medical registrar or senior house officer, who took a detailed history. Routine investigations in all patients comprised haemoglobin, white cell count, erythrocyte sedimentation rate, blood urea, serum electrolytes, and blood sugar estimations, chest radiograph, and electrocardiogram. In addition any appropriate special investigations were also arranged, such as exercise tests, barium studies, electroencephalography, etc. After a short interval the patient returned to the clinic to see me, when the following steps were undertaken:

(1) The referral letter was read carefully and a note made on whether a specific diagnosis was offered, or whether referral was on the basis of symptoms/signs only.

(2) The history obtained at the first attendance was read and supplemented by any relevant questions that had been omitted by the junior staff.

(3) A specific diagnosis was made where possible and the management decided on the basis of this completed history. Management could be referral back to the general practitioner with or without treatment, follow-up in the medical clinic again with or without treatment, hospital admission, or referral to another hospital department.

(4) The initial examination findings were studied and any omissions again made good by me.

(5) The diagnosis and management based on the history were reviewed in the light of the examination findings and any necessary modifications made.

(6) Finally, the investigations were assessed and any contribution

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by routine investigation or special investigation to diagnosis and management was assessed.

To check the accuracy of the hospital diagnosis a questionnaire was circulated to general practitioners 18 to 30 months after the initial referral, asking whether the diagnosis was still considered correct or whether any new developments had occurred to alter the hospital diagnosis. This questionnaire was not, however, sent in relation to all patients seen. Where the hospital diagnosis confirmed the practitioner's diagnosis—for instance, in anginal patients—or where objective findings placed the diagnosis beyond doubt, as in hypertension, rheumatic heart disease, diabetes, thyrotoxicosis, etc, no follow-up was considered necessary.

Results

In the two-year period 630 outpatients were seen, who were classified according to the system involved, based on the practitioner's referral letter (table I). Most referrals were for cardiovascular problems of which the majority were patients with chest pain (65%). Neurological problems, mainly loss of consciousness, came next followed in order of frequency by endocrine problems (mainly diabetes and thyroid disorder), miscellaneous problems, alimentary, respiratory, and urinary problems.

TABLE I—Classification based on the general practitioners' referral letter

Cardiovascular	276
Chest pain	180
Hypertension	32
Arrhythmias	18
Heart failure	8
Murmurs	26
Other	12
Respiratory	36
Dyspnoea	20
Bronchitis	12
Other	4
Alimentary	52
Indigestion	43
Bowel change	4
Other	5
Urinary	19
Neurological	119
Loss of consciousness	62
Headache	28
Paraesthesia/weakness	22
Other	7
Endocrine	65
Diabetes	37
Thyroid disorder	25
Other	3
Miscellaneous	63
Loss of weight, lack of energy, obesity, joint problems, anxiety, anaemia, etc	

The value of the history, examination, and investigations in making the diagnosis is shown in table II. Where total percentages in this and subsequent tables do not add up to 100% the discrepancy is due to patients in whom no diagnosis could be made. The history decided the diagnoses in two-thirds of the cardiovascular patients overall; clinical examination contributed to only one-quarter of diagnoses.

When the 180 patients with chest pain are considered separately, the history gave the diagnosis in 90%, and examination was of no diagnostic value at all. Routine investigations, mainly chest radiographs and electrocardiography, helped with only 3% of diagnosis and special tests, mainly exercise electrocardiography, with 6%. The diagnostic value of the history was also high in neurological problems with examination contributing even less than in cardiovascular problems, and routine investigations were again of minimal value.

TABLE II—Diagnostic value of history, examination, and investigations

Referral diagnosis	No of patients	Investigations			
		History	Examination	Routine	Special
Cardiovascular	276	67%	24%	3%	6%
Neurological	119	63%	12%	3%	14%
Endocrine	65	32%	15%	11%	42%
Alimentary	52	27%	0	0	58%
Respiratory	36	47%	22%	17%	14%
Urinary	19	53%	10%	5%	26%
Miscellaneous	63	46%	8%	8%	21%
Total	630	56%	17%	5%	18%

The history was also the main diagnostic method in respiratory, urinary, and miscellaneous problems. It was of least value in alimentary problems where the main diagnostic help was provided by the special radiological tests. Special investigations were also of primary diagnostic value in endocrine problems. Clinical examination and routine investigations were of no help in alimentary problems and little help in urinary problems.

The importance of the history, examination, and investigations in deciding management is shown in table III. The history was the major determining factor in the cardiovascular, neurological, respiratory, and miscellaneous groups. Examination was most helpful in respiratory disease, mainly in diagnosing chronic bronchitis and emphysema, and rather less so in cardiovascular problems, where the main findings were hypertension and rheumatic heart disease. Examination helped least in alimentary problems. Routine investigations were of least value in cardiovascular and neurological management, and of most value in endocrine problems, mainly due to blood sugar concentrations in diabetics. As expected also, the routine chest radiograph was important in the management of respiratory problems, and routine urine examination in urinary problems. The special investigations were again of most value in alimentary and endocrine problems.

TABLE III—Management of history, examination, and investigations

Referral diagnosis	No of patients	Investigations			
		History	Examination	Routine	Special
Cardiovascular	276	58%	25%	4%	13%
Neurological	119	55%	13%	3%	21%
Endocrine	65	11%	14%	32%	43%
Alimentary	52	19%	2%	0	63%
Respiratory	36	36%	28%	19%	17%
Urinary	19	26%	5%	21%	42%
Miscellaneous	63	44%	6%	11%	21%
Total	630	46%	17%	9%	24%

The incidence of abnormal results in all the routine investigations is shown in table IV, which also indicates whether the abnormality relates to the primary condition for which the patient was referred or to an associated unexpected but clinically significant condition. The limited number of positive results with every investigation in every group of patients is obvious. The overall incidence of positive blood or urine test results did not exceed 5%, and when considered in relation to the primary condition for which the patient was referred, gave diagnostic help in even less. The most useful routine tests were the chest radiograph and electrocardiogram, but even they were of primary diagnostic help in only 5% and 12% respectively.

The diagnostic value of the more specific special investigations was greater (table V). A positive test occurred most often with the vitalogram in respiratory problems, but even then decided the diagnosis in only 21%. The glucose tolerance test was of the greatest diagnostic value of all the special tests, diagnosing 70% of the diabetic problems. Barium meal tests and cholecystography contributed substantially to the diagnosis of alimentary problems. The electroencephalogram, though often positive, decided the diagnosis in only 16% of cases; the echoencephalogram and brain scan were of no value. Thyroid function tests were of considerable diagnostic value. The exercise test was of negligible diagnostic help in chest pain.

The accuracy of the general practitioner's diagnosis is shown in table VI. A definite diagnosis was most often made in potential diabetics and accuracy was high. Just over half the cardiovascular problems were referred with a diagnosis, mainly in patients with chest pain, and accuracy was again high. Although a diagnosis was infrequent with neurological symptoms, accuracy was very high. Diagnosis and confirmation rate were low in alimentary problems. The miscellaneous group, though infrequent with diagnosis, had a very high accuracy rate.

Table VII shows the results of the follow-up questionnaire on the original hospital diagnosis in 548 patients. There was a 60% response, and the overwhelming majority of the answers confirmed the original diagnosis.

Cost of investigations

Table VIII shows the individual cost of the various routine investigations and the total cost of the negative investigations during the

two-year period of the study. The annual cost of these useless investigations was £3598.72.

A small survey among 28 doctors in the Trent Region to discover how many carried out routine investigations in their new outpatients similar to the procedure in the present study showed that 43% did so.

If this pattern was reflected nationally among the 1044 doctors employed in the NHS, the total annual cost of useless routine investigations would amount to £1 651 422. Table IX shows the cost of routine investigations in those patients in whom the diagnosis had already been made on the basis of the history and examination. The annual cost to my medical clinic was £2823 and again if a similar pattern is reflected nationally the total annual cost to the NHS would be £1 267 083.

TABLE VIII—Cost of investigations

	Cost per test (£)	No of negative tests	Cost of negative tests (£)
Haemoglobin/white cell count	1.64	625	1025.00
ESR	1.64	621	1018.44
Urine	0.99	598	592.02
Blood urea and electrolytes	1.04	603	627.12
Blood sugar	1.04	605	629.20
Chest radiograph	1.26	538	677.88
ECG	2.18	510	1111.80
Total			£5681.46

TABLE IV—Incidence of abnormal routine investigations and relevance to diagnosis

	No done	Hb/WCC		ESR		Urine		Urea and electrolytes		Sugar		Chest radiograph		ECG	
		1°	2°	1°	2°	1°	2°	1°	2°	1°	2°	1°	2°	1°	2°
Cardiovascular	276	1	9	2	1	0	9	6	6	0	1	21	33	66	16
Neurological	119	0	4	0	1	0	3	0	3	0	1	0	10	2	9
Endocrine	65	0	3	0	1	12	0	0	4	21	0	2	7	2	7
Alimentary	52	0	1	0	0	0	0	0	1	0	1	0	3	1	5
Respiratory	36	1	0	2	0	0	3	0	4	0	0	7	3	3	4
Urinary	19	0	1	1	0	3	0	0	0	0	1	0	0	0	0
Miscellaneous	63	4	1	1	0	0	2	2	1	0	0	0	6	1	4
Total	630	6 (1%)	19 (3%)	6 (1%)	3 (0.5%)	15 (2%)	17 (3%)	8 (1%)	19 (3%)	21 (3%)	4 (1%)	30 (5%)	62 (10%)	75 (12%)	45 (7%)

1° = Primary condition for which patient was referred.
2° = Unexpected co-existent but clinically significant condition.

TABLE V—Incidence of abnormal special investigations and relevance to diagnosis

	No of patients referred	No having test	% with positive test	% of positive results in which investigation decides diagnosis
Chest pain—exercise ECG	180	49	24%	2%
Dyspnoea—vitalogram	36	14	79%	21%
Alimentary problems				
(a) Barium meal	52	35	35%	69%
(b) Barium enema		5	0	0
(c) Cholecystogram		19	32%	100%
Neurological problems				
(a) Electroencephalogram	119	59	42%	16%
(b) Echoencephalogram		40	0	0
(c) Brain scan		11	0	0
Thyroid				
(a) PBI	26	22	23%	40%
(b) ¹³¹ I		6	50%	50%
(c) T3 uptake		22	23%	40%
Diabetes—glucose tolerance test	36	18	56%	70%
Total	438	300	30%	50%

TABLE VI—Accuracy of general practitioner's diagnosis

	No of patients	No referred with definite diagnosis	Diagnosis confirmed
Cardiovascular	276	146 (53%)	79%
Neurological	119	31 (26%)	94%
Endocrine	65	48 (74%)	62%
Alimentary	52	15 (29%)	33%
Respiratory	36	11 (31%)	75%
Urinary	19	7 (37%)	71%
Miscellaneous	63	16 (25%)	94%
Total	630	274	76%

TABLE VII—Results of follow-up diagnostic questionnaires

	No of patients	No of questionnaires sent	Answers received	
			Same diagnosis	Different diagnosis
Cardiovascular	276	271	124	7
Neurological	119	111	73	5
Endocrine	65	30	22	0
Alimentary	52	38	27	2
Respiratory	36	25	19	4
Urinary	19	14	10	0
Miscellaneous	63	59	41	0
Total	630	548	316	18

TABLE IX—Cost of routine investigations in patients already diagnosed on basis of history and examination

	Total No of patients	No of patients diagnosed	Cost of routine investigations in diagnosed patients (£)
Cardiovascular	276	257	3107.38
Neurological	119	89	1101.82
Endocrine	65	31	383.78
Alimentary	52	14	173.32
Respiratory	36	25	309.50
Urinary	19	12	148.56
Miscellaneous	63	34	420.92
Total cost in the two-year study			£5645.28
Cost per year			£2822.64

Discussion

This study has clearly shown the major importance of the history in deciding the diagnosis and management of 630 medical outpatients. It gave the diagnosis in about two-thirds of the cardiovascular and neurological problems overall. The largest group of patients in the study were those with chest pain, and in these patients the history decided 90% of the diagnoses. In the respiratory, urinary, and miscellaneous

groups the history was also the most important diagnostic tool. These findings support the views expressed by Platt¹ on the vital importance of the history in clinical medicine. Similar findings were also reported by Hampton *et al*² in a more limited study of 120 medical outpatients. Clinical examination contributed much less diagnostic help, its main benefits being confined to cardiovascular problems in the detection of hypertension and valvular heart disease, and in respiratory problems in indicating chronic bronchitis and emphysema. Similar results emerged in relation to the major value of the history in patient management, with much less help provided by examination findings.

Routine blood count, erythrocyte sedimentation rate, blood urea, and serum electrolyte estimations were of primary diagnostic help in only 1% of patients overall. Routine urine examination and blood sugar estimations also contributed little to diagnosis, apart from diabetic patients. Chest radiographs were slightly more helpful in respiratory and cardiovascular problems as was the electrocardiogram in cardiovascular problems. Nevertheless, urinary and blood sugar estimations in diabetics and chest radiographs and electrocardiograms in respiratory and cardiovascular problems are hardly "routine" since they are specifically orientated to these problems.

The special investigations were of more value in diagnosis and management. The most useful were barium meals and cholecystograms, which decided most of the alimentary diagnostic problems. Thyroid function tests and glucose tolerance tests were also of considerable help in the appropriate endocrine disorder. The exercise electrocardiogram contributed little in cardiovascular problems, and the electroencephalogram was also of minor value in neurological problems.

What are the implications of the present study? First and foremost is guidance on the educational requirements of medical students. Conventional training is based on a combination of history and examination findings before the diagnosis is considered. A similar system is widespread in published case presentations in medical journals. Much greater emphasis should be placed on the diagnostic and management value of the history. Students, and postgraduates, should be well trained in taking a good history and in drawing diagnostic conclusions from the history before embarking on the examination. This will encourage the student to seek specific examination findings to confirm or refute the diagnosis based on the history. The traditional case presentation of history and examination followed by differential diagnosis should be changed to history, differential diagnosis, and *relevant* examination findings. A similar approach could be encouraged in medical journals and textbooks where

inadequate emphasis on the importance of the history is often all too evident.

The study has also shown clearly the limited value of routine blood investigations. Some doctors may carry out these routine investigations because they think it makes their approach more scientific; others, perhaps, because they fear they might miss some other serious co-existent condition; yet others may consider it desirable to have baseline measurements of these parameters to compare with possible future disorders. Emphasis on the scientific investigational approach, however, commendable though this may appear, could lead to unselective application of laboratory investigations and minimise the importance of good history-taking in diagnosis and management. The value of the routine blood and urine investigations in the present study in showing unsuspected significant co-existing disease was small, only 9.5% of patients. A similar limited incidence of unexpected abnormal routine laboratory results was also reported by Brod³ in his study of 200 medical outpatients.

Another important consideration is the cost of valueless routine investigations. In the Barnsley District General Hospital alone an annual saving of £2822 could have been achieved in one medical clinic by omitting routine investigations in patients in whom the diagnosis had already been made on the basis of the history and clinical examination, and if the national picture followed the pattern of the local survey carried out in the Trent Region, an annual total of over £1.25 million could have been saved. If no routine investigations are done at all the local saving would be £7799 and the national saving £3 501 930, and the corresponding loss of help in diagnosis and management would be negligible.

The justification for any investigation should surely be to answer a specific clinical question relating to diagnosis and management only when there is doubt as to either, or to measure the effect of treatment that cannot be assessed on symptoms or signs alone. Where these requirements are not operative, however, and where the result of the investigation, whether positive or negative, is unlikely to change either the diagnosis or management of the patient, there can be little justification for asking for it.

References

- ¹ Platt, R, *Manchester University Medical School Gazette*, 1947, **27**, 139.
- ² Hampton, J R, *et al*, *British Medical Journal*, 1975, **2**, 486.
- ³ Brod, J, *Journal of the Royal College of Physicians*, 1977, **11**, 323.

What is the gastric bypass operation, and are there any serious side effects?

The management of gross refractory obesity by gastric bypass was started by Mason *et al* in Iowa, USA, in 1965.^{1,2} Since then the procedure has gained in popularity in the States, and to a lesser extent in New Zealand. In Britain it is under trial at centres in Birmingham and London but is performed less often because of greater priorities demanded by other surgery in the NHS. The procedure necessitates high gastric transection to create a proximal pouch of 10% the size of the original gastric reservoir. This is anastomosed to the jejunum as in a Polya gastrectomy, but the stoma size is made no more than 1.2 cm in diameter. The bypassed stomach is anchored in situ and is available for restoration of continuity if the need arises. The use of stainless steel stapler instruments have made the procedure much easier.

The hazards are those of a difficult major operation in massively obese patients, who are always bad risks. The operative mortality of about 1.5% is greater than that of jejunioleal bypass, deaths mainly being due to peritonitis caused by suture line leakage and pulmonary embolism. Vomiting, gastro-oesophageal reflux, and dumping may be troublesome in the early months, and the incidence of stomal ulcer varies from 1% to 6%. These problems diminish considerably by six months, after which side effects are less than after jejunioleal bypass.

The weight reduction achieved by gastric reduction is as good as that achieved by jejunioleal bypass,^{3,4} though whether this will be sustained in the long term remains to be seen. The indications for this procedure are the same as for jejunioleal bypass. It is recommendable as a last resort in the massively obese patient who is reasonably intelligent. As it is such a technically difficult operation, I prefer to reduce weight by stringent dieting, with dental splintage if necessary and applicable, or even jejunioleal bypass, deferring gastric reduction to a stage when the excess weight has been halved in order to continue the reduction and to prevent another gain.

- ¹ Mason, E E, and Ito, G, *Annals of Surgery*, 1969, **170**, 329.
- ² Mason, E E, *et al*, *Annals of Surgery*, 1975, **182**, 405.
- ³ Griffen, E D, Young, V L, and Stevenson, C C, *Annals of Surgery*, 1977, **186**, 500.
- ⁴ Alden, J F, *Archives of Surgery*, 1977, **112**, 799.

Can a constipated adult with coeliac disease who has been advised to have a gluten-free diet use bran?

Bran contains gluten and should not be given to coeliac patients. One of the hydrophilic colloid preparations (Celevac, Isogel, Normacol-special) would be an adequate substitute.