

The electrocardiogram in general practice: its use and its interpretation

D C Macallan MRCP J A Bell FRCP M Braddick MRCP K Endersby MRCP
J Rizzo-Naudi MRCP Department of Cardiology, Battle Hospital, Oxford Road, Reading RG3 1AG

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Summary

General practitioners in one health district were surveyed by postal questionnaire (including 15 sample electrocardiogram tracings) to assess their usage and competence in interpretation of the electrocardiogram. A response rate of 60% was achieved, of whom 40% said they used the electrocardiogram at least monthly and 43% used it 'always' or 'usually' in patients with suspected myocardial infarction at home. Overall competence in recognizing a variety of abnormalities was felt to be good. Recent qualification, the possession of a higher qualification (MRCP/MRCGP) and frequency of usage were associated with better performance. Even so, unequivocal acute myocardial infarction was misdiagnosed by 20% of respondents. These findings have implications for the provision of electrocardiographic services in primary care and the management of patients in the home with suspected myocardial infarction, particularly with the advent of thrombolytic therapy.

Introduction

The electrocardiogram is an invaluable tool in the management of patients with cardiac disease and an increasing number of general practitioners now have the facilities to perform electrocardiography in the surgery or in the patient's home. Many general practitioners have no specialist training in cardiology and use the electrocardiogram with relative infrequency. These factors may impose some limitation on the value of this investigation.

This study was designed to assess the ability of general practitioners to recognize electrocardiographic abnormalities using a series of 15 sample electrocardiograms and to identify those characteristics which were associated with a greater accuracy in interpretation. The findings have implications for the provision of electrocardiographic services in primary care.

Method

All the general practices in West Berkshire were circulated with a preliminary questionnaire to determine whether or not the practice possessed an electrocardiogram machine, and to confirm the names of the doctors in each practice and their year of qualification. They were asked whether they would be prepared to complete a questionnaire on their management of patients with suspected myocardial infarction and an accompanying questionnaire involving the interpretation of 15 electrocardiograms. Doctors who agreed to participate were then sent the questionnaires, together with a stamped addressed envelope for their anonymous return and a stamped

addressed postcard for separate return to enable a record of replies to be kept.

The management questionnaire comprised an initial database for the doctor (number of years since qualification, possession of MRCP or MRCGP diplomas and distance from the nearest coronary care unit) followed by a series of questions to explore their frequency of use of electrocardiogram machines, their reliance on electrocardiograms in arriving at the diagnosis of an acute myocardial infarction and whether or not they were asked to interpret their partner's electrocardiograms.

The electrocardiogram questionnaire consisted of 15 twelve lead electrocardiograms (see Table 1). The participants were asked to record the abnormalities they could identify without recourse to textbooks or other aids. The replies were marked jointly by two doctors with cardiology experience according to a predetermined marking schedule giving a maximum of 2 marks for a correct answer. With regard to the value of those factors related to the accuracy of interpretation of the electrocardiogram (Table 2), part marks were awarded for partially correct answers or reasonable alternatives to the correct answer. For those results documented in Tables 1, 3 and 4, answers identifying myocardial infarction but not the anatomical site and timing were marked as correct.

Table 1. Recognition of ECG abnormalities

	Correct replies	
Normal	94	(67%)
<i>Myocardial infarction</i>		
Anterior, acute	112	(80%)
Inferior, established●	50	(36%)
True posterior, acute	12	(9%)
<i>Arrhythmia</i>		
Atrial fibrillation	91	(65%)
Ventricular extrasystole	133	(95%)
1st degree heart block●	70	(50%)
Complete heart block	119	(85%)
Left bundle branch block	93	(66%)
Wolffe-Parkinson-White	20	(14%)
Atrial extrasystole	47	(34%)
<i>Hypertrophy</i>		
Left ventricular	107	(76%)
Right ventricular	38	(27%)
<i>Technical errors</i>		
Paper speed 50 mm/s	17	(12%)
Half calibration	12	(9%)
Failure to switch aVf to V	27	(19%)

●Present on same ECG (n=140)

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Table 2. Factors related to accuracy of interpretation of ECG

		Median score	(n)		Significance
1 Years qualified	<10	16.5	(39)	}	$P \leq 0.01 \bullet$ $P \leq 0.01 \bullet$
	10-19	14.9	(64)		
	≥ 20	11.0	(37)		
2 Possession of higher qualification	MRCP+MRCGP	18.5	(11)	}	$P < 0.01 \bullet$ $P \leq 0.01 \bullet$
	MRCGP alone	15.0	(63)		
	neither	12.8	(66)		
3 Frequency of use of ECG machine per month ($n=126$, omitted by 14)	> once	16.5	(51)	}	$P \leq 0.01 \bullet$ $P \leq 0.01 \bullet$
	\leq once	13.5	(52)		
	never	11.3	(23)		
4 Frequency of interpretation of partner's ECG	regularly	17.0	(4)	}	NS \bullet $P \leq 0.01 \bullet$
	sometimes	15.5	(83)		
	never	13.0	(53)		
5 Frequency of use of ECG in suspected MI	always/usually	14.8	(60)	}	NS Δ
	often	13.5	(30)		
	rarely/never	13.5	(50)		
6 Influence of ECG in arriving at diagnosis of MI	essential/very important	15.3	(38)	}	NS Δ
	fairly important	14.0	(48)		
	of little/unimportant	14.0	(52)		

\bullet Mann-Whitney U test

Δ Kruskal-Wallis one-way analysis of variance by ranks

The results were analysed using the chi-squared test and the non-parametric Kruskal-Wallis one-way analysis of variance in conjunction with the Mann-Whitney U test.

Results

Response rates and sample population

The sample population consisted of 233 general practitioners in 57 practices. Completed questionnaires were received from 140 (60%) of these, with representatives from 43 (75%) of the 57 practices. Participants had been qualified for fewer years than non-respondents (15 versus 30 years median; $P < 0.05$) and tended to be members of larger practices (median practice size 5 versus 4 partners; $P < 0.01$).

Thirty of the 57 practices (53%) possessed their own electrocardiogram machines and these tended to be the larger practices which included 151 of the 233 practitioners (65%). Among participants the proportion was higher (82%). Eighty per cent (24 out of 30) of those practices with 4 or more partners and 22% (6 out of 27) of those with less than 4 partners possessed an electrocardiogram machine whilst none of the single-handed practices did ($P < 0.001$).

Fifty-one out of 126 participants (40%) said they used an electrocardiogram machine more than once a month, 52 (41%) less than once a month and 23 (19%) never. Fourteen participants omitted this question.

The 140 participants had been qualified for a median of 15 years (range 4-49 years). Forty (28%) practised within 3 miles of the nearest coronary care unit, 50 (36%) within 10 miles and 50 (36%) beyond 10 miles.

Seventy-four (54%) possessed a higher qualification, of whom 69 (49%) held the MRCGP, 11 (8%) the MRCP and 6 (4%) both. Fourteen (10%) were GP trainers.

The questionnaire also enquired whether the general practitioners were asked by their partners to

interpret electrocardiograms; 83 (59%) said that this was 'sometimes' the case whilst 4 (3%) indicated that this was a 'regular' occurrence. Participants were asked about their management of a patient in the home with a suspected acute myocardial infarction and how strongly they were influenced by electrocardiogram changes in arriving at their diagnosis. Sixty (43%) said they 'always' or 'usually' carried out an electrocardiogram examination, 30 (21%) 'often' and 50 (36%) 'rarely' or 'never' did. Thirty-eight (27%) considered electrocardiogram changes 'essential' or 'very important' in their assessment, 48 (35%) said it was 'fairly important' and 52 (38%) 'of little importance' or 'unimportant'. This last question was omitted by 2 respondents.

Recognition of electrocardiogram abnormalities

The number and proportion of correct responses is shown in Table 1.

Factors influencing accuracy of electrocardiogram interpretation

Those factors associated with a greater accuracy of interpretation of the electrocardiogram were identified. The total score, with a possible range of 0-30, was compared with various parameters of the participant population. These results are shown in Table 2.

General practitioners who more frequently used an electrocardiogram in suspected myocardial infarction or who were more strongly influenced by electrocardiographic changes in arriving at a diagnosis of myocardial infarction, were no more competent at overall electrocardiogram interpretation than their colleagues. More specifically, there was no relationship between those who were strongly influenced by the electrocardiogram and their ability to recognize either an acute anterior or an established inferior infarct (Table 3).

Table 3. Accuracy of diagnosis of ECG changes of MI compared with influence of ECG on diagnosis

Strength of influence of ECG	Acute anterior myocardial infarction (% correct)	Inferior myocardial infarction (% correct)
Very important/essential	87% (33/38)	47% (18/38)
Fairly important	79% (38/48)	40% (19/48)
Little/unimportant	77% (40/52)	25% (13/52)

NS*

NS*

(n=138, omitted by 2)

*Chi-squared tests

Table 4. Accuracy of electrocardiogram interpretation.

	This study	Selected GPs ³	US hospital residents ⁴
Normal	67%	66%	—
Acute myocardial infarction	80%	74%	79%
Left bundle branch block	66%	66%	91%
Left ventricular hypertrophy	76%	38%	84%
Technical error (mean)	13%	—	37%
	(n=140)	(n=50)	(n=81)

Discussion

An increasing number of general practitioners now have the ability to perform electrocardiography. In this study 65% of general practitioners, representing 57% of the practices in a mixed rural and urban community, had access to their own electrocardiogram facilities compared with 34% of general practitioners in a postal survey in 1974¹ and 10% of a study in 1969². In this study 40% of general practitioners said that they performed an electrocardiogram at least once a month and 43% said they would perform an electrocardiogram if called to see a patient at home with a suspected myocardial infarction. Ability to interpret the electrocardiogram correctly is therefore perceived to be a relevant skill for general practitioners.

All general practitioners in the district were invited to participate but the participating population was not truly representative, participants tending to be younger than non-participants and to be members of larger practices; they were more likely to have access to electrocardiogram facilities. Participants were asked to complete the questionnaire under 'exam conditions' but there was no invigilation. All these factors would be expected to bias the results favourably.

In view of the relative infrequency of use of the electrocardiogram, compared with physicians or cardiologists, overall competence of the general practitioners studied was high. Our results accord well with those reported by Rawles³ among a smaller group of selected general practitioners in Aberdeen and do not compare unfavourably with

those found in a sample of Hospital Residents in the USA⁴ (see Table 4). In both our study and that of Pinkerton⁴ there was a low level of alertness for detecting technical errors.

As expected, several factors were associated with overall diagnostic ability, particularly recent qualification, possession of a higher qualification, frequency of use of the electrocardiogram and frequency of interpretation of one's partner's electrocardiograms. The question remains, however, as to how standards of electrocardiogram interpretation may be improved and indeed whether or not this is either appropriate or desirable, particularly for infrequent users of the electrocardiogram. Several centres run courses and these are of undoubted value for interested practitioners. Many cardiac centres provide an electrocardiogram interpretive service which can be used as an educational tool. More recently interpretive electrocardiogram recorders have become available and although more expensive than conventional recorders they perhaps deserve more serious consideration in the light of our findings.

It might be argued that general practitioners are aware of their own limitations and that those who perform less well are those who rely less heavily on the electrocardiogram. Our study does not support this argument as no association was found between reliance upon the electrocardiogram and diagnostic ability defined either in terms of overall score (see Table 2) or in terms of the recognition of the changes of myocardial infarction (see Table 3).

We feel that our study highlights one facet of the dilemma facing general practitioners in the management of acute chest pain at home. The detection and reversal of potentially lethal arrhythmias in coronary care units has long been the principal rationale behind the early transfer of patients with acute chest pain to hospital. The advent of thrombolytic therapy provides a further compelling argument for the early transfer of these patients to hospital. One contributory factor delaying this transfer has been shown to be the attendance and examination by the general practitioner⁵. It certainly can be argued that, as the electrocardiogram may be normal in the early stages of myocardial infarction, so it follows that time spent performing an electrocardiogram in the patient's home may not help in the diagnosis or management, especially if the history is highly suggestive. In this study more than half of the replying general practitioners stated that they more often than not performed an electrocardiogram in such patients. This may cause additional delay in transfer which cannot be justified in view of our recorded figures for the accuracy of electrocardiogram interpretation; one in five general practitioners failed to recognize an unequivocal anterior myocardial infarct.

A British Heart Foundation Working Group concluded that, in the light of present knowledge, thrombolytic treatment should be deferred until the patient is admitted to hospital⁶. However, when the results of on-going trials to assess the safety and efficacy of thrombolytic therapy in primary care are available, it may well be recommended that thrombolytic therapy should be started routinely before admission to hospital. Thrombolytic therapy is not without risk, particularly when conditions other than myocardial infarction are treated in error⁷. The findings of the ASSET study indicated that patients

with normal electrocardiograms at the time of randomization had a low case fatality rate⁸ and therefore it may be argued that these patients would have less to gain from thrombolysis to justify its use. It is therefore important that general practitioners considering administration of thrombolytic treatment at home should be able to recognize the diagnostic changes on the electrocardiogram suggestive of early myocardial infarction and identify with confidence a normal tracing.

The electrocardiogram is a useful tool for cardiac patients in the primary care setting. This study highlights the difficulty that some general practitioners experience when attempting to interpret the electrocardiogram. At present for many general practitioners management decisions in the context of suspected acute myocardial infarction should be guided by the history and clinical findings rather than electrocardiographic data.

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