

Atrial fibrillation: a comparison of methods to identify cases in general practice

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SUMMARY

The importance of atrial fibrillation as a treatable risk factor for stroke is well established. Less is known about how to find previously unidentified cases within the community so that antithrombotic treatment can be offered to a wider group of at-risk patients. The aim of our study was to examine ways to improve the efficiency of practice-based screening for atrial fibrillation, including issues of time and financial cost. We used different combinations of pulse palpation and interpretation of 12-lead and bipolar electrocardiographs as carried out by practice nurses. The best strategy for the detection of atrial fibrillation in a practice population would appear to be to screen all eligible subjects by nurse pulse palpation, followed by 12-lead electrocardiograph readings in those who have a pulse suggestive of atrial fibrillation. The electrocardiograph interpretation can be undertaken effectively by a trained nurse.

Keywords: atrial fibrillation; general practice; pulse palpation; practice nurses.

Introduction

THE prevalence of atrial fibrillation has been estimated at 5% in those aged over 65 years.¹ The use of warfarin in hospital-based trials has shown significant reduction in stroke risk in patients with atrial fibrillation.² This has led to efforts to find the best method for identifying patients in the community who have atrial fibrillation so that antithrombotic treatment can be considered. Hill *et al* invited patients aged 65 years and over in a practice population to attend for a 12-lead electrocardiograph. This method had a small yield at the cost of a high workload.³ Other work has demonstrated that about three-quarters of cases of atrial fibrillation already have a record of the problem in their general practice notes.⁴ A large population study compared prescription searches for digoxin with pulse palpation by a nurse as a means of identifying atrial fibrillation. Digoxin-based searches picked up only half of the cases. Pulse palpation had a much better sensitivity but at the cost of a higher number of false positives.⁵

In our study, we examined the validity of identifying atrial fibrillation through combinations of pulse palpation and interpreta-

tion of electrocardiographs as carried out by practice nurses and a general practitioner (GP).

Methods

The study patients were all recruited from a single practice. Patients aged 65 years or over with a diagnosis of atrial fibrillation were identified by searching computerised records using the Read codes for atrial fibrillation and digoxin prescription. An equal number of patients aged 65 years or over, without either code in their computer records, was sampled. All patients were invited to attend the surgery by appointment. The patients were instructed not to divulge any information about their medical history or medication to the recording nurse.

One nurse (Nurse A: JS) saw all the patients and had no prior knowledge of their medical history. Her background was in both community and accident and emergency (A&E) nursing, and she had experience of taking and interpreting electrocardiograms. She palpated the pulse and recorded the result as 'regular' or 'irregular'. She then recorded bipolar and 12-lead electrocardiograms (ECGs), labelling them with an identifying number only. Bipolar ECGs depend on limb leads only, do not require removal of clothing, and therefore are a simpler, quicker procedure. At a later date both types of ECG were interpreted independently by the nurse and one of the GP partners in the practice (SS) and, for the 12-lead only, a cardiologist. They were unaware of the results of the pulse palpation. All procedures were timed.

Other nurses with different previous experience of pulse palpation and ECG interpretation reviewed a random sample of the patients. Nurse B was a practice nurse with no additional ECG training. Nurse C was also a practice nurse but formerly worked on a coronary care unit and had been trained there to interpret ECGs.

The 12-lead electrocardiogram interpreted by the consultant cardiologist was used as the 'gold standard' for comparison. Different combinations of pulse palpation and ECG interpretation by nurses and the GP were analysed to determine the most efficient method of screening for the gold standard. A simple analysis of time and financial costs was also undertaken. Costs were estimated using British Medical Association and Whitley Council rates for GPs and nurses respectively.

Results

A total of 86 patients attended out of 154 invited, a response rate of 56%. Of these, 26 (30%) had atrial fibrillation and 60 (70%) were in sinus rhythm according to the 12-lead ECG as interpreted by the consultant cardiologist.

Against this gold standard high sensitivities were recorded generally for each of the methods (one-step strategies in Table 1). There was more variation in specificity, although all methods were above 75%. Nurse interpretation of the ECGs, with the exception of Nurse C, was inferior to those of the GP. The more experienced the nurse, the better the test performance. Indeed, bipolar testing and reading by Nurse C (the trained cardiology nurse) had a 100% sensitivity and specificity as a one-step strategy. The specificity of nurse palpation alone (Nurse A) was significantly lower than that achieved by GP interpretation of either a bipolar or a 12-lead ECG alone.

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Submitted: 13 March 2000; Editor's response: 5 June 2000; final acceptance: 4 August 2000.

© British Journal of General Practice, 2000, 50, 727-729.

Table 1. Sensitivity and specificity statistics relating to different methods of screening for atrial fibrillation.

Assessor (method)	Test result	AF ('gold standard')		% Sensitivity (95% CI)	% Sensitivity (95% CI)	Estimate of average	
		No	Yes			Time (seconds)	Cost ^a (pence)
One-step strategies							
Nurse A (pulse)	Negative	46	0	100	77	73	16
	Positive	14	26	(87–100)	(66–87)		
Nurse B (pulse) ^b	Negative	21	1	92	84	73	16
	Positive	4	12	(64–100)	(64–96)		
Nurse A (bipolar)	Negative	53	2	92	88	201	45
	Positive	7	24	(75–99)	(80–97)		
Nurse B (bipolar) ^b	Negative	23	1	92	92	201	45
	Positive	2	12	(64–100)	(74–99)		
Nurse C (bipolar) ^b	Negative	35	0	100	100	201	45
	Positive	0	13	(75–100)	(90–100)		
GP (bipolar)	Negative	59	1	96	98	189	59
	Positive	1	25	(80–100)	(91–100)		
Nurse A (12-lead)	Negative	56	1	96	93	680	152
	Positive	4	25	(80–100)	(84–98)		
Nurse B (12-lead) ^b	Negative	19	0	100	76	680	152
	Positive	6	13	(75–100)	(59–93)		
GP (12-lead)	Negative	59	0	100	98	662	165
	Positive	1	26	(87–100)	(91–100)		
Two-step strategies^c							
Nurse A (pulse) $\bar{\cap}$ Nurse A (bipolar)	Negative	57	2	92	95	127	28
	Positive	3	24	(75–99)	(86–99)		
Nurse A (pulse) $\bar{\cap}$ GP (bipolar)	Negative	59	1	96	98	124	32
	Positive	1	25	(80–100)	(91–100)		
Nurse A (pulse) $\bar{\cap}$ Nurse A (12-lead)	Negative	59	1	96	98	256	57
	Positive	1	25	(80–100)	(91–100)		
Nurse A (pulse) $\bar{\cap}$ GP (12-lead)	Negative	59	0	100	98	251	60
	Positive	1	26	(87–100)	(91–100)		
Nurse B (pulse) $\bar{\cap}$ GP (bipolar) ^b	Negative	25	2	85	100	124	32
	Positive	0	11	(55–98)	(86–100)		
Nurse B (pulse) $\bar{\cap}$ GP (12-lead) ^b	Negative	25	1	92	100	251	60
	Positive	0	12	(64–100)	(86–100)		

Nurse A (JS) was an A&E nurse with previous experience in interpreting electrocardiographs; Nurse B was a practising nurse with no additional electrocardiogram training; Nurse C was a practice nurse but formerly worked on a coronary care unit and had been trained there to interpret electrocardiograms. ^aCosts are based on average gross hourly salaries for GPs of £31.43 (GP locum BMA rates) and nurses of £8.06 according to Grade E, midpoint Whitley scale. ^bTime and cost estimates are based on readings given by Nurse A. ^cTest positives from the first step are 're-tested' according to the second method labelled; nurse was Nurse A. Time and cost estimates are based on population estimates of a 5% prevalence of atrial fibrillation in the general population aged 65 years and over and 100% sensitivity and 77% specificity for the pulse method (Nurse A). This equates to a probability of 0.269 associated with a test positive at the first step so that we can predict that 73.1% of individuals will be screened out by initial palpation.

To investigate combinations of methods, patients with a positive test according to Nurse A's interpretation of the pulse palpation were considered as being re-tested by one of the ECG methods (one-step strategies). Compared with the nurse palpation alone, there were improvements in specificity recorded by such two-step methods resulting in nearly all non-cases being correctly identified. These improvements were all statistically significant ($P < 0.05$) by McNemar's test.

There was a significant increase overall in the time taken by Nurse A to obtain readings of pulse palpation (mean = 73 seconds), bipolar ECG (mean = 163 seconds), and 12-lead ECG (mean = 636 seconds). Average times taken for ECG interpretation were 38, 26, 44, and 26 seconds for nurse bipolar, GP bipolar, nurse 12-lead, and GP 12-lead respectively. The two-step strategies that combine pulse and bipolar would reduce recording time compared with bipolar testing of all individuals.

Addition of 12-lead ECG interpretation by a GP in only those patients identified by the nurse as positive on pulse palpation gave an overall sensitivity of 100% and specificity of 98%, with lower total time and financial cost than if the GP ECG was used as the sole screening method. It is estimated that there would be

an average 62% reduction in time per patient assessment between 12-lead ECG as a one-step method applied to all subjects aged 65 years or over and 12-lead ECG as a second step restricted to those with an irregular pulse on nurse palpation.

Finally, to investigate the performance of the practice nurse who had no specialised cardiology, A&E or electrocardiography experience, we examined two-step strategies in the subgroup of patients seen by Nurse B for pulse palpation plus GP interpretation of electrocardiographs (Table 1). Although the numbers were small, sensitivity was lower than for Nurse A; however, there was 100% specificity.

Discussion

The aim of our patient selection process was to ensure a study group that contained a mixture of patients with gold standard atrial fibrillation and patients without atrial fibrillation. Non-response to invitation was unlikely to represent a bias in this study for two reasons. First, all attending patients had a 12-lead ECG interpreted by a consultant cardiologist and this was used as a gold standard to separate the patients into 'cases' of atrial fib-

rillation and 'controls'. Secondly, the nurse had no prior knowledge of the patients or the proportion of atrial fibrillation cases within the study population. However, when considering the broader applicability of the results of this study to actual screening programmes in primary care, the issue of participation rates among the elderly population would need to be taken into account in judging its overall usefulness.

The high sensitivity of pulse palpation by nurse screening of older patients for atrial fibrillation confirms the picture from an earlier study.⁵ In that study the disadvantage was high false positive rates. In our study, carrying out 12-lead electrocardiography in all pulse-positive patients with interpretation by the GP would improve specificity but increase the average time and cost per patient tested. However, this is still clearly more efficient than screening all patients with 12-lead electrocardiography in the first place. Furthermore, the 12-lead electrocardiograph is also then available for use in the clinical management of the confirmed case.

Other two-step strategies also appear to be efficient in terms of low costs and high detection rates. In particular, although the two-step strategy with bipolar GP readings had lower sensitivity than the two-step strategy with 12-lead readings, the difference was based on only one misclassified case. It is important not to rule out this option on the basis of one result, especially since bipolar readings are clearly quicker to obtain than 12-leads. However, any patient with atrial fibrillation will need a 12-lead ECG for assessment anyway. We can thus compare two strategies: the two-step strategy with 12-lead GP readings of all pulse positives versus a three-step approach, in which nurse palpation is followed by bipolar readings in the pulse positives and 12-lead ECG assessment of the bipolar positives. The sensitivity would be 96% (25/26) and specificity would be 98% (59/60). This approach would take on average 239 seconds to complete and cost 61 pence per person based on a population screening programme. The time and cost is similar to the two-step strategy involving GP 12-lead electrocardiographs. Furthermore, there is inconvenience in adding an additional step to the screening process. Thus, potential loss of sensitivity and inconvenience suggests that the two-step strategy, involving GP 12-lead electrocardiographs, would still be the preferred approach to use.

The full results refer to a practice nurse with A&E training and experience in electrocardiography. A nurse with cardiology experience, using and interpreting bipolar ECGs, is an effective alternative. However, in most practices, nursing expertise may be closer to that of Nurse B. In this regard, it is promising that the performance of the two-step strategy involving palpation by Nurse B and 12-lead ECG readings by the GP was close to that of the more experienced nurse.

Our conclusion is that practice nurse pulse palpation plus 12-lead ECG reading by a GP is an efficient means of screening older patients for atrial fibrillation. The potential of screening using pulse palpation and bipolar readings taken and read by a trained nurse should, however, be more extensively explored.

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Acknowledgements

Dr Malcolm Clarke very generously interpreted the electrocardiograms. We thank Elizabeth Boath, Priscilla Masters, and Jane Matthews for their vital work with our project and the patients who participated. An initial pilot study was funded by a Small Projects Grant from the West Midlands Regional Health Authority. This led to the full study, which was supported by the North Staffordshire Health Authority.

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