Diagnosing arrhythmias in general practice: the BEAT study

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Chapter 5

Predictive value of history taking and physical examination in diagnosing arrhythmias in general practice

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ABSTRACT

Background
Palpitations and light-headedness are common symptoms that may be indicative of cardiac arrhythmias. Effective triage by the general practitioner (GP) might prevent delayed treatment or inappropriate referrals. The aim of this study was to determine the capability of Dutch GPs to assess the presence of cardiac arrhythmias and which signs and symptoms are used in predicting the presence of arrhythmias and which actually are related to the presence of arrhythmias.

Methods
A consecutive cohort of 127 patients presenting with palpitations and/or light-headedness to 41 GPs in the Netherlands underwent physical examination patient history and standard electrocardiogram. The GPs estimation of the probability of patients having an arrhythmia was compared with the diagnostic result of 30-days continuous event recording (CER). We assessed discriminating factors that can assist a GP in diagnosing an arrhythmia.

Results
No correlation was found between the GPs assessment of risk and actual diagnoses. GPs were more likely to predict an arrhythmia in patients who suffer from hypertension (p=0.049) or patients with a history of cardiovascular disease (p=0.006). Vasovagal symptoms (odds ratio (OR) = 2.91 95% confidence interval (CI) 1.1 to 7.6) and bradycardia (OR=4.2, 95% CI 1.3-14.0) were significantly more common in patients with a CER diagnosis of arrhythmia.

Conclusion
Prediction of arrhythmias by GPs based on history taking and physical examination alone is not accurate. These parameters are insufficient to decide which patients need further diagnostic evaluation. A diagnostic facility with low threshold for GPs is essential for an adequate diagnostic process in patients with palpitations and light-headedness.

Keywords: continuous event recorder, general practice, light headedness, palpitations, triage.
INTRODUCTION

Eight per thousand enlisted patients consult their general practitioner (GP) every year complaining of new episodes of irregular heartbeats, pounding, and racing of the heart. Less than half of these patients will be diagnosed with an arrhythmia, of which the majority will have a benign diagnosis. As some of these patients may have a serious cardiac arrhythmia that requires treatment, triage of these patients for further specialised diagnostic work-up or treatment is essential.

Cardiology textbooks and previous clinical studies emphasise the importance of the relation between signs, symptoms and medical history and clinically relevant arrhythmias. A standard 12-lead electrocardiogram (ECG) is readily available in general practice when any doubt remains after careful history taking and physical examination and provides a diagnosis when an arrhythmia is seen during symptoms. The majority of patients, however, does not experience symptoms during consultation and obtaining a symptomatic ECG most of the time is not possible.

In earlier empirical general practice based studies, several characteristics taken from medical history and physical examination were associated with relevant arrhythmias: age, gender, the use of cardiovascular drugs, regular palpitations, palpitations at work and during consultation and palpitations affected by sleeping. These associations however were not very strong and their overall value for establishing a diagnosis limited.

In this paper we aim to determine how accurately the GP can assess whether patients with complaints of palpitations and/or light-headedness suffer from cardiac arrhythmia and for whom further diagnostics are warranted, as well as to determine which factors from history-taking and physical examination the GP presently uses to make such an assessment. In addition we examined, in patients with palpitations and/or light-headedness, which factors from history and physical examination can assist GPs in identifying patients with a clinically relevant arrhythmia.

METHODS

Study design

The study was performed among 41 GPs practicing in different urban and suburban areas of the Netherlands from October 1999 to June 2002. Patients who consulted their GP with new complaints of palpitations and/or light-headedness were enrolled. These patients were in the intervention arm of a clinical trial, which included diagnostic workup using continuous event recording (CER). The methodology of this study is described in more detail earlier in this journal. Eligible patients underwent routine assessment that consisted of an interview,
physical examination and a 12-lead ECG. Patients were included in the study if the initial ECG was inconclusive. These patients received a CER for a maximum period of 30 days.

**Instruments**

The CER (Card Guard CG-6106 loop recorder) continuously records data, but stores only data when the patient manually activates the device. It then stores information 30 seconds before and 2 minutes after activation. Patients were asked to activate the memory of the recorder when they experienced the symptoms for which they consulted their GPs. This CER diagnosis is used as the reference standard.

The GPs recorded 17 items from patients’ history, complaints and results of the physical examination. These items were based on previous literature or chosen on clinical grounds by our study group and included gender and age, the nature of the patients’ complaints, including duration of pre-medical period, number of episodes in the last month, the duration of a typical episode, character of palpitations.3,4,9-11 GPs also registered whether particular triggers initiated the complaints (emotional moment, stress, exertion or during rest moments) and whether the symptoms included sweating or paleness (vasovagal signs). Risk factors for cardiovascular disease were recorded (including smoking, alcohol use, hypercholesterolemia, history of hypertension, 1st grade familiar cardiovascular disease and diabetes mellitus), prior cardiac disease and the use of cardiac medication was noted (ß-blockers, Ca-antagonists, Digoxin or any other anti-arrhythmic drug). From physical examination, body mass index (BMI), quality and rate of the pulse (at palpitation or auscultation) and blood pressure were recorded. At inclusion GPs made an estimation of the presence of an arrhythmia on a visual analogue scale from 0% to 100%. GPs were also asked to describe what their next course of action would have been if the CER, as part of the trial, was not available.

**Outcomes**

As reference standard, we used the rhythm, registered by the CER during complaints, similar as the ones for which the patient visited the GP. A CER is the instrument of choice in patients with paroxysmal symptoms and yield more diagnoses than the classical Holter registration. (2,7,9) The advantage of the CER over other diagnostic instruments is that the registration of an event is directly linked to experience of symptoms. As all of the study patients were symptomatic, we used a patient-triggered device to avoid false positive outcomes that would be likely with automated triggered event recorders. (12) Arrhythmias were defined as all rhythms, which were not between 60-100 beats per minute and not considered normal sinus rhythm, recorded by the standard ECG or CER. Differentiation was made between clinically relevant arrhythmias, less relevant arrhythmias and normal sinus rhythm. Relevant arrhythmias were defined as rhythms
for which medical intervention and/or further investigation was advisable, including atrial fibrillation (AF), atrial flutter, atrial tachycardia, supra ventricular tachycardia not otherwise specified (SVT) and ventricular tachycardia. Less relevant arrhythmias were defined as arrhythmias, that explained patients complaints, but for which no specialized care was indicated, including premature beats (ventricular or atrial), sinus tachycardia and bradycardia. Normal sinus rhythm (SR) was defined as more than 3 recordings of SR during CER recording.

The study was approved by the medical ethical committee of the Academic Medical Centre in Amsterdam.

**Statistical analysis**

*Accurately predicting an arrhythmia by the GP.* In a histogram, the correlation between the likelihood of an arrhythmia as assessed by the GP and the empirical probability of an arrhythmia after 30 days of CER was analysed. We used univariate analyses to determine which items from the history and physical examination GPs used to make this prediction. A p-value < 0.05 was considered statistically significant.

*Actual factors predictive for arrhythmia.* We identified in a univariate analysis possible indicators related to the probability of finding a relevant arrhythmia using Pearson chi-square tests (p<0.1). Multivariate analysis for the detection of relevant arrhythmia was done using a logistic regression model.

**RESULTS**

GPs included 253 patients. In eight patients, a diagnosis was established with the initial routine ECG: AF (n=1), runs of ventricular extrasystoles (n=4) and conduction abnormalities needing further investigation by a cardiologist (n=3). They were not further randomised for this study. From the two study groups, 127 patients were randomised to CER for 30 days. The majority (83/127) showed an arrhythmia during the registration period and 19% (24/127) of these patients were diagnosed with a relevant arrhythmia. The mean age of the patients was 50 years (SD ±14), 74% were female (Table 1). At baseline, the majority of patients (62%) had their first episode within the last year, and 28% within the last 3 months before study entrance. Sixty percent of a patient’s typical episode tended to last more then 5 minutes.
Accurately predicting an arrhythmia by the GP

At study inclusion, GPs were asked to predict the possibility of the presence of any arrhythmia, not only relevant arrhythmias. The GP predicted a 0% chance of the presence of an arrhythmia in four patients, all of who turned out to register an arrhythmia with the CER (one relevant arrhythmia, and three less relevant arrhythmias). In the lowest prediction-ranges (0-20%), four (3.1%) relevant arrhythmias and 24 (19%) less serious arrhythmias were found (Figure 1). Among the patients of whom the GP predicted a 50% or lower probability of having an arrhythmia, more than 50% of the relevant arrhythmias were found (14 of 24 patients). Finally, of the eight patients where the GP predicted a 100% chance of arrhythmia, only five patients were actually diagnosed with an arrhythmia, of which three with a relevant arrhythmia.

We asked GPs for their diagnostic policy if our trial would not have been conducted (Table 2). GPs deemed further diagnostic evaluation necessary in only 13 (54%) of the 24 patients who turned out to have a relevant arrhythmia. Of the remaining 103 patients with a less relevant arrhythmia or no arrhythmia at all, further diagnostic evaluation would have been performed in 40 (39%) patients, of whom 28 would have been referred to a cardiologist. For 51 (49%) of these patients an expectant policy would have been chosen, while specific medication would have been prescribed to 12 patients.

Table 1. Number and type of CER diagnoses

|                  | n   | %  |
|------------------|-----|----|
| Number of patients | 127 |    |
| Arrhythmia on CER | 83/127 | 65 |
| Relevant diagnosis | 24/83 | 29 |
| Supraventricular tachycardia not specified | 12/83 | 14 |
| Atrial fibrillation | 10/83 | 12 |
| SAN-exit block | 2/83 | 2 |
| Less relevant diagnosis | 59/83 | 71 |
| Sinus tachycardia | 19/83 | 23 |
| Ventricular extrasystoles (< 3/30 secs) | 34/83 | 41 |
| Atrial extrasystoles | 6/83 | 7 |
| No arrhythmia on CER | 44/127 | 35 |
| Symptoms, but no abnormalities on ECG | 21/127 | 17 |
| No symptoms during intervention period | 21/127 | 17 |
| Failure to record | 2/127 | 2 |
Predictive factors for a clinically relevant arrhythmia

In the univariate analysis, only the presence of vasovagal complaints (sweating and paleness) during palpitations and the presence of bradycardia during examination were more frequently present among patients with serious arrhythmia than among the others (Table 3). These factors were included in a multivariate model. Based on previous literature, age and cardiac medication were also included in the multivariate model. This multivariate analysis showed that age [odds ratio (OR) = 1.01 per year, 95% confidence interval (CI) 0.97-1.05] and cardiac medication (OR = 1.37, 95% CI 0.43-4.37) were not independently predictive for the presence of a relevant arrhythmia, while vasovagal symptoms reported by the patient (sweating and paleness) (OR = 2.92, 95% CI 1.12-7.62),
Table 3. Baseline characteristics; association between baseline characteristics and GPs prediction of a relevant cardiac arrhythmia (univariate analysis), to determine which factors GPs used the most to predict a serious arrhythmia.

| Patient characteristic | Mean probability given by GP of an arrhythmia (%) | GPs prediction of a relevant arrhythmia (n=24) | P-value* | P-value** |
|------------------------|--------------------------------------------------|-----------------------------------------------|----------|-----------|
| **Age in quartiles**   |                                                  |                                               |          |           |
| 18-41                  | 33                                               | 5 (15%)                                      | 0.533    | 0.333     |
| 42-48                  | 30                                               | 3 (10%)                                      |          |           |
| 49-60                  | 32                                               | 8 (25%)                                      |          |           |
| > 61                   | 32                                               | 8 (25%)                                      |          |           |
| **Gender**             |                                                  |                                               | 0.494    | 0.362     |
| Female                 | 94                                               | 16 (17%)                                     |          |           |
| Male                   | 33                                               | 8 (24%)                                      |          |           |
| **Time since first episode:** |                                            |                                               | 0.362    | 0.416     |
| Week-3 months          | 43                                               | 6 (14%)                                      |          |           |
| 3 months-1 year        | 35                                               | 6 (17%)                                      |          |           |
| >1 year                | 49                                               | 12 (25%)                                     |          | 0.196     |
| **Number of episodes last month:** |                                      |                                               | 0.255    | 0.180     |
| 1-7 episodes           | 40                                               | 11 (28%)                                     |          |           |
| 8-30 episodes          | 56                                               | 7 (13%)                                      |          |           |
| >30 episodes           | 31                                               | 6 (19%)                                      |          |           |
| **Duration of typical episode:** |                                          |                                               | 0.122    | 0.367     |
| <1 min.                | 24                                               | 5 (21%)                                      |          |           |
| 1-5 min.               | 27                                               | 8 (33%)                                      |          |           |
| 6 min.-1 hour          | 26                                               | 5 (21%)                                      |          |           |
| >1 hour                | 24                                               | 4 (17%)                                      |          | 0.102     |
| Variable               | 26                                               | 2 (8%)                                       |          |           |
| **Heart skipped a Beat** |                                              |                                               | 0.365    | 0.730     |
| Yes                    | 78                                               | 14 (18%)                                     |          |           |
| No                     | 49                                               | 10 (20%)                                     |          |           |
| **Runs of beats**      |                                                  |                                               | 0.442    | 0.235     |
| Yes                    | 82                                               | 18 (22%)                                     |          |           |
| No                     | 45                                               | 6 (13%)                                      |          |           |
| **Presyncope**         |                                                  |                                               | 0.760    | 0.857     |
| Yes                    | 72                                               | 14 (19%)                                     |          |           |
| No                     | 55                                               | 10 (18%)                                     |          |           |
| **Trigger / catalyst***|                                                  |                                               | 0.004*   | 0.703     |
| Yes                    | 52                                               | 9 (17%)                                      |          |           |
| No                     | 75                                               | 15 (20%)                                     |          |           |
| **Palpitation during rest** |                                          |                                               | 0.187    | 0.925     |
| Yes                    | 71                                               | 13 (18%)                                     |          |           |
| No                     | 51                                               | 9 (17%)                                      |          |           |
| **Vasovagal symptoms** (Pale and/or sweating) | |                                               | 0.152    | 0.027*    |
Predictive value of history taking and physical examination

The overall strengths of these associations were minimal. Approximately 30% of patients with a relevant arrhythmia would have been missed as they scored negative on both of these predictors (bradycardia and vasovagal symptoms). GPs were more likely to predict a patient having an arrhythmia if they suffered from hypertension (GPs estimate patients with hypertension 11% higher than normotensive patients, \( p = 0.049 \)) and if patients were known to suffer from cardiovascular disease (GPs estimate patients with cardiovascular history 21% higher than patients without cardiovascular disease, \( p = 0.018 \)).

| Table 3 (continued) | Patient n | Mean probability given by GP of an arrhythmia (%) | P-value* | Patients with relevant arrhythmia (n=24) | P-value** |
|----------------------|-----------|-----------------------------------------------|----------|----------------------------------------|----------|
|                      |           |                                               |          |                                        |          |
| Yes                  | 49        | 48                                            |          | 14 (29%)                               |          |
| No                   | 78        | 41                                            |          | 10 (13%)                               |          |
| Cardiovascular risk factor± |          |                                               | 0.975    | 0.830                                  |          |
| Yes                  | 87        | 44                                            |          | 71 (69%)                               |          |
| No                   | 40        | 44                                            |          | 16 (67%)                               |          |
| Cardiovascular disease in history |          |                                               | 0.018*   | 0.363                                  |          |
| Yes                  | 12        | 63                                            |          | 1 (8%)                                 |          |
| No                   | 111       | 42                                            |          | 21 (19%)                               |          |
| Cardiac medication |          |                                               | 0.767    | 0.195                                  |          |
| Yes                  | 25        | 45                                            |          | 7 (28%)                                |          |
| No                   | 102       | 43                                            |          | 17 (17%)                               |          |
| Physical examination |          |                                               |          |                                        |          |
| Abnormal heart rate (HR) ∞ |          |                                               | 0.919    | 0.016*                                 |          |
| Yes                  | 17        | 43                                            |          | 7 (29%)                                |          |
| No                   | 110       | 44                                            |          | 10 (10%)                               |          |
| Body Mass Index      |          |                                               | 0.774    | 0.455                                  |          |
| Underweight/ normal  | 61        | 45                                            |          | 9 (15%)                                | Test for |
| Overweight           | 50        | 41                                            |          | 11 (22%)                               | trend:   |
| Obesity              | 15        | 45                                            |          | 4 (27%)                                | 0.215    |
| Hypertension at PE   |          |                                               | 0.049*   | 0.976                                  |          |
| Yes                  | 42        | 51                                            |          | 8 (19%)                                |          |
| No                   | 85        | 40                                            |          | 16 (19%)                               |          |

*ANOVA \( p = 0.05 \), n.a. = not applicable, PE = physical exam
** Pearson’s Chi² \( p = 0.05 \)

± Cardiac risk factors included: smoking, alcohol, hypercholesterolemia, familiar risk (1st grade), history of hypertension and diabetes. In separate univariate analyses these risk factors individually were not significant predictors.

∞ Abnormal heart rate (HR) includes 16 patients with bradycardia (HR< 60) and 1 patient with tachycardia (HR> 100).

N= not always 127 or 24, if GPs did not fill inn the CRFs on that question.

as well as bradycardia (OR= 4.24 95% CI 1.28-14.0) were predictive of a diagnosis of a relevant arrhythmia (table 4).
DISCUSSION

The aim of this study was to determine whether GPs were able to predict which patients were most likely to be diagnosed with an arrhythmia, after taking medical history and performing a physical and ECG examination. In addition we examined which factors from history and physical examination GPs use for their prediction and which factors empirically can assist GPs in identifying patients with a clinically relevant arrhythmia and who might need further diagnostic evaluation. From patients presenting to the general practitioner with palpitations and/or light-headedness and no diagnosis on the standard 12-lead ECG, 20% showed a clinically relevant arrhythmia when evaluated with a CER. Of these, paroxysmal AF and other SVTs were the most commonly diagnosed clinically relevant arrhythmias. GP’s only predicted 50% of these patients correctly, meaning that only half of these patients would have been correctly referred for further diagnostic work-up, leaving half of these patients undiagnosed and thereby untreated (Table 2). On the other hand GPs would have referred 40 of the 127 patients to a specialist, of whom 28 (70%) did not have a relevant cardiac problem. Using the CER doubles the finding of important diagnoses and possibly substantially reduces unnecessary referrals.

Two factors from history taking and physical examination contributed to the GPs suspicion of an arrhythmia: the presence of hypertension and a patient’s history of cardiovascular disease. From literature, it is known that these are commonly used factors in predicting arrhythmias.7,12-14 In this study neither of these factors had an association with the presence of an arrhythmia diagnosed by the CER.

Two factors increased the likelihood of having a relevant arrhythmia: bradycardia during consultation and vasovagal symptoms. If the GPs would have used these factors as a guide for further diagnostics 7 of the 24 patients with serious arrhythmias would not

### Table 4. Predictive factors for a serious arrhythmia versus a less serious arrhythmia, sinus rhythm and no diagnosis (Multivariate logistic regression)

| Factor                     | Odds Ratio | 95% CI lower | 95% CI upper | P-value |
|----------------------------|------------|--------------|--------------|---------|
| Age per 1 year increments  | 1.01       | 0.97         | 1.05         | 0.571   |
| Vasovagal symptoms         | 2.85       | 1.11         | 7.31         | 0.029*  |
| Abnormal heart rate (HR)   | 3.55       | 1.11         | 11.4         | 0.033*  |
| Cardiac medication         | 1.42       | 0.45         | 4.47         | 0.551   |

*Statistical significance at p =0.05
have been diagnosed because they scored negative on both predictive factors. Therefore, the predictive power of these indicators is not strong enough to guide practical decision-making of the GP.

This is not the first study to show that GPs have difficulties to correctly diagnose patients using signs and symptoms.\textsuperscript{15} Evidence on diagnostic accuracy and precision is scant and hard to find\textsuperscript{16}, but the literature suggests that physical examination and history taking alone may not be sufficient as triage instruments for patients with palpitations and light-headedness.\textsuperscript{17}

GPs were asked about their medical management in this trial situation. However, they could act differently in a normal practice situation. Besides, GPs are inclined to do more tests if a patient visits the physician for a second time with the same complaints. In this case, GPs may be more likely to install further diagnostic test. Therefore, we cannot rule out that eventually more patients would have been correctly diagnosed.

Although we asked GPs to include patients consecutively, the GPs were not fully compliant with this. This might have biased our results, but effects on our analysis seem negligible, since the GPs did not make their selection on the basis of the probability of arrhythmias.\textsuperscript{9}

A further limitation of this study was the small sample size, which inevitably results in a small number of possible predictors and low statistical power. For example previous research identified age and cardiac medication as relevant predictive factors for arrhythmias, but in our model, neither age nor cardiac medication was a statistically relevant contributor. This could have potentially been caused by the limited number of patients in our study group.

**CONCLUSION**

This study confirmed that an accurate prediction by general practitioners of the presence of a (relevant) arrhythmia in patients presenting with palpitation and/or light-headedness, with an inconclusive standard ECG, is not possible at this moment. GPs do not have an accurate instrument at hand to predict which patients might profit from further diagnostic evaluation. As our sample was small, further research is needed to develop accurate triage rules.

In cases where as standard ECG does not lead to a diagnosis, evidence suggests that a CER might be very helpful in the decision to treat or refer a patient. Reassuring a patient without using this diagnostic test might be premature.\textsuperscript{9} Therefore a low threshold for further diagnostic testing seems adequate.
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