Efficacy of diagnostic tools for detecting cardiac arrhythmias: systematic literature search

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Background/objectives. **Symptoms suggestive of cardiac arrhythmias are a challenge to the diagnosis. Physical examination and a 12-lead ECG are of limited value, as rhythm disturbances are frequently of a paroxysmal nature. New technologies facilitate a more accurate diagnosis. The objective of this study was to review the medical literature in an effort to define a guide to rational diagnostic testing.**
Methods. **Primary studies on the use of a diagnostic tool in the evaluation of palpitations were searched in MEDLINE, and EMBASE with an additional reference check.**
Results. **Two types of studies were found: descriptive and experimental studies, which compared the yield of two or more devices or diagnostic strategies. Holter monitors seemed to have less diagnostic yield (33 to 35%) than event recorders. Automatically triggered recorders detect more arrhythmias (72 to 80%) than patient-triggered devices (17 to 75%). Implantable devices are used for prolonged monitoring periods in patients with infrequent symptoms or unexplained syncope.**
Conclusion. **The choice of the device depends on the characteristics of the symptoms and the patient. Due to methodological shortcomings of the included studies no evidence-based diagnostic strategy can be proposed. (Neth Heart J 2010;18:543-51.)**

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Physicians commonly face patients with symptoms suggestive of cardiac arrhythmias, such as palpitations. However, as the majority of patients do not experience symptoms during consultation and medical history and physical examination are usually inconclusive, diagnostic evaluation is difficult and further diagnostic tests are often indicated. An ECG during symptoms is considered to be the reference standard, but obtaining a symptomatic standard ECG is often not possible.[1] Increased emphasis on outpatient diagnosis and recent technical developments have created techniques that facilitate obtaining a symptomatic ECG in an ambulant patient.

A systematic literature search was performed to analyse the available monitoring techniques to diagnose patients with symptoms of palpitations. Based on this research and clinical reasoning we define a guide to rational diagnostic testing in these patients.

Methods

Search strategy

We performed a literature search, using MEDLINE (01/1966-03/2007) and EMBASE (01/1988-03/2007). The complete search strategy is available upon request from the corresponding author. Searches were limited to original studies in humans. We excluded letters and editorials. Languages other than German, French, English, Dutch or Italian were excluded.

Inclusion of studies

The first selection was on title and abstract. The article had to describe an original study on the use of a diagnostic tool, other than a standard ECG in the evaluation of adult outpatients with complaints of palpitations. Duplicates and articles without an abstract were removed. The search was supplemented by reference checking for any missing studies. Although we planned to include only prospective or

transversal studies with a clear reference standard this did not prove to be feasible, so we included all original studies on the use of new technology, irrespective of study design.

Two authors (EH, HvW) independently assessed the methodology of the included studies, using the appropriate instruments and extracted data.[2] In case of any disagreement, consensus was reached after extensive discussion.

Endpoints

In a true diagnostic study the results of an index test are compared with the results of a reference test. However, when studying the results of new technologies that are supposed to be more sensitive and/or specific than existing ones, such study designs are not feasible.[3] Therefore evaluation of such new technologies should focus on the clinical consequences.[4] Thus adequate endpoints of diagnostic studies in case of palpitations, in which a new technology is studied, can be 'detected arrhythmias' (with or without clinical consequences) or 'explained symptoms' (with or without consequences in management). These outcomes are different, as a detected arrhythmia does not necessarily explain the symptoms for which patients seek medical help, and not all arrhythmias are clinically relevant. On the other hand relevant arrhythmias do not always produce symptoms. Therefore we report both endpoints, detected arrhythmias as well as explained episodes, whenever possible. We use the term 'relevant arrhythmia' when treatment and/or further clinical evaluation is needed. We considered an arrhythmia relevant in case of (paroxysmal) atrial fibrillation (PAF), atrial flutter, atrial tachycardia, other supraventricular tachycardia (SVT), ventricular tachycardia or escape rhythm.

We intended to perform a meta-analysis, but as the data could not be combined, studies are reported in a narrative form.

Results

The results of the search and subsequent assessment of identified studies are summarised in figure 1. Our search yielded 1700 articles. After reading the title and abstract, 38 articles were labelled potentially relevant.

Four reviews were excluded because these reviews were not systematic and included no original data. One reference could not be retrieved, even after mailing the author, 11 articles did not describe a diagnostic method or included patients without palpitations. Reference checking yielded a total of six additional relevant articles. Finally 28 studies were available for analysis (figure 1). Performing meta-analysis did not prove to be possible, either due to clinical heterogeneity or due to methodological heterogeneity.

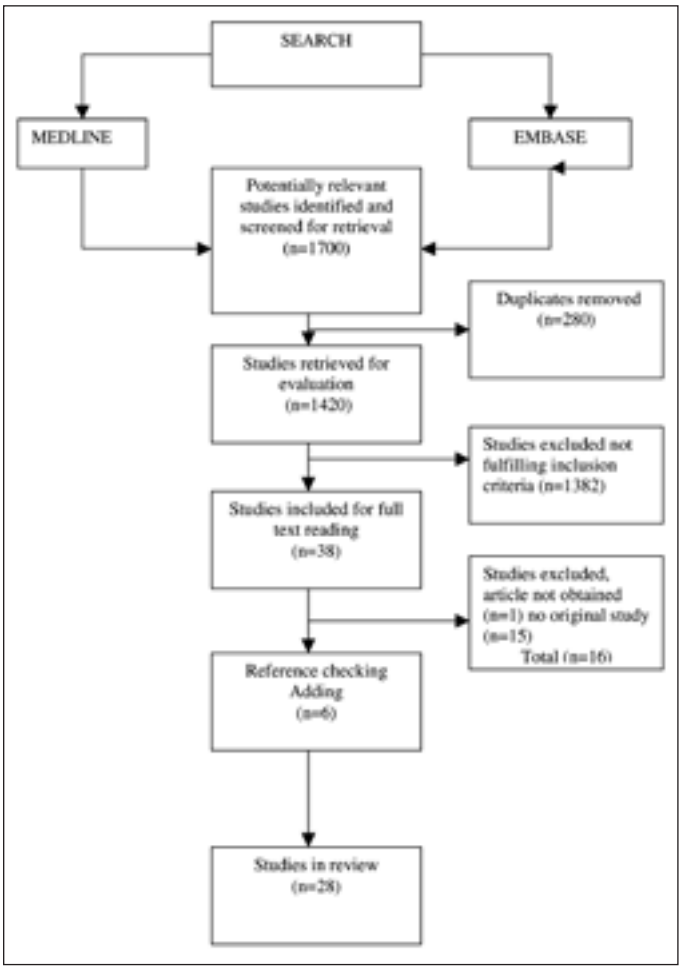

Figure 1. Flow chart of studies through the stages of the review.

Available technologies

Our search yielded six different diagnostic devices, which are currently available to register an ECG while the patient is ambulant (table 1).

1. **Holter monitoring** continuously records a 12-lead ECG over a 24 to 48 hour period. Recently even up to 72 hours. Since 1960, it has been the first choice for additional workup in detecting and quantification of suspected arrhythmias. To link ECG changes to occurring symptoms patients must keep up a diary during the monitoring period.
2. **External event recorders without loop,** also known as trans telephonic monitoring (TTM) are a form of non-continuous ambulatory recordings. After activation by the patient an ECG is recorded. The recorded event must be directly transmitted by telephone to a receiving centre.
3. **Event recorders with looping memory** (continuous event recorders: CER) make a continuous one-lead recording, but the rhythm strip will only be saved when a patient activates the device. Most devices can be programmed to save pre-ac-

Table 1. Types of devices for specific patient groups and their complaints of palpitations.

Device	Patient activated	Automatic activated	Memory	Duration	Leads
Holter monitor		X		24-48 hours	Variable till 12 leads
Event recorder no-loop (TTM)	X			Unlimited	Variable
Event recorder with loop (CER)	X		X	Unlimited	2-3 leads
Autotriggered event recorder (R-test evolution, MCOT)	X	X	X	7 days	1-3 leads
Implantable loop recorder		X	X	12-24 months	2 leads

TTM=trans-telephonic monitoring, CER=continuous event recorder, MCOT=mobile cardiac outpatient telemetry.

tivation and post-activation rhythm strips. Several designs are available, for example, with electrodes attached to the chest, with a device around the wrist or a handheld credit card design.

4. **Autotriggered event monitors with looping memory (At-CER)** automatically recognise (pre-specified) high or low heart rates and were introduced a few years ago. Several types of devices are now available,[5] R-test evolution (RTE) performs a continuous ECG analysis combined with an automatic storage of abnormal events detected in a 20-minute solid-state memory with autonomy of up to seven days. In addition, the patient can trigger a recording in case of symptoms. These functions can run simultaneously. The most recent advancement in ambulatory arrhythmia monitoring is **mobile cardiac outpatient telemetry**.[6] Patients wear three chest leads attached to a portable sensor that continuously detects asymptomatic pre-specified arrhythmias and transmits the ECG data in real-time to a pocket-sized monitor at the patient's home. If the algorithms in the monitor detect an abnormal heartbeat, the monitor automatically transmits the patient's ECG data to the monitoring centre using wireless communications. Also away from home the device communicates continuously with the service centre.
5. **Implantable autotriggered loop recorders (ILR**) require a minor invasive procedure. Recording possibilities are the same as with non-implantable autotriggered loop recorders.[7] Because external electrodes are not necessary the ILR can be used by patients for a long period of time (12 to 24 months). Currently, remote transmission capabilities are not available.
6. **Pacemakers and cardiodefibrillators** are implanted primarily to pace and/or shock the heart. These devices can be programmed to detect and store rhythm abnormalities as well and send data to a remote receiving facility.[8]

The yield of available devices

The search yielded two types of studies. Descriptive (prospective and historical) cohort studies, describing the yield of a device in terms of explained episodes or diagnosed arrhythmias. The second type are experimental studies, which compare the yield of two or more devices or diagnostic strategies in the same patient or in randomised groups of patients.

For all included studies we report on the aim, setting, inclusion criteria, completeness of follow-up, sample size documented, statistical analyses described and outcomes. In case of a randomised trial we used the quality criteria as mentioned by Jadad: 1) randomisation of participants; 2) blinding of patients, caregivers and those assessing outcome; and 3) full description of withdrawals and dropouts.[9]

Descriptive studies

Of the 28 studies 12 were simple descriptive studies, which described the yield of Holter monitoring and event recording with and without loop in a group of patients. The study device serves as its own reference test and the outcomes are described in terms of proportions of patients in which a relevant or less relevant arrhythmia is diagnosed or changes in medical management have been implemented. These studies are described in table 2. The patients included in these studies are not comparable and many studies described inclusion criteria superficially; most patients were in tertiary care with a variable amount of (sometimes previously known) cardiac pathology. Event recording with loop seems to generate most diagnoses, but comparison of the results of these studies is methodologically not possible and would probably lead to false conclusions. Recommendations have to be based on studies which compared the yield of two or more devices in the same or in randomised groups of patients.[10-21]

Comparative studies

These studies have in common that the outcomes of the studied devices are compared with another

Table 2. Descriptive studies.

	Source	Study design/ Aim	Inclusion criteria	Setting/Gender/ Mean age	Instrument/ Registration time	Dropout	Outcome and diagnoses
Holter	Erikson 1980	Retrospective, descriptive Diagnostic yield	Palpitations, dizziness, falls breathlessness, chest pain, syncope	Tertiary care n=150 57% males 59 years	Portable one-channel cassette tape recorder	ND	29% relevant diagnoses 46% management change
	Rana 1989	Retrospective, descriptive Diagnostic yield, management	Palpitations, dizziness, falls breathlessness, chest pain, syncope	Geriatric OPs n=252 Gender 60-92 years	Reynolds one-channel ECG recorder 24 hours	ND	12% relevant diagnoses 10% change in management
	McClennen 2000	Retrospective, descriptive Diagnostic yield and cost	Palpitations, pre-syncope, cerebral ischaemia, AF evaluation	Tertiary care n=164 74% males 59 years	2x24 h Holter	ND	Day 1: 19% relevant diagnoses Day 2: 3% relevant diagnoses
Event recorder no loop	Safe 1990	Prospective descriptive Diagnostic yield	73 palpitations, 6 dizziness, 3 chest pain and palpitations Standard ECG not diagnostic	Tertiary care n=82 62% males 17-76 years	CER, no loop, (stores 32 sec) 1 month	1 patient	23% diagnoses 13% relevant diagnoses
	Assayag 1992	Retrospective Diagnostic yield	Palpitations 41% cardiopathology	Tertiary care n=1287 37% males 52 years	CER no loop	196 incomplete files	42% diagnoses
	Schuchert 2002	Prospective, descriptive Diagnostic yield	Palpitations, Holter neg 43% cardiopathology	OPs n=55 38% males 46 years	One-channel ECG (handheld), 6 weeks	ND	32% relevant diagnoses
	Shanit 1996	Prospective, descriptive Diagnostic yield	Chest pain, arrhythmia, hypertension, reassurance	OP n=2563 ?? ??	12 lead ECG (handheld)	ND	26% relevant diagnoses
Event recorder with memory loop	Summerton 2000	Prospective Diagnostic yield	Palpitations	Primary care n=139 33% male 45 years	Rhythm card (handheld), no pre event memory 2 weeks	ND	30% diagnoses, 19% relevant diagnoses
	Fogel 1997	Prospective Diagnostic yield, cost	Palpitations, pre-syncope 25% cardiopathology	OPs n=184 31% males 44 years	Wrist CER 4 weeks	ND	66% patients with palpitations, 43% relevant diagnoses Most cost-effective with palpitations
	Zimetbaum 1998	Prospective Diagnostic yield, cost, diagnoses timing	Palpitations	OPs n=112 26% males 52 years	CER 4 weeks	7 patients, incomplete files	84% diagnoses <2weeks, 36% relevant diagnoses 2 weeks cost-effective

Table 2. Descriptive studies (continued).

	Source	Study design/ Aim	Inclusion criteria	Setting/Gender/ Mean age	Instrument/ Registration time	Dropout	Outcome and diagnoses
Event recorder with memory loop	Brown 1987	Retrospective Diagnostic yield	Palpitations dizziness, syncope, abnormal Holter, symptoms after treatment 39% cardio-pathology	OPs n=106 ?? 58 years	CER 3 weeks	6 patients, incomplete files	66% diagnoses, 7% relevant diagnoses
	Wu Chih Cheng 2003	Retrospective Diagnostic yield	Palpitations, pre-syncope, chest pain, dyspnoea 50% cardio-pathology	Tertiary care n=660 47% males 53 years	CER 30 days	ND	64% diagnoses Palpitation group 66% diagnoses

ND=not described. OP=outpatients, AF=atrial fibrillation, CER=continuous event recorder

diagnostic test. As in descriptive studies, combining of results was methodologically not possible in these studies because of the diversity of the studied populations and the variation in tested devices. Most patients were in tertiary care with a variable amount of (sometimes previously known) cardiac pathology. Many studies described inclusion criteria superficially, although in more recent studies this is done more appropriately following a protocol (table 3).

CER vs. Holter monitoring.
In six studies the CER is compared with Holter monitoring (24 to 48 hours). Registration time with the CER varied from one week to six months. The studied populations consisted of 50 to 100 patients, one study described 310 patients. The patient populations consisted of primary and secondary care patient groups. From the latter, about 41% of the patients had documented structural heart disease. Outcomes were described in terms of proportions of patients in whom a relevant or less relevant arrhythmia was diagnosed or in whom changes in medical management were implemented. With the CER, a diagnosis was established in a range 21 to 62% of the studied patients, compared with a maximum of 30% with Holter monitoring. The CER was better at excluding arrhythmias during symptoms than the Holter monitor (34 and 2%, respectively).[22-27]

CER vs. ECG monitoring,
Records of 91 patients were reviewed. Within 30 days the CER was diagnostic in 37% of patients, while a 12-lead ECG was diagnostic in 10% of patients.[28]

CER vs. usual GP care
In a randomised trial the diagnostic yield of CER versus usual care in general practice was compared. Within one month, 83% of the patients recorded an episode. The CER diagnosed 67% of patients with a cardiac arrhythmia, while the GPs diagnosed 27% of patients with a cardiac arrhythmia ($p<0.05$) after six months.[29]

AT-CER (R-test evolution) vs. patient-triggered mode of the AT-CER
In three studies with 262 (range 65 to 101) patients, the automatically triggered mode was compared with the patient-triggered mode of the device. In two of these studies, patients had negative 24-hour Holter monitoring. All studies included selected patients with a history of pre-existent cardiac pathology. Registration time varied from 77 to 103 hours. With both modes of the device, in more than 80% of the patients (range 75 to 88%) a diagnosis could be established. When compared with the patient-triggered mode, in all three studies the automatically triggered mode of the device found an additional amount of relevant diagnoses (range 11 to 17%).[5,30,31]

In a fourth larger study by Reifel et al.,[32] with 1800 patients, the AT-CER was compared with the traditional CER and 24-hour Holter monitoring. Each group consisted of 600 patients. The patient group who used the AT-CER had a diagnostic yield of 71 vs. 27% with the patient-triggered CER and 6% diagnosis with 24-hour Holter monitoring. Recording time of CER and AT-CER was one month.

CER vs. AT-CER (by MCOT)
In a randomised trial the diagnostic yield of CER versus AT-CER (by MCOT) was tested during 30 days in 266 patients. Previous Holter monitoring

Table 3. Comparative studies.

	Source	Study design/ Aim	Inclusion criteria	Setting/ Gender/ Mean age	Blinding observer	Dropout	Instrument/ Registration time	Proportion patients with diagnoses*
CER vs Holter	Grodman 1979	Prospective, comparative Diagnostic yield	Palpitations	- OPs - n=59 - 45% males - 50 years	ND	19 failed transmitting, 4 failed for technical reasons	CER (cardiobeeper) vs Holter, simultaneously 1 week	Holter 3 pts, CER 3 pts, Holter and CER together 9 pts
	Visser 1984	Prospective, comparative Diagnostic yield	Palpitations	- OPs - n=50 - 34% males - 44 years	ND	3 pts, ND	CER (cardiobeeper) vs Holter, same patient group, max 6 wks	CER 62%, Holter 12%
	Scalvini 2005	Prospective, randomised, 1:1 Diagnostic yield	Palpitations 41% cardiopathology	- Tertiary care - n=310 - 24% males - 52 years	No	ND	CER vs Holter at same time 7 days	CER 52%, Holter 48%
	Kus 1995	Prospective cross-over Diagnostic yield	Palpitations	- Tertiary care - n=100 - 34% males - 55 years	ND	3 pts, technical reasons	First Holter then CER max 25 days	CER 21%, Holter 30% Exclusion diagnoses CER 34% vs Holter 2%
	Kinlay 1996	Prospective randomised, crossover Diagnostic yield	Palpitations	- OPs - n=43 - 12% males - 45 years	Blinded for data, results	2 pts, non compliance	Post-event monitor (handheld) vs 48-h Holter 3 months	CER 67%*, Holter 30%*
	Klootwijk 1986	Prospective cohort Diagnostic yield	Palpitations 24-h Holter twice neg.	- OPs - n=100 - ?? - ??	NA	ND	First 2 * Holter, then CER (handheld) Max 6 months	2* negative Holter, CER 48%
CER vs ECG	Wu Jenny 1995	Retrospective Diagnostic yield, costs	Palpitations pre-syncope, syncope, dizziness	- OPs - n=91 - 94% males - 64 years	NA	5 pts from TTM; 5 incomplete files	First Ambulatory ECG than CER 30 days	CER 37%, ECG 10%
CER vs GP care	Hoefman 2005	Prospective, randomised, 1:1 Diagnostic yield	Palpitations and/or dizziness	- GP - n=244 - 26% males - 50 years	No blinding	1 pt, non-compliance	CER/ usual care GP, 30 days	CER 67%, usual care 27% significant*
	Roche 2002	Prospective Diagnostic yield	Palpitations and neg. 24-h Holter. 40% cardio-pathology	- OPs - n=65 - 69% males - 63 years	NA	ND	R-test evolution (RTE) manually and automatically triggered 77 hours	AT-CER 80%, pt-triggered 67%

Table 3. Comparative studies (continued).

	Source	Study design/ Aim	Inclusion criteria	Setting/Gender/ Mean age	Blinding observer	Dropout	Instrument/ Registration time	Proportion patients with diagnoses*
CER vs AT-CER	Martinez 2004	Prospective Diagnostic yield	Palpitations, dizzy, syncope, neg Holter 11% cardio- pathology	- OPs - n=96 - 52% males - 37 years	NA	ND	R-test evolution (RTE) manually and automatically triggered 5.2 days	CER mode 22%, additional diagnoses in automatic recordings 17%
	Balmelli 2003	Prospective Diagnostic yield	Palpitations, dizziness, syncope 52% cardio-pathology	- OPs - n=101 - 60% males - 54 years	Cardio. blinded for results	ND	R-test evolution (RTE) manually and automatically triggered 7 days	Pt-triggered 37%, autotriggered 63%, additional diagnoses in asymptomatic pts 61%
	Reiffel 2005	Retrospective 1:1:1 Diagnostic yield	Unknown	- Tertiary care - n=1800 - 40% males	NA	ND	HM/CER/ AT-CER 30 days	AT-CER 71% , CER 27% HM 6%
	Rothman 2007	Prospective randomised 1:1 Diagnostic yield	Palpitations, cardio-pathology: MCOT 84%, CER 62%	- OPs - n=266 - 34% males - 56 years	Double-blinded to history, randomisation	MCOT 13 pts, CER 7 pts technical reasons, non-compliance	AT-CER (MCOT), CER 30 days	MCOT 41% CER 15%*
	Olson 2007	Retrospective; palpitation n=76 syncope n=17, evaluation therapy n=19 Diagnostic yield	Palpitations, (pre)syncope, therapy evaluation 33% cardio-pathology	- OPs - n=122 - 43% males - 58 years	NA	ND	MCOT, automatic mode, patient-triggered mode Duration ??	Palpitation group: 73% symptomatic diagnoses. in 11% asymptomatic diagnoses, in previous diagnosed group 47%
CER vs ILR	Ng 2003	Retrospective Diagnostic yield	Palpitations, (pre)syncope	- Tertiary care - n=50 - 44% males - 54 years	NA	ND	ILR (Reveal plus) automatic and Pt triggered 12 months	Autotriggered 10%, pt-triggered 16%, inappropriate activation autotriggered mode
	Giada 2007	Prospective randomised 1:1 Diagnostic yield	Palpitations initial negative evaluation	- OPs - n=50 - 34% males - 47 years	No blinding	ND	Conventional group: Holter, CER, EP vs ILR 12 months	Conventional strategy group 21%, ILR 73%*

* p<0.05. NA=not applicable, ND=not described, GP=general practice, MCOT=mobile cardiac output telemetry, CER=continuous event recorder, ILR=implantable loop recorder, TTM=trans-telephonic monitoring, EP=electrophysiological testing, pts=patients.

was non-diagnostic. With the autotriggered mode, an arrhythmia was detected in 41% of the patients, compared with 15% in the CER group.[33]

Diagnostic yield in automatic vs. patient-triggered mode using an MCOT-CER

Olson et al.[34] reviewed records of 122 patients evaluated with an MCOT AT-CER. An arrhythmia was recorded in 73% of the patients with new-onset palpitations. In 11% of the patients, an automatic registration of an asymptomatic arrhythmia occurred.

In patients with previously diagnosed arrhythmias, an arrhythmia was documented in 47%. Documentation of these arrhythmias was automatically triggered in 63%, and 41% of the arrhythmias remained asymptomatic.

Automatic implantable loop recording (ILR) versus patient-triggered recordings

Ng et al.[35] compared the diagnostic yield of patient-triggered vs. automatic activation mode of the ILR in 50 patients. Using patient-triggered mode, arrhythmias occurring simultaneously with symptoms were registered in 16% of the patients. No relevant arrhythmias were detected by auto-activation only. The effectiveness of auto-activation to detect arrhythmia was reduced due to a high rate of inappropriate activation (83%), due to under- and over-sensing of the device. Withdrawals were not described.

ILR versus conventional strategy

Giada et al.[36] studied 50 patients in whom initial cardiological evaluation did not yield a diagnosis. The diagnostic yield of the ILR was randomly compared with conventional strategy (24-hour Holter recording, a four-week period of CER, and/ or electrophysiological testing if the previous two strategies yielded negative results). A diagnosis was obtained in five patients (21%) of the conventional strategy group: two patients were diagnosed with a CER and three patients were diagnosed with electrophysiological studies. With the ILR, arrhythmias were documented within one year in 19 patients (73%).

Discussion

We searched for studies evaluating the clinical utility of available technologies to diagnose palpitations and found six different groups of devices with different application characteristics. Twenty-eight studies were identified. Most of these studies described the yield of a specific device in a small group and of mostly highly selected patients. Therefore many of the studies are not very informative. Comparative studies provided more information, but most studies suffered from methodological shortcomings. Advice on which device to use for which problem or for which patient therefore is not straightforward and mainly based on the frequency of symptoms and the consideration of whether or not patients feel palpitations. When diagnosing palpitations and a standard ECG does not provide an explanation of the symptoms, Holter monitoring can be used when a patient has very frequent (daily) symptoms, an event recorder (auto- or patient-triggered) can be used when a patient has weekly symptoms. In symptomatic patients, patient-activated devices are preferred above autotriggered devices as the relation between symptoms and ECG abnormalities is clear. Autotriggered devices may more often detect an abnormality of the rhythm, but as direct linkage to perceived symptoms is missing, these devices are less well capable of explaining symptomatic episodes, unless used in the patient-triggered mode. Besides, the patient triggering can be used to demonstrate that the rhythm is not abnormal during symptoms, thus providing reassurance to anxious patients (and to their physicians because of exclusion of relevant arrhythmias). When a patient cannot operate the device (comorbidity, old age) an autotriggered recorder or MCOT can be used. A second reason for an autotriggered device is palpitation of an irregular pulse without the patient feeling any irregularity, in case of possible PAF.

Limitations

Cardiac monitoring devices are described in the literature under different names. Although we tried to perform a maximally sensitive search strategy, some studies may have been missed. Many of the identified studies are of weak methodology and comparison of the results of the studies is hazardous. The lack of true diagnostic studies is not just caused by weak methodology, however, but also by the lack of an accepted reference standard. Obtaining a registration of a rhythm that shows abnormalities might be considered to be a reference standard, but linking of such an abnormality to symptoms is not without uncertainties and sometimes even wrong.

CERs come in a variety of models. As the design of the devices may influence capability and readiness of recording arrhythmias, this may in part explain the observed differences in diagnostic yield.

Conclusion

Recent developments in ambulatory ECG recording offer the opportunity to diagnose most symptoms of palpitations, also in ambulant patients and in primary care. The choice of the device depends on frequency and character of the symptoms and is not evidence-based. Infrequent paroxysmal asymptomatic arrhythmias can best be documented using an AT-CER or an ILR for an extended period. In primary care, patient-triggered event recording has the advantage of a direct link between arrhythmias and symptoms, which makes it possible to not only diagnose relevant arrhythmias, but also dem-

onstrate harmless rhythm disturbances (as sinus tachycardia) as an explanation for symptoms to the patient. When asymptomatic episodes are suspected or patients are incapable of operating the device an autotriggered device is preferred.

Future research should focus on comparison of different devices in homogenous patient groups. The outcome should be reported in two ways: explained episodes and clinically relevant arrhythmia.

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