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Reliability of pulse palpation in the detection of atrial fibrillation in an elderly population

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ABSTRACT

Purpose: Atrial fibrillation (AF) may first present as an ischemic stroke. Pulse palpation is a potential screening method for asymptomatic AF. We aimed to assess the reliability of pulse palpation by the elderly in detecting AF.

Materials and methods: After brief information and training session conducted by a nurse, 173 subjects aged ≥75 years were instructed to palpate their pulse regularly for a month. After this, their ability to distinguish sinus rhythm (SR), SR with premature ventricular contractions (PVC) and AF by pulse palpation was assessed using an anatomic human arm model programmable with various rhythms. A control group of 57 healthcare professionals received the same information but not the training. Subjects unable to find the pulse were excluded (25 (14.5%) of the elderly and none in the healthcare group).

Results: The median age of the elderly subjects was 78.4 [3.9] years and 98 (56.6%) were women. There were no differences between the elderly and healthcare groups in detecting SR (97.3% vs. 96.5%) or SR with PVCs (74.3% vs. 71.4%), but the elderly subjects identified slow (81.8% vs. 56.1%) and fast AF (91.9% vs. 80.7%) significantly better than the healthcare group. The ability to recognize SR with PVCs by the elderly was independently predicted by previous pulse palpation experience, secondary or higher level of education and one-point increase in MMSE score, while identifying the other rhythms had no predictors.

Conclusions: The elderly can learn to reliably distinguish a normal rhythm after education. Pulse self-palpation may be a useful low-cost method to screen for asymptomatic AF.

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Atrial fibrillation; screening; asymptomatic conditions; stroke; prevention

Introduction

Atrial fibrillation (AF) is a significant risk factor of thromboembolism and ischemic stroke [1], and it is known that 15–25% of all ischemic strokes are associated with AF [2,3]. However, with effective oral anticoagulation therapy, 2/3 of all ischemic strokes associated with AF may be avoided [4].

AF is asymptomatic or 'silent' in 10–40% of the cases [5], delaying the implementation of protective anticoagulant medication in a significant proportion of patients suffering from the condition. Consequently, stroke is too often the first manifestation of the arrhythmia [6]. Early detection is of the utmost importance to avoid unnecessary strokes, and consequently inexpensive and widely practicable screening measures are direly needed.

AF may be distinguished by pulse irregularity, and pulse palpation is a potential screening method for silent AF. The screening approach promoted by the European Society of Cardiology in their 2012 focused update of their guidelines to manage AF is opportunistic pulse palpation by health care personnel in subjects aged at least 65 years followed by ECG recording when irregularity is detected [7]. The purpose of this study was to investigate the ability of elderly subjects themselves to recognize the underlying heart rhythm by pulse palpation.

Materials and methods

Study population and education

In the LietoAF Study, 205 persons aged 75 years or older living in Lieto, a municipality in South-Western Finland, were randomly recruited in 2012 from 300 willing and eligible subjects, who had no history of chronic AF, did not use oral anticoagulants and were not in need of permanent institutional care (http://www.ClinicalTrials.gov identifier: NCT01721005) [8].

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During the baseline visit of the study, information was recorded on the subjects' medical history, lifestyle factors, social factors and education, and a Mini-Mental State Examination (MMSE) was performed. Afterwards, a single cardiac nurse taught the subjects to assess the rate and regularity of their pulse according to a standardized protocol. First, the subjects received information on the health implications of AF (i.e. risk of thromboembolism and ischemic stroke), its clinical presentation and frequent asymptomatic nature. The potential health benefits of regular pulse palpation were explained (i.e. catching asymptomatic AF and timely implementation of anticoagulation therapy to avoid stroke). Then, the nurse taught the technique of pulse palpation with special focus on assessing heart rate and rhythm regularity. In the third phase, the subjects freely palpated their radial and carotid pulses. In the final phase, the nurse assessed the achieved capability of pulse palpation by having the subjects palpate their pulse at a preferred site and counting out loud in time with their pulse and simultaneously herself palpating the subjects' pulse at another site. The time spent at each phase varied individually as needed, but the maximum time spent on education was 10 minutes.

After the initial education session, the subjects were asked to palpate their own pulse twice-daily and seek immediate medical attention in the case of observed irregularity. They were followed for three years and new AF diagnoses were recorded. The main purpose of the LietoAF Study is to assess the feasibility of self-palpation of pulse in the screening of AF during a three-year follow-up. The one-month follow-up results have been previously reported elsewhere [8], and the results of the full follow-up will be reported later.

At the one-month follow-up visit of the on-going LietoAF Study, all subjects were additionally given basic information on the physiology of the heart by the same cardiac nurse. The concepts of sinus rhythm (SR), AF and premature (ventricular) contractions (PVC) were talked through and it was explained that SR features a regular pulse, SR with PVCs features an irregular pulse with underlying regularity and that AF presents as an irregular pulse with no underlying regularity. A maximum of five minutes was spent on this education session. Right afterwards, the ability to discriminate AF, SR and PVCs was assessed in altogether 173 willing subjects.

A control group of 57 was recruited from health care personnel, and they received the same information on pulse palpation by the same cardiac nurse, but they did not have a month of regular pulse palpation practice like the elderly subjects had. The control group was composed of 10 nurses, 17 final year paramedic students, 15 final year nursing students and 15 paramedic students with one full year of studies left. The final year nursing and paramedic students had 6–12 months of full-time clinical experience while the other paramedic students had good theoretical knowledge of the matter due to their studies but limited clinical experience. The nurses had a varying amount of years of clinical experience, but this was not recorded in detail.

Figure 1. SimPad BloodPressure trainer; manufacturer: Laerdal.

Study protocol

An anatomic model of a human arm programmable with various rhythms and rates and with three locations for pulse palpation (the radial, cubital and axillary arteries) was used for the measurements (SimPad BloodPressure Trainer; manufacturer: Laerdal (Figure 1)). The subjects were alone with the nurse in a separate closed examination room for the duration of the testing to avoid interference from other participants or outside people. The subjects were told that the pulse palpation arm would be programmed to present one of the three possible rhythms (SR, SR with PVCs or AF) with different ventricular rates one after another. To avoid guesswork on the subjects' part, the subjects were told that the number of rhythms presented would vary by number, order and ventricular rate between subjects. However, all subjects were actually presented with four rhythms (SR (rate 60),

slow AF (rate 60), fast AF (rate 120) and SR with PVCs (rate 80)) in the following order: SR, fast AF, slow AF, SR and SR with PVCs. SR was presented twice to further control the possibility of guessing.

First, it was assessed whether the subjects were able to locate the pulse at any of the possible sites while the programmed rhythm was SR with a ventricular rate of 60. From this point forward, the subjects continued to palpate the pulse without interruptions, except to find the pulse again if needed, until the end of testing. Before commencing the experiment, the subjects were told to verbally notify the study nurse every time they thought the rhythm had changed. Then, the study nurse would ask the subjects whether the rhythm was regular or irregular and whether the rhythm was SR, SR with PVCs or AF, and she would record their answers. After this, the subjects were presented with the different rhythms as described above. A maximum time of 120 seconds was given to identify each rhythm, which the subjects were not aware of. When the subjects had reported that the rhythm had changed and assessed which of the three possibilities in their opinion it was, the current rhythm was maintained for a random length of time before moving on to the next one. The time point of the next change of rhythm was programmed each time right after the subjects had determined the current rhythm so that they could not identify from the actions of the study nurse when the change would occur.

Study ethics

The study protocol was approved by the Medical Ethics Committee of The Hospital District of Southwest Finland. All patients enrolled in the study provided written informed consent for participation. The study conforms to the Declaration of Helsinki.

Statistical analyses

The statistical analyses were performed with IBM SPSS Statistics software (version 22.0, SPSS, Inc., Chicago, IL). Continuous data are presented as median [interquartile range] and categorical variables as absolute number and percentage. Fisher's exact test was used to compare differences between proportions. Mann–Whitney's *U* was used for the analysis of continuous variables. For repeated measures, McNemar's test was used. Based on the results of bivariable comparisons, logistic regression analyses were conducted to analyze the independent predictors of correct identification of different rhythms by pulse palpation. Two-sided differences were considered significant if the null hypothesis could be rejected at the .05 probability level.

Table 1. Baseline characteristics of the elderly subjects.

N	173
Age, years	78.4 [3.9]
Female gender	98 (56.6)
Secondary or higher level of education	76 (43.9)
Functional independence	163 (94.2)
Computer at home	66 (38.2)
At least weekly exercise	138 (79.8)
MMSE score	29 [2]
MMSE score $\geq$24	170 (98.3)
History of AF or another arrhythmia	8 (4.6)
History of participation in competitive sports	13 (17.5)
Previous experience of pulse palpation	62 (35.8)
Ability to count own heart rate	129 (74.6)

AF: atrial fibrillation; MMSE: Mini-Mental State Examination.
Values are presented as number (%) or median [interquartile range].

Results

The median age of the subjects in the elderly group was 78.4 [3.9] years and 98 (56.6%) of them were women. The baseline characteristics of the elderly group are presented in Table 1. Altogether 152 (87.9%) elderly subjects had palpated their pulse daily during the preceding month. Out of all 173 subjects in the elderly group, 148 (85.5%) subjects could correctly identify SR, 124 (71.7%) identified slow AF, 142 (82.1%) identified fast AF and 110 (63.6%) identified SR with PVC. Altogether 25 subjects (14.5%) in the elderly group were unable to find the pulse at least during one of the presented rhythms. The subjects' inability to palpate the pulse in this group had no independent predictors. The subjects in the healthcare group could find the pulse in all instances. The difference between the two groups regarding the ability to find the pulse was statistically significant ($p = .001$). Subjects unable to find the pulse at least once were excluded from further analyses.

There were no differences between the elderly and healthcare groups in detecting SR or SR with PVCs, but the elderly subjects identified slow and fast AF significantly better than the healthcare personnel. The subjects' ability to determine the correct rhythm by pulse palpation in the elderly and healthcare groups is depicted in Table 2. Fast AF was correctly identified significantly more often than slow AF in the elderly group ($p = .003$). In the elderly group, the ability to correctly recognize SR with PVC was independently predicted by previous experience of pulse palpation, secondary or higher level of education and one-point increase in MMSE score, while the ability to correctly identify SR or fast or slow AF had no independent predictors (Table 3).

Table 2. The ability of the subjects to determine the correct rhythm by pulse palpation in the elderly and healthcare groups.

	Elderly group		Healthcare group		
N (%)	148 (100)	95% CI (%)	57 (100)	95% CI (%)	*p* Value
SR, rate 60	144 (97.3)	94.6–100.0	55 (96.5)	91.6–100.0	.671
AF, rate 60	121 (81.8)	75.5–88.1	32 (56.1)	43.0–69.2	<.001
AF, rate 120	136 (91.9)	87.4–96.4	46 (80.7)	70.2–91.2	.045
SR with PVC, rate 80	110 (74.3)	67.1–81.5	40 (71.4)	59.4–83.4	.723

AF: atrial fibrillation; PVC: premature ventricular contraction; SR: sinus rhythm.
Values are presented as number (%).

Table 3. The independent predictors of correct identification of rhythm by the elderly.

	Incorrect identification	Correct identification	Univariate *p* Value	Multivariate *p* Value	OR	95% CI
N = 148	*n* (%)	*n* (%)				
SR with PVCs	38 (100)	110 (100)				
Previous experience of pulse palpation	4 (10.5)	50 (45.5)	<.001	<.001	8.05	2.55–25.42
Secondary or higher level of education	11 (28.9)	54 (49.1)	.037	.020	2.78	1.17–6.60
One-point increase in MMSE score	28 [3]	29 [2]	.005	.019	1.34	1.05–1.70
SR						
One-point increase in MMSE score	28 [3]	29 [2]	.090	.192	1.40	0.84–2.32
Fast AF						
One-year decrease in age	79.4 [5.8]	78.4 [3.8]	.071	.055	1.17	0.97–1.37
Slow AF						
–						

AF: atrial fibrillation; CI: confidence interval; MMSE: Mini-Mental State Examination; OR: odds ratio; PVC: premature ventricular contraction.
Values are presented as number (%) or median [interquartile range].

SR was presented twice to the subjects to control for the possibility of guessing. The second presented SR was correctly identified by 140 (95.2%) of the elderly subjects and 53 (96.4%) subjects in the healthcare group. In comparison to the first SR presented, there were no differences in correct identification rate in either the elderly group ($p = .344$) or the healthcare group ($p = 1.000$). The second presented SR was used only for this part of the analyses, while the SR presented first was used in all other analyses.

Discussion

These results show that pulse palpation by the elderly has a rate-dependent accuracy of 82–92% to detect AF. The accuracy to detect normal SR was excellent at 97%, while considerably fewer subjects, 74%, correctly distinguished SR with PVCs.

These figures are significantly better than those achieved by Munschauer et al. in 161 subjects who palpated the pulse of two persons, one in normal SR and one in AF [9]. The achieved sensitivity and specificity to identify AF were 76% and 86%, respectively. The better results in the present study may be explained by the fact that the subjects in our study had one month of experience of regular pulse palpation. It was not a surprise that good cognitive capacity and experience of pulse palpation predicted correct identification of SR with PVCs, which was the most difficult task included in our protocol.

Importantly, the trained elderly subjects could identify AF better than healthcare personnel. A possible explanation for this is that a large share of the healthcare group consisted of nursing students with somewhat limited clinical experience. Another affecting factor is that the healthcare group, although having received identical training to the elderly subjects, lacked a month's worth of regular pulse palpation experience in comparison. Previous studies have shown that nurses recognize AF by pulse palpation with a sensitivity and specificity of 91–100% and 70–77%, respectively [10–13]. These studies considered any irregularity as a positive screening test and as such their results are comparable to those achieved by the elderly in this study. Our findings highlight that even healthcare professionals require practice and tutoring to be able to reliably interpret the findings of pulse palpation.

The current recommendation for screening of AF is opportunistic pulse palpation by healthcare professionals in patients aged 65 years or older, followed by the recording of an ECG when irregularity is detected [7]. In a previous report of 14,802 subjects aged 65 years or more by Fitzmaurice et al., opportunistic and systematic screening with a single ECG recording both detected 1.6% new AF during a 12 month follow-up, while standard practice identified only 1.0% new AF [14]. However, healthcare visits by individuals are usually rare with a limited chance to catch an often paroxysmal arrhythmia, which is the main caveat of opportunistic screening. Regular self-assessment of pulse could potentially overcome this matter. The results of this study show that the elderly can reliably distinguish normal rhythm by pulse palpation and suggest that self-palpation of pulse could potentially act in a cognitively unimpaired

population as a first step of a stepwise screening strategy, in which those with detected irregularity would be screened with more laborious and costly methods, such as long-term or repeated ECG monitoring.

The approach of long-term regular self-monitoring of pulse for screening of AF has, however, several potential threats too. Most importantly, maintaining a regular pulse palpation habit requires considerable effort on the subjects' part unless sufficient automatism regarding the action can be promoted. Consequently, the persistence of a regular pulse palpation habit might be poor during extended time periods, rendering constructing an effective screening program difficult. Also, monitoring oneself continuously for signs of illness could feasibly cause increased anxiety and significantly lower quality of life and as such any screening program would be unethical due to causing more harm than good. A screening intervention could also significantly increase the use of healthcare services elevating financial costs substantially. The LietoAF Study, which this paper is a subanalysis of, assesses the feasibility of long-term regular pulse self-palpation in the screening of AF and was designed to address these concerns. The one-month follow-up's results have been reported previously, and during this brief time, over 80% of the subjects continued assessing their pulse regularity daily, no increase in healthcare service visits was observed and quality of life was unaffected [8]. Whether these concerns materialize during a longer time period, will be reported with the results of the full three years of follow-up of the study at a later time.

For ethical and financial reasons, any potential screening program should be targeted towards a population with risk factors of thromboembolism and who as such would benefit from oral anticoagulation medication. Another key requirement is the balance between the price of case-finding and incurred costs on society as a whole. In an approach where pulse self-palpation is used as a preliminary screening test, the majority of the costs would likely be caused by the costly follow-up tests. The approach could also elevate costs significantly by increasing healthcare contacts substantially as discussed above. However, the costs of instructing pulse-palpation would most likely be comparatively negligible, e.g. because the education could feasibly be given to larger groups at a time. Determining this matter thoroughly is important but however out of the scope of the current study and subject to further research.

Some limitations need to be addressed. The use of an artificial anatomic model as opposed to an actual human model for pulse palpation can be seen as a limitation. On the other hand, it ensures standardized and uniform circumstances for all subjects, which undoubtedly is an advantage of this study compared to the previous studies. Another limitation is the lack of physicians in the healthcare group preventing us from comparing the ability to distinguish AF between different healthcare professionals. The relative lack of clinical experience of a large share of the control group may also be a limitation. It is likely that the majority of those who could not identify AF or SR with PVCs did recognize the pulse irregularity. However, this information was not recorded, which is a limitation.

In conclusion, elderly subjects are capable of reliably distinguishing a normal rhythm, but recognizing AF as the cause of irregularity is much more difficult. Self-palpation of pulse may be a viable low-cost method for screening asymptomatic AF, but confirmatory tests are needed after a positive pulse palpation finding.

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Disclosure statement

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References

[1] Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: the Framingham Study. Stroke. 1991;22:983–988.

[2] Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation: a major contributor to stroke in the elderly. The Framingham Study. Arch Intern Med. 1987;147: 1561–1564.

[3] Marini C, De Santis F, Sacco S, et al. Contribution of atrial fibrillation to incidence and outcome of ischemic stroke: results from a population-based study. Stroke. 2005;36:1115–1119.

[4] Hart RG, Pearce LA, Aguilar MI. Meta-analysis: antithrombotic therapy to prevent stroke in patients who have nonvalvular atrial fibrillation. Ann Intern Med. 2007;146:857–867.

[5] Savelieva I, Camm AJ. Clinical relevance of silent atrial fibrillation: prevalence, prognosis, quality of life, and management. J Interv Card Electrophysiol. 2000;4: 369–382.

[6] Jaakkola J, Mustonen P, Kivinemi T, et al. Stroke as the first manifestation of atrial fibrillation. PLoS One. 2016. DOI:10.1371/journal.pone.0168010

[7] Camm AJ, Lip GY, De Caterina R, et al. 2012 focused update of the ESC Guidelines for the management of atrial fibrillation: an update of the 2010 ESC Guidelines for the management of atrial fibrillation. Developed with the special contribution of the European Heart Rhythm Association. Europace. 2012; 14:1385–1413.

[8] Virtanen R, Kryssi V, Vasankari T, et al. Self-detection of atrial fibrillation in an aged population: the LietoAF Study. Eur J Prev Cardiol. 2014;21:1437–1442.

[9] Munschauer FE, Hens MM, Priore RL, et al. Screening for atrial fibrillation in the community: a multicenter validation trial. J Stroke Cerebrovasc Dis. 1999;8: 99–103.

[10] Cooke G, Doust J, Sanders S. Is pulse palpation helpful in detecting atrial fibrillation? A systematic review: particular high-risk patients may benefit from repeated testing. J Fam Pract. 2016;55:130–135.

[11] Sudlow M, Rodgers H, Kenny RA, et al. Identification of patients with atrial fibrillation in general practice: a study of screening methods. BMJ. 1998;317:327–328.

[12] Somerville S, Somerville J, Croft P, et al. Atrial fibrillation: a comparison of methods to identify cases in general practice. Br J Gen Pract. 2000;50:727–729.

[13] Morgan S, Mant D. Randomised trial of two approaches to screening for atrial fibrillation in UK general practice. Br J Gen Pract. 2002;52:373–380.

[14] Fitzmaurice DA, Hobbs FR, Jowett S, et al. Screening versus routine practice in detection of atrial fibrillation in patients aged 65 or over: cluster randomised controlled trial. BMJ. 2007;335:383.