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Can novice physicians perform a high-quality record of a 12-lead electrocardiographic examination? Preliminary data

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Abstract

High-quality 12-lead electrocardiogram recording is one of the most important elements of the patient's physical examination, not only in the case of chest pain. Carelessness and inaccuracy in the method of placing the electrodes on the patient's body results in poor record

quality which may affect the wrong therapeutic decisions and the possibility of exposing the patient of health or even life loss.

The aim of the study was to determine the reliability of ECG electrodes placement on the patient's body by novice physicians.

The study group consisted of 53 novice physicians who carry out a postgraduate internship including 58% of female. Results were collected with the use of authorial and anonymous questionnaire where participants marked the correct position of all ECG electrodes.

The correct position of the V1 electrode in the fourth right intercostal space was identified by only 19% of the respondents. Additionally, V1 and V2 were often (37.7%) incorrectly placed parasternally in the right and left second intercostal spaces. Only 2% of the study participants knew the correct position of the V3R electrode. Only 23% of participants knew the correct location of V7 lead, 15% location of V8 and 17% of V9 electrode.

It is necessary to propagate the correct technique of performing a 12-lead electrocardiogram recording of the heart in group of novice physicians. More detailed and practical training is undoubtedly indicated. Critical review of training and education curricula is therefore recommended.

Key words: 12-lead ECG, Electrocardiogram, quality of care and outcomes, additional leads, right ventricle

Introduction

High-quality 12-lead electrocardiogram recording is one of the most important elements of the patient's physical examination. This test can be carried out by nurses, paramedics as well as physicians. However, performing a 12-lead high-quality ECG examination may be technically difficult to perform. This may be due to many factors, for example: anatomy of the patient (women with large breasts, patients with significant obesity), agitation of the patient, forced position of the patient's body (older people, associated with accompanying ailments such as strong dyspnoea), increased sweating (in shock), lack of cooperation from the patient side (senile dementia, mental illness). In addition, problems with performing this test may be associated with lack of knowledge from medical staff about correct places of ECG electrodes on the patient's body. Their incorrect placement of limb and also precordial electrodes is associated with a large number of artifacts and errors in the record, which may have a disastrous

effect on the healing process and may expose the patient to health loss or even life [1-4]. What's more, unfortunately, but the results of many authors' research show that these errors are not sporadic and concern almost all medical groups [5, 6]. In connection with the above, it seems to be important to regularly check the knowledge and technical skills of medical personnel regarding the implementation of the 12-lead high-quality ECG record. The above recommendation is particularly important in the group of novice physicians who have relatively low professional experience.

Purpose of work

The aim of the study was to determine the reliability of ECG electrodes placement on the patient's body by novice physicians.

Material and methods

Examined group constituted of 53 novice physicians who carry out a postgraduate internship. In the study involved physicians who do not have more than one year of professional experience. The examination was led by 2 months from May till June 2018.

The study was conducted with the use of authorial and anonymous questionnaire form. All of participants were asked to complete a questionnaire and marked on diagrams of the patient's chest wall the positions where they would place precordial electrodes (V1-V6), right-sided precordial leads (V3R, V4R, V5R, V6R) and posterior leads (V7, V8, V9). In addition, they were asked about the correct placement of the limb leads in the normal and high-quality electrocardiogram examination. The written invitation described the goals and aims of the study and assured the physicians that all data was confidential and collected anonymously. Due to voluntary participation in this study, formal written consent was waived. Data from the questionnaires was collected in Microsoft Excel form. All analysis was performed with the use of Statistica 13.1 EN statistics software (StatSoft, Tulsa, OK, USA). The data is presented as a number and percent.

Results

53 novice physicians who carry out a postgraduate internship completed the survey (22 [41.5%] male and 31 [58.5%] female). Study participants were also asked to self-assess their level of knowledge and skills in the technique of recording electrocardiographic examination. The analysis shows that novice physicians are aware that their level of knowledge is average or low. The highest number of respondents assessed their knowledge and skills of 12-lead ECG

examination as “average” (53%) or as “low” (34%). Most women assessed their level of knowledge and skills as “low” and “average” (45.2%) while the majority of men rate it as “average” (63.6%). All answers concerning the self-assessment of knowledge and skills level of 12-lead ECG examination are shown in Table 1.

Table 1. Self-assessment of knowledge and skills level of 12-lead ECG examination in study group.

Declared level of knowledge	Very low **n** ***(%)***	Low **n** ***(%)***	Average **n** ***(%)***	High **n** ***(%)***	Very high **n** ***(%)***
All	5 (9.4)	18 (34)	28 (52.8)	2 (3.8)	0 (0)
Women	3 (9.7)	14 (45.2)	14 (45.2)	0 (0)	0 (0)
Men	2 (9.1)	4 (18.2)	14 (63.6)	2 (9.1)	0 (0)

(Source: Own study)

66% of participants of the study correctly indicated the answer to the question about which symbols are marked by the bipolar limb lead according to Einthoven (I, II, III), while almost 4% of respondents admitted that they do not know the correct answer. In addition, 68% of the participants knew what symbols of unipolar drains lead according to Goldberger were marked with (aVL, aVR, aVF). In terms of gender, there were no significant differences in the percentage of correct answers.

The correct position of the V1 electrode in the fourth right intercostal space was identified by only 19% of the respondents. Notably, V1 and V2 were often (37.7%) incorrectly placed parasternally in the right (V1) and left (V2) second intercostal spaces. Less than 21% of novice physicians correctly indicated the location of the V2 and V3 electrodes. Analyzing the location of subsequent V4, V5 and V6 electrodes, it can be concluded that a larger percentage of the respondents correctly placed these electrodes on the patient’s chest wall, respectively: 25%, 26% and 28% of the surveyed physicians. Table 2 contains the results of the correct placement of V1-V6 electrodes, taking into account the gender of the respondents.

Table 2. Correct placement of V1-V6 electrodes.

	V1		V2		V3		V4		V5		V6	
Correct electrode placement	18.9%		20.8%		20.8%		24.5%		26.4%		28.3%	
Correct placement of electrodes divided into gender	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
	25.8 %	9.1 %	25.8 %	13.6 %	22.6 %	18.2 %	25.8 %	22.8 %	25.8 %	27.3 %	29 %	27 %
Unfamiliarity of correct placement	7.5%		7.5%		7.5%		7.5%		7.5%		7.5%	

(Source: Own study)

The results of research about the correct position of right-sided, ventricular precordial leads (V3R, V4R, V5R, V6R) turn out to be surprising. Only 2% of the study participants knew the correct position of the V3R electrode. Furthermore, next of right-sided precordial leads were known only to a small percentage of novice physicians (5.7%) (Tab.3.). Among participants, over half of them admitted that they do not know the correct position of right-sided precordial leads.

Table 3. Correct placement of V3R-V6R electrodes.

	V3R		V4R		V5R		V6R	
Correct electrode placement	1.9%		5.7%		5.7%		5.7%	
Correct placement of electrodes divided into gender	♀	♂	♀	♂	♀	♂	♀	♂
	0%	4.5%	3.2%	9.1%	3.2%	9.1%	3.2%	9.1%
Unfamiliarity of correct placement	54.7%		58.5%		58.5%		58.5%	

(Source: Own study)

The posterior leads - V7, V8 and V9 results are similar. Only 23% of the study participants knew the correct location of V7 lead. About 15% of novice physicians know the location of V8 electrode and 17% of V9 electrode (Table 4). A large part of young physicians

admitted that they have no knowledge where to place posterior leads on the patient's chest wall (from 32% to 40%).

Table 4. Correct placement of V7-V9 electrodes.

	V7		V8		V9	
Correct electrode placement	22.6%		15.1%		17%	
Correct placement of electrodes divided into gender	♀	♂	♀	♂	♀	♂
	19.4%	27.3%	19.4%	9.1%	22.6%	9.1%
Unfamiliarity of correct placement	32.1%		35.8%		39.6%	

(Source: Own study)

The present study shows that correct location of limb leads is known to a large percentage of novice physicians. Red lead was correctly located on the right arm by almost 90% of study participant. 81% of them correctly located yellow lead, 87% black lead and 76% green one (Tab. 5.). Moreover, almost 6% of novice physicians admitted that they do not know the correct placement of the yellow limb electrode.

Table 5. Correct placement of limb electrodes.

	Red		Yellow		Green		Black	
Correct electrode placement	88.7%		81.1%		75.5%		86.8%	
Correct placement of electrodes divided into gender	♀	♂	♀	♂	♀	♂	♀	♂
	93.5%	81.8%	90.3%	68.2%	80.6%	68.2%	90.3%	81.8%
Unfamiliarity of correct placement	1.9%		5.7%		1.9%		1.9%	

(Source: Own study)

Discussion

In this study, we found that knowledge about the technical implementation of a 12-lead electrocardiogram by novice physicians is surprisingly very small. There is a fairly high probability that young physicians asked to do an ECG examination can do it carelessly, improperly and in the situation of the need to extend the examination with non-standard electrode arrangements, they may not have any knowledge how to do it. Our research shows that many of physicians (38%) wrongly believe that V1 and V2 should be placed in the second

intercostal space. However, other authors research confirms that this is a very often made mistake. Research of Rajaganeshan et. al. shows that 90% of technicians, 49% of nurses, 31% of non-cardiologists and only 16% of cardiologists can marked the correct position of the V1 electrode [6]. Similar results were obtained Wenger and Kligfield in theirs study, specifying that the V1 and V2 electrodes were placed the most peripheral in relation to their anatomically defined precordium sites [5].

Many scientists confirm that the use of alternative, non-standard electrode arrangements on the patient's chest wall may positively influence the probability of detecting clinically significant changes [7]. Thanks to this, many authors recommend placing the electrodes in the right-side position (V3R, V4R, V5R, V6R) or use electrodes to assess the posterior wall of the heart (V7, V8, V9) [7-9]. Unfortunately, this research shows that only 2% of novice physicians know exactly where to place the V3R electrode and about 6% of the V4R, V5R and V6R electrodes. The results for non-standard electrodes placed above the back wall are relatively better. About 22% of respondents had a good location for the V7 electrode, 15% for the V8 electrode and 17% for the V9 electrode. It seems promising that a fairly large part of the study participants know about their lack of knowledge and clearly admit to them in this study.

This study show that the results regarding the correct placement of limb electrodes by the study participants are quite well formed. For each of the four electrodes, at least 75% of the correct answers were recorded. However, due to the fact that this error is quite often described [6], reminding trainings should be run successively as often as possible. In eliminating errors, it may also be very important to introduce various types of control cards [10], thanks to which it will be possible to re-evaluate the correct placement of electrodes on the patient's body.

In connection with such unsatisfactory results of this research, it seems advisable to create a system of extended training both from the technical aspects of the electrocardiographic examination and from the basic analysis of the results of such a test for novice physicians. In addition, it seems important to draw attention to the current education and training program of physicians in terms of the described aspect. It is important that every physician can perform a high quality record of a 12-lead electrocardiographic examination of a patient in a state of health or life threat [11]. The lack of such skills may expose the patient to loss of health or life while the medical staff may be legally liable. The unnecessary delay in undertaking this test may therefore positively affect both sides in the entire diagnostic and therapeutic process.

Conclusions

It is necessary to propagate the correct technique of performing a 12-lead rhythm recording of the heart in group of young physicians. More detailed and practical training is undoubtedly indicated. Critical review of training and education curricula is therefore recommended. Further studies are needed to confirm these findings.

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