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Original Article

ABILITY OF NURSES INTERPRET A 12-LEAD ELECTROCARDIOGRAPHY

HABILIDADE DOS ENFERMEIROS NA INTERPRETAÇÃO DO ELETROCARDIOGRAMA DE 12 DERIVAÇÕES

HABILIDAD DE LOS ENFERMEROS PARA LA INTERPRETACIÓN DEL ELECTROCARDIOGRAMA DE 12 DERIVACIONES

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Objective: to evaluate the ability of nurses to recognize electrocardiographic changes requiring immediate intervention and to compare their performance in case of arrhythmias, according the type of unit where they work. Method: this is a cross-sectional study with 100 nurses from a cardiopneumology hospital. Data collection took place between March and November 2015. An instrument with data characterizing the participants and 10 clinical cases with electrocardiographic tracing was used. Results: 89% of the nurses identified pulseless ventricular tachycardia, 77%, ventricular fibrillation, and 81%, pulseless electrical activity, although less than half were able to identify ischemic changes. Nurses working in critical areas analyze more traces in their routine than those in non-critical areas (p = 0.019) and they feel more confident to do this work. Conclusion: Nurses have sufficient ability to identify changes in cardiac rhythm. No differences were found in performance when the types of unit were compared.

Descriptors: Electrocardiography; Heart Arrhythmias; Emergencies; Nursing.

Objetivo: avaliar a habilidade de enfermeiros no reconhecimento de alterações eletrocardiográficas de intervenção imediata e comparar a atuação desses frente às arritmias, segundo o tipo de unidade em que atuam. Método: estudo transversal com 100 enfermeiros de um hospital especializado em cardiopneumologia. A coleta de dados ocorreu entre março e novembro de 2015. Foi utilizado instrumento com dados de caracterização dos participantes e 10 casos clínicos com traçados eletrocardiográficos. Resultados: 89% dos enfermeiros identificaram a taquicardia ventricular sem pulso, 77% a fibrilação ventricular e 81% a atividade elétrica sem pulso, entretanto menos da metade conseguiu identificar as alterações isquêmicas. Enfermeiros de áreas críticas analisam mais traçados na sua rotina quando comparados àqueles das áreas não críticas (p=0,019) e sentem-se mais seguros para isso. Conclusão: os enfermeiros têm habilidade suficiente para identificar as alterações do ritmo cardíaco. Não houve diferença em relação a atuação, quando comparados com o tipo de unidade.

Descritores: Eletrocardiografia; Arritmias Cardíacas; Emergências; Enfermagem.

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Objetivo: evaluar habilidad de enfermeros para reconocimiento de alteraciones electrocardiográficas de intervención inmediata y comparar su actuación ante arritmias, según el tipo de unidad donde actúan. Método: estudio transversal, con 100 enfermeros de un hospital especializado en cardiología y neumonología. Datos recolectados entre marzo y noviembre de 2015. Fue utilizado instrumento con datos de caracterización de participantes, y 10 casos clínicos con trazados electrocardiográficos. Resultados: 89% de los enfermeros identificaron la taquicardia ventricular sin pulso, 77% la fibrilación ventricular, y 81% la actividad eléctrica sin pulso; sin embargo, menos de la mitad consiguió identificar las alteraciones isquémicas. Los enfermeros de áreas críticas analizan más trazados en su rutina en comparación con aquellos de las áreas no críticas (p=0,019) y se sienten más seguros para eso. Conclusión: los enfermeros tienen habilidad suficiente para identificar las alteraciones del ritmo cardíaco. No existió diferencia respecto de su actuación, comparados según tipo de unidad.

Descriptores: Electrocardiografía; Arritmias Cardíacas; Urgencias Médicas; Enfermería.

Introduction

Patient monitoring by electrocardiogram (ECG) is essential in all hospital units because this is able to detect cardiac electrical conduction abnormalities, predicting risks to the life of the patient. In addition, it allows the monitoring of ST segment morphology, in which changes may indicate the onset of myocardial ischemia or recurrence of coronary perfusion impairment, especially after percutaneous coronary angioplasty[1].

The 12-lead ECG is able to reflect alterations resulting from myocardial dysfunctions in several scenarios, such as coronary artery disease, cardiomyopathies, arterial hypertension, metabolic diseases, electrolyte abnormalities, toxic and therapeutic drug effects, among others. Arrhythmias can be interpreted by reading ECGs in 84% of the cases. In this way, ECG application in clinical practice becomes ample and functional[2-3].

Considered a gold standard for the noninvasive diagnosis of cardiac arrhythmias and coronary ischemia, the ECG can also be used as a complementary method for the detection of structural and metabolic alterations[2]. Thorough study and methodical analysis of waves, intervals and conduction segments are the basis for interpreting normal ECGs, cardiocirculatory pathologies and extracardiac conditions that modify the tracing.

Several studies described in the literature have already evaluated the ability of medical professionals to accurately interpret electrocardiographic changes, especially those related to ischemic changes[4-6]. However, the number of studies that sought to evaluate the knowledge of nurses on the interpretation of electrocardiographic alterations is still scarce[7-8]. A recent randomized clinical trial involving 134 third-year undergraduate nursing students at the Athens University evaluated two teaching strategies for interpreting cardiac arrhythmias and it showed that all students had difficulty recognizing the tachyarrhythmias presented (ventricular tachycardia, atrial fibrillation and supraventricular tachycardia)[9].

Considering that nurses are the care team professionals who continuously stay at the side of the patient, it is of fundamental importance that they be able to recognize normal and pathological electrocardiographic tracings. This competence will provide them with subsidies for the interpretation of electrocardiographic and clinical alterations that patients under their care may present, allowing the adoption of appropriate and immediate interventions[2,10].

This article aims to evaluate nurses' ability to recognize electrocardiographic changes that require immediate intervention, as well as to compare their performance facing arrhythmias according the type of unit in which they work.

Method

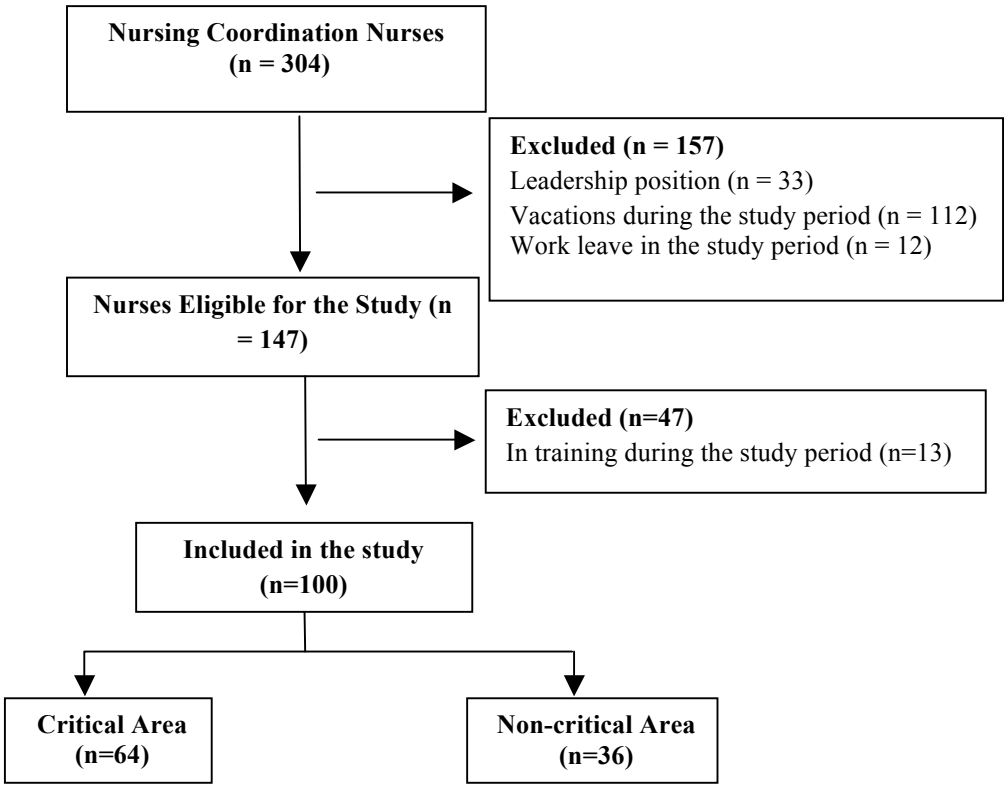
This is a cross-sectional and unicentric study carried out in a highly complex hospital

specialized in cardiopneumology, the Heart Institute (InCor) at the Clinical Hospital of the Medical School of the University of São Paulo (HCFMUSP), Brazil.

An instrument with questions for sociodemographic characterization of participants and with 10 clinical cases, each accompanied by an electrocardiographic tracing, was prepared for data collection. The rhythms presented in the tracings were: monomorphic ventricular tachycardia, anterior wall infarction, inferior wall infarction, atrial fibrillation, ventricular fibrillation, atrial flutter, pulseless electrical activity, complete atrioventricular block, supraventricular tachycardia and type-I second degree atrioventricular block. The instrument with clinical cases was validated by two cardiology nurse specialists, both instructors of the *Advanced Cardiac Life Support* (ACLS) course by the *American Heart Association* (AHA).

For comparison of some variables, we divided participants into two groups, according to work units (Figure 1). For this study, a convenience sample was used. Nurses from non-critical units (impatient units) and critical units (clinical, surgical and coronary intensive care units and emergency unit) that met the criterion of working directly with patients were included in the sample. Nurses who were in leadership positions, those who were in the training period (less than three months in the institution) or who were for some reason removed from their duties and those who were on vacation during the collection period were excluded.

Figure 1 – Study flowchart



Source: Created by the authors.

The instrument application was performed by two researchers in the work unit of each nurse participating in the research during working hours, but in a quiet place, so that there was no interference during case resolution. Data collection took place from March to November 2015. The time spent (in minutes) to answer the questions was computed with a digital timer.

For data analysis, values above 70% of correct answers in clinical cases were

considered satisfactory. For statistical analysis, the Kolmogorov-Smirnov test was used to verify the normal distribution of continuous variables. Categorical variables were presented as absolute and relative frequencies; continuous variables were expressed as means, standard deviations, medians and interquartile ranges. Difference between groups was assessed using the t-Student, Mann-Whitney U, Chi-square and Fisher exact tests. Pearson's correlation was used to test the association between some variables. Value of $p < 0.05$ were considered significant. The Statistical Package for the Social Sciences (SPSS version 20.0; IBM, Armonk, USA) was used for data analysis.

The research project was submitted to InCor's Scientific Committee and to the Ethics Committee for Analysis of Research Projects (CAPPesq) of HCFMUSP, and it was approved under number 1.053.0487.

Results

Predominance of females (80%) with a mean age of 33 + 8 years was observed in the sample studied. Most of participants (71%) received their degree from private institutions and 90.2% of them have a specialization in cardiology, emergency or intensive care. Most of the evaluated nurses (73%) reported they were taught some theoretical content related to ECG during their course, and 86% had attended the *Advanced Cardiac Life Support* (ACLS) course and they were certified by the *American Heart Association* (AHA) within the period of validity (Table 1).

Table 1 – Demographic characterization of nurses who participated in the study – São Paulo, SP, Brazil, 2016. (n = 100)

Demographic caracterization	Data*
Age, years	33 + 8
Gender, female	80 (80)
Experience as nurse	6 (4 – 11)
Experience interpreting ECG	4 (2 – 10)
Graduated in private institution	71 (71)
Content about ECG during graduation	73 (73)
Specialization	86 (86)
Specialization area	
Cardiology	52 (64,2)
Intensive Care Unit (ICU)	16 (19,8)
Emergency	5 (6,2)
Eletrocardiogram course (ECG)	34 (34)
Advanced Cardiac Life Support (ACLS)	86 (86)
Working shift	
Morning	34 (34)
Afternoon	37 (37)
Night	29 (29)
Type units they work	
Critical	64 (64)
Non-critical	36 (36)

Source: Created by the authors..

* Data expressed as absolute (n) and relative (%) frequency, mean, standard deviation, median and interquartile range.

Table 2 presents the percentage of questions correctly answered by the nurses who participated in the study. We observed that of the majority of participants identified cardiorespiratory arrest rates (pulseless ventricular tachycardia – 89%, ventricular fibrillation – 77% and pulseless

electrical activity – 81%) and they succeeded in interpreting the tracings related to cardiac arrhythmias. However, less than half of nurses were able to identify changes related to acute myocardial infarction.

Table 2 – Frequency of correct answers for ten scenarios among nurses who participated in the study – São Paulo, SP, Brazil, 2016. (n = 100)

Electrocardiographic Change Type	N (%)*
Rhythms of Cardiopulmonary Arrest	
Pulseless ventricular tachycardia	89 (89)
Ventricular fibrillation	77 (77)
Pulseless electrical activity	81 (81)
Arrhythmias	
Atrial fibrilation	64 (64)
Atrial Flutter	67 (67)
Complete Atrioventricular Block	70 (70)
2nd Degree Atrioventricular Block	86 (86)
Supraventricular Tachycardia	81 (81)
Myocardial Infarction	
Anterior Wall Infarction	46 (46)
Inferior Wall Infarction	44 (44)

Source: Created by the authors.

* Data expressed in absolute (n) and relative (%) frequency.

Variables were compared according to the type of unit where the nurses worked (critical and non-critical). There was no difference in mean age (33 + 7 years vs. 34 + 8 years, p = 0.072), gender (78.1% vs. 83.3%, p = 0.610) or median of correct answers [7 (6 – 8.75) correct answers vs. 7 (6 – 8) correct answers, p = 0.556] in critical and non-critical units, respectively (Table 3). However, when asked if they usually analyze patients' ECG tracings in their daily practice, there was a difference between the units, being this practice more common among nurses of critical units (81.2% vs. 58.3%, p = 0.019).

We asked the nurses about their perception to interpret ECG tracings in their work routine. We found a significant difference between groups. Those of the critical units felt more confident to interpret the ECG than those of the non-critical units (51.6% and 30.6%, respectively, p = 0.040).

Table 3 – Comparison of characteristics among nurses of Critical and Non-Critical Units who participated in the study – São Paulo, SP, Brazil, 2016 (to be continued)

Variables	Critical Unit* (n=64)	Non-critical Unit* (n=36)	P (value)
Age, years	33 + 7	34 + 8	0.472
Gender, female	50 (78.1)	30 (83.3)	0.610
Median of correct answers	7 (6 – 8.75)	7 (6 – 8)	0.556
Experience as nurse, years	6 (3 – 10)	7.5 (4 – 12)	0.220
Experience with ECG, years	3 (2 – 10)	5.5 (2 – 12.75)	0.197
Degree in private institution	46 (71.9)	25 (69.4)	0.821
Content about ECG during graduation	46 (71.9)	27 (75)	0.817
Specialization	53 (82.8)	33 (91.7)	0.368
Specialization area			
Cardiology	30 (61.2)	22 (68.8)	0.469
Intensive care unit (ICU)	4 (12.5)	12 (24.5)	
Emergency	2 (4.1)	3 (9.4)	

Table 3 – Comparison of characteristics among nurses of Critical and Non-Critical Units who participated in the study – São Paulo, SP, Brazil, 2016 (conclusion)

Variables	Critical Unit* (n=64)	Non-critical Unit* (n=36)	P (value)
Electrocardiogram course (ECG)	18 (28.1)	16 (44.4)	0.125
Advanced Cardiac Life Support(ACLS)	44 (68.8)	25 (69.4)	1.000
Usually analyze ECGs in the Unit	52 (81.2)	21 (58.3)	0.019
Feel confident to evaluate ECG tracings	33 (51.6)	11 (30.6)	0.040

Source: Created by the authors.

* Data expressed as absolute (n) and relative (%), mean, standard deviation, median and interquartile range.

During the tracing interpretation, nurses had their response time recorded. When comparing the time spent by nurses of the two types of unit, it was observed that those of the critical units were faster than those of the non-critical units. In general, the degree of difficulty reported by the majority (74%) of the participants to respond to the cases was low, and the majority (73%) was able to complete the test within 15 minutes.

Pearson's correlation between the time taken to respond the questionnaire and the attendance to ECG course revealed a negligible and negative correlation, with no statistical significance (r: -0.036; p = 0.721). When the time spent in answering the questionnaire was related to having attended the ACLS course, there was no negligible and positive correlation, but without statistical significance (r: 0.129; p = 0.199).

Discussion

This is the first study in the country that addresses the proposed theme with the objective of evaluating the ability of nurses of a high complexity cardiopneumology hospital to identify abnormal electrocardiographic tracings with that require immediate intervention. There is little research evaluating the nurses' ability to analyze electrocardiographic tracings of patients under their care and who present severe alterations.

Nurses work in therapy and its supervision, when this care is provided by the nursing team. Thus, the rapid identification and interpretation of the changes presented in the 12-lead electrocardiogram by the nurse allows the anticipation of potentially fatal events to the patients[11].

Promising results in the early identification and adequate care of cardiorespiratory arrest (CRA) are directly related to the interaction, agility and knowledge of basic and advanced life support maneuvers by the team involved. A review study[12], the importance of training in cardiopulmonary resuscitation for health professionals was evaluated. The authors reported that the participation of trained staff and the homogeneity of CRA maneuvers are skills directly related to the nurses' role as professionals qualified to instruct and develop planning and implementation of actions during the CRA care.

The vast majority of nurses in this study were certified by the *American Heart Association* (AHA), a fact that may justify the good results found in this series, since the training offered by the AHA is based on protocols that aim to guarantee the standardization of procedures and recommended techniques for the care of patients who are victims of CRA and the systematized evaluation of the ECG.

A study carried out in Sweden[13] with the objective of describing the practical skills of nurses of an emergency mobile service on ECG interpretation demonstrated that, even nurses experient in in coronary unit care had a mean score of 46% in the analysis of electrocardiographic tracings with ST segment elevation.

Another study[7] performed with US nurses showed an even lower percentage of correct answers by nurses (20%) in the interpretation of tracings related to acute myocardial infarction (AMI). As in this study, even in centers where nurses have an average time of experience with critical patients greater than 10 years and with continuous training, the identification of a serious and potentially fatal problem may be difficult to identify for these professionals. To minimize this problem, other studies should be carried out to improve the training techniques in electrocardiogram interpretation by nurses.

In a study with educational intervention[14], nurses from an American hospital were trained to identify arrhythmias. At the end of the one-day course, the nurses performed a knowledge assessment and those who obtained an average over 80% were approved. Subsequently, the authors followed 32 of these nurses and compared their performance with other 32 professionals who had not obtained an average above 80%. In the logistic regression analysis, authors identified that those approved in the test had increased chances of success when compared to those that did not reach the minimum percentage (OR: 5.040; p = 0.0008).

In this study, we sought to identify whether nurses working in different types of units who had undergone previous electrocardiogram training or obtained the certification of the AHA's *Advanced Cardiac Life Suport* (ACLS) course would influence the results of the test. These expectations were not confirmed. This is different from what was reported by a study that examined the accuracy of cardiac rhythm interpretation[14] by medical-surgical nurses. This difference of results can be explained by the different methodology adopted in the training of that center and by the fact that this study is observational. ACLS training was not offered in order to assess the post-training ability of Brazilian nurses, but rather to train them to improve the quality of care provided.

Nurses working in critical units were able to respond more rapidly to the questions because they have the habit of performing this task more frequently during care practice. They displayed a greater ability to analyze tracings when compared to the nurses of the non-critical units.

This study has limitations. First, the fact that a multiple-choice instrument was applied allowed previous deductions on the resolution of the cases and consequently interfered in the participants' responses. Secondly, the test was applied during the period of nurses' activities. And, finally, the high number of refusals to participate in the study limited the performance of some analyses.

Conclusion

The present study allowed us to conclude that nurses have the ability to identify changes in cardiorespiratory arrest rhythms and cardiac arrhythmias. However, they have difficulties in identifying electrocardiographic changes related to acute myocardial infarction. The results showed that the nurses of critical units evaluate the electrocardiogram of patients with higher frequency and they self-report ability to perform this activity in their routine.

Collaborations:

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2. writing and critical review of intellectual content: Eduesley Santana-Santos and Emile Clara Pires.

3. final approval of the version to be published: Eduesley Santana-Santos and Renata Eloah de Lucena Ferretti-Rebustini.

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