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Atypical electrocardiographic leads and their use by nurses: a systematic review

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KEY WORDS: ECG with 12 leads, Electrocardiogram, Electrocardiography, Right electrocardiogram, Posterior electrocardiogram, Nursing.

ABSTRACT

Introduction. An electrocardiogram (ECG) is a procedure by which the electrical activity of the heart is recorded. This is made possible by placing electrodes at certain strategic points on the chest and on the upper and lower limbs. It is in the Coronary Care Unit where, in addition to the ECG of the left side of the heart (ECG-L), the ECG of the right side (ECG-R) and the posterior side (ECG-P) are also used, in order to rule out other locations of an infarction, such as a right ventricular infarction (RVI).

Goals. To show the performance of 12-lead ECG modalities other than the traditional ECG (L-ECG) and to list the nursing competencies explicit in the documents selected.

Method. Systematised literature review. Term: "Electrocardiography AND Myocardial Infarction OR Acute Coronary Syndrome AND Critical care NOT children." The main biases identified in this study were selection and publication bias.

Results and discussion. Twelve articles were selected for analysis. The variables used to tabulate the information were author, year, journal, country and language, among others. With regard to the other variables, the sociodemographic/health profile, the type of ECG and nursing competencies were used.

Conclusions. There is evidence of three different ECG modalities that assess the electrical activity of the heart from different anatomical points, and which show the functioning of the "electrical cable" cardiac conduction system. Among the main nursing competencies that are used in techniques/procedures, the early assessment of ECG alterations stands out, given the need for rapid treatment in these cases as it is a time-dependent pathology.

INTRODUCTION

Basic ECG interpretation

Cardiac conduction system

The cardiac conduction system consists of the following nodes:

Sinus node (N-SA). Located in the vena cava; it is defined as the physiological pacemaker, as the first electrical stimuli of the heart start rhythmically and automatically. Under normal conditions it marks the contraction frequency of the heart muscle: 60 - 100 beats/minute. Once the atrial tissue is fully stimulated, the impulse is transmitted through the internodal pathways. (Gersh, B. J., 2001) (Oliveró & Güell, 1990)

Internodal pathways. There are three such pathways, transmitting the stimulus through the atria to the atrioventricular node: Bachmann's bundle (anterior), Wenckebach's bundle (middle) and Thorel's bundle (posterior).

Atrioventricular node (AVN). Located in the right portion of the junction of the interatrial and interventricular septa. The stimulus in this node undergoes a slight slowing (0.1 second), at which time the atria contract and the ventricles fill up. When the stimulus is generated in this node, the rate is 60 beats/minute.

Bundle of His. Responsible for transmitting the stimulus throughout the ventricle. It has two branches; the right and the left.

Purkinje fibres. These fibres constitute a network of nerve fibres that run along the bundle of His. Their function is to innervate the ventricular muscle. This is when the ventricles contract and blood is ejected from the heart.

Electrical activity therefore starts in the pacemaker cells of the N-SA and is distributed throughout the heart from cell to cell as they are all connected due to junctions in their membranes. This connection and the help of dedicated conduction cells means that the depolarisation that occurs in the pacemaker cells travels rapidly through the heart muscle, promoting synchronised contraction of the cells. (Gersh, B. J., 2001)

Electrocardiographic cycle

The electrical recording of the heart consists of a systole and a diastole cycle. Systole is the period of depolarisation - cardiac contraction; diastole is the period of electrical rest. Repolarisation is the period of muscle relaxation. (Azcona, L., 2009)

Genesis of the cardiac cycle

Ionic changes on both sides of the cell membrane give rise to the electrical curve, known as the transmembrane action potential (TAP). Action potentials are due to changes in the cardiac cell's permeability of Na+, K+ and Ca++ (conductance); this change in permeability is caused by a different distribution inside and outside the cell. The membrane action potential is made up of four different phases:

PHASE 0. Depolarisation. Na+ and Ca++ enter the cell.

PHASE 1 and 2. Slow repolarisation. K+ flows out to the exterior.

PHASE 3. Rapid repolarisation. K+ is released. The gradient increases in favour of the inner electronegativity.

PHASE 4. Ion concentrations are established prior to depolarisation.

When a cell depolarises, it causes the surrounding cells to also depolarise. This causes a change in the charge; they go from negative to positive, thus causing the muscle to contract (systole), while on the other hand, repolarisation produces the opposite effect, going from positive to negative and thus causing the cardiac muscle to relax (diastole). (Granero Molina, J., & Fernández Sola, C., 2011)

Electrocardiographic recording

Defined as the graphic representation of the electrical changes occurring in the myocardium. Upward deflections are considered POSITIVE, and downward deflections are considered NEGATIVE.

Nomenclature and meaning of each wave.

- P WAVE (atrial). Atrial depolarisation. This is the first wave we encounter. It has an inverted u-shape and represents the moment of contraction of the atria, i.e. when the blood passes from the atrium to the ventricle.
- PR INTERVAL. Atrial depolarisation and atrioventricular conduction. This is the isoelectric line between the P wave and the QRS complex. At this instant the atria complete their emptying.
- QRS COMPLEX (ventricle). Ventricular depolarisation. This complex represents the contraction of the ventricles and therefore the ejection of blood.
    - Q wave. This is the first negative deflection after the PR interval. It should be reflected only in some leads, which is why the Q wave does not always have to appear.
    - R wave. This wave does not always precede the Q wave; it is any positive deflection that appears after the PR interval. Its height is extremely variable.
    - S wave. Starts where the R wave becomes negative with respect to the isoelectric line.
- ST SEGMENT. Ventricular repolarisation. The isoelectric line from the end of the S wave to the beginning of the T wave. This segment can be of great help in detecting heart failure.
- T WAVE. End of ventricular repolarisation. This is usually a positive wave. The T wave shows the instant at which the heart is in a relaxation phase after expelling blood from the ventricles.
- QT INTERVAL. Ventricular depolarisation and repolarisation. This is the time from the beginning of the Q wave to the end of the T wave.

Electrocardiographic leads.

These are electrical connections made to record the electrocardiogram. A lead is formed by the union of two electrodes. Each lead provides us with a different cardiac view. Conventionally there are 12:

- 6 limb leads (frontal plane).
- 6 precordial (horizontal plane).

Frontal plane

- Limb leads (monopolar). They record the potential variations detected at a given point. The other electrode is considered to have 0 electrical activity.

  AVR. Right upper limb (RUL) AVL. Left upper limb (LUL) AVF. Left lower limb (LLL)
- Limb leads (bipolar). They record the difference in electrical potential between two points of inverse electrical charge.

  I. Records the potential difference between the left upper limb (LUL) and the right upper limb (RUL).

  II. Records the potential difference between the left lower limb (LLL) and the right upper limb (RUL).

  III. Records the potential difference between the left lower limb (LLL) and the left upper limb (LUL).

(Hernández Padilla, J. M., 2016)

- Monopolar and bipolar leads.

The values of the different leads show that the sum of the voltage of leads I and II is equal to lead II. This is Einthoven's Law:

(Pozas Garza, G., 2014)

For the orientation of the above derivations, Einthoven used Kirchhoff's second law, which refers to the fact that the sum of the voltage differences between different points in a closed circuit is zero. This law confirms Einthoven's law, since if we have two of the leads, the other can be calculated mathematically.

(González Cevallos, L. A., 2017) (Pozas Garza, G., 2014)

It was Willem Einthoven who invented the electrocardiogram. Instead of using electrodes, patients at that time dipped their limbs into buckets of water and salt (conductive solution). In 1913 he also published the theoretical and practical basis of electrocardiography: the equilateral triangle. This triangle, better known as Einthoven's triangle, was formed by leads I, II and III. Near the centre of the triangle is the heart. (Acevedo, P. C., 2009) (Gersh, B. J., 2001). In 1924 he won a Nobel Prize for his invention: the electrocardiogram.

- Precordial leads. Horizontal (or sagittal) plane.

  They record potential differences detected from one point. The other electrode is considered to have 0 activity. On this plane, we find the six precordial leads: V1, V2, V3, V4, V5, V6. The aforementioned leads are classified into right (V1 and V2), middle (V3 and V4) and left (V5 and V6) leads. They are placed on the chest. (Hernández Padilla, J. M, 2016)

The electrocardiographic paper.

The paper used to record the ECG is millimetric.

- The abscissa (vertical) axis measures voltage (height) in millivolts.
- The coordinate (horizontal) axis measures time (length) in seconds.

The paper is divided into large squares, and each large square is made up of five small squares. A large square measures 5x5 mm, so a small square measures 1x1 mm.

Each small square is equivalent to:

- Horizontally: 0.04 seconds (at a ratio of 25 mm/s)
- Vertically: 0.1 mV (at a voltage of 1 cm/mV). The large squares are therefore equivalent to:
- Horizontally: 0.2 seconds (at a ratio of 25 mm/s)
- Vertically: 0.5 mV (with a voltage of 1 cm/mV)

(Granero Molina, J., & Fernández Sola, C., 2011)

Waves, segments and intervals

- Waves. P, Q, R, S, T, U, (+/-).
- ST. segment (isoelectric).
- Intervals. (waves and segments).
    - P WAVE. Atrial activation or depolarisation, i.e. atrial contraction occurs. Voltage < 2.5 mm; duration < 0.12 seconds.
    - Q WAVE. Duration < 0.04 seconds. Voltage < ¼ of the next R (0.04 seconds in myocardial necrosis).
    - PR INTERVAL. From the onset of the P wave to the onset of the QRS complex. Intra-atrial conduction time, atrioventricular conduction time and the His-Purkinje system. Favours the atria and ventricles not contracting at the same time. From 0.12 to 0.20 seconds. Increases in 1st degree AV block; decreases in WPW syndrome, tachycardia, etc.
    - QRS COMPLEX. Ventricular depolarisation, i.e. ventricular contraction. Duration <0.12 seconds. If increased, it can lead to ventricular hypertrophy, ventricular rhythms, block (right and left bundle branch).
    - QT INTERVAL. Starts at the beginning of the Q wave and lasts until the end of the T wave. Ventricular activation and repolarisation, i.e. ventricular contraction occurs. Adjusts to the rate of 0.35-0.45 seconds (< 0.40 seconds). If found to be decreased, hyperkalaemia; if increased, the administration of antiarrhythmic drugs becomes necessary.
    - ST SEGMENT. Basic in the study of ischaemic heart disease. If instead of following the isoelectric line, it is increased, it means that an acute myocardial infarction (AMI) is occurring. A decrease, i.e. below the isoelectric line, is due to a subendocardial infarction.
    - T-wave. Ventricular repolarisation. Ventricular diastole begins at the end of this wave. It measures < 0.2 s in limb leads and < 0.4 s in precordial leads. Depending on which lead we look at, it may be negative or positive: if the QRS is positive, this will be positive too. On the other hand, if the QRS is negative, the T wave will also show as negative.
    - J POINT. This is the point at which the ST segment meets the QRS.
    - QRS.
    - U WAVE. Should be equal to the T wave. It is negative in hypokalaemia. (Granero Molina, J., & Fernández Sola, C., 2011)

Artefacts

- Respiration (oscillation). This is one of the most common artefacts, which is why there are filters to ensure that cardiac activity is correctly reflected on the electrocardiogram and is not modified due to the small oscillations that may occur when the patient breathes. (Niebla, J. G., 2009)
- Patient movement. It is important that the patient should not move during the test.
- Calibration. It is essential that the equipment used to record the electrical activity of the heart is correctly calibrated. (Niebla, J. G., 2009)
- External cardiac massage (ECM). This produces variations in the electrocardiogram, which is why, if a patient needs to be resuscitated, he could be monitored by methods other than ECG with electrodes (transesophageal probe). (Cabrera S., Farías C., Hervé C., & Vargas R., 2009)
- Tremor (cold, Parkinson's, etc.). Tremor is one of the causes that could hinder the correct performance of the ECG, since, as mentioned above, the patient's movement could cause the electrocardiographic recording to be incorrect. In this case, instead of placing the electrodes on the distal part of the extremities, it is advisable to place them on the proximal part. (Granero Molina, J., & Fernández Sola, C., 2011) (Niebla, J. G., 2009)

- Poor contact or misplacement of the electrodes leads to an incorrect recording and thus to a mistaken diagnosis.

GOALS

To show the performance of 12-lead ECG modalities other than the traditional ECG (left-sided ECG), to describe other ECG modalities other than the traditional mode, to assess the socio-demographic and health profile of patients undergoing the different ECG modalities and to list the nursing competences specified in the selected documents.

MATERIAL AND METHODS

Study design

Systematised literature review. This study aims to increase knowledge about the performance of different types of 12-lead electrocardiograms by nursing staff. A narrative literature review was carried out to critically analyse what is known and what is not known about this procedure.

Research question

PICO question.

- Problem. Nurses have limited knowledge of performing 12-lead ECGs in a care setting.
- Intervention. Conducting a literature search for evidence of left, right and posterior ECGs.
- Comparison. Not applicable.
- Expected result. In the peer-reviewed literature, the use of ECGs other than the classic ECG (ECG of the left side of the heart) is explicitly mentioned.

Protocol and recording

First of all, a Gantt diagram was drawn up, i.e. the schedule for this study, containing each one of the different sections to be carried out, both theoretical and empirical. Next, we proceeded to the search, selection and analysis of the documents selected, based on the Prisma® recommendations (Page et al. 2021).

Eligibility criteria

The selection of documents was initially determined according to their being explicit, reproducible and based on the goals of the study.

Selection criteria

The selection criteria are the inclusion and exclusion criteria of the actual articles. This facilitates the final selection of papers and is based on the PICO question and the goals chosen for this study. We searched for articles indexed in the selected databases (DB).

Inclusion criteria

- Publications with no language restriction.
- Articles published in the last 10 years.
- Adult population, 18 years and over.
- Both sexes.
- Articles dealing in general with electrocardiography.
- Articles dealing with electrocardiogram techniques.
- Types. Initially of the literature review type: narratives in their various subtypes, and systematic reviews. Other qualitative typologies that meet the rest of the criteria.
- Selection by title. Articles selected should include at least 2 health descriptors in their title.
- Selection by summary. Taking into account the goals and the research question, the lead researcher, once she had read it, decided whether the document was suitable for obtaining the necessary information to continue with the research.

Exclusion criteria.

- Patients under 18 years of age.
- Non-human studies.
- Impossibility of free full text.
- Articles not related to electrocardiograms or electrocardiography.
- Articles in which there was evidence of a breach of bioethical principles.
- Articles presenting a conflict of interest.

Sources of information

Primary and secondary sources were consulted, carrying out systematic and exhaustive searches in the MEDLINE®, MEDES®, PUBMED® and CINAHL® databases for potentially relevant studies carried out in the last 10 years, from 2011 to 2021, with free full text in any language.

Search for information

To answer the question posed, a search strategy developed by MEDLINE® was designed based on descriptors obtained from a Medical Subject Headings thesaurus (MESH thesaurus) and Boolean operators (AND, NOT, OR). It was then adapted to each database.

The search was performed using the following MESH terms: Electrocardiography, Myocardial Infarction, Critical care, Children, Acute Coronary Syndrome.

The MESH terms were linked together using Boolean operators to perform a logical and correct search in the databases.

To make it easier to find information that would be useful, we further narrowed the search by adding subheadings in the PubMed database: Classification, Diagnosis, Diagnostic imaging, Etiology, Prevention and control.

Subsequently, manual search strategies were carried out by looking at the bibliography of the articles found in the databases and locating complementary studies that were added in the literature review selection process. Relevant authors specialising in the topic, identified in the previous search process and bibliographies, were also added.

Selecting studies

To choose the right studies, we first assessed the titles, abstracts and keywords of the articles found using the thesaurus. The studies considered most relevant for the review were selected.

Once the identification process was completed, 2 screening phases were carried out. In the first phase, possible duplications were discarded and then, after reading the titles, abstracts and keywords, the inclusion and exclusion criteria and the PICO question were used to discard those that were not of interest.

Once the articles had been selected, the full texts of most of the studies were accessed and critical reading was carried out using the CASPe® Guide. (Cabello, J.B., 2005) (Annex 2)

The average score of the CASPe® Guide, once all the articles had been critically analysed, was 5.5 points (out of 7). The answer “yes” was given 1 point, “don’t know” 0.5 points and “no” 0 points. The average score (5.2 points) of the articles was judged to be optimal and therefore the articles were of good design.

Data extraction process and data listing

The data extraction process was carried out independently by the lead researcher during the critical reading phase. At the same time as the extraction, the data was compiled in a Microsoft Word® table prepared in order to create a data listing. A record was made of the author, country, journal, year of publication, design and most relevant findings.

Bias in individual studies

Particular attention was paid to selection and publication bias.

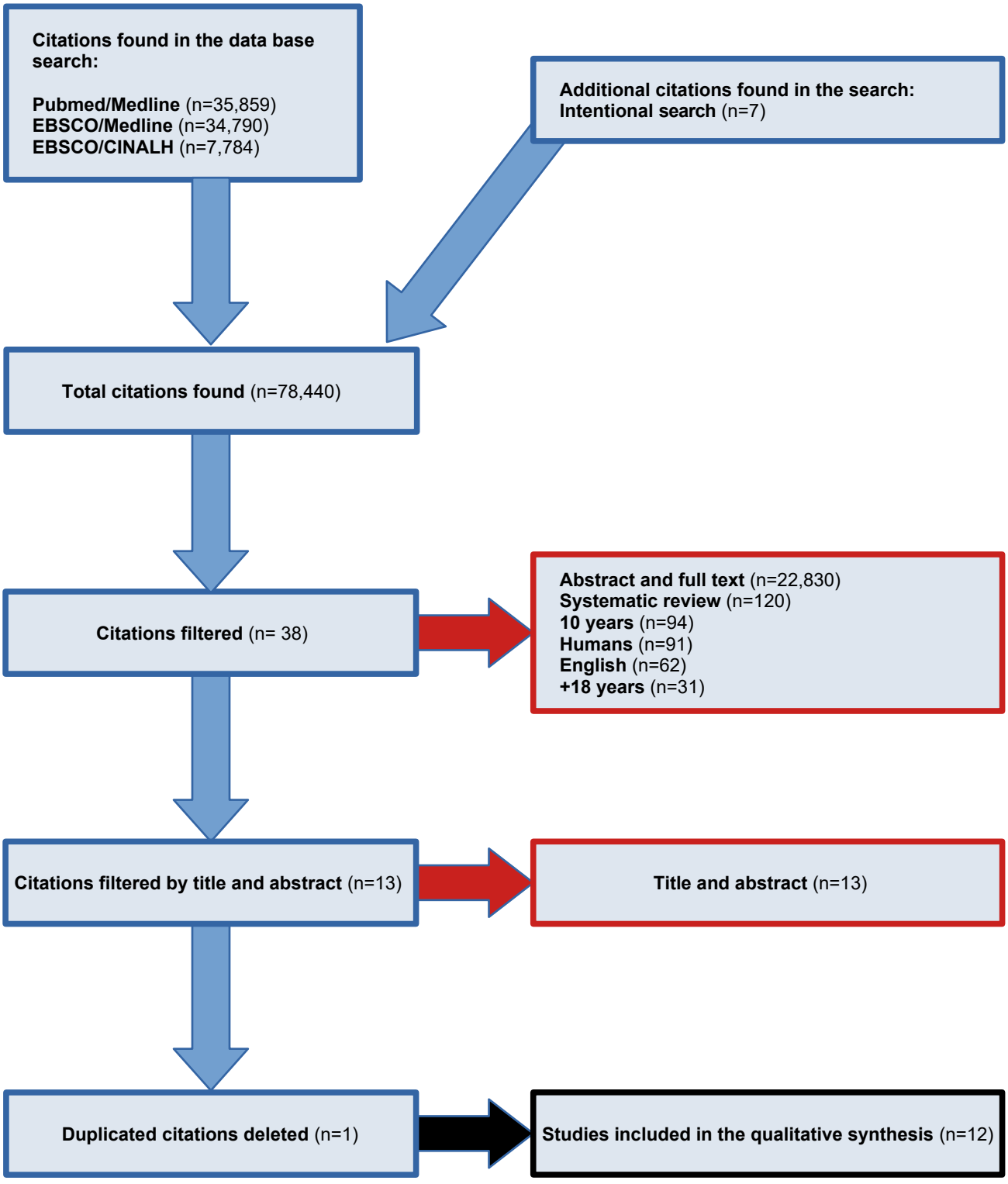
Conflict of interest

This study does not present any conflicts of interest with any individual, company or institution.

Ethical considerations

Despite the fact that the study is qualitative, the lead researcher took documents containing personal data into account; such data was made anonymous in order to maintain confidentiality, while maintaining bioethical principles.

RESULTS

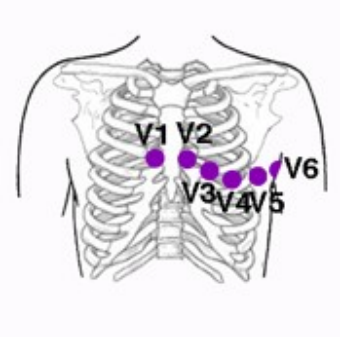
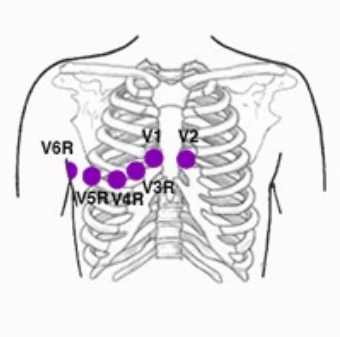
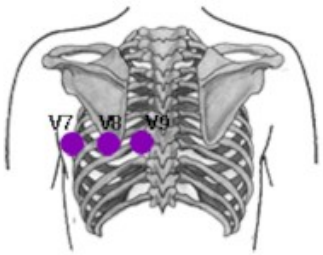

Citations found in the data base search:
Pubmed/Medline (n=35,859)
EBSCO/Medline (n=34,790)
EBSCO/CINALH (n=7,784)
Additional citations found in the search:
Intentional search (n=7)
Total citations found (n=78,440)
Citations filtered (n= 38)
Abstract and full text (n=22,830)
Systematic review (n=120)
10 years (n=94)
Humans (n=91)
English (n=62)
+18 years (n=31)
Citations filtered by title and abstract (n=13)
Title and abstract (n=13)
Duplicated citations deleted (n=1)
Studies included in the qualitative synthesis (n=12)

Article classification table

*RB	1	2	3	4	5
Year of publication	2018	2019	2013	2018	2019
Authors	Mebazaa A, et al	Seher Çatalkaya Demir, Erdem Demir y Sibel Çatalkaya	Ivanov Igor et al	Oliveira Guimarães, David Bernar, et al	Alrawashdeh, Ahmad; Nehme, Ziad; Williams, Brett; Stub, Dion
Type of study	Systematic review	Systematic review	Narrative review	Systematic review	Meta-analysis and systematic review
Language used	English	English	English	English	English
Place/Country it was published in	France Germany	Turkey	Serbia	Brazil	Australia
Journal in which it was published	Intensive Care Med	Biomolecules	Medicinski pregled	Journal of Nursing UFPE / Revista de Enfermagem UFPE	Medicina de emergencia de Australasia
Degree of scientific evidence	1	1	3	1	1
Other diagnostic tests	Cardiac catheterisation analysis: cardiac biomarkers	Coronary angiography CBC: cardiac biomarkers	CBC: myocardial necrosis biomarkers	Serum markers (CK-MB and troponins)	Not stated
ECG type	Left side	Left side	Left side	Left side	Left side
Other ECG modalities	Not stated	Not stated	Right side	Not stated	Not stated
Sociodemographic profile	Not stated	Not stated	Not stated	Not stated	Not stated
Socio-sanitary profile	ACS Cardiogenic shock	Tako-Tsubo (TTC) ST-segment elevation myocardial infarction (STEMI)	Angina pectoris AMI Left bundle branch block (LBBB)	ACS AMI	ACS STEMI
Nursing competences	Not stated	Not stated	Not stated	Optimising care with nursing interventions in the recognition of infarction and initiation of thrombolysis. When receiving a patient with chest pain, in order to apply faster and more effective care, the nurse should perform the ECG in order to define	Not stated

*RB	6	7	8	9	10	11
Year of publication	2010	2016	2004	2008	2020	2014
Authors	Pozas Garza, Gerardo	Kozaci, N., Ay, M. O., Beydilli, I., Kartal, Z. A., Celik, A., Sasmaz, I., & Guven, R.	Manuel Cárdenas	García Niebla, Javier	Dono Díaz, M.ª de los Ángeles, et al.	López-Flores, L., et al.
Type of study	Non-analytical study	Analysis of cases and monitoring	Non-analytical study	Non-analytical study	Non-analytical study	Non-analytical study
Language used	Spanish	English	Spanish	Spanish	Galician	Spanish
Place/Country it was published in	Mexico	Turkey	Mexico	Spain	Spain	Mexico
Journal in which it was published	Avances	Elsevier	Medigraphic	Enfermería clínica	Fémora	Revista mexicana de enfermería cardiológica
Degree of scientific evidence	3	2++	3	3	3	3
Other diagnostic tests	Not stated	Computed tomography with contrast Pulmonary artery angiography	Not stated	Not stated	Not stated	Not stated
ECG type	Left side	Left side	Left side	Left side	Left side	Left side
Other ECG modalities	Right and posterior side	Right side	Right side	Not stated	Right and posterior side	Right side
Sociodemographic profile	Not stated	18 men and 38 women	Not stated	Not stated	The patient required an ECG in all cases.	Not stated
Socio-sanitary profile	AMI Intraventricular conduction disorders Ventricular pre-excitation (Wolff-Parkinson-White) Cardiac arrhythmias	EPA (Acute Pulmonary Embolism)	AMI	Cardiac diseases in general	Right ventricular infarction. Extensive or posterior left ventricular infarction.	AMI. Ischaemic heart disease,
Nursing competences	The electrocardiogram acquisition technique, performed by the technical and nursing staff, is fundamental to the quality of the study and its reproducibility. The interpretation of the study is based on a thorough knowledge of the anatomy, physiology and haemodynamics of the heart, and assumes that the electrocardiogram was obtained in the correct way.	Not stated	Not stated	It states that the performance of ECGs is an eminently nursing technique.	Joshua It tells us about related nursing diagnoses and states that the procedure is aimed at healthcare workers.	Nursing interventions

ECG Modalities

		
LEFT ECG	**RIGHT ECG**	**POSTERIOR ECG**
V1: in the fourth intercostal space, on the right edge of the sternum. **V2**: in the fourth intercostal space, on the left edge of the sternum. **V3**: halfway between electrodes V2 and V4. **V4**: in the fifth intercostal space on the mid-clavicular line (the perpendicular line form the middle of the collar bone). **V5**: on the same horizontal line as electrode V4, but on the anterior axillary line (the perpendicular line from between the middle and the side of the collar bone). **V6**: on the same horizontal line as electrodes V4 and V5, but on the medial axillary line (the perpendicular line from the centre of the armpit).	It is recommendable to place right leads where the right ventricular infarction is suspected in patients with a lower right myocardial infarction. **V1**: The same as in the normal place. **V2**: The same as in the normal place. **V3R**: Halfway between V1 and V4R. **V4R**: In the fifth right intercostal space and the medial clavicular line. **V5R**: In the fifth right intercostal space and the anterior axillary line. **V6R**: In the fifth right intercostal space and on the medial axillary line.	Posterior leads are useful above all on suspicion of posterior infarction. Electrodes V4, V5 and V6 are put in place in the same intercostal space as the regular precordial electrodes although, they go round to the patient's back. **V7 (V4)**: In the fifth right intercostal space and on the posterior axillary line. **V8 (V5)**: In the fifth intercostal space and on the medial scapular line, at the lower angle of the scapula. **V9 (V6)**: In the fifth right intercostal space and on the left paravertebral line.

DISCUSSION

Interpretation of the results

The information obtained from the articles was extracted from the Pubmed, Cinhal, Medline and Medes databases, but no results were obtained in the latter that met any of the goals. The descriptors used were: “Electrocardiography, Myocardial Infarction, Acute Coronary Syndrome, Critical care y children”. The search terms were completed with the Boolean operators AND, NOT and OR. In the first search, after applying the filters shown in the flowchart, 5 articles were selected; (Mebazaa A, 2018) (Çatalkaya Demir, 2019) (Ivanov, 2013) (Oliveira Guimarães, 2018) and (Alrawashdeh, 2019). Once the first search in the aforementioned databases was completed, a second intentional search was carried out. 7 articles were selected (Pozas Garza, 2010) (Kozaci, 2016) (Cárdenas, 2004)
(Niebla, 2008) (Dono MA., 2020) (López-Flores, 2014) (Pineda, 2021).

Year of publication

The articles selected in the first search were all published in the last 10 years, i.e. in a time range from 2011 to 2021. None were found more recent than 2019 (Mebazaa A, 2018) (Çatalkaya Demir, 2019) (Ivanov, 2013) (Oliveira Guimarães, 2018) (Alrawashdeh, 2019). The articles found in the intentional search span from 2004 to 2021; (Pozas Garza, 2010) (Kozaci, 2016) (Cárdenas, 2004) (Niebla, 2008) (Dono MA., 2020) (López-Flores, 2014) and (Pineda, 2021).

Type of study and level of evidence

Of the 12 articles selected, 6 were non-analytical studies (Pineda, 2021) (López-Flores, 2014) (Dono MA., 2020) (Niebla, 2008) (Cárdenas, 2004) and (Pozas Garza, 2010),

3 were systematic reviews (Mebazaa A, 2018) (Çatalkaya Demir, 2019) and (Oliveira Guimarães, 2018), one was a narrative type review (Ivanov, 2013), another was a meta-analysis (Alrawashdeh, 2019) and one more was an analytical case-control study (Kozaci, 2016).

This is why the 6 non-analytical studies have a degree of evidence of 3 points according to the SIGN scale, the systematic reviews have a score of 1+, the narrative of 3, the meta-analysis has the same score as the systematic review, 1+; and finally, the analytical case-control study, which has a score of 2++. (Annex 3)

Language

As far as the language of the articles is concerned, 50% of them were written in English (Mebazaa A, 2018) (Çatalkaya Demir, 2019) (Ivanov, 2013) (Oliveira Guimarães, 2018) (Alrawashdeh,

2019) and (Kozaci, 2016), the rest in Spanish (Pozas Garza, 2010) (Cárdenas, 2004) (Niebla, 2008) (López-Flores, 2014) and (Pineda, 2021), except one which was written in Galician (Dono MA., 2020).

Countries

The articles found come from different countries in both Europe (Mebazaa A, 2018) (Ivanov, 2013) (Niebla, 2008) (Dono MA., 2020) (Kozaci, 2016) and (Çatalkaya Demir, 2019), and South America (Oliveira Guimarães, 2018) and (Pineda, 2021), North America (Pozas Garza, 2010) (Cárdenas, 2004) and (López-Flores, 2014), Oceania (Alrawashdeh, 2019) and Asia (Kozaci,
2016) (Çatalkaya Demir, 2019).

Journal

Each article came from a different journal; no journal was found to have more than one article that met the research goals. Main journals: Revista médica de Chile (Pineda, 2021), Revista mexicana de enfermería cardiológica (López-Flores, 2014), Fémora (Dono MA., 2020), Enfermería clínica (Niebla, 2008), Medigraphic (Cárdenas, 2004), Elsevier (Kozaci, 2016), Avances (Pozas Garza, 2010), Medicina de emergencia de Australasia (Alrawashdeh, 2019), Journal of Nursing UFPE / Revista de Enfermagem UFPE (Oliveira Guimarães, 2018), Medicinski pregled (Ivanov, 2013), Biomolecules (Çatalkaya Demir, 2019) and Intensive Care Med (Mebazaa A, 2018).

Other diagnostic tests

The main diagnostic tests other than ECG were cardiac catheterisation (Mebazaa A, 2018), four of the articles concerned a cardiac biomarker analysis (Mebazaa A, 2018) (Çatalkaya Demir, 2019) (Ivanov, 2013) and (Oliveira Guimarães, 2018), coronary angiography (Çatalkaya Demir, 2019) and (Kozaci, 2016) and contrast-enhanced computed tomography (CT) (Kozaci, 2016).

ECG type

All 12 articles discussed the “typical” electrocardiogram, i.e. the 12-lead electrocardiogram we are all familiar with from the left side of the heart. However, only 3 of them mentioned the electrocardiogram of the posterior side (Pozas Garza, 2010) (Dono MA., 2020) and (Pineda, 2021), and 6 the right side (Ivanov, 2013) (Pozas Garza, 2010) (Kozaci, 2016) (Cárdenas, 2004) (Dono MA., 2020) and (López-Flores, 2014) (Annex 4).

Socio-demographic profile

In this section, hardly any information was explicit. Only three of the articles referred to the socio-demographic profile about which they were concerned. One of them referred to 18 men and 38 women (gender) (Kozaci, 2016), another to all cases in which the patient required an ECG (Dono MA., 2020), and another to women only (Pineda, 2021). In the other 9 articles, the profile was not given. The age of the patients was not mentioned either. Both gender and age are independent variables in any study, in order to assess significant differences and obtain statistical inferences.

Socio-health profile

Among the socio-health profile referred to in the articles are AMI (Acute Myocardial Infarction) (López-Flores, 2014) (Cárdenas, 2004) (Pozas Garza, 2010) (Oliveira Guimarães, 2018) and (Ivanov, 2013), and ACS (Acute Coronary Syndrome) (Mebazaa A, 2018) (Oliveira Guimarães, 2018) and (Alrawashdeh, 2019), two concepts that refer to the same nosological entity. The peer-reviewed literature currently speaks of Acute Coronary Syndrome, which encompasses both AMI and angina, terms that despite the fact that they are still used, have now been replaced by STEACS (ST-elevation acute coronary syndrome) (Pineda, 2021) and NSTEACS (Non ST-elevation acute coronary syndrome) (Pineda, 2021) as this concept encompasses whether the lesion is maintained or not (in relation to the lack of blood supply to the myocardium).

Also mentioned were cardiogenic shock (Mebazaa A, 2018), TTC (Tako-Tsubo) (Çatalkaya Demir, 2019), STEMI (ST-elevation myocardial infarction) (Çatalkaya Demir, 2019) (Alrawashdeh, 2019), angina pectoris (Ivanov, 2013), LBBB (left bundle branch block) (Ivanov, 2013), intraventricular conduction disturbances (Pozas Garza, 2010), ventricular pre-excitation (Wolff-Parkinson-White) (Pozas Garza, 2010), cardiac arrhythmias (Pozas Garza, 2010), APE (acute pulmonary embolism) (Kozaci, 2016), heart disease in general (Niebla, 2008), right ventricular infarction (Dono MA. , 2020),

extensive or posterior left ventricular infarction (Dono MA., 2020), ischaemic heart disease, valvular heart disease, rhythm or conduction disturbances, cardiomyopathies and electrolyte disorders (López-Flores, 2014).

Nursing competences

Only 5 of the 12 articles selected referred to the nursing skills (techniques/procedures) in obtaining a 12-lead ECG (Oliveira Guimarães, 2018) (Pozas Garza, 2010) (Niebla, 2008) and (Dono MA., 2020) (López-Flores, 2014). More specifically, emphasis was placed on the early detection of ECG alterations by the nurse, with a view to early treatment (given that acute coronary syndrome is a time-dependent entity, i.e. the sooner the problem/alteration is solved, the fewer sequelae will occur in the medium and long term). An electrocardiographic alteration should always be interpreted together with the clinical symptoms: in this case pain in the precordial area that may radiate, nausea and vomiting, among others.

However, despite citing the performance of the three types of ECG: left, right and posterior, the placement of the electrodes and their pathophysiological explanation has been scarce. It is important to emphasise these aspects in publications in order to increase the visibility of the technique and mastering it. Perhaps the problem lies in the fact that both right-sided ECG and posterior ECG are only performed in certain units, especially in critical care units: ICU and REA.

It would therefore be convenient to train students at university in these two techniques so that when they observe them in the care setting, they are familiar with them and can provide quality care.

Bias

The main biases were selection and publication bias. Selection bias refers to the selection of articles after the term search. The filters were applied objectively; however, the selection of documents by title and abstract is more subjective. In order to minimise this bias, it would be ideal if the final selection of articles were made by a person outside the research. Publication bias occurs when the author of an article publishes what interests him or her, often only positive aspects of his or her research. Thus, when other researchers conduct a literature review on the topic in question, and use the article, they will only find what the original author has published and not all the evidence related to the topic.

Future lines of research

It is necessary to acquire further knowledge of the different types of ECG: left (L-ECG), right (R-ECG) and posterior (P-ECG). More specifically, a prospective multicentre study should be carried out in critical care units, assessing these ECG types over 12 months, with socio-demographic data (age and gender) and socio-health data (diagnosis, drugs taken, comorbidity of interest, among others).

CONCLUSIONS

There is evidence of three different ECG modalities that assess the electrical activity of the heart from different anatomical points, and which show the functioning of the “electrical cable” cardiac conduction system. Three ECG modalities were also described, including the left heart ECG (the traditional and best known), the right heart ECG (especially when the V1 and V2 precordial leads are altered in a left heart ECG), and the posterior ECG. In each of these, the placement of the electrodes detecting the electrical activity is different. Regarding the socio-demographic and socio-health profile, the information contained in the articles was scarce; more ECGs were performed on females than on males. With regard to the socio-health profile and more specifically in the field of ACS, ST-segment elevation (STEACS), cardiogenic shock, left bundle branch block and the Wolff-Parkinson-White syndrome, among others, all stand out. Among the main nursing competencies that are used in techniques/procedures, the early assessment of ECG alterations stands out, given the need for rapid treatment in these cases as it is a time-dependent pathology. It is the nurse who, after a precordial pain crisis, performs the 12-lead ECG, and assesses alterations - especially ST elevation - and in which leads it has occurred. She then informs the physician to verify the situation and proceed with treatment. The placement of the electrodes in the right place, in each of the modalities described in the study, is undoubtedly of vital importance in order to assess the exact cardiac location of the ischaemia/necrosis/arrhythmia.

BIBLIOGRAPHY

1. ACEVEDO, P. C. (1 June 2009). Einthoven y el electrocardiograma. Obtained from historical review.
2. ALRAWASHDEH, A., NEHME, Z., WILLIAMS, B. AND STUB, D. (2019). Impacto del sistema de atención de electrocardiografía de 12 derivaciones en los retrasos del servicio médico de emergencia en el infarto de miocardio con elevación del segmento ST: una revisión sistemática y un metaanálisis. Medicina de emergencia de Australasia, 31 (5), 702-709.
3. AZCONA, L. (2009). Libro de la salud cardiovascular. Obtained from Chapter 4: El electrocardiograma.
4. CABELLO, J.B. (2005) por CASPe. Plantilla para ayudarte a entender una Revisión Sistemática. In: CASPe. Guías CASPe de Lectura Crítica de la Literatura Médica. Alicante: CASPe; 2005. Cuaderno I. p.13-17
5. CABRERA S., M., FARÍAS C., J., HERVÉ C., M., & VARGAS R., M. (2009). Utilidad de la ecocardiografía transesofágica en el manejo de un paro cardiaco intraoperatorio. Obtained from CasoClínico.
6. CÁRDENAS, M. (2004). Infarto posterior (dorsal) e infarto del ventrículo derecho. Archivos de Cardiología de México, 74 (s1), pp. 38-43.
7. CARMONA-SIMARRO JV (2021). Kate: Cuidados de Enfermería en el paciente crítico. Psylocom Ediciones. Valencia.
8. ÇATALKAYA DEMIR, S., DEMIR, E. Y ÇATALKAYA, S. (2019). Los patrones electrocardiográficos yestacionales permiten diferenciar con precisión la miocardiopatía de tako-tsubo del infarto agudo de miocardio anterior: resultados de un estudio multicéntrico y resumen sistemático de los estudiosdisponibles. Biomoléculas, 9 (2), 51.
9. CAVALHEIRO, J. T., FERREIRA, G. L., DE SOUZA, M. B., & FERREIRA, A. M. (2019). Nursing interventions for patients with acute pain.
10. DONO MA., GONZÁLEZ MR., CALVO JA., VÁZQUEZ M., RODRÍGUEZ I., VÁZQUEZ V., RODRÍGUEZ A., ARRIARÁN MV., DÍAZ I,. ARIAS SM., (2020). Procedimiento de administración de realización de electrocardiograma. Servicio Galego de Saude.
11. GARCÍA NIEBLA, J., LLONTOP-GARCÍA P, VALLE-RACERO JI, SERRA-AUTONELL G, BATCHVAROV VN, DE LUNA, AB. (2009). Errores y artefactos más comunes en la obtención del electrocardiograma. 14(4):389-403.
12. GERSH, B. J. (2001). Libro del corazón. Guía de la Clínica Mayo.
13. GONZÁLEZ CEVALLOS, L. A. (15 March 2017). Comparación de métodos para la detección de punto R en la señal de ECG. Obtained from Universidad Católica de Santiago de Guayaquil: http://repositorio.ucsg.edu.ec/handle/3317/7696
14. GRANERO MOLINA, J., & FERNÁNDEZ SOLA, C. (2011). Soporte vital básico y avanzado. Almería: University of Almería.
15. HERNÁNDEZ PADILLA, J. M. (12 October 2016). Capítulo 12: Electrocardiografía básica.
16. IVANOV, I., BUGARSKI, S., DEJANOVIĆ, J., STOJSIĆ MILOSAVLJEVIĆ, A., RADISIĆ BOSIĆ, J., & VUJIN, B. (2013). Electrocardiographic signs of acute myocardial infarction in left bundle branch block. Medicinski pregled, 66(11-12), 503–506. https://doi.org/10.2298/mpns1312503i
17. KOZACI, N., AY, M. O., BEYDILLI, I., KARTAL, Z. A., CELIK, A., SASMAZ, I., & GUVEN, R. (2016). Right-sided electrocardiogram usage in acute pulmonary embolism. The American Journal of Emergency Medicine, 34(8), 1437–1441. https://doi.org/10.1016/j.ajem.2016.04.025

18. LÓPEZ-FLORES, L., HERNÁNDEZ-MORALES, S., GARCÍA-MERINO, R. M., & FLORES-MONTES, I. (2014). Intervenciones de enfermería en la toma de electrocardiograma, círculo torácico y medrano. Revista mexicana de enfermería cardiológica, 22(2), 78-84.

19. MANTEROLA, C., ASENJO-LOBOS, C., & OTZEN, T. (2014). Jerarquización de la evidencia: Niveles de evidencia y grados de recomendación de uso actual. Revista chilena de infectología, 31(6), 705-718.

20. MEBAZAA, A., COMBES, A., VAN DIEPEN, S., HOLLINGER, A., KATZ, J. N., LANDONI, G., ... & THIELE, H. (2018). Management of cardiogenic shock complicating myocardial infarction. Intensive Care Medicine, 44(6), 760-773.

21. NALAN KOZACI, MEHMET OGUZHAN AY, INAN BEYDILLI, ZEYNEP ASLI KARTAL, AHMET CELIK, IKBAL SASMAZ, RAMAZAN GUVEN (2016). Right-sided electrocardiogram usage in acute pulmonary embolism. The American Journal of Emergency Medicine, 34(8), 1437–1441. https://doi.org/10.1016/j.ajem.2016.04.025

22. NIEBLA, J. G. (2008). El electrocardiograma como técnica enfermera: la calidad del registro electrocardiográfico. Enfermería Clínica, 18(4), 226.

23. NOLAN JP, SOAR J, ZIDEMAN DA, BIARENT D, BOSSAERT LL, DEAKIN C, KOSTER RW, WYLLIE J, BÖTTIGER B. On behalf of the ERC. Guidelines Writing Group. European Resuscitation Council Guidelines for Resuscitation 2010. Section 1. Executive Summary. Resuscitation 2010; 81: 1219-1276.

24. OLIVEIRA GUIMARÃES, D. B., SILVA RODRIGUES, T., MAZZA OLIVEIRA, S. C., & SILVA DANTAS AVELINO, F. V. (2018). Electrocardiogram Gate Time in Patients with Thoracic Pain in the Emergency Room. Journal of Nursing UFPE / Revista de Enfermagem UFPE, 12(4), 1027–1036. https://doi-org.ezproxy.universidadeuropea.es/10.5205/1981-8963-v12i4a231123p1027-1036- 2018

25. OLIVERÓ, D., & GÜELL, D. J. (1990). El Infarto. Barcelona: Emeká.

26. PAGE, M. J., MCKENZIE, J. E., BOSSUYT, P. M., BOUTRON, I., HOFFMANN, T. C., MULROW, C. D., ... & MOHER, D. (2021). Declaración PRISMA 2020: una guía actualizada para la publicación de revisiones sistemáticas. Revista Española de Cardiología, 74(9), 790-799.

27. PINEDA, FERNANDO, DIGHERO, BRUNO, MERUANE, JORGE, CATALDO, PABLA, & URIARTE, POLENTZI. (2021). El infarto oculto. Las claves para el diagnóstico precoz de infarto posterior. Revista médica de Chile, 149(8), 1223-1230. https://dx.doi.org/10.4067/s0034-98872021000801223

28. POZAS GARZA, G. (2010). Implementación de una técnica estándar para la adquisición del electrocardiograma. Avances, Nº20, Volumen 7, 52-56.

29. POZAS GARZA, G. (2014). Error en la técnica de registro electrocardiográfico: derivaciones del plano frontal. Obtenido de Educación médica.