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INDEX

DADES DEL TRABALL

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Título: Sensitivity and specificity of the electrocardiogram to detect chronic myocardial infarction of the anteroseptal wall.

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ABSTRACT: ECG is the first bed-to side available diagnostic tool for myocardial infarction (MI) detection in clinical practice. Its value was ascertained mainly with anathomopathological old studies. Contrast enhanced magnetic resonance (CE-MR) is actually the preferred technique for MI detection. This study investigated the value of the ECG (SE and ES) to detect MI in the anteroseptal zone. Conclusion:the sensitivity and specificity of 4 ECG patterns in the anteroseptal zone was ascertainded. Of note, despite the fact that extensive Q waves in the anterior leads are obseved, necrosis is usually limited if VL lead is not affected.

RESUM: L`electrocardiograma és la primera eina diagnòstica fàcilment disponible per la detecció de l´infart a la práctica clínica. El seu valor va ser donat principalment amb estudis antics anatomopatològics. La ressonància magnètica cardíaca actualment és la tècnica d`elecció per la detecció de l`infart. Aquest estudi investiga el valor de l`electrocardiograma (sensibilitat i especificitat) per detectar infarts de la zona anteroseptal. Conclusiò: la sensibilitat y la especificitat de quatre patents electrocardiogràfiques de la zona anteroseptal va ser valorada. Així mateix, encara que s`observin extenses ones Q en les derivacions anteriors la necrosis és usualment limitada si VL no está afectat.

INTRODUCTION:

The sensitivity (SE) and specificity (ES) of Q-wave -wave myocardial infarction (MI) was fist studied in the 1940s (1-2). After this extensive anathomopathological correlation study, this classification became the most popular for Q wave MI (3-9). According to this classification, the presence of Q-waves in leads V1-2 corresponds to septal MI, in leads V3-4 to anterior MI, in leads V5-6 and/or I VL to low and high lateral MI respectively,

However, clear evidence exists of the limitations of this strict classification owing to dificulties in correlating precordial leads with affected walls (precordial electrodes are often not well placed) and to changes in the precordial lead-heart wall realtionship in subjets with different body builds (10-12). Furthermore, a large amount of information has been obtained from electrophisiological (13), hemodinamyc and angiographic studies (14-16) and, particularly, correlations with imaging technique for identifying the area of necrosis .Contrast enhanced cardiovascular magnetic resonance (CE-CMR) has become the gold standard for MI detection. Therefore, it is the ideal technique for asessing the ECG value and its sensitivity and specificity for different MI detection (20-24).

We retrospectively analized 24 cases of MI of the anteroseptal zone in which CE-CMR was performed and ECG was available for comparison. We described the different MI patterns according to necrosis location and calculated their SE and ES.

MATERIAL AND METHODS

CE-CMR and ECG findings were retrospectively analyzed in 24 patients in the chronic phase of anteroseptal zone myocardial infarction (MI). Chronic MI was defined as any infarction detected by the ECG after at least three weeks of the index event. Standard 12-lead ECGs were recorded at 25 mm/s speed and 10 mm/1 mV voltaje. The ECG recordings were reviewed by 2 independent investigators blinded to clinical and CMR data. In cases of discrepancy, the final decisión was made by a third investigator. MI was diagnosed according to the following ECG criteria: 1) Q wave ≥40 ms in leads I, VL; 2) Q-wave > 30 mseg in ≥ 2 contiguos precordial leads; or 3) any Q-wave in V1-V2 or R wave <= 0.1 mV in V1-2.

CE-CMR were performed with a Philips Intera 1.5 T scanner in all patients. After the usual scout planes had been obtained, steady –state free-precession cine-MR images were acquired in individual long axis planes and in multiple 10 mm thick short axis slices from the atriventriclar ring to the apex of the left ventricle. Sixteen phases of the cardiac cycle were acquired for each slice and displayed as a loop.

Intravenous gadobutrol (Gadovist Schering AG, Berlin, Germany) was injected at a dose of 0.1 mmol/kg. A 3D inversion recovery segmented gradient echo sequence was acquired 10 minutes after contrast adminsitration to asess delayed contrast myocardial hyperenhancement (HE). Inversion times were adjusted to null the signal from normal myocardium (200-300 mseg) This sequence was prescribed in a multiple short axis planes using the same orientation as the cine-MR images and acquired during a patient breath-hold or approximately 20 seconds.

In order to correlate CMR and ECG findings, we divided the left ventricle into 17 different areas and segments (fig 1) according to the North American Societies Imaging Statemnet (25). This practical anatomic approach makes the location easier to understand to every clinician and facilitates comparison and infarction quantification. The so called bull`s eye disribution was then used to correlate Q waves on the ECG with necrosis assesed by gadolinium HE.

We calculated the sensitivities and specificities of different ECG patterns by using a 2 X 2 contingence tables.

RESULTS

When necrosis was located mainly in the septal zone of the left ventricle assesed by CMR (segments 13-14-7-8 and sometimes part of 1 and 2 of the NASI classification) , the ECG showed Q waves in V1-2 leads with a SE of 86 % and ES of 98% (see figure 2).

When necrosis was located in the anteroseptal and apical zone of the left ventricle (segments 13-14-15- 16-17 and sometimes part of 7-8-9), the ECG showed Q waves in V1-2 to V4-6 with a SE of 86% and ES of 98% (see figure 3).

When necrosis was more extensive affecting the anterior, septal ,apical and also lateral zones of the left ventricle (segments1-2-3-7-8-9-13-14-15-16-17) the ECG showed Q waves in V1-2 to V4-6 but also I and VL with a SE of 80% and ES of 98%.

Finally, when necrosis was located in a limited part of the anterior and the mid and apical part of the lateral wall of the left ventricle (clasically misnamed as the " high lateral MI" (segments 7-12-13-16-17) , the ECG showed Q waves in VL and sometimos V2-3 with a SE of 40% and ES of 100% (see figure 4).

TYPE OF MI	**NASI classification segments affected by MRI**	**ECG pattern**	**SE and ES**
Septal N= 7 cases	2-8-14-7-13	Q in V1-2	SE 86% ES 98%
Apical/anterior N= 7 cases	13-14-15-16-17 7-8-9	Q in V1 to V4-6	SE 86% ES 98%
Extensive Anterior N= 5 cases	1-2-3-7-8-9-13-14-15-16-17	Q in V1 to V4-6 and Q in I VL	SE 80% ES 98%
Anterolateral N= 5 cases	7-13-12-16-17	Q in VL and sometimes in V2-3	SE 40% ES 100%

Table 1 shows the relationship with the corresponding ECG patterns sensitivity and specificity, and the most frequent segments of the left ventricle infarcted as was assesed by gadolinium hyperenhancement. MI= myocardial infarction. NASI= North American Society Imaging; ECG= electrocardiogram; SE= sensitivity ; ES = specificity.

CONCLUSION:

The ECG showed acceptable sensitivity and high specificity for MI detection in the anteroseptal zone of the left ventricle. Our results confirm previous investigation that also used magnetic resonance for infarction location and sensitivity and specificity assessment (26). Given the high resolution of the CMR to study MI location, our understanding of the different ECG patterns of MI expression and their clinical application could be improved with more extensive research. For example, in clinical practice we tend to overestimate the importance of a MI if extensive Q waves are present in leads V1 to V6. On the other hand, this study and many others showed this undesirable interpretation, since the infarction is small and usually located in the most apical/ anteroapical aspect of the left ventricle as assesed by MRI.

We also found in this study that the ECG is less sensitive to detect anterolateral infaction . Usually the very known high lateral infaction is also a misnomer, since in cases of Q waves in VL and V2-3 the laterobasal wall of the left ventricle is usually not infarcted as we confirmed in our serie. This is easily undestood because the left circumflex artery supplies this territory, then Q wave presence in VL lead associated with Q waves in V1-2 leads better reflects mid anterior or apicolateral infaction.

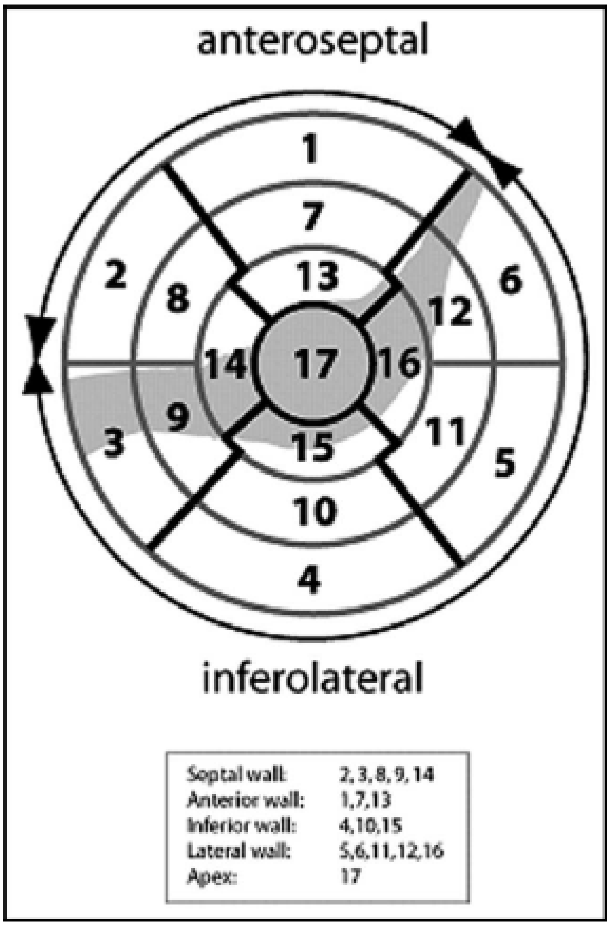
If Q waves are present in leads V1-6 but also VL, the infaction may be bigger with extensive compromise of the septum, anterior and part of the lateral wall. In these cases, more proximal left anterior descendent coronary artery occlusion is present in the angiography and cardiogenic shock may dominate the clinical picture in the acute phase.

This substudy is the very begining of a more extensive investigation that has the aim to obtain a new ECG classification, updated to real clinical scenario and validated with much more cases (27). It is well known that the actual MI classification is old fashion (28-29-30), and our intention is to improve the ECG clinical utility in the chronic phase of MI.

Finally, the results of this preliminary study should be confirmed with more extensive research, given to this new and contemporary terminology first used by Bayés de Luna and coworkers more extensive evidence and wide acceptance.

FIGURES

Figure 1: Bull`s eye image representation of the left ventricle and its segments according to the North American Societies of Imaging Statement.



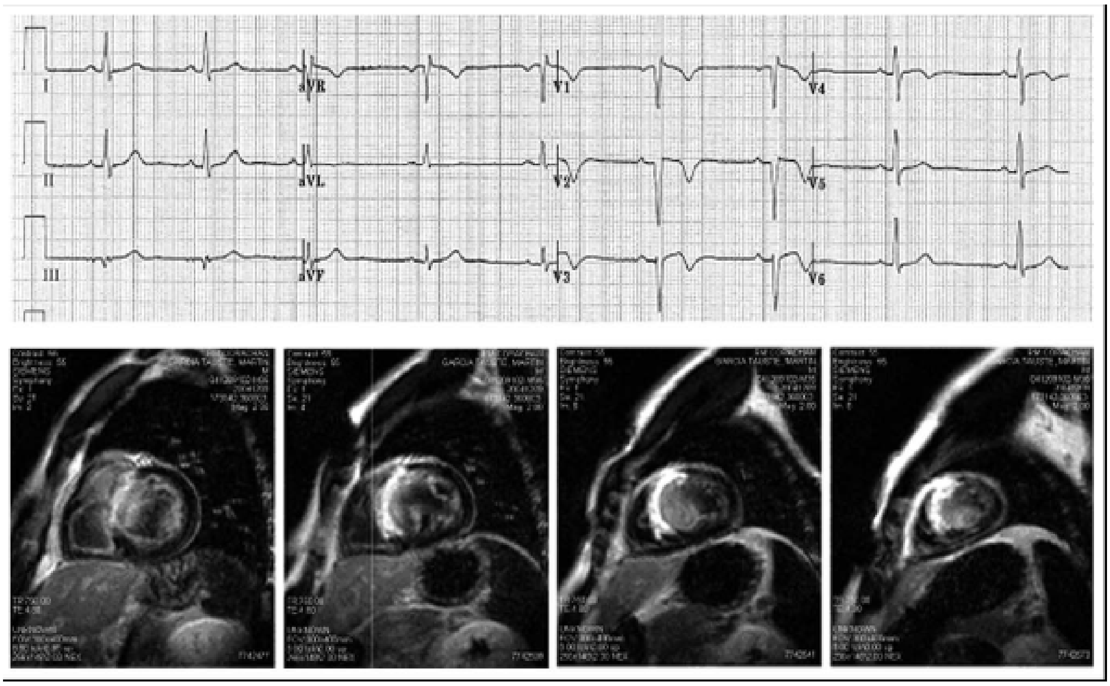


Figure 2: An example of septal myocardial infarction. In this case the ECG an MRI image of extensive septal infarction is showed. ECG shows Qr in V1, QS in V2 and rS in V3 with negative T waves in V1-3. Bottom: short axis CE-CMR image shows gadolinium HE in the basal, mid and apical septum. The anterior wall is only slightly involved despite extensive septal compromise.

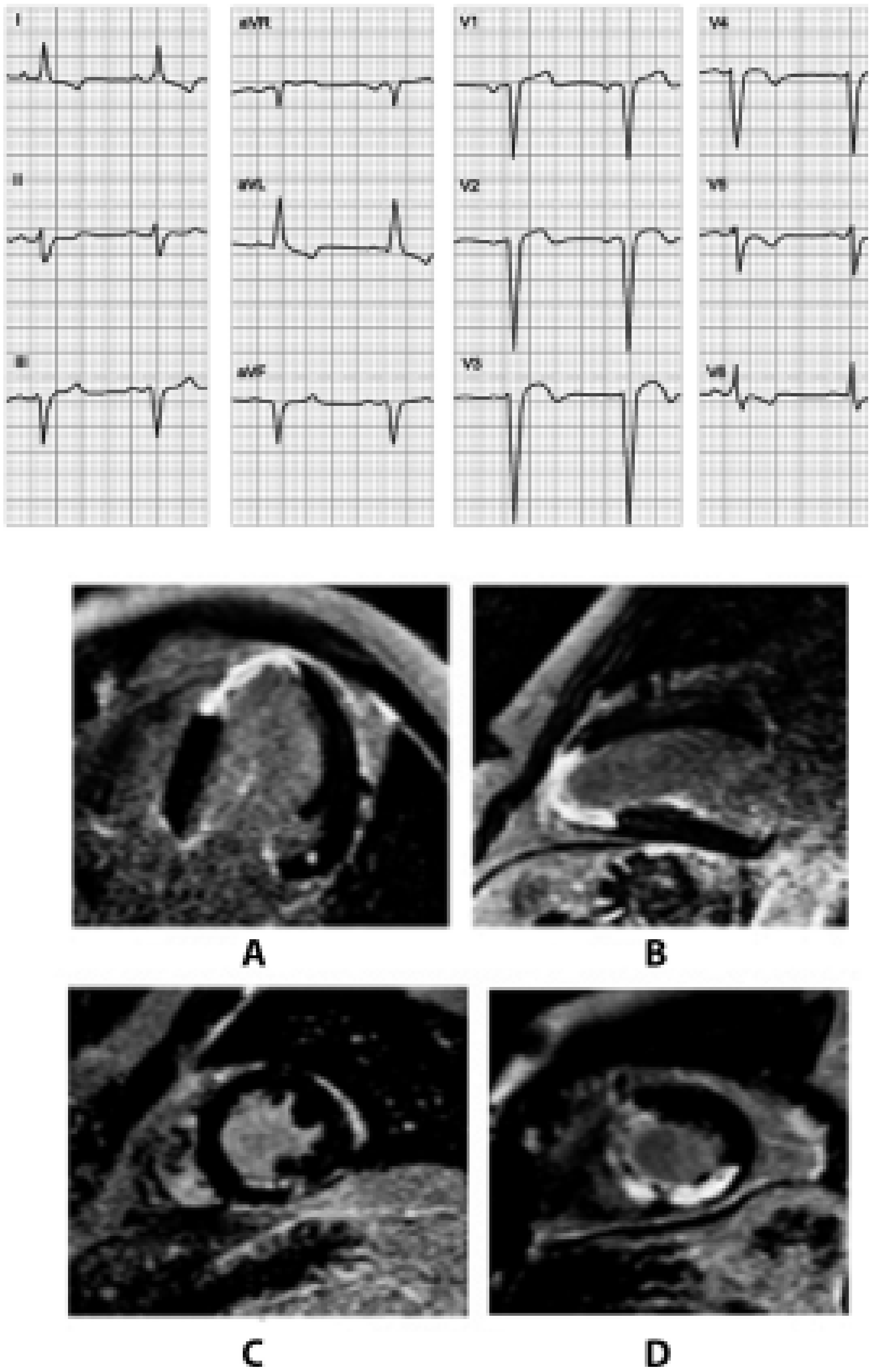


Figure 3: ECG and CE-CMR in a patient with apical MI. A) Horizontal long axis view: myocardial HE (bright area) indicates mid-low and apical septal necrosis. B) Vertical long axix view HE shows apical necrosis involving the anterior and the inferior wall at this level C) Short axis view at the mid level: the absence of myocardial HE at this level indicates that the mid septum is spared. D) Short axis view at the apical level : HE corresponding to an inferior and septal myocardial necrosis. Notice that at this level part of the anterior wall also shows HE indicating necrosis

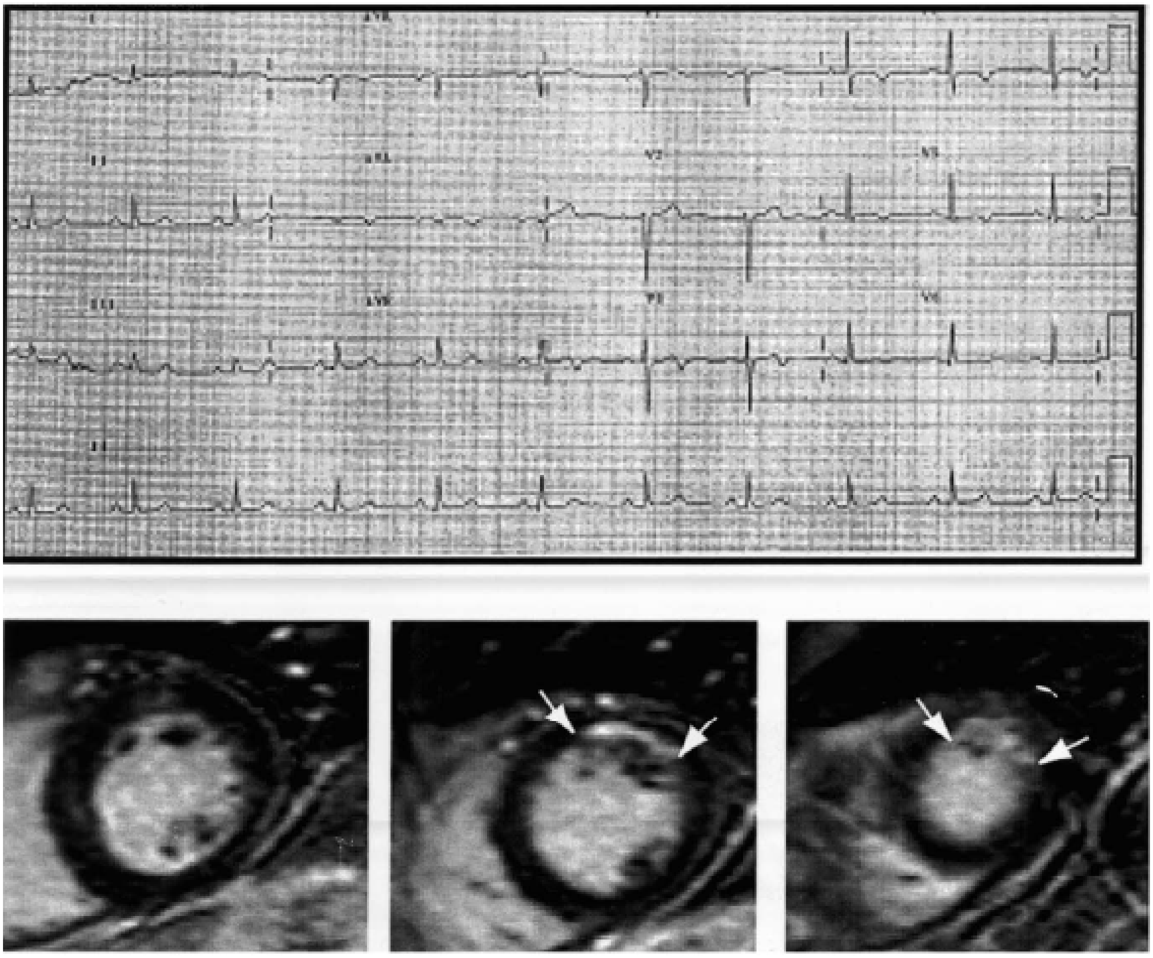


Figure 4: EGG and CE-CMR images of limited anterolateral MI
Electrocardiogram shows QS morphology in lead aVL
and a low-voltage r wave in lead V2. *Bottom*, Short-axis CE-CMR image shows
myocardial hyperenhancement *(arrows)* of the anterior wall at the mid
(middle) and apical *(right)* levels with small involvement of the lateral wall. No
hyperenhancement is observed at the basal level *(left)*.

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