Journal of Heart

Research Article | Vol 2 Issue 2

Comparison of Non-Invasive versus Invasive Examinations in the Diagnosis of the Guilty Vessel in Acute Myocardial Infarction

Sandra Tobar[1], Ana María Naranjo[2], Patricio Huerta[3], Darío Martínez[4] and Sergio Jiménez[5,6*]

[1]*Departament of Nursing, University of Tarapacá, Iquique, Chile*

[2]*Departament of Nursing, University of Tarapacá, Arica, Chile*

[3]*Departament of Kinesiology and Nutrition, University of Tarapacá, Iquique, Chile*

[4]*Hemodinamia Unit, Ernesto Torres Galdames Hospital, Iquique, Chile*

[5]*Departament of Kinesiology, University of Atacama, Copiapó, Chile*

[6]*Neural Control of Movement Laboratory, Medicine and Health, University of Wollongong, Australia*

Correspondence should be addressed to Sergio Jimenez, sergio.jimenez@uda.cl

Received Date: November 28, 2020; **Accepted Date:** December 13, 2020; **Published Date:** December 20, 2020

ABSTRACT

INTRODUCTION

Determining the guilty artery during an acute myocardial infarction (AMI) is essential for the course of a patient's survival. However, the use of invasive and high-cost exam to ensure the correct diagnosis of IAM is prioritized during such emergency. Nonetheless, the use of non-invasive, easy-to-use and low-cost procedures could be a fruitful help on the absence of high technological resources.

AIM

The objective of this study was to compare the use of two non-invasive methods of electrocardiogram (ECG) and echocardiography (ECHO) versus the invasive coronary angiography (CG) method in 54 patients diagnosed with AMI during the 2018.

RESULTS

High sensitivity and specificity were found among ECG, ECHO with CG near to 80% for the right coronary artery and anterior descending artery. In the case of the circumflex artery, there were obtained between ECG and CG a specificity around the 50%, while between ECHO and CG it was the 100%. Both bivariate analysis and the correlation between non-invasive (ECG and ECHO) versus invasive (CG) tests were significant ($p < 0.0001$) with a high positive correlation respectively.

CONCLUSION

The use of a previous ECG and ECHO examination could approach quickly the identification of the guilty artery properly to determine the appropriate coronary catheter to intervene properly, regardless, to the use of the CG.

KEYWORDS

Electrocardiogram; Echocardiogram; Coronary angiography; Guilty artery: Acute myocardial infarction

Citation: Sandra Tobar, Comparison of Non-Invasive versus Invasive Examinations in the Diagnosis of the Guilty Vessel in Acute Myocardial Infarction. J Heart 2(2):71-77.

ABBREVIATIONS

ECHO: Echocardiography; CG: Coronary Angiography; ECG: Electrocardiogram; AMI: Acute Myocardial Infarction; CX: Circumflex Artery; AD: Anterior Descending Artery; RC: Right Coronary Artery

INTRODUCTION

As the World Health Organization (WHO) have reported, cardiovascular diseases (CVD) causes 17,500,000 deaths per year, reaching almost half of total mortality in developed countries [1]. Hence, 6.6% of people over 17 years of age are at cardiovascular risk when there are associated risk factors (RF). Among the RFs that influence the development of CVD are: Arterial hypertension (HTN), smoking, obesity, diabetes mellitus (DM), sedentary lifestyle, among others [2,3]. So, disorders of the heart and blood vessels that cause CVD includes coronary heart disease (CHD), cerebrovascular disease, hypertension, peripheral artery disease, rheumatic heart disease, congenital heart disease, and heart failure [4].

In Chile, according to the Ministry of Health (MINSAL), cardiovascular disease (CVD) is the leading cause of death, with 30% of the total number of deaths, and is the third most common cause of disability [5]. Indeed, more than half of adults have two or more cardiovascular risk factors in this country [6]. Globally, by 2020 CVDs will be the leading cause of death [3]. In the latest National Health Survey 2016-2017, the prevalence of hypertension is close to 26%, while the prevalence of high total cholesterol reached 72.2%, and the HDL cholesterol is 45.8% in people over 20 years of age in Chile [7]. Although Chile could cover most of CVD diagnosis, most of such resources are centralized in main cities. Provincial health unities must send those patients to such biggest areas to corroborate a heart attack and its specific aetiology.

The coronary heart diseases (CHD) affect the blood vessels that supply the heart. The most frequent and dangerous issue is the accumulation of fat on the walls of the coronary arteries [8]. It has been established that the erosion, cracking or rupture of fragile atherosclerotic plaques is the initiating mechanism of coronary thrombotic occlusion, which produces intra-plate haemorrhages, coronary spasms and luminal occlusive thrombosis [9]. This plate rupture affects the lipid-loaded plaques mostly, with an endothelial layer weakened by the activity of internal collagenase (metalloproteinase) derived from macrophages. These macrophages arrive on the plaque from monocytes in the blood in response to inflammation mediators and adhesion molecules [8]. The onset of such ACS is an endothelial dysfunction with cell apoptosis, which is produced by the immune - inflammation axis and tissue factor, among others, determining the common hypercoagulability [10]. Arterial atherogenesis is the main etiological agent of Acute Coronary Syndromes (ACS) [4].

The clinical manifestations of plaque rupture with partial obstruction or occlusion of the affected artery include: Acute myocardial infarction (AMI), unstable angina, and sudden death from ventricular fibrillation (VF) [3,10]. Among the reasons for this plaque rupture are the maintenance of the smoking habit, the increase in the prevalence of obesity, metabolic syndrome and Type 2 Diabetes Mellitus (DM2) [4,9].

Technological advances in medicine have provided important diagnostic and treatment methods in the area of coronary diseases such as ACS and AMI. Some non-invasive method such as Electrocardiography (ECG) and Echocardiography (ECHO), or invasive ones as coronary angiography (CG) have been used widely for coronary diseases diagnosis [6,11]. The ECG and ECHO type examinations are low cost and quick to diagnose for

infarcted patients. However, CG maintains high cost and invasive technique categorization, which leads to classification as a complex and high risk procedure. Although there are studies that correlate ECG and GCC examinations [12,13], there is no evidence from similar studies to prove the efficacy of the joint execution of these three tests on infarct patients.

To do so, the purpose of this study was to evaluate the correlation between non-invasive (ECG and ECHO) and invasive (CG) methods with the aim of implementing a diagnostic prediction procedure, in order to optimize the resources of the public health system. It is hypostatized that non-invasive tests would have a positive correlation in comparison to invasive technique, in order to provide timely care to the patient with a heart attack.

MATERIAL AND METHODS

The present had a descriptive/comparative cross-sectional analytical design, which was carried out in a cardiology unit of a hospital centre, during the months of January 2018 to December 2018. The sample was non-probabilistic for convenience due to the availability of patients and the required information. The target population was 108 patients who presented AMI with ST supernatural level, which were performed CG. The final sample was 57 patients corresponding to 52.8% of the target population, who met the following inclusion criteria: previous EKG and ECG results, authorised (written) and signed consent for this study. Patients with incomplete data were excluded, due to their seriousness. Both the informed consent and the research project were approved by the Scientific-Ethical Committee of the local University (CEC-UTA 05/2017).

The data collection was obtained by the nurse and medical technologist of the hemodynamics unit of the hospital. The tests were applied and conducted by the unit's haemodynamics, based on ECHO, ECG and GC. The information obtained was entered into an Excel spreadsheet (4Version, Microsoft365 Inc. SA. USA). Sociodemographic variables were evaluated, such as: Age, sex, MD, ATH, dyslipidemia, smoking, heart attack and types of infarction (with or without ST segment elevation) and previous coronary intervention (PCI). For the comparative variables, the results of ECHO and ECG examinations compared with CG were analysed.

The data were transferred to the STATA 14.1 statistical programme (StataCorp LP, TXS, USA) in which, the descriptive variables were processed through univariate analysis using measures of central tendency, frequency, means, standard deviation (SD). For the bivariate analysis, differences in means and variances through chi^2 were performed with 95% reliability. For the comparative analysis, the sensitivity, specificity and dispersion test were used, and finally, the Pearson correlation test was used to correlate the test results.

RESULTS

Descriptive Analysis of the Sample

Regarding to the descriptive analysis, this study observed the percentages to age, sex, risk factors and diagnosis prior to AMI. The average age of the sample was 61.2 years ± 10.2 years. Half of the patients were between 55 years and 69 years old; the youngest was 40 years and the oldest 83 years. The average age for men was 63.5 years ± 9.3 years, while women were averaged 57.7 years ± 11.1 years. The prevalence of AMI less than 64 years the percentage of women was 40% and for men 60%. For patients with AMI over 65 years old, women were accounted for 27.3% and men 72.7%.

The values for cardiovascular risk factors associated with AMI, 59.6% of patients had high blood pressure; 66.7% of them had diabetes mellitus II (MDII); 64.9% of them smoked cigarettes and 86% had presented dyslipidemia. In the case of patients with history of coronary events

prior to AMI, a 50.9% of them showed unstable angina; 14% of these patients revealed previous AMI; 5.3% presented previous PCI and 29.8% did not show previous cardiovascular diagnosis.

Descriptive and comparative statistical analysis according to type of examinations and ami etiology

The distribution according to diagnosis based on the ECG examination shows that 42.1% had AD lesions, 40.4% of patients showed CD lesions and 7% CX lesions. In addition, 8.8% of the patients showed a combination of DA-CX lesions and 1.8% a combination of CD-CX (Figure 1).

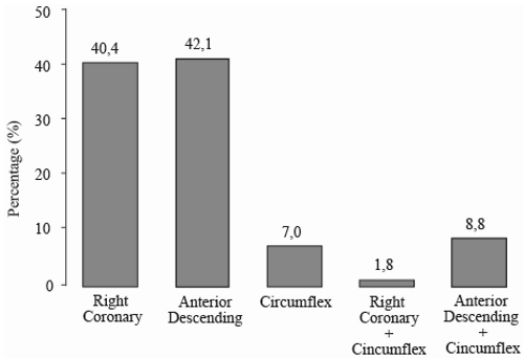

Figure 1: Distribution of the sample according to the results of compromised artery by the electrocardiogram.

For the results according to ECO examination it is observed that 50.9% present an l of the anterior descendant, 38.6% show a lesion of the right coronary, 7% show a lesion of the circumflex artery and 3.5% do not present lesions (Figure 2).

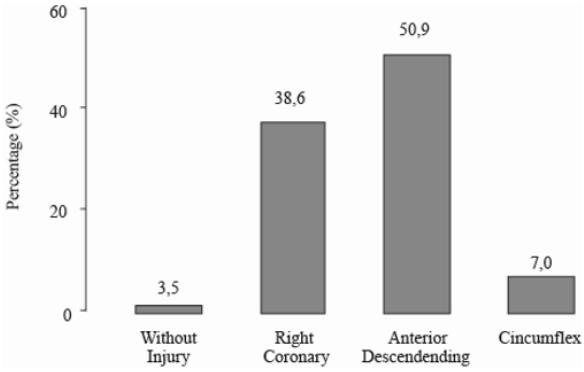

Figure 2: Distribution of the sample according to the results of the guilty artery by the Echocardiogram examination.

The diagnosis according to the GC examination shows that 40.4% of the patient's present CD lesion, 36.8% present DA lesion, 12.3% CX lesion and 10.5% of the patients do not present lesions (Figure 3).

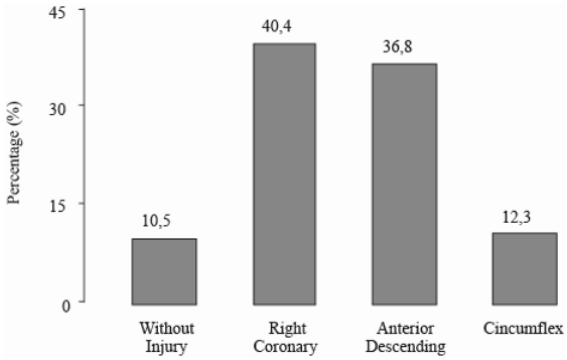

Figure 3: Distribution of the sample according to the results of the compromised artery by the coronariography examination.

Table 1 shows the bivariate analysis of the non-invasive vs. invasive measurements according to the vessel involved. Regarding to detection of vessel guilty of CD obstruction between ECG and GC, a sensitivity of 20/23 patient´s number was observed in both tests, with a specificity of 86.95%. For CD obstruction between both measurements, a sensitivity of 19/24 patients was showed with specificity of 79.16%. In the analysis of CX obstruction for these two measurements, a sensitivity of 4/7 patients was obtained with a specificity of 57.14%. In the bivariate analysis between CD obstructions, ECHO compared to CG diagnoses, the sensitivity was 18/21 patients with specificity of 85.71%. For the detection of DA obstruction, the sensitivity was 18/23, with specificity of 78.26% for both tests. For CX obstruction, the sensitivity was 4/4 patients, with specificity of 100% when ECHO and CG were compared.

Table 2 represents the correlation of Pearson's chi^2 according to the ECG and ECHO, both versus CG variables. According to this measurement, a strong correlation between ECG and CG was established ($r = 0.6308$) for the identification of the guilty vessel and a statistically significant relationship ($p < 0.0001$).

	Coronariography								
	Right Coronary			Anterior Descendant			Circumflex Artery		
	Total	Sensibility	Especificity (%)	Total	Sensibility	Especificity (%)	Total	Sensibility	Especificity (%)
Electrocardiography	20	20/23	86,95	19	19/24	79,16	4	04-Jul	57,14
Echocardiography	18	18/21	85,71	18	18/23	78,26	4	04-Apr	100

Table 1: Relationship between non-invasive (ECO and ECG) versus invasive (CG) measurements of sensitivity and specificity by guilty vessel.

Furthermore, a strong correlation between guilty vessel by ECHO and guilty vessel by GC (r = 0.6427) was observed, within a statistically significant relationship (p <0.0001). These values are observed in Figure 4 where, both slope lines show a trend towards a positive correlation. So, it could be inferred that, a high coincidence between the diagnoses of both non-invasive tests versus the invasive one, showed an increasing positive relationship, demonstrating a high correlation between the mentioned tests.

Coronariography		
Electrocardiography	r = 0.6308	P <0.0001
Echocardiography	r = 0.6427	P <0.0001

Table 2: Correlation of Pearson's chi^2 (r) between to the non-invasive (ECO and ECG) versus the invasive (CG) examination variables.

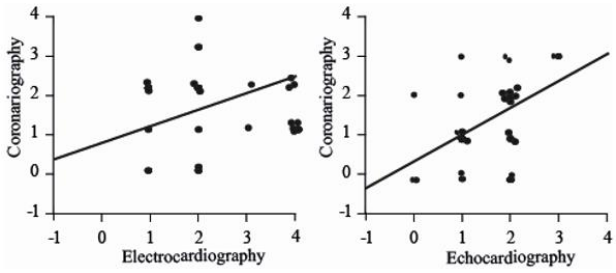

Figure 4: On the left: Dispersion and slope lines in the correlation between GC and ECG. On the right: Dispersion and slope in the GC-ECHO correlation.

DISCUSSION

Results from this research revealed that acute myocardial infarction was 61.2 years in the entire sample. Also, the mean of age in men was 63.5 years and, in women 57.7 years old, similar to the previous report of incidence pond lethality by acute myocardial infarction in Chile [14]. They averaged men´s age that suffered IMA in 65 years old, whereas the mean age for women was 74 years. So, it could be noticed that almost a third part of AMI incidences in Chile are related to men mostly. Note that, our results revealed an increase of IAM in men (72.7%) and in women (27.3%) when the subjects were over 65 years old.

This research showed a similar risk factor as a previous study where all our participants had at least one of them (HTA, MD, smoking, dyslipidemia) associated with IAM. However, the most notorious was the HTA with 59% of frequency on our patients. Our result was according to a cardiovascular study [15], where all risk factors mentioned above were repeated.

In the comparison between non-invasive examinations with coronariography, similar findings were observed in a previous report [16]. Such a coincidence with our study could be done by the elevated cardiac cost generated by the DA [17]. In this case, AD descends through the interventricular septum and originates the ventricular septal arteries. This branch is responsible for perfusing blood to the front left side of the heart [18]. The similarity of the order of the obstruction of the vessel responsible for the infarction, starting with the DA, followed by the CD ending with the CX, demonstrates the proportion generated by the demand for cardiac cost [19]. So, the function of the segments of the heart muscle is

comparable, in both invasive and non-invasive techniques regarding previous and this novel results.

The high coincidence, specificity and correlation obtained in the comparison of the cardiographic techniques in this study, means that both the use of ECG and EKG, can solve the diagnosis of AMI by themselves, being low cost and fast execution methods [10,12,13,15]. Hence, from an early stage of the pathological event, can directly assist in the identification of the culprit vessel that would be causing ACS, especially the presence of AMI, without requiring invasive diagnostic methods, for example, in geographic locations that do not have advanced diagnostic procedures. The use of these non-invasive methods in conjunction with efficient training of the health team could clarify the diagnosis and optimize the timely treatment of this type of pathology. On the other hand, hemodynamic teams, by having a previous ECG and ECHO examination, have the possibility of addressing the patient in a timely manner, quickly identifying the vessel responsible for the infarction and thus adequately choosing the catheter to be used in the intervention of the affected coronary trunk.

CONCLUSION

By having a previous ECG and ECHO examination, the patient can be approached to a quickly identification of the guilty coronary vessel despite using a high cost examination. Therefore, the appropriate choose the catheter determined for the affected coronary trunk cold be easily determined by ECG and ECHO, based on our results. We also conclude that, the use of these low-cost and non-invasive diagnostic tools in the most precarious localities would have a reliability and sensitivity to detect IAM similar to an expensive and invasive traditional protocol alternative.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ACKNOWLEDGEMENT

Special thanks to Medical Technologist Luis Ramos Munizaga of the Hemodynamic, Unit of the Ernesto Torres Galdames Hospital in Iquique for his special dedication, commitment and support in carrying out this study.

REFERENCES

1. Sánchez-Arias AG, Bobadilla-Serrano ME, Dimas-Altamirano B, et al. (2016) Cardiovascular disease: First cause of morbidity in a tertiary hospital. Mexican Journal of Cardiology 27(s3): 98-102.
2. Norte Navarro AI, Sansano Perea M, Martínez Sanz JM, et al. (2016) Study of cardiovascular disease risk factors in Spanish university workers. Hospital Nutrition 33(3): 644-648.
3. American Diabetes Association (2016) Cardiovascular disease and risk management. Diabetes Care 39(Supplement 1): S60-S71.
4. Arteaga Llona A (1991) Atherosclerotic coronary heart disease in Chile: Contributions from 30 years of research. ARS MEDICA Journal of Medical Sciences 20(2): 143-146.
5. Rondanelli IR, Lindermeyer B, Alberto L (2008) Epidemiology of coronary heart disease in Chile. Las Condes Clinical Medical Journal 19(1): 6-13.
6. Cristina EFM (2012) Cardiovascular risk prevention: Chilean policies. Las Condes Clinical Medical Journal 23(6): 651-655.
7. de Salud Pública S (2017) National health survery 2016-2017 first results. Santiago.

8. Rodríguez T, Malvezzi M, Chatenoud L, et al. (2006) Trends in mortality from coronary heart and cerebrovascular diseases in the Americas: 1970-2000. Heart 92(4): 453-460.
9. Banegas JR, Villar F, Graciani A, et al. (2006) Epidemiology of cardiovascular diseases in Spain. Spanish Journal of Cardiology 6(7): 3G-12G.
10. Yusuf S, Hawken S, Ôunpuu S, et al. (2004) Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. The Lancet 364(9438): 937-952.
11. Guarda E, Prieto JC, Sanhueza P, et al. (2009) 2009 Guidelines of the Chilean society of cardiology for the treatment of acute myocardial infarction with supra-elevation of the ST. Chilean Journal of Cardiology 28(2): 223-254.
12. Costa YBC, Mauro VM, Charask A, et al. (2006) Usefulness of a VR shunt in identifying the artery responsible for inferior infarction. Argentine Journal of Cardiology 74(1): 28-34.
13. Huerta P, Naranjo AM, Martínez D (2018) Correlation between electrocardiographic and coronary angiographic studies in coronary heart disease. International Journal of Morphology 36(4): 1514-1518.
14. Nazzal C, Alonso FT (2011) Incidence and fatality due to acute myocardial infarction in Chile: 2001-2007. Medical Journal of Chile 139(10): 1253-1260.
15. McDonald K (2008) Prevalence of heart failure: A reflection of the good and the bad of modern cardiovascular support. Spanish Journal of Cardiology 61(10): 1010-1012.
16. Loaiza XAC, Castro MLA, Villalva EAL, et al. (2019) Coronary bypass surgery. Techniques, postoperative complications and cardiac rehabilitation. RECIMUNDO: Scientific Journal of Research and Knowledge 3(1): 500-521.
17. Rodríguez-Blanco S, Valdés-Recarey M, Leyva Quert AY (2017) Superdominant anterior descending coronary artery. Spanish Journal of Cardiology 70(11): 1006.
18. Sorí YP, Moya VAH, Reyes IP, et al. (2019) Histology of atheroma plaque in coronary arteries of deceased patients after surgical myocardial revascularization. Clinic and Research in Arteriosclerosis 31(2): 63-72.
19. Kapur NK, Alkhouli MA, DeMartini TJ, et al. (2019) Unloading the left ventricle before reperfusion in patients with anterior ST-segment-elevation myocardial infarction: A pilot study using the Impella CP. Circulation 139(3): 337-346.