

CARDIOVASCULAR AND METABOLIC SCIENCE

Continuation of the Revista Mexicana de Cardiología

2020



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Current knowledge**
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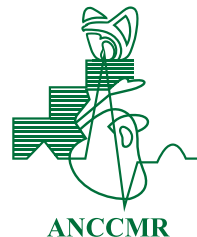
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Editor's letter

Carta del Editor

Eduardo Meaney*

My colleague and friend Dr. Thelma Rodríguez, who served as Executive Editor of our Journal in recent years, have had to resign to her position for personal reasons. A brilliant and meticulous clinician and hard-working professional, Dr. Rodríguez performed all the difficult editorial tasks with efficiency and a spirit of collaboration. Certainly, we will miss her close collaboration and advice.

Dr. Maria del Pilar Ortiz Vilchis, a young physician, with a Master and Doctorate in Sciences, has been designed as Executive Editor of the Journal, with the consent of the new President of our Association, Dr. Gabriela Borraro. Dr. Ortiz, who I know since her formative years, will continue the efforts of Dr. Rodríguez to improve the level of the Journal until reaching the goals that we all expect and desire. While we give her the warmest welcome as a prominent member of our Editorial Committee, we want to express her our highest confidence and consideration.

Dr. Pedro Gutiérrez, the former past President of our Association, did a magnificent job,

amidst the complex, threatening and unknown reality imposed by the COVID-19 pandemic. Despite all the obstacles, ANCAM, under his leadership, is now stronger and has a growing academic importance in our country. We would like to acknowledge that Dr. Gutiérrez granted a great freedom to the Editorial Committee, as the former Presidents Dr. José Manuel Enciso and Dr. Francisco Javier León did in their respective administrations. Editorial freedom is an essential requirement for the performance and evolution of a scientific journal.

Dr. Ortiz and I also want to thank Dr. Borraro for allowing us to continue leading the Editorial Committee. Our President can be sure that we will never betray that trust and that we will continue in the arduous fight to improve the quality of our Journal, to the limit of our strength and competence.

Correspondence to:

Eduardo Meaney, MD, PhD

E-mail: lalitimini1@gmail.com

www.medigraphic.org.mx

* Editor in Chief.

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ANCAM and its Journal: a long way ahead

La ANCAM y su revista: un largo camino por delante

Eduardo Meaney*

Only those individuals, communities and nations that have the capacity to reshape and adapt themselves to the changes and challenges that life imposes, can evolve, and succeed in the long term. Our beloved Association, ANCAM, during its still short life, has demonstrated the ability to transform itself, understanding the encryption of the newer times and adequately remodelling to adjust to the needs and demands of a complex new era. It was just yesterday when a small group of dreamers, led by our founder Dr. Guillermo González, gave life to a new cardiology society that against all odds, in a relatively short lapse has become a splendid and successful professional and academic organization.

But, together with the pride that such success awakens, we must not rest in the comfortable bed of complacency. Rather, we must remain critical, dissatisfied, and attentive to attain the multiple goals that we have not yet achieved. The spirit of ANCAM, since it was born, has been inclusion, democracy, and acceptance of diversity. Those are the strengths that have brought together other commendable sister associations, with which we make up a formidable body that covers all the vast fields of the basic science, clinical medicine, therapeutics, and prevention, which are the fundamental pillars and foundations of cardiovascular and cardiometabolic science.

Our journal must be at the height of the development of our Association. But that ascent will only be attained with the assistance

and cooperation of all of us. We acknowledge and appreciate the invaluable help and editorial independence that our former Presidents, Drs. José Manuel Enciso Muñoz, Francisco Javier León Hernández, and Pedro Gutiérrez Fajardo, generously gave us. We also want to thank our new President, Dr. Gabriela Borraro Sánchez, for having granted us her trust and support to continue in this difficult but rewarding editorial task. In a short time, the Board of Directors and the Advisory Council of our Association will study a series of actions that the Editorial Committee is proposing to achieve our incorporation to the MEDLINE® and PubMed® database, which will improve the visibility of the scientific material published here.

One of my motivational manias, which reminds that the rainbow is not at the end of the road, but on the road itself, is expressed beautifully in the poem of Robert Frost:

*The woods are lovely dark and deep
But I have promises to keep,
and miles to go before I sleep,
and miles to go before I sleep*

Our Association and its Journal, despite their successes and achievements, still have a long way to go before they can lay down to rest.

The Editorial Committee wishes to thank all those who have made it possible for the journal to continue its path: authors, reviewers, directors, the hard-working and gifted administrative

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To all of them, our most sincere gratitude.

Correspondence to:

Eduardo Meaney, MD, PhD

E-mail: lalitomini1@gmail.com

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Current knowledge of cardiopulmonary resuscitation among the university population of central-western Mexico

Conocimiento actual de la reanimación cardiopulmonar en la población universitaria del centro-occidente de México

José Raúl Nieto-Saucedo,* Agustín Ramiro Urzúa-González,† Alfonso Vivanco-Lira,*§ Ignacio Horta-Padilla,* Salvador Fabián Gutiérrez-Aguirre*

Keywords:

Cardiopulmonary resuscitation, cardiac arrest, sudden death, university, Mexico.

Palabras clave:

Reanimación cardiopulmonar, paro cardiaco, muerte súbita, universidad, México.

* Medical Student at Medicine and Nutrition Department. University of Guanajuato. Leon, Guanajuato. Mexico.

† Cardiologist and Internist, Masters in Hospital Administration and Health Services, Master in Cardiovascular Theory; assigned to the Cardiovascular Intensive Care Unit of the High Specialty Regional Hospital of Bajío (HRAEB). Leon, Guanajuato. Mexico.

§ Mathematics student at Exact Sciences and Engineering Division. Open and Distance Learning University of Mexico. Mexico City, Mexico.

ABSTRACT

Introduction: Out-of-hospital cardiac arrest is a leading cause of global mortality; it is estimated that each year 33,000 to 53,000 people die from sudden death in Mexico. Cardiopulmonary resuscitation (CPR) learning at younger ages has shown promising results, prompting the recommendation of CPR training in the high-school curricula. Currently, there is no information about CPR knowledge in the university population of our country. **Objective:** We aimed at estimating the level of knowledge and attitude towards CPR among the university students of central-western Mexico. **Material and methods:** A cross-sectional, descriptive study was conducted among the students of 30 Mexican university centers between February and March 2020; a self-administered questionnaire was distributed to the participants. All data were collected and statistically analyzed. **Results:** Two hundred ninety-four ($n = 294$) students were included (mean age 21.04 ± 1.95 years). Although 37% of students had been previously trained, only 12.9% could give an accurate description of the CPR technique. Notably, 98.9% of the participants desire to receive additional CPR training, and 57.1% would be willing to act if they had the appropriate prior knowledge. Health science students had the highest number of correct answers among other academic areas ($p = 0.001$). **Conclusions:** Despite the evidence supporting CPR training and familiarization with automated external defibrillators at younger ages, Mexico has no laws to promote them in the high-school curricula. The poor outcomes obtained reinforce the necessity for better health policies and practical CPR training, probably through innovative methods that allow retention of knowledge.

RESUMEN

Introducción: El paro cardiaco extrahospitalario es una causa importante de mortalidad global; se estima que cada año mueren entre 33,000-53,000 personas a causa de muerte súbita en México. El aprendizaje de reanimación cardiopulmonar (RCP) a edades tempranas ha mostrado resultados prometedores, recomendando incluir su entrenamiento dentro del currículum escolar. Actualmente, no existe información acerca del conocimiento en RCP de la población universitaria de nuestro país. **Objetivo:** Estimar el nivel de conocimiento y actitud frente a RCP en estudiantes universitarios del Centro-Occidente de México. **Material y métodos:** Un estudio transversal y descriptivo fue realizado en estudiantes de 30 centros universitarios entre febrero-marzo de 2020, un cuestionario autoadministrado fue distribuido a los participantes. La información fue recolectada y analizada estadísticamente. **Resultados:** Doscientos noventa y cuatro estudiantes ($n = 294$) fueron incluidos (edad media 21.04 ± 1.95 años). Pese a que 37% de los estudiantes había sido previamente entrenado, únicamente 12.9% fue capaz de detallar correctamente la técnica de RCP. Notablemente, 98.9% estaría dispuesto a recibir aprendizaje adicional y 57.1% estaría dispuesto a actuar si tuviera los conocimientos previos adecuados. Los estudiantes de ciencias de salud tuvieron el mayor número de respuestas correctas frente a otras áreas académicas ($p = 0.001$). **Conclusiones:** Pese a la evidencia a favor del aprendizaje en RCP y familiarización con desfibriladores externos automáticos a edades tempranas, México no cuenta con alguna legislación para incluirlo en el currículum escolar medio-superior. Los pobres resultados obtenidos refuerzan la necesidad de mejores políticas en salud y un entrenamiento práctico en RCP, probablemente mediante métodos innovadores que permitan la retención del conocimiento

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INTRODUCTION

Out-of-hospital cardiac arrest (OHCA) is a leading cause of global mortality.¹ It is defined as the loss of functional cardiac mechanical activity, and consequently, loss of systemic circulation outside a hospital. There is no exact data on its incidence in Mexico since a considerable number of events are not registered.² Sudden cardiac death (SCD) is responsible for approximately 30% of all cardiovascular deaths;³ some authors have calculated that approximately 33,000 to 53,000 SCDs occur per year in our country.⁴ Survival rates vary across the world (from 3 to 22%); they depend directly on the skills and knowledge about cardiopulmonary resuscitation (CPR) of the first witness, where the sooner the chain of survival is activated, the higher probability of the victim's survival.^{5,6} Between 10-65% of OHCA victims receive CPR, depending on their geographical situation.⁷⁻⁹

Early and effective CPR can prolong the window of opportunity for successful defibrillation with the presence of shockable rhythms: ventricular fibrillation (VF) or pulseless ventricular tachycardia (pVT). If no care is provided, the chance of survival decreases by 7-10% for every minute of CPR delay.¹⁰ Besides, after survival, the probability of favorable neurological outcomes at one month decreases by 4-8% for every minute of CPR delay.¹¹ For better outcomes, an automatic external defibrillator (AED) must be available to reach the patient in 4-5 minutes,¹² but usually, the first defibrillation by health care providers is delayed beyond this period.¹³ Some Mexican states have implemented cardio-protected areas (ideally any place with the potential to gather more than 500 people at a time) to allow easy access to AEDs.^{6,14}

In our country, the chain of survival is based on identifying the victim, emergency medical services (EMS) activation through the 9-1-1 call requesting an AED, and CPR initiation (hands-only or compressions plus ventilation support).

Despite the effort to teach the population basic CPR techniques, poor outcomes have persisted for almost 30 years.^{1,8} These results can be improved by a coordinated effort to optimize the local chain of survival. Positive

outcomes have been recorded in some regions where weaknesses in the chain are identified and corrected.^{15,16}

The proportion of CPR trained individuals fluctuates in different countries. The main reason for this variation is the difference between various educational systems, such as CPR training as part of the scholar curricula; no time and no interest to learn CPR, afraid of doing something wrong, a fear of legal liability, and other reasons are obstacles that limit the scope of CPR.¹⁷ Developed countries report that even more than half of their university students had been trained in CPR techniques; these countries also show better OHCA outcomes.¹⁸⁻²¹ In contrast, developing countries have shown lower rates of CPR training in their population.^{17,22}

Some authors have proposed to start CPR learning at younger ages, where satisfaction and confidence levels are higher.²³ Evidence supports the implementation of CPR training and the familiarization of how to use an AED at schools;⁵ over the long term, children and teenagers trained in CPR will contribute to the number of adults with knowledge about CPR in the community, increasing the number of witnesses willing to act. Despite the degradation of CPR skills, prior learning improves performance compared with untrained individuals.²⁴

Schools represent an ideal opportunity since they allow access to a large part of the population with a well-defined structure.⁷ However, there are currently no studies assessing the prevalence of university students with knowledge about CPR in Mexico.

Objective: The main goal was to estimate the level of knowledge and attitude towards CPR among the university population of central-western Mexico.

MATERIAL AND METHODS

Study design: A cross-sectional, descriptive study was carried out between February and March of 2020. An anonymous survey made by the authors was used to determine the knowledge about CPR, previous training status, and willingness to learn and act in a real-world scenario. All participants gave their consent to realize this study.

Settings and study subjects: The study was conducted by medical students from the University of Guanajuato. Inclusion criteria were: ≥ 18-years-old students who were enrolled in a university at the moment of the study and adequately answered the survey. All medical students were excluded from the analysis. **Survey instrument:** We used an 11-item question survey made on Google Forms platform that included: age, gender, city, university, career, knowledge of the CPR concept, previous training status, the place where the subject was trained, description of the technique (cardiac arrest identification, activation of EMS and rhythm of compressions), willingness to learn and finally, willingness to act in a real-world scenario. The full-scale instrument is shown in [Table 1](#).

Outcomes: The primary outcome of the study was to assess prior knowledge of the CPR concept and technique. Secondary outcomes were to know where they had previously gained the knowledge, differences among age, gender, university of origin (public or private), and

academic area to which the student belongs (health, economic-administrative, exact sciences and engineering, architecture and design, or social sciences).

Data analysis: We used descriptive statistics to summarize the data; the Microsoft Excel 2010 software was used to organize the data and provide the estimated values. The IBM SPSS software was used to represent the data and compute the Cronbach’s alpha coefficient to obtain the instrument’s internal reliability. The GraphPad software was used to compute the Fisher’s Exact Test values. The χ^2 test with Yates’ correction was performed by hand using the expression $\chi^2 = \sum_{i=1}^n ((O_i - E_i) - 0.5)^2 / E_i$, where O_i stands for the observed data, E_i is the expected value, and 0.5 is the correction value.

RESULTS

We received 312 answered surveys, but only 294 participants (from 30 university centers) who completed the survey adequately and met the criteria were included, demographic features are shown in [Table 2](#); the majority of respondents were female (54.08%), the mean age of the sample was 21.04 years, and 74.14% of the subjects attended public universities; the academic area to which they belong was also assessed, five were distinguished: health sciences (23.12%), economic-administrative (14.96%), exact sciences and engineering (41.94%), architecture, art and design (13.94%), and social sciences (6.46%).

The overall results are in [Table 3](#). Two hundred and fifty students (85%) had ever heard about the CPR concept, but only 37% (n = 109) were trained. Of these 109 participants, 34.9% correctly remembered the CPR technique, while the other 65.1% answered incorrectly. Only 54 of 294 (18.36%) participants were trained at a school; 38 of 294 (12.92%) were able to describe the correct CPR technique; almost all, 291 of 294 (98.97%) were willing to receive additional CPR learning, and finally, 168 of 294 (57.14%) were willing to act in a real-world scenario.

From the last pieces of information and based on the population’s demographic features, we compared the number of correct answers from items I.1-6 between different groups.

Table 1: The survey instrument used to assess demographics, prior knowledge, and attitudes towards the cardiopulmonary resuscitation technique.	
Item	Question
A.1	Age
A.2	Sex
A.3	City in which you study
A.4	University
A.5	Bachelor’s degree
I.1	Are you familiar with the concept of CPR?
I.2	Have you received any training before?
I.3	Where did you receive your prior training?
I.4	Accurate depiction of the technique
I.5	Are you willing to learn?
I.6	Are you willing to be the first one to act with your prior knowledge?

The items A.1-5 assess the population demographic features while the items I.1-6 assess both knowledge and attitudes towards the technique.

Table 2: Demographic features of the interviewed population.

Characteristic evaluated		n (%)
Age	Group	
	≤ 21 years	182 (61.90)
	> 21 years	112 (38.10)
Gender	Female	159 (54.08)
	Male	135 (45.92)
Type of school	Public	218 (74.15)
	Private	76 (25.85)
State	Guanajuato	201 (68.37)
	Queretaro	50 (17.01)
	Michoacan	40 (13.60)
	Others (Jalisco, Mexico City)	3 (1.02)
Area	Exact sciences and Engineering	122 (41.50)
	Health sciences	68 (23.13)
	Economic-Administrative	44 (14.97)
	Architecture, Art and Design	41 (13.94)
	Social sciences	19 (6.46)

We compared the number of correct answers between males and females: 88.89 vs 81.76% had ever heard the concept of CPR ($p = 0.1018$); 39.25 vs 35.22% had received CPR training ($p = 0.5448$); 14.07 vs 22.01% received their formation at school, 22.96 vs 11.94% received their training at a first-aid course, and 2.22 vs 1.25% at another site ($p = 0.0401$), for male and female groups, respectively. The item concerning where was the knowledge obtained, displayed a statistically meaningful difference.

In regards to the age comparison, we distinguished two groups: those with 21.04 years of age or younger and those older than 21.04 years, no statistically meaningful items were found, with an overall amount of correct answers between the younger and the older

group of 54.02 vs 55.80% ($p = 0.4906$); 84.61 vs 85.71% were familiar with the concept of CPR ($p = 0.8673$), and 35.16 vs 40.17% had been trained ($p = 0.4558$), for the younger and the older group, respectively.

When comparing those from private versus public schools, no statistically meaningful differences in the items were found, the percentages of correct answers were: 81.57 vs 86.23% of students were familiar with the concept of CPR ($p = 0.3521$), and 31.57 vs 38.99% had received formation ($p = 0.2722$), for private and public schools, respectively.

Finally, when comparing the academic area to which their college degree belongs, there was a statistically meaningful overall difference in the items 1.1-6 together ($p = 0.001$); when comparing the individual items, only item number 1 (1.1) displayed a statistically meaningful difference: 94.11% of health students, 72.73% of economic-administrative students, 85.24% of exact sciences and engineering students, 82.92% of architecture and design students, and 84.21% of social sciences students were familiar with the concept of CPR ($p = 0.043$).

The remaining items and their percentages are shown in [Table 4](#).

DISCUSSION

Although high-quality CPR has been a significant advance in OHCA care, CPR knowledge levels in Mexico remain low. Bystanders play a crucial role before the EMS arrives;^{8,25} for this reason, the implementation of massive CPR teaching programs seeks to increase the number of bystanders willing to act.

Recently, the American Heart Association (AHA), the European Resuscitation Council (ERC), and the World Health Organization (WHO) endorsed the recommendation to train schoolchildren in CPR.²⁶ There is an international trend in implementing mandatory CPR education in the scholar curricula.²⁷⁻³⁰ Consequently, there is an increase in training at younger ages; interestingly there is also a demonstrated increase in training at all ages, which has suggested a greater diffusion, awareness, and initiative for CPR training among adults, even schoolchildren could reach relatives and friends.^{31,32}

In our study, 12.9% of all university students knew the correct CPR technique and 37% had been trained in CPR at some point in their lives, nonetheless only about a third (34.8%) of them were able to describe the CPR technique correctly, reflecting a lack of knowledge retention even among trained students. CPR teaching could be improved with the implementation of high-fidelity medical simulation programs, attached to current guidelines.³³

Compared with other series, our cohort has lower rates of previous CPR training against developed and high-income countries (as Norway, Denmark, USA, Portugal, and Japan)^{19,21,28,29,31} but is similar to those found in upper-middle, lower-middle and low-income countries (as China, Turkey, and Malaysia).^{17,34} Unfortunately, to this date, Mexico has no programs

to implement mandatory CPR training in the scholar curricula; we face several barriers to improve these health policies, especially their economic cost and trainer availability.³⁵

Although we did not find a significant difference between students' knowledge from the public and private universities, socioeconomic status is likely a key determinant of access to CPR learning and survival rates,^{27,36} since many low-income students fail to reach a university education, we do not know their current status in our country. This problem also represents the situation in low-income cities and neighborhoods, where the impact of cardiac disease is disproportionately felt. Gender may play a role in the acquirement of CPR knowledge since one item was found statistically significant ($p = 0.0401$), showing that the

Table 3: Overall survey results about knowledge and attitude towards cardiopulmonary resuscitation.

Item assessed	Answer	n (%)
Are you familiar with the concept of CPR?	Yes	250 (85.03)
	No	44 (14.97)
Have you received any CPR training before?	Yes	109 (37.07)
	No	185 (62.93)
If so, where did you receive your prior training?	School	54 (49.54)*
	First-aid course	50 (45.87)*
	Other (work, by a relative)	5 (4.59)*
Accurate depiction of CPR technique (identification, activation of EMS and rhythm of compressions)	Correct	38 (12.93)
	Incorrect	71 (24.15)
	Not answered	185 (62.92)
Are you willing to learn?	Yes	291 (98.98)
	No	3 (1.02)
With the previously acquired knowledge, would you be willing to act in a real-world scenario?	Yes	168 (57.14)
	No	13 (4.42)
	I am not sure	113 (38.44)

CPR = cardiopulmonary resuscitation, * Over the n = 109 trained.

Table 4: Breakdown of the frequencies of correct answers obtained per group compared.

N = 294 subjects n (%)			
Item	Male n = 135	Female n = 159	p value (Fisher's exact test)
Overall	506/810 (62.46)	589/954 (61.74)	0.164
I.1	120 (88.89)	130 (81.76)	0.1018
I.2	53 (39.25)	56 (35.22)	0.5448
I.3			
School	19 (14.07)	35 (22.01)	0.0401*
First-aid course	31 (22.96)	19 (11.94)	
Other	3 (2.22)	2 (1.25)	
I.4	18 (13.34)	20 (12.57)	0.8632
I.5	132 (97.78)	159 (100.00)	0.0957
I.6	82 (60.74)	86 (54.08)	0.2875
Groups compared by gender n (%)			
Item	≤ 21.04 years-old n = 182	> 21.04 years-old n = 112	p value (Fisher's exact test)
Overall	590/1,092 (54.02)	375/672 (55.80)	0.4906
I.1	154 (84.61)	96 (85.71)	0.8673
I.2	64 (35.16)	45 (40.17)	0.4558
I.3			
School	33 (18.13)	21 (18.75)	0.7919*
First-aid course	28 (15.38)	22 (19.64)	
Other	3 (1.64)	2 (1.78%)	
I.4	25 (13.73)	13 (11.60)	0.7209
I.5	180 (98.90)	111 (99.10)	1
I.6	103 (56.59)	65 (58.03)	0.9035
Groups compared by age n (%)			
Item	Private school n = 76	Public school n = 218	p value (Fisher's exact test)
Overall	235/456 (51.53)	730/1,308 (55.81)	0.1261
I.1	62 (81.57)	188 (86.23)	0.3521
I.2	24 (31.57)	85 (38.99)	0.2722
I.3			
School	15 (19.73)	39 (17.88)	0.3593*
First-aid course	8 (10.52)	42 (19.26)	
Other	1 (1.31)	4 (1.83)	
I.4	7 (9.21)	31 (14.22)	0.3234
I.5	75 (98.68)	216 (99.08)	1
I.6	43 (56.57)	125 (57.33)	1
Groups compared by school type (private vs public) n (%)			

Continue to Table 4: Breakdown of the frequencies of correct answers obtained per group compared.

Item	H n = 68	EA n = 44	EI n = 122	AD n = 41	S n = 19	p value (χ^2 test)
Overall	259/408 (63.48)	128/264 (48.49)	386/732 (52.73)	130/246 (52.84)	62/114 (54.83)	0.0010
I.1	64 (94.11)	32 (72.73)	104 (85.24)	34 (82.92)	16 (84.21)	0.0438
I.2	35 (51.47)	13 (29.54)	39 (31.96)	15 (36.58)	7 (36.84)	0.0755
I.3						
School	20 (29.41)	7 (15.9)	14 (11.47)	8 (19.51)	5 (26.31)	< 0.1000 [‡]
First-aid course	15 (22.05)	6 (13.63)	23 (18.85)	4 (9.75)	2 (10.52)	
Other	0	0	2 (1.63)	3 (7.31)	0	
I.4	14 (20.58)	3 (6.81)	13 (10.65)	6 (14.63)	2 (10.52)	0.2171
I.5	68 (100)	44 (100)	120 (98.36)	40 (97.56)	19 (100)	> 0.9950 [‡]
I.6	43 (63.52%)	23 (52.27)	71 (58.19)	20 (48.78)	11 (57.89)	0.6114
Groups compared by academic area to which their bachelor's degree pertains, n (%)						

The first line after depicting the group corresponds to the amount of overall correct answers, with a total amount of 1,764 answers; (H = health sciences students, EA = economic administrative students, EI = exact sciences and engineering students, AD = architecture, art and design students, S = social sciences students); * Indicates the computation of the probabilities by the χ^2 test, [‡] Indicates that the Yates' correction has been addressed to compute the probabilities; bold characters indicate the item as being statistically significant.

place where CPR concepts are learned, could be influenced by gender, where more women gain their knowledge at schools, and more men gain their CPR knowledge at first-aid courses. The academic area seems to influence general knowledge about CPR, based on a statistically significant difference observed regarding all of the correct answers ($p = 0.001$), where health sciences students had the highest score and economic-administrative students the lowest. However, despite this difference, their results remained suboptimal. From this, we gather that both gender and the academic area may play a role in knowledge and attitudes towards CPR.

Sasson et al.⁸ estimate that the number needed to treat (NNT) to survive OHCA due to bystander CPR initiation is between 24 to 36. However, fear of harming the victim, doing mouth-to-mouth breathing, and lack of self-confidence in their abilities remain as significant limitations in our environment.³⁵ Studies have shown that compression-only CPR is effective and can improve survival outcomes;³⁷ this is supported because when

cardiac arrest occurs, the average healthy adult has 2 liters of oxygen in his body. Oxygen consumption is approximately 250 cm³ per minute; thus, this well-oxygenated patient has approximately 8 minutes' worth of oxygen within the body, making chest compressions the main CPR action.³⁸ For that reason, the AHA has changed their CPR algorithm from A-B-C (Airway-Breathing-Circulation) to **C-A-B** since 2010,³⁹ to make sure we provide a high-quality technique, with an adequate chest compression depth (5-6 centimeters) and rate (100-120/minute).

The vast majority (98.9%) of the subjects are willing to learn how to save a life through CPR; nevertheless, their willingness to act in a real-world scenario drops to 57%, data which reflects the interest of the university population to learn CPR in an environment with a lack of opportunities to do so, where 62.9% of the sample had not received CPR training despite attending university. These results should be interpreted as an incentive to promote further private and public initiatives that seek to train the population in resuscitation maneuvers.

Limitations

This study had several limitations. Firstly, the sample used may not represent the entirety of the Mexican population, considering that the participants are directly related to a higher education level, this may lead to overestimated scores, which may be addressed in the future by promoting a more heterogeneous sample. Secondly, the evaluation of theoretical knowledge may not reflect the real practical skills of the participants. Thirdly, no different items were used to assess the CPR technique step by step. Finally, the instrument was tested for internal reliability using the computation of Cronbach's alpha coefficient; our instrument displayed $\alpha < 0.7$, however, this coefficient is dependent on the number of items, being the number of items ω , $\omega > 10$ is desired to allow the coefficient to determine the internal reliability of the instrument more precisely.⁴⁰ Currently, information about CPR in Mexican schools is quite limited. Further work will have to be promoted in this and other populations to determine the current status in our country.

CONCLUSIONS

Despite the evidence in favor of learning CPR and AED use at younger ages, Mexico has no laws to promote CPR training in the high-school curricula. This population may represent an excellent opportunity to increase the rate of victims receiving adequate care outside a hospital with CPR and early defibrillation in the future. The poor outcomes obtained in this study reinforce the necessity for better health policies and practical CPR training, probably through innovative methods that allow retention of knowledge.

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Correspondence to:

José Raúl Nieto-Saucedo

Universidad de Guanajuato Campus León.

División de Ciencias de la Salud,

Blyd Cañaveral Núm. 1001,

Fracciones de los Aguirre, 37672,

León, Gto. México.

Tel: 417 100 7976

ORCID: 0000-0002-8429-4530.

E-mail: jr.nietosaucedo@ugto.mx



Radiofrequency ablation as a treatment for tachycardiomyopathy induced by premature ventricular contractions in the tricuspid annulus

Ablación con radiofrecuencia como tratamiento para taquicardiomiopatía inducida por complejos ventriculares prematuros originados en el anillo tricuspídeo

Heberto Aquino Bruno,* Yeiscimin Sánchez Escobedo,*
Mariana Lourdes Añas Méndez,* Karla Ivette Bozada Nolasco,* Carlos De la Fuente Macip,*
Arturo Enríquez Silverio,* Ulises Rojel Martínez†

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Palabras clave:

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* Electrophysiology
and Cardiac Stimulation
Laboratory.
† President of
SOMEEC. Chief of
Electrophysiology and
Cardiac Stimulation
Laboratory.

Puebla General Hospital
«Dr. Eduardo Vázquez
Navarro», Health
Services of the State
of Puebla, Mexico.

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ABSTRACT

Introduction: Most ventricular arrhythmias are related to structural heart disease. When they occur in anatomically normal hearts are known as idiopathic arrhythmias. The highest percentage of premature ventricular complexes (PVC) is originated in the right ventricular outflow tract. However, less frequent sites have been described, such as the tricuspid annulus. Irregular rhythm along with a high percentage of arrhythmic burden (AB) have an important role in the deterioration of left ventricular function. **Objective:** To describe the return to normal ventricular function after PVC radiofrequency ablation (RFA). **Case study:** A 75-year-old man, without relevant history, presented with mild exertion dyspnea and frequent palpitations. The physical examination was normal, the 12-lead electrocardiogram showed premature ventricular contractions with a left bundle branch block (LBBB) pattern and superior axis. A Holter monitoring documented a 35% arrhythmic burden and transthoracic echocardiography demonstrated an LVEF of 40% and global hypokinesia, without valvular heart disease. An electrophysiological study was conducted with three-dimensional mapping that observed the origin of the PVC at the septal tricuspid annulus. RFA was performed in this area, resulting in the immediate disappearance of PVC. **Results:** At 3 months a 24-hour Holter monitoring showed 0.02% of AB and a transthoracic echocardiogram showed LVEF of 65%. **Conclusion:** Premature ventricular contractions originating from the tricuspid annulus are an uncommon cause of tachycardiomyopathy and RFA treatment is safe and effective.

RESUMEN

Introducción: La mayoría de las arritmias ventriculares están relacionadas con patología estructural del corazón; cuando ocurren en corazones anatómicamente normales se consideran arritmias idiopáticas. El mayor porcentaje de los complejos ventriculares prematuros (CVP) se atribuyen al tracto de salida del ventrículo derecho; sin embargo, se han identificado sitios menos frecuentes como el anillo tricuspídeo. La asincronía y el ritmo irregular junto con un alto porcentaje de la carga arritmica (CA) tienen un rol importante en el deterioro de la función ventricular izquierda. **Objetivo:** Describir la normalización de la función ventricular posterior a ablación con radiofrecuencia de los CVP. **Caso clínico:** Hombre de 75 años de edad, sin antecedentes de importancia; acudió por presentar disnea de medianos esfuerzos y palpitaciones frecuentes. La exploración física fue normal, el electrocardiograma de 12 derivaciones mostró CVP con patrón de bloqueo de rama izquierda; un monitoreo Holter documentó 35% de carga arritmica, un ecocardiograma transtorácico reportó FEVI de 40% e hipocinesia generalizada, sin valvulopatías. Se decidió realizar estudio electrofisiológico con mapeo tridimensional, donde se observó el origen de las CVP a nivel del septal del anillo tricuspídeo, se procedió a ablación con radiofrecuencia en dicha zona, lo que mostró desaparición inmediata de las extrasístoles. **Resultados:** A los tres meses, un monitoreo Holter de 24 h reportó sin evidencia de arritmias ventriculares y un ecocardiograma transtorácico demostró FEVI de 65%. **Conclusión:** Los complejos ventriculares prematuros del anillo tricuspídeo son una causa rara de cardiomiopatía, el tratamiento mediante ablación con radiofrecuencia es una terapia eficaz y segura.

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Abbreviations:

- PVC = Premature ventricular complexes.
- AB = Arrhythmic burden.
- LVEF = Left ventricular ejection fraction.
- IVA = Idiopathic ventricular arrhythmias.
- TA = Tricuspid annulus.
- AiTCM = Arrhythmia-induced tachycardiomyopathy.
- LVD = Left ventricular dysfunction.
- VE = Ventricular extrasistoles.
- RFA = Radiofrequency ablation.
- LBBB = Left bundle branch block.

Abreviaturas:

- CVP = Complejos ventriculares prematuros.
- CA = Carga arritmica.
- FEVI = Fracción de expulsión de ventrículo izquierdo.

INTRODUCTION

Most ventricular arrhythmias are associated with structural heart disease, primarily of ischemic etiology. However, a small subset occurs in patients with anatomically healthy hearts and are known as idiopathic arrhythmias.¹

Although idiopathic ventricular tachycardias (IVT) were previously considered benign and non-life-threatening, there is currently evidence that frequent premature ventricular complexes (PVC) are associated with a substantial increase in the risk of sudden cardiac death.² Also, it has been reported that between 9% and 34% of patients with IVT develop tachycardiomyopathy.^{3,4} The majority of PVC originate in the right ventricle outflow tract,^{5,6} however, others such as the tricuspid annulus (TA) have been identified as less frequent sites, accounting for between 8-9% of cases.⁶⁻⁸

Arrhythmia-induced tachycardiomyopathy (AiTCM) is defined as a reduced left ventricular ejection fraction (LVEF) \leq 50% in the absence of any underlying heart disease, with an improvement in LVEF of \geq 15% after effective ventricular arrhythmia treatment.⁹

Radiofrequency ablation (RFA) treatment is advised when an idiopathic ventricular arrhythmia occurs together with left ventricular dysfunction (LVD).¹⁰⁻¹²

The following case shows a patient that presented symptomatic PVC's originating in the TA who underwent RFA.

CASE PRESENTATION

A 75-year-old man, without relevant history, presented with mild exertion dyspnea and palpitations. The physical examination was normal, the 12-lead electrocardiogram showed premature ventricular contractions with a left bundle branch block pattern, normal axis, QS in V1, transition zone between V2-V3, R in D1 and aVL, QS in aVR, which suggested an origin in the tricuspid annulus (Figure 1). A Holter monitoring, documented a 35% arrhythmic burden and transthoracic echocardiography demonstrated an LVEF of 40%, global hypokinesia, and diastolic dysfunction type I without structural heart disease. An electrophysiological study was performed using EnSite Precision

Abbott® three-dimensional mapping software (Figure 2). The study showed fragmented and low amplitude electrograms (100 ms duration and $<$ 1 mV) and the precocity index of the ventricular electrogram (-28 ms) in the septal region of the tricuspid annulus (Figure 3). An irrigated FlexAbility™ Abbott® catheter was used to RFA of 30 W with a temperature limit of 25 °C. The PVC's disappeared during the administration of RFA (Figure 4). Programmed ventricular stimulation was performed, with and without dobutamine infusion, without inducing contractions, neither other ventricular arrhythmias.

Fluoroscopy time was 26 minutes and there were no complications during the procedure. At 3 months, a 24-hour Holter monitoring was performed without evidence of ventricular arrhythmias. The AB was reduced from 35% to 0.02% with otherwise morphology from PVC's

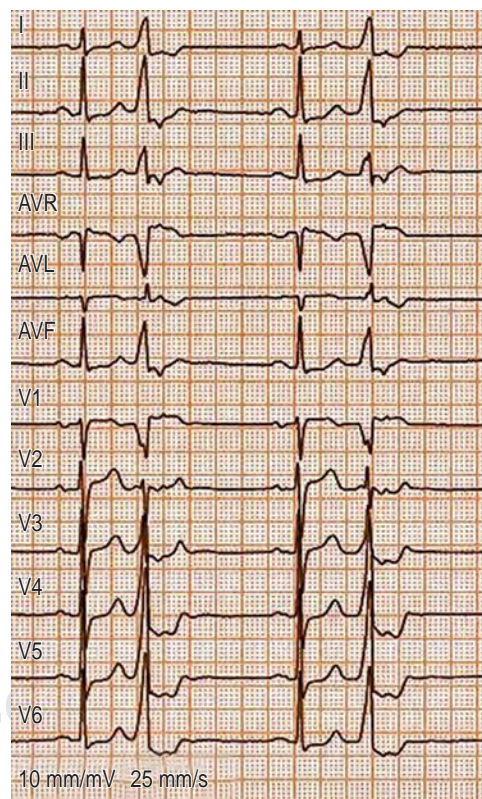


Figure 1: Contractions with a left bundle branch block pattern, normal axis, QRS duration 120 ms transition zone between V2-V3 and QS in V1 (TA septal region), R in DI and aVL, QS in aVR.

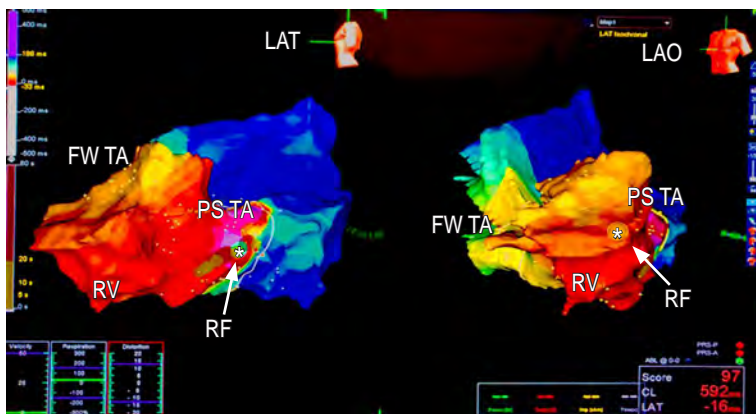


Figure 2: Three-dimensional map made with the EnSite system®, localization of the tricuspid annulus with contractions originating at the posteroseptal level (*). The red color represents the origin of the arrhythmia, the degradation towards blue and violet, are the regions where it is depolarized a later way. LAO = left anterior oblique projection; LAT = lateral projection; PS TA = posteroseptal TA; FW TA = free wall TA; RV = right ventricle; RF = radiofrequency; RV = right ventricle; RF = radiofrequency target foci.

treated and a transthoracic echocardiogram reported LVEF of 65% without mobility impairments. The ectopic focus was eliminated with the recovery of ventricular systolic function.

DISCUSSION

Seventy to eighty percent of PVC originate in the right ventricle outflow tract.^{5,6} Less frequent origin sites such as the TA have been identified and accounting for between 8-9% of cases.

There is low evidence of PVCs originating from the TA due to their low incidence. To locate the site of origin of the arrhythmia, an appropriate electrocardiographic analysis must be performed. There are two studies of patients with PVC originating in the TA.^{7,8} Both coincide with the electrocardiographic characteristics of the PVC of this region, with LBBB patterns that have transition zones in V2-V3 and positive polarity in V6 and DI. There are two previously cases reporting of TA PVCs that were associated with tachycardiomyopathy.^{13,14}

The association of fast and irregular ventricular rhythms with higher AB has been established as the main cause of tachycardiomyopathy.^{11,12,15,16} There is evidence that an AB greater than 10% may result in LVD,^{8,16-18}

however, PVC burden greater than 24% appears to be independently associated with a decreased ejection fraction.¹⁹ In such cases either pharmacological treatment or catheter ablation is necessary.

There are 2 types of AiTCM: type 1, in which arrhythmia is the only cause of tachycardiomyopathy, and left ventricular function returns to normal after successful treatment; type 2 refers to arrhythmic event exacerbates underlying damage, and its treatment results in partial resolution of the tachycardiomyopathy.^{11,16}

The treatment with RFA is recommended and has demonstrated high success rates when arrhythmias are associated with ventricular dysfunction or situations with AB > 10%.¹⁵ Regarding anatomy, treatment has been observed as more effective in patients with structurally healthy hearts and origin in the right ventricle,^{8-11,20} with a success rate between 80% and 90%.

AiTCM patients are often highly symptomatic with a significantly reduced quality of life, hence the importance of timely diagnosis and treatment given the reversibility of ventricular dysfunction.

According to the 2019 expert consensus statement of ventricular arrhythmias,²¹ catheter ablation is recommended in patients with cardiomyopathy caused by PVC predominantly monomorphic, frequent, and for whom antiarrhythmic drugs are ineffective, not tolerated, or not preferred for long-term therapy (class I).

Different reports have shown that, after undergoing ablation treatment, patients with

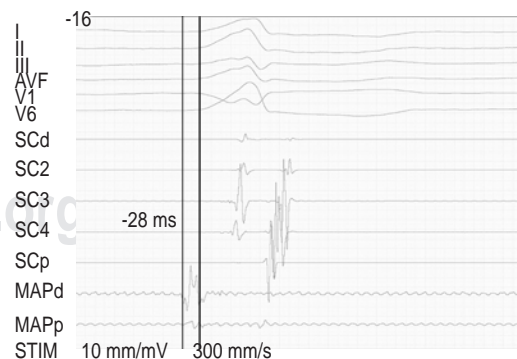


Figure 3: Intracavitary electrograms with maximum precocity of -28 ms.

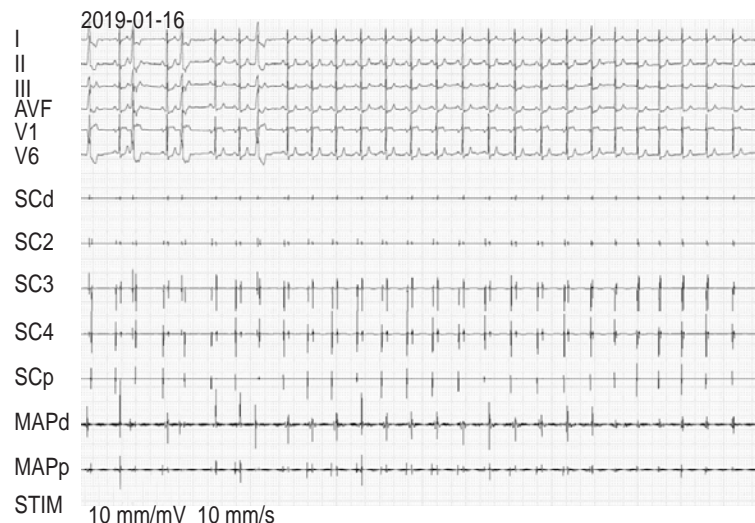


Figure 4: Disappearance of contractions after the application of radiofrequency of 30 W with a temperature limit of 25 °C.

tachycardiomyopathy experience ejection fraction recovery within the first 12 weeks, so it is recommended to perform an echocardiogram and Holter monitor control 3 months after ablation.²¹⁻²³

The patient described in this report had an initial AB of 35% and an echocardiogram reported an LVEF of 40% without evidence of ischemia or structural alteration. After undergoing RFA, follow-up tests were performed at 3 months demonstrating a decrease in arrhythmic burden (0.02%) and the LVEF increased to 65%, thus complying with the criteria of AiTCM type 1.

CONCLUSIONS

Premature ventricular contractions originating from the tricuspid annulus are an uncommon cause of type 1 cardiomyopathy. High arrhythmic burden is the main determinant for ventricular dysfunction. Radiofrequency ablation is safe, effective, and indicated for patients in whom antiarrhythmic drugs are ineffective, not tolerated, or not preferred for long-term therapy.

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Correspondence to:

Dr. Heberto Aquino Bruno

Electrophysiology and Cardiac Stimulation Laboratory,
Puebla General Hospital «Dr Eduardo Vázquez Navarro»,
Health Services of the State of Puebla,
Mexico.

Antiguo Camino Guadalupe Hidalgo 11350,
Guadalupe Hidalgo, 72490,
Puebla, Puebla, Mexico.

Tel: +52 222 112 35 29

E-mail: ha_bruno11@hotmail.com



Pre-syncope and ablation of moderator band premature ventricular contraction

Pre-síncope y ablación de la contracción ventricular prematura con origen en la banda moderadora

William-Fernando Bautista-Vargas*

Keywords:

Ventricular premature complexes, syncope, catheter ablation.

Palabras clave:

Complejos prematuros ventriculares, síncope, ablación por catéter.

ABSTRACT

Introduction: Premature ventricular complex (PVC) is a frequent diagnostic entity. The underlying cardiac condition is important to establish a prognosis; in the majority of the cases with normal heart, PVCs have a good prognosis; nevertheless, there is a specific morphology of PVC related to serious cardiac issues. The moderator band (MB) PVCs are one of these, described in a normal heart condition; however, MB- PVC can lead to ventricular tachycardia, ventricular fibrillation, or even sudden cardiac death. **Material and methods:** The case of a 25-year-old female patient with very symptomatic, precordial palpitations is presented with a history of presyncope. The workflow showed a normal transthoracic echocardiogram, normal cardiac MRI, and evidence of bigeminy cardiac rhythm even an unstable ventricular tachycardia induction in an electrophysiology study. She was taken to ablation therapy, PVCs from the moderator band were found with the highest activation of -52 ms, the use of intracardiac echocardiogram, and successful ablation in an uncommon PVC location is reported. **Results:** The radiofrequency ablation therapy with 35 watts and 42 °C at the highest activation point on the lateral aspect of moderator band (MB) was successful therapy with the induction of ventricular tachycardia during the application of radiofrequency as a result finish of PVCs. **Conclusions:** In patients with pre-syncope, syncope, and even aborted sudden cardiac death secondary to ventricular tachycardia or ventricular fibrillation premature ventricular complexes should be addressed with an invasive strategy as RF ablation therapy with the aim of finish a trigger condition. The moderator band is considered an arrhythmogenic structure, PVCs coming from a MB should be addressed as potential death risk and invasive therapy should be considered earlier than antiarrhythmic drugs.

RESUMEN

Introducción: El complejo ventricular prematuro (CVP) es una entidad de diagnóstico frecuente. La condición cardíaca subyacente es importante para establecer un pronóstico; en la mayoría de los casos con un corazón normal, los CVP tienen un buen pronóstico; sin embargo, existe una morfología específica de éstos relacionada con problemas cardíacos graves. Los CVP de la Banda Moderadora (MB) son uno de éstos, descritos en una condición cardíaca normal; sin embargo, los CVP de la Banda Moderadora pueden llevar a una taquicardia ventricular, fibrilación ventricular o, incluso, muerte súbita cardíaca. **Material y métodos:** Paciente de 25 años con palpitaciones precordiales muy sintomáticas se presenta con un historial de presíncope. El flujo de trabajo mostró un ecocardiograma transtorácico normal, una resonancia magnética cardíaca normal y evidencia de un ritmo cardíaco bigémico; incluso una inducción de taquicardia ventricular inestable en un estudio electrofisiológico. Se llevó a terapia de ablación, se encontraron CVP de la banda moderadora con la activación más alta de -52ms, el uso de ecocardiograma intracardiaco, y se informa de una ablación exitosa en un lugar poco común de CVP. **Resultados:** La terapia de ablación por radiofrecuencia con 35 watts y 42°C en el punto de activación más alto en el aspecto lateral de la banda moderadora (BM) fue una terapia exitosa con la inducción de taquicardia ventricular durante la aplicación de la radiofrecuencia como resultado del acabado de los CVP. **Conclusiones:** En los pacientes con muerte cardíaca súbita pre-síncope, síncope e incluso abortada secundaria a taquicardia ventricular o fibrilación ventricular, los complejos ventriculares prematuros deben ser abordados con una estrategia invasiva como la terapia de ablación por radiofrecuencia, con el objetivo de terminar con una condición desencadenante. La banda moderadora se considera una estructura arritmogénica, los CVP provenientes de una BM deben ser abordados como un riesgo potencial de muerte y la terapia invasiva debe ser considerada antes que los medicamentos antiarrítmicos.

* Head of Department of Electrophysiology. St. Sophia Hospital. Manizales, Caldas, Colombia.

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INTRODUCTION

The prevalence of premature ventricular complex (PVC) is determinate by a diagnostic method. Nowadays more people are been using a cardiac monitoring wrist for sports or lazy activities, and it is common to hear about PVC in general populations, it seems that in a few hours of using a monitoring device as a rule almost everyone will have a PVC, not specific data have been published regarding the prevalence of wrist monitoring device.¹ Other modalities are reported: in a study of 122,043 subjects using a conventional electrocardiogram (ECG) for about 48 seconds the prevalence of PVC was reported in 0.8%.² In another study using a 2 minutes ECG monitoring in 13,456 subjects with no history of heart failure and no coronary disease, it is reported a prevalence of 5.5% of PVC.³

The symptoms, PVC burden (percentage in a 24 hours Holter), and the presence of structural heart disease are important information to consider to bring the right treatment.¹ A broad symptom can be present from the skyped precordial chest palpitations to ventricular tachycardia even ventricular fibrillation and sudden cardiac death. As a handy approach, the PVC burden in a 24 hours Holter (10% or more) can be used as an indication to proceed to further therapy with an invasive strategy if there is a cardiomyopathy risk or monitoring medication treatment if the PVC burden is not significant.⁴ There are different tools to figure out if there is or not a normal heart; the ECG brings the information of underline diseases, the

echocardiogram, and more recently the cardiac MRI are useful tools to clarify further conditions; even though the structural heart disease has a hard impact into the prognosis, there is on the contrary PVC with normal heart related with ventricular tachycardia (VT), Ventricular Fibrillation (VF), even Sudden Cardiac Death (SCD).¹

The moderator band premature ventricular complex is a potentially dangerous entity, even with a low PVC burden can lead to VT, VF, or SCD in which cases the prevalence is reported up to 2.5%;^{5,6} nonetheless, there are no data in the general population, further investigation is needed to clarify the epidemiological data.

CASE PRESENTATION

A 25-year-old lady presented to the emergency room complained of precordial palpitations skipped beats like; related to pre-syncope feeling but nor loss of consciousness. Despite she was on metoprolol 50 mg bid and propafenone 150 mg bid, her symptoms were uncontrolled. In the last year, she was admitted several times to the emergency room in a different institution because of pre-syncope episodes, and even had an EP study that concludes unstable ventricular tachycardia which was not able to be ablated due to patient due to the instability of the patient hemodynamic and was planned to implant an implantable loop recorder, and keep on medication. During the follow up she was transferred to our clinic and complained of developing much more severe symptoms with ventricular bigeminy rhythm even with a short coupling interval, so it was planned to

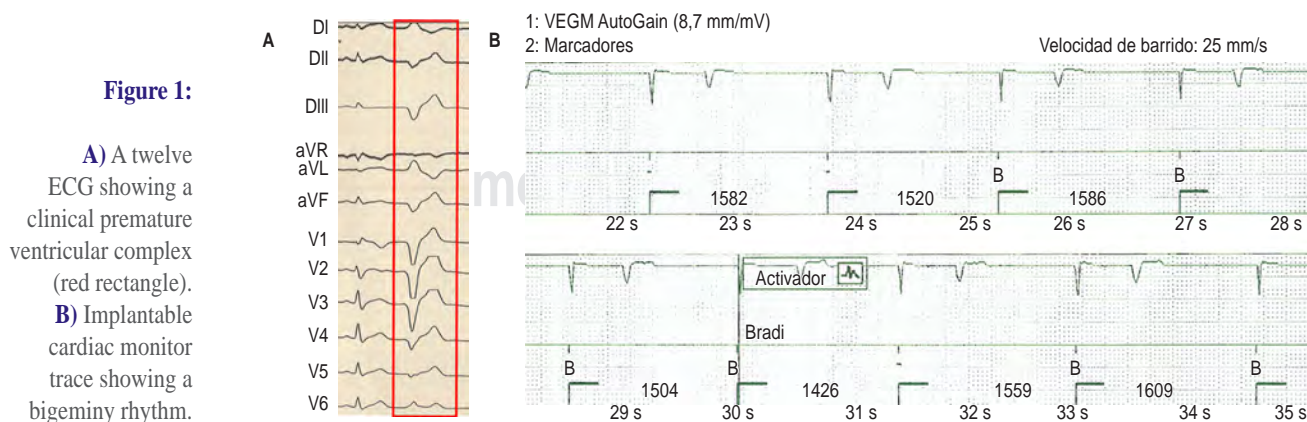
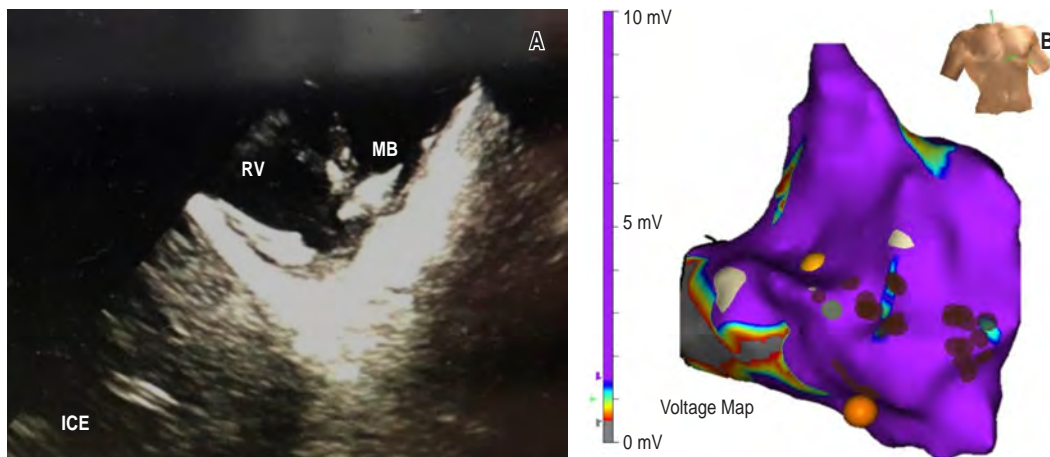


Figure 2:

- A)** Intracardiac echocardiogram (ICE) of the right ventricle (RV) showing a moderator band (MB).
- B)** Voltage map scale (0.5-1.5 mv) showing a normal voltage map.



hospitalize the patient since the medication is not effective.

The electrocardiogram showed ventricular bigeminy, with narrow ventricular premature contractions that are negative in DII, DIII, aVF, aVR, positive in aVL, DI, and V1 with a late precordial transition at V6 (Figure 1). She also had a normal transthoracic echocardiogram, there was no late enhancement in the cardiac MRI, even a normal coronary angiogram. Finally, the patient was taken for an electrophysiology study since she was symptomatic and there was no improvement of her condition on medication.

All medications were discontinued five half-lives, and on the day of the procedure she was in a fasting state, she was taken to Electrophysiology Laboratory with a bigeminy rhythm. Bilateral femoral groin accesses were performed, then a coronary sinus catheter was advanced, an intracardiac echocardiogram probe was used and a bidirectional irrigated catheter, D-F catheter, and Duo-Decapolar catheter were used too. During intracardiac echocardiogram visualization, it was noted a hyper-refringent on the moderator band, then the 3D mapping using the Ensite system (St. Jude Medical, St. Paul, Mn, USA) was performed. During the voltage map, there was no scar noted (Figure 2) and during the activation map we found a -52 ms activation at the inferior part of the moderator band, then ablation was performed with 35 watts and 42 °C lead to a rapid, stable ventricular tachycardia that was terminated immediately during ablation and disappearance of the PVCs, and as a result, we decided to

apply consolidation points of ablation on that area, with a good outcome. At the end of the procedure, the patient was on sinus rhythm and the implantable loop recorder interrogation during the follow-up did not show any ventricular premature contractions (Figure 3).

DISCUSSION

The moderator band first described as a structure to protect the right ventricle from distention,⁷ goes from the lateral free wall to the septum, it is a muscle structure that courses inferiorly from the right ventricular septum to the base of the anterior papillary muscle of the tricuspid valve,^{8,9} and it is histologically composed by a complex sheaths structure as well as myocardium and more density of specialized Purkinje cells, than the rest of the right ventricle,¹⁰ considered as an important structure because contains a right atrioventricular bundle. Loukas and col. in a morphological study have been classified into five different types from a very thick muscular structure to the absence of the moderator band, they described a mean of the thickness of 4.5 ± 1.8 mm and mean of length of 16.23 ± 2.3 mm.¹¹ The arterial irrigation of the moderator band is from branches of the left coronary system can be found from the second anterior septal artery up to 72% of the cases, 18% from the first anterior septal artery, and 7% from the third anterior septal artery.⁸

The moderator band is considered as a source of potentially fatal arrhythmias as ventricular tachycardia or ventricular fibrillation.¹²

The right band moderator PVC is a rare entity, the prevalence is estimated at 2.5%; however, could be more because the patients who died as a result of this arrhythmia are not counted in the clinical studies; the concern of this kind of arrhythmia is that can lead to ventricular fibrillation and eventually death if there is a delay in the treatment.⁶

The PVC from MB has a LBBB morphology with a left superior axis, and late transition typically from V4 and forward; moreover it can be different if the heart anatomy has congenital variations as it was described by Yasumoto in a patient with corrected transposition of great arteries, where the morphology of PVC was RBBB like.^{13,14}

Treatment of moderator band PVC could be tricky, typically the antiarrhythmic drugs do not work very well because high doses are required and the chance of secondary effects are more likely to be present,¹⁵ with no guarantee of total PVC suppression, as a result, invasive strategy with catheter ablation could be considered as a first option.¹⁶

The ablation is an effective strategy to treat a moderator band premature ventricle contractions, the 3D mapping and intracardiac

echocardiogram are used not only as helping tools to ensure a good definition and contact between catheters and tissue but also to improve ablation lesion and effectiveness and safeness of therapy.⁶

Mapping PVC from MB could be an issue, therefore some strategies should be considered to increase the chance of success as medication drips used during mapping a PVC as isoproterenol or dobutamine iv, pacing during mapping to induce PVC, pace mapping approaches, even using multipolar catheters as Pentaray (Biosense Webster, Diamond Bar, California), to collect as many activation points as you can on one touch.¹⁷

The moderator band contains Purkinje system cells is consider a potentially arrhythmogenic structure, PVC from this structure can lead to a ventricular fibrillation; ablation can be a real challenge to a electrophysiologist;¹⁸ even though, there are several aspects to consider: first the best target is difficult to achieve described as the identification of preceding Purkinje potential, pre ventricular activation, concordant morphology with pace mapping; second: stability is difficult to achieve in this structure, some strategies are been proposed:

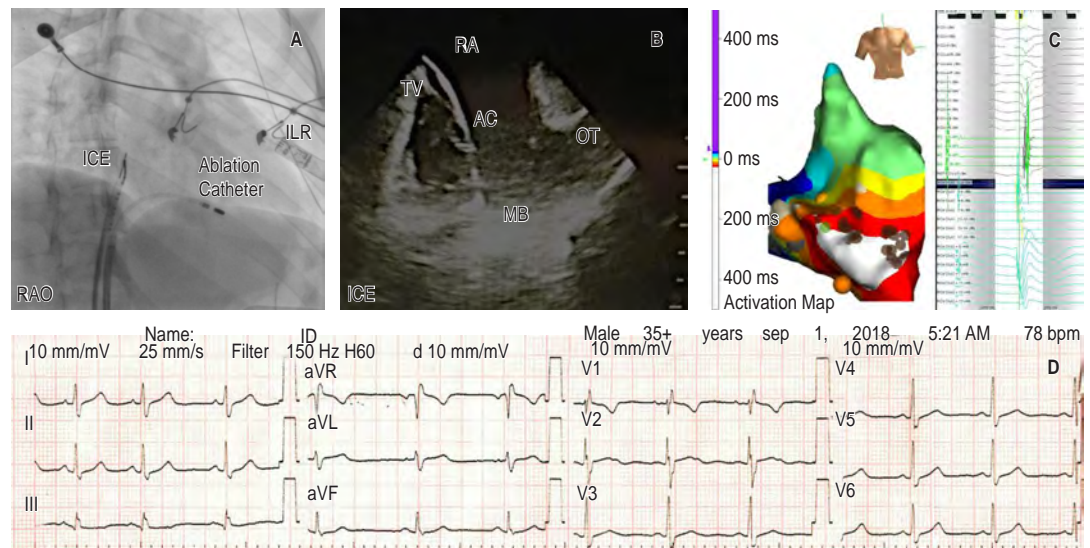


Figure 3: **A)** Right anterior oblique fluoroscopic projection (RAO), showing ablation catheter (AC) at the moderator band (MB). **B)** Intracardiac echocardiogram (ICE) showing the ablation catheter. **C)** Activation map showing the point with the highest precocity -54 ms. **D)** First day ECG with sinus rhythm without premature ventricular contractions (PVC) ILR: implantable loop recorder (ICE), right atrium (RA), tricuspid valve (TV), outflow tract (OT).

using a tridimensional mapping, intracardiac echocardiogram, even cryo catheters to freeze de area,¹⁹ or a strategy who includes: a 3D mapping, ICE, radiofrequency and 23 mm balloon to cryoablation (freezing up to 4 minutes up to -47 °C) has been reported in the setting of a patient with already two failed procedures with successful results,²⁰ at last but not less the ablation with RF or Cryo could be trigger VF or VT, as a destruction of conduction cells during applications.¹⁹

The percentages of the patients who might need a second procedure have been reported up to 60%; and the possible reasons to explain failed procedures or turn an early successful ablation into a fail therapy with increasing of PVC burden are: poor tissue contact with ablation catheter, lack of stability, insufficient deep lesions during ablation, and change of PVC exit (as a result of ablation points); though, a failed procedure can be dangerous to the patient if the clinic is syncope or even ventricular tachycardia or ventricular fibrillation.⁶

CONCLUSIONS

Nowadays the diagnosis of a premature ventricular complex is more common; even though, some specific PVC morphologies should have a more careful follow-up, because of the direct association with ventricular tachycardia, ventricular fibrillation, or even sudden cardiac death, especially the majority of these PVCs are not even symptomatic. The moderator band PVCs are a potentially risky entity and typically presented in a normal heart; moreover, further evaluation is always needed. Ablation therapy should be considered as a first therapy even though there is not a significant PVC burden in patients with a history of pre-syncope, syncope, or severe symptomatic episodes not controlled with antiarrhythmic drugs.

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Correspondence to:**William-Fernando Bautista-Vargas**Carrera 23 #65^a-41 Consultorio 904,

ZIP code: 170003, Manizales,

Caldas, Colombia.

Phone: +573125315075

E-mail: Williambautista679@icloud.com

www.medigraphic.org.mx



Is coronary artery myocardial bridging always a benign condition?

¿Los puentes musculares arteriales coronarios son siempre una condición benigna?

Coral Serrano Arroyo,* Denisse Guzmán Ramírez,† Eva del Carmen Palacios García‡

Keywords:

Myocardial bridge, acute coronary syndrome, cardiogenic shock.

Palabras clave:

Puentes musculares, síndrome coronario agudo, choque cardiogénico.

ABSTRACT

Introduction: The myocardial bridging (MB) is a rare clinical entity, with a prevalence of 0.15-16% in angiographic series and 5-86% in autopsy series; considered of benign course; commonly associated with hypertrophic cardiomyopathy and infrequently with acute coronary syndromes (ACS). **Justification:** Report this rare association of pathologies, with few reports in the literature. **Clinical case:** 61-years-old male, without previous chronic degenerative diseases, current smoker. He started 4 hours prior to admission with sudden angular chest pain, dyspnea, and profuse diaphoresis. Electrocardiogram: left bundle branch block, sinus rhythm with HR 44 bpm. Troponin I: 0.6 µg/L. A diagnosis of STEMI with cardiogenic shock was integrated. Emergency coronary angiography was performed reporting epicardial arteries without obstructive lesions, with the presence of muscle bridges in the left anterior descending artery in the middle and distal segments, in the first diagonal and the vertical segment of the right coronary artery with severe milking phenomenon. Ventriculogram: with mild anteroapical hypokinesia and asymmetric septal hypertrophy of the left ventricle without intraventricular gradient or Brockenbrough-Braunwald phenomenon. No clinical improvement despite specific treatment management, so a successful supra-arterial decompression myotomy was performed. Vasoactive amines were withdrawn, with an adequate postoperative clinical course, so he was discharged home asymptomatic. Control echocardiogram without alterations of ventricular mobility, remaining asymptomatic at six months of follow-up. **Conclusions:** Although infrequent as in our case, the association of hypertrophic cardiomyopathy and MB may occur with ACS. This association has not been ruled out as a possible cause of ischemia and sudden death in these patients. The literature supports the use of beta-blockers and supra-arterial myotomy or coronary bypass as surgical treatment. Percutaneous treatment is not recommended. There is no consensus for its management, and treatment must be individualized in each patient.

RESUMEN

Introducción: El puente miocárdico (PM) es una entidad clínica poco frecuente, con prevalencia 0.15-16% en series angiográficas y 5-86% en series de autopsias; considerada de curso benigno; comúnmente asociado con miocardiopatía hipertrófica e infrecuentemente a síndromes coronarios agudos (SICA). **Justificación:** Reportar esta rara asociación de patologías, con escasos reportes en la literatura. **Caso clínico:** Masculino 61 años, sin enfermedades crónicas degenerativas previas, tabaquismo positivo. Inició 4 horas previas a su ingreso con dolor torácico anginoso súbito, disnea y diaforesis profusa. Electrocardiograma: bloqueo de rama izquierda, ritmo sinusal con FC 44 lpm. Troponina I: 0.6 µg/L. Se integró diagnóstico de IAMCEST con choque cardiogénico. Se realizó coronariografía de emergencia reportando arterias epicárdicas sin lesiones obstructivas, con presencia de puentes musculares en la descendente anterior en el segmento medio y distal, en la primera diagonal y en el segmento vertical de la coronaria derecha con fenómeno de milking severo. Ventriculograma: con hipocinesia anteroapical leve e hipertrofia septal asimétrica del ventrículo izquierdo sin gradiente intraventricular, ni fenómeno de Brockenbrough-Braunwald. Sin mejoría clínica a pesar del manejo tratamiento específico, por lo que se realizó miotomía de descompresión supraarterial exitosa. Se retiraron las aminas vasoactivas, cursando con adecuada evolución clínica postquirúrgica, por lo que se egresa a su domicilio asintomático. Ecocardiograma de control sin alteraciones de la movilidad ventricular, permaneciendo asintomático a los seis meses de seguimiento. **Conclusiones:** Aunque infrecuente como en nuestro caso, la asociación de miocardiopatía hipertrófica y PM pueden cursar con SICA. No se ha descartado esta asociación como una posible causa de isquemia y muerte súbita en estos pacientes. La literatura apoya el uso de betabloqueadores y miotomía supraarterial o bypass coronario como tratamiento quirúrgico. No se recomienda el tratamiento percutáneo. No existe un consenso para su manejo y el tratamiento debe individualizarse en cada paciente.

* Cardiology Resident.

† Cardiology and Echocardiography Department.

UMA Hospital de Cardiología No. 34, IMSS. Ciudad de México, México.

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INTRODUCTION

Myocardial bridging (MB) is a congenital abnormality defined by a segment of a coronary artery that takes a «tunneled» intramuscular course under a bridge of overlying myocardium, resulting in systolic compression.¹ Its incidence ranges from 1.5 to 16% when assessed by angiography and up to 86% in some autopsy series.²

Traditionally, MB has been considered a benign condition; however, severe bridging of the major coronary arteries can produce silent ischemia, stable angina, acute coronary syndromes, stress cardiomyopathy, or malignant arrhythmias possibly leading to sudden cardiac death.³

The bridged coronary segment compressed at systole (milking effect), contributes to myocardial supply-demand mismatch and development of ischemic symptoms. The mechanism is not completely understood.⁴ Pathophysiologic factors that may exacerbate myocardial bridges are the patient's age, heart rate, left ventricular hypertrophy, and the presence of coronary atherosclerosis, since all of these may worsen the supply-demand mismatch imposed by the bridge, reducing coronary reserve.⁵ Herrmann et al. suggested that the wrapping of the myocardial bridge by myocardial fibers contracting in systole limits the vasodilation capacity to nitroglycerin at the myocardial bridge, compared to the anatomically unrestricted conditions and vasodilation in the segments proximal and distal to it. Also, previous data suggest that MB is associated with the development of atherosclerosis proximal to the tunneled artery, but currently, no data demonstrate this as an independent factor.⁶ Cay et al. showed that systolic compression > 50% of the native lumen might predict future cardiac events.⁷ A higher prevalence of MB and/or milking arteries has been already demonstrated in patients with hypertrophic cardiomyopathy (HCM) than in healthy subjects.⁸ And children with HCM were found to carry an increased risk for ventricular arrhythmias and sudden death if systolic compression was > 80%. These factors also can contribute to explaining cardiovascular outcomes.⁹

It is extremely rare for multiple arteries or segments to be affected simultaneously by

MB. Only symptomatic patients or those with straight forward clinical signs of ischemia require treatment. The cornerstone treatment is medical with beta-blockers and calcium channel blockers, being the regimen of choice.¹⁰ In contrast to atherosclerotic MI, the role of PCI in MB ACS is very limited due to the adverse outcome reported in the literature.¹¹ Surgical treatment with dissection of the overlying myocardium is reserved for patients with persistent symptoms refractory to medical therapy, in whom ischemic changes are proven, and for those with high-risk markers such as life-threatening ventricular arrhythmias, aborted sudden death, or nonfatal myocardial infarction.¹²

CASE PRESENTATION

61-years-old male, without previous chronic degenerative diseases, current smoker. He started 4 hours before admission with sudden anginal chest pain, dyspnea, and profuse diaphoresis. Electrocardiogram: left bundle branch block, sinus rhythm with HR 44 bpm. Troponin I: 0.6 µg/L. A diagnosis of STEMI with cardiogenic shock was integrated. Emergency coronary angiography was performed reporting epicardial arteries without obstructive lesions, with the presence of muscle bridges in the left anterior descending artery in the middle and distal segments, in the first diagonal and the vertical segment of the right coronary artery with severe milking phenomenon (*Figure 1*). Ventriculogram: with mild anteroapical hypokinesia and asymmetric septal hypertrophy of the left ventricle without intraventricular gradient or Brockenbrough-Braunwald phenomenon (*Figure 2*). No clinical improvement despite specific treatment management, so a successful supra-arterial decompression myotomy was performed. Vasoactive amines were withdrawn, with an adequate postoperative clinical course, so he was discharged home asymptomatic. Control echocardiogram without alterations of ventricular mobility, remaining asymptomatic at six months of follow-up.

DISCUSSION

Acute management of MB associated with a STEMI remains a challenge. Patients can be

managed with medications, via surgical approach or via percutaneous coronary intervention (PCI) although controversial.¹³ The use of PCI has been limited by the presence of in-stent restenosis, stent fracture, and perforation during stent deployment. Coronary artery bypass grafting and supraarterial myotomy are the surgical strategies that may improve the quality of life in symptomatic adult patients. In cases where multiple arteries or segments are affected simultaneously by MB, supraarterial myotomy seemed the most reasonable choice.¹⁴

In this case, we determined that the cause of the patient's clinical condition was related directly to MB since the echocardiogram showed a non-obstructive asymmetric septal hypertrophic cardiomyopathy and the coronary angiography had no obstructive coronary artery

disease or another pathological finding that could explain the patient's critical state except for several myocardial bridges on multiple arteries with severe milking effect, refractory to optimal medical treatment.

CONCLUSIONS

MB treatment is still challenging, and there is little information about prognosis and outcomes in these patients. Although myocardial bridging is mostly asymptomatic and can be an incidental finding on angiography or autopsy, symptomatic patients with severe milking effect may present myocardial ischemia, acute coronary syndromes, exercise-induced dysrhythmias, myocardial stunning, transient ventricular dysfunction, syncope, or even sudden death.¹⁵ The

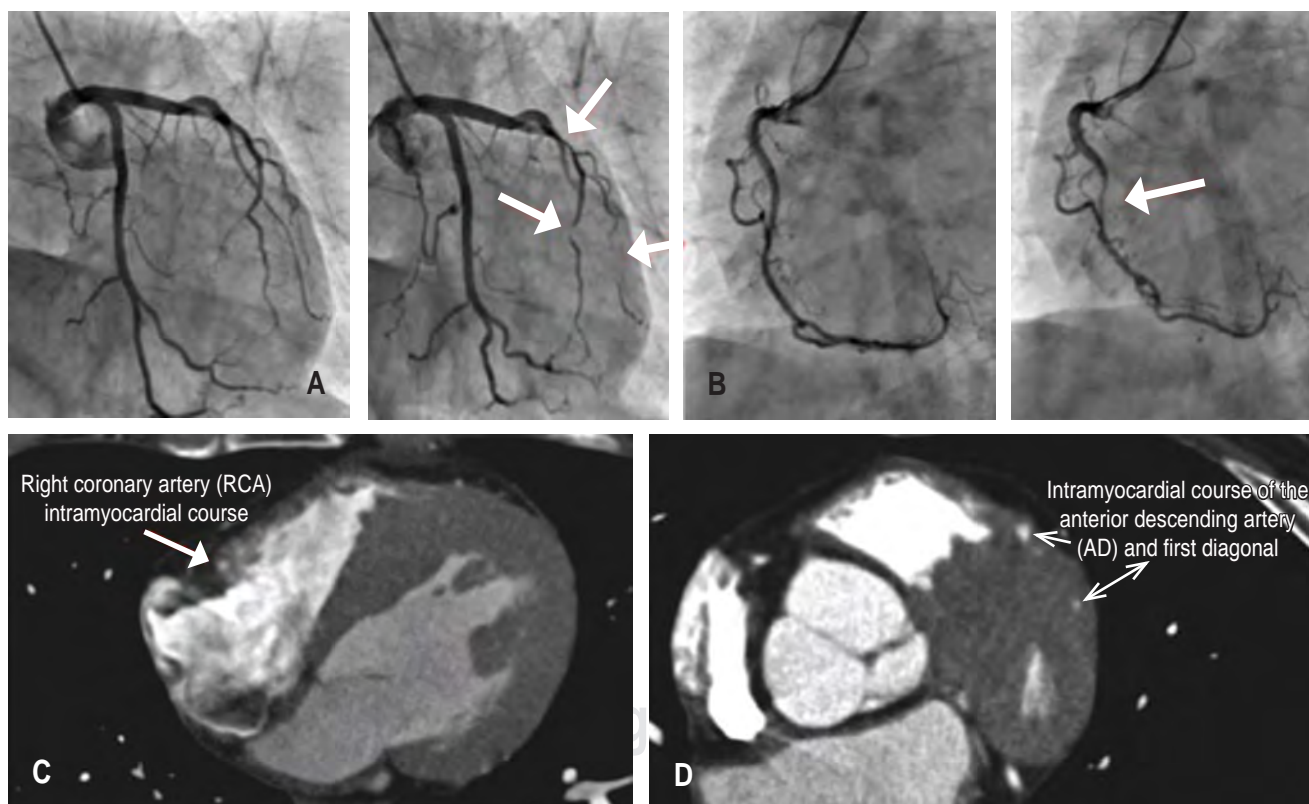


Figure 1: **A)** Myocardial bridging of the middle and distal segments of the left anterior descending coronary artery and first diagonal. **B)** Myocardial bridge of the vertical segment of the right coronary artery with milking phenomenon causing almost total occlusion of the vessels. **C)** Angiotomography shows the intramyocardial course of the right coronary artery. **D)** Angiotomography confirm myocardial bridging of the middle and distal segments of the left anterior descending coronary artery and first diagonal.

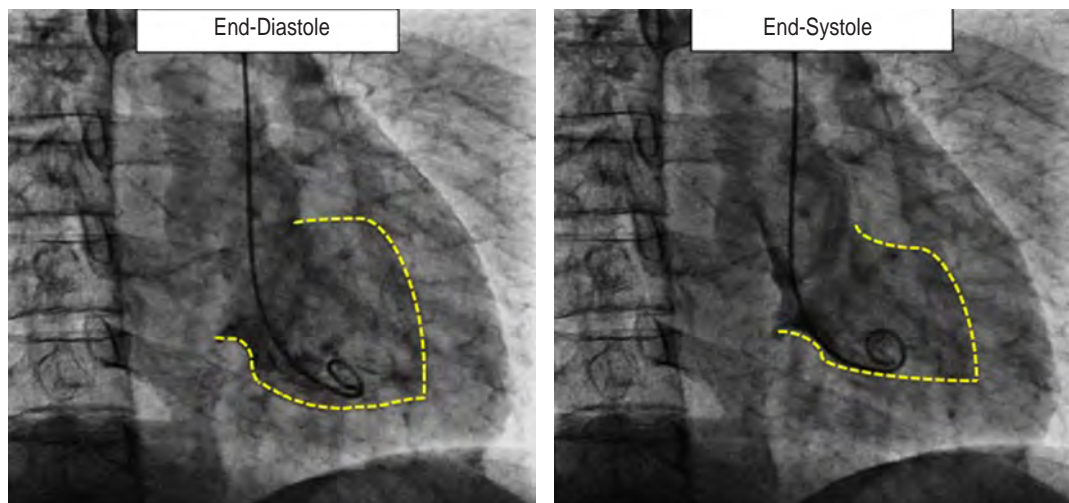


Figure 2: Ventriculogram: mild anteroapical hypokinesia and asymmetric septal hypertrophy of the left ventricle.

association of hypertrophic cardiomyopathy and MB may occur with ACS. This association has not been ruled out as a possible cause of ischemia and sudden death in these patients.⁹

Medical treatment with beta-blockers and calcium channel blockers remains the mainstay of treatment; nevertheless in patients refractory to intensified medical therapy, surgical intervention, can be a feasible and safe treatment and it should be considered in these patients.¹⁶

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Correspondence to:
Coral Serrano Arroyo
E-mail: coral.se.ar@gmail.com



The COVID pandemic in children: an alert

La pandemia de COVID en niños: una alerta

Carlos Alva Espinosa*

Keywords:

Multisystem inflammatory syndrome in children associated with COVID-19, MIS-C PIMS-TS, Kawasaki-like multisystem inflammatory syndrome.

Palabras clave:

Síndrome inflamatorio multisistémico en niños asociado con COVID-19, MIS-C PIMS-TS, síndrome inflamatorio multisistémico tipo Kawasaki.

ABSTRACT

During the initial months of the COVID-19 pandemic, the disease was thought to be benign and infrequent in children. Since March, multisystem inflammatory syndrome (MIS-C) in children associated with the pandemic has emerged as a serious disease. It has similarities with Kawasaki disease, but also important differences, such as older age, additional abdominal symptoms, respiratory difficulties, increased severity of inflammation, heart failure, and shock. We speculate in this review: 1. If MIS-C is an accelerated form of Kawasaki disease. 2. If it is a different form. 3. Simply MIS-C is a serious variant of COVID 19 in children. The presence of the multisystem inflammatory syndrome in children associated with COVID-19 (MIS-C or PIMS-TS), in much of the world, should alert the medical community in countries where it has not yet been recognized.

RESUMEN

Durante los meses iniciales de la pandemia de COVID-19, se pensaba que la enfermedad en los niños era benigna y poco frecuente, a partir de marzo ha surgido el síndrome inflamatorio multisistémico (MIS-C) en niños asociado con la pandemia como una enfermedad grave. Tiene similitudes con la enfermedad de Kawasaki, aunque también importantes diferencias, como mayor edad, adicionales síntomas abdominales, escasos respiratorios, incremento en la severidad de la inflamación, falla cardíaca y choque. Especulamos en esta revisión: 1) si MIS-C es una acelerada forma de Kawasaki, 2) si se trata de una entidad diferente, o 3) simplemente MIS-C es una variante grave de COVID-19 en niños. La presencia del síndrome inflamatorio multisistémico en niños asociado con COVID-19 (MIS-C o PIMS-TS), en buena parte del mundo, debe alertar a la comunidad médica en los países en los que por el momento no se ha reconocido.

INTRODUCTION

The incidence of COVID-19 infection in the pediatric population during the initial months of the pandemic was very low. It was found in 1-5% of all confirmed cases in a systematic review of 45 published works,¹ with a course that was almost always benign, only two children died by March 20, so the attention was focused mainly on adults with comorbidities.²⁻⁶ The relationship of MIS-C to SARS-CoV-2 infection suggests that the pathogenesis involves post-infectious immune dysregulation. Patients with MIS-C should ideally be managed in a pediatric intensive care environment since rapid clinical deterioration may occur. Objectives: to describe the characteristics of children and adolescents affected by an outbreak of Kawasaki-

like multisystem inflammatory syndrome and to evaluate a potential temporal association with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, and compare these characteristics with other pediatric inflammatory disorders.

However, as of March, a group of doctors in England observed cases in school children with a clinical picture ranging from fever, rash, conjunctivitis, gastrointestinal symptoms, shock, multiple organ failure with indicators of cytokine storm and cardiac biomarkers.⁷ The alert was issued by the National Health Service of the United Kingdom, the Royal College of Pediatrics World Health Organization, the European Center for Disease Prevention Centers for Disease Control and Prevention of the United States.⁸ The name assigned to

* Cardiólogo
Pediatra y Cardiólogo
Clínico, Hospital
Ángeles Pedregal.
Ex-Presidente
Asociación Nacional de
Cardiólogos de México.
Miembro Titular de la
Academia Nacional
de Medicina. Ciudad
de México, México.

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this condition in Europe is Pediatric Inflammatory Multisystem Syndrome associated with SARS-CoV-2 (PIMS-TS). While in America it is called multisystem inflammatory syndrome in children (MIS-C). The English group reported 58 hospitalized cases. Interestingly 78% had positive evidence for SARS-CoV-2 by IgG. All children had indicators of inflammation and similar difficulties with Kawasaki disease, including but not limited to the development of coronary abnormalities in 14%.⁷ Since then publications on this syndrome have appeared in Italy,⁹ Spain,¹⁰ Switzerland,¹¹ and France,^{12,13} reporting at least 70 cases. The French group studied 21 children with clinical signs and symptoms similar to that observed by the English group but with a higher proportion of positivity to SARS-CoV-2 and myocarditis. The similarities with Kawasaki disease were notable to the extent that they coined in their work the term Kawasaki-like multisystem inflammatory syndrome in children. They also found, like other groups, differences with this disease: older age (mean 7.9 years), (in Kawasaki 80% are younger than 5 years¹⁴) more abdominal symptoms, myocarditis, higher elevations of inflammatory markers, (procalcitonin X10 times higher compared to the measurement in patients with Kawasaki and shock). Additionally, African ancestry was identified in the majority of Paris patients.¹³ In contrast, Kawasaki disease, although known in most countries, including Mexico, is much more frequent in children of Japanese descent.¹⁴

Several publications have appeared in North America.¹⁵⁻¹⁸ The New York series had 33 cases and an average age of 10 years, Hispanic or Latino descent was 66% of the cases. The levels of C-reactive protein, procalcitonin, d-dimer, and pro-BNP were elevated in all patients. Left ventricular ejection fraction (LVEF) was found to be decreased in 66% of the cases. In this series, only one patient died (3%).¹⁸

Most children with MIS-C have been treated with IV immunoglobulin, and aspirin (as in Kawasaki disease). Additionally, several have received high doses of steroids. Only in a few cases, tocilizumab was used. Around 50% have required intensive therapy while a few have needed extracorporeal membrane oxygenation

(ECMO). The response to treatment has been favorable in most cases.^{9-13,15-18}

QUESTIONS AND HYPOTHESES

1. The relationship of MIS-C or PIMS-TS with SARS-CoV-2 is currently only temporary. Up to date, there is no causality evidence. The suggested hypothesis proposes that it is a delayed hyperimmune reaction to infection with SARS-CoV-2. This delay can be supported by the cases of children negative to PCR but positive to IgG. It could also explain what happened in the New York cases: its appearance was observed one month after the peak in adults. However, several questions arise: Why have no cases been described in China? It could be a higher susceptibility in western populations or due to a possible mutation of the virus. The link to COVID-19 with the new syndrome would be strengthened if, in the countries where the pandemic has been reduced, the incidence of MIS-C cases also decreases.
2. What is the relationship between MIS-C or PIMS-TS to Kawasaki disease?

A surprising fact in this relationship is the Lombardy report in Italy. The region most affected by the pandemic reported a 30 times higher incidence of Kawasaki cases when compared to the average incidence of the previous five years.⁹

Kawasaki disease is the leading cause of acquired heart disease in children.¹⁹ An entity that has been known for more than 50 years due to an unknown etiology, widely dispersed throughout the world. It has been associated with previous respiratory virus infections, but not all have this history. Children present an inflammatory disease with medium-caliber vasculitis with a predilection for coronary arteries where aneurysm formation is the most feared complication.²⁰ While MIS-C patients are older, less coronary disease, but cardiac dysfunction and shock are more frequent. In Kawasaki, IL-1 elevation plays an important role.²¹ By contrast, in MIS-C, IL-1 is normal with an elevated level of IL-6. We can now make the following speculations: 1. MIS-C is an accelerated Kawasaki, 2. It is a different

entity, or 3. simply MIS-C is a serious variant of COVID-19 in children. In any case, it is difficult to avoid a relationship with SARS-CoV-2. More in-depth studies will be necessary to clarify these doubts. Recently, the WHO has made a website available to register new cases of MIS-C from anywhere in the world. In America, Texas Children's Hospital, and Baylor College of Medicine in Houston with SISIAC, also have a website: <https://tch-redcap.texaschildrens.org/REDCap/surveys/?s=M3C98E7KYJ> to register new cases.²²

THE SITUATION IN LATIN AMERICA

In Mexico, more than 500 cases of Kawasaki were reported annually during the last 5 years²³ and coronary complications are well known.^{24,25}

Up to date, we have not found any reported case of MIS-C or PIMS-TS, in Latin America. However, it could be possible that with the increasing number of cases in this region of the world, new cases will appear with this new syndrome.

CONCLUSIONS

COVID-19-associated multisystem inflammatory syndrome in children (MIS-C or PIMS-TS) has emerged as a serious disease temporarily related to COVID-19. It has similarities to Kawasaki disease, but also important differences, such as older age, more abdominal symptoms, respiratory difficulties, more severe inflammation, heart failure, and shock. IL-6 is significantly elevated while IL-1 is normal. The suggested pathophysiology proposes a delayed hyperimmune reaction to infection with SARS-CoV-2. Timely cared patients have responded well to treatment with IgG, aspirin, and steroids, as do Kawasaki patients. We speculate in this review if MIS-C is an accelerated Kawasaki disease, a different entity, or a serious variant of COVID-19 in children.

Further studies are needed to answer these questions. In any case, the wide spreading of COVID-19 associated with multisystem inflammatory syndrome in children (MIS-C) should alert physicians in countries where this syndrome has not been observed so far.

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Correspondence to:**Carlos Alva Espinosa**

Consulting room 217,
Hospital Ángeles Pedregal,
Camino a Santa Teresa No. 1055,
Col. Héroes de Padierna, 10700,
Alcaldía Magdalena Contreras,
CDMX, México.

E-mail: carlosalvaespinosa@yahoo.com.mx



Implementation of a new echocardiographic practice during the COVID-19 pandemic

Implementación de una nueva práctica ecocardiográfica durante la pandemia COVID-19

Meredith López-Rincón,* Denisse Guzmán-Ramírez,* José María Hernández-Hernández,‡
Susana Farías-Vergara,§ Guillermo Sahagún-Sánchez¶

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* Cardiología e Imagen cardíaca, adscrito al Servicio de Ecocardiografía de UMAE No. 34, IMSS.

‡ Cardiología e Imagen cardíaca, vicepresidente de SISIA.

§ Cardiología y Ecocardiografía, adscrito al Servicio de Ecocardiografía de UMAE No. 34, IMSS.

¶ Cardiología y Ecocardiografía, presidente de SOME-ic.

ABSTRACT

Due to the COVID-19 (SARS-CoV-2) pandemic, healthcare logistics have changed abruptly and significantly in all medical specialties, of which cardiovascular services are no exception. Assessment of urgent and priority cases did not stop, both medical personnel and patients required adaptation of personal protective measures to prevent the spread of a highly contagious and potentially fatal virus for this vulnerable population with cardiovascular disease. In the time that has elapsed since the beginning of said pandemic to date, the health sector has become immersed in a fortuitous and challenging situation for its work environment. Considering that this virus could remain endemic, it is necessary to devise a protocol for a gradual and safe reincorporation of services at all levels of care. This document provides an update on recommendations for the return to a safe but no less efficient echocardiographic practice, based on expert opinions, some international guidelines along with evidence available until recently on several main echocardiographic findings in patients with cardiovascular disease by COVID-19, providing a general approach that can be adapted to the guidelines of each health institution in this country.

RESUMEN

Debido a la pandemia por el virus COVID-19 (SARS-CoV-2) la logística de atención hospitalaria ha cambiado de manera abrupta y significativa en todas las especialidades médicas, de entre las cuales, los servicios cardiovasculares no son la excepción. La valoración de casos urgentes y prioritarios no se detuvo, tanto el personal de salud como los pacientes requirieron adaptarse a las medidas de protección personal para evitar la diseminación de un virus altamente contagioso y potencialmente mortal para este grupo de población vulnerable con enfermedad cardiovascular. En el tiempo transcurrido desde el inicio de la pandemia hasta la actualidad, el sector salud se ha visto inmerso en una situación fortuita y desafiante para su ámbito laboral, considerando que el virus podría permanecer endémico, es necesario llevar a cabo un protocolo para la reincorporación de los servicios de todos los niveles de atención de manera paulatina y segura. Este documento proporciona una puesta al día en recomendaciones para el regreso a una práctica ecocardiográfica segura pero no menos eficiente, basada en opiniones de expertos, algunas guías internacionales y la evidencia disponible hasta fechas recientes sobre los principales hallazgos ecocardiográficos en pacientes con afección cardiovascular por COVID-19, proporcionando un enfoque general y que pueda adaptarse a las directrices de cada institución de salud en este país.

INTRODUCTION

The COVID-19 pandemic has revolutionized the entire world, generating a radical change in health care in general and a significant impact on the care of patients with cardiovascular disease, having to adapt abruptly

with general protection measures and a total reorganization in its logistics to prevent the transmission of this virus while at the same time providing a continuum of care to cardiovascular emergencies at the beginning of the pandemic, considering that these are the leading cause of death worldwide.

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Recent reports demonstrate a deleterious effect on the quality of care for all chronic diseases, including cardiovascular diseases, which at this time have been under-diagnosed due to the deferral of elective cardiovascular imaging studies for both screening and follow-up. Cardiovascular emergencies even record fatal outcomes associated with delays in transfers and even the population's fear of going to a hospital. This odyssey has been exhausting, ranging from having the ability to discern patients who should continue to receive care in person or at a distance according to their risk (based on clinical status and disease stage), to reinventing remote consultation care with complicated and costly systems that have had to be implemented in a short period of time to follow up on cardiovascular patients, methods for assortment of medication, among others, which is true telemedicine. Health professionals, amidst such chaos and work overload in the emergency departments, have had to set up respiratory triage units in practically every hospital in this country, with the purpose of classifying patients according to severity states of SARS-CoV-2 disease, and among these, early suspicion of cardiovascular affection by COVID-19, as it can occur in up to 17-20% of cases.^{1,2}

Echocardiography, being a non-invasive imaging modality with high availability, and its ability to provide extensive and detailed information in real time, has become the first-line tool for cardiovascular diagnosis; however, due to the high contagiousness of the virus and its transmission mechanism, it has become a risky procedure due to the proximity with the patient for the performance of said examination.³⁻⁶ The requirements for imaging studies have decreased by 50-90% depending on the type of examination; among these transesophageal studies have been to be classified as high-risk because of their ability to generate aerosols that remain virtually suspended temporarily; stress studies with exercise have been deferred or replaced by other imaging modalities with less risk of exposure, by a possibility of contamination secondary to droplets or aerosols generated in the effort and cough.⁷⁻¹⁰

The echocardiographic department has undergone adaptations, which includes the

route of admission of every patient, the time for performance of studies, and an exhaustive and frequent cleaning of the equipment with chlorine solutions and other agents to minimize the spread of this virus.^{6,8,11} The echocardiograms should be done in the shortest time possible to minimize exposure, used a focused protocol limited to what is required and with echocardiographic views that provide more information, considering that in COVID-19 patients in mechanical ventilatory support in prone position only apical view can be acquired.^{2,12} This new pathology has also been incorporated to the echocardiographic etiologic range, learning in an accelerated way through this short period of time to identify severity factors and even some prognostic echocardiographic data in the follow-up of patients with COVID-19. Therefore, it will be a dynamic balancing process to provide essential cardiovascular care to the general population and the provision of care for the continuous fluctuations of patients who are suspected or positive for COVID-19.

The pandemic seems to be spreading with continuous incidence of cases in different regions of this country, it is imperative to achieve a balance between the risk of infection and the risk represented by any delay in diagnosis and management of cardiovascular diseases; This document provides strategies and considerations based on recommendations from the different international societies of echocardiography and cardiac imaging, as well as on the scientific evidence available so far on the usefulness of echocardiography in patients affected by SARS-CoV-2. With the objective of gradually reincorporating the usual functioning of echocardiography services in a phased manner, adopting all necessary measures and providing care to cardiovascular patients in a safe and efficient manner while the health emergency lasts.

General considerations

The re-establishment of the normal functioning of the department should be carried out with close communication between the referring physicians, echocardiographic physicians and administrative staff according to the following:

- Phase 2: selected studies in which its performance marks a change in the management or prognosis of each patient.
- Phase 1: most studies with maximum precautions, with a possibility of postponing stable patients in follow-up.
- Phase 0: all routine studies with pre-testing (if available) and personal protective equipment according to pandemic status.

Generally, it is recommended to schedule staggered appointments, in the case of multiple studies organize a single visit, apply a symptom questionnaire in a telephone schedule appointments (*Anexo 1*). Upon arrival of each patient take body temperature and reapply symptom questionnaire, and seek direct entry to the examination.^{1,3} In the waiting room, ensure that the recommended distance between patients exists and they must be unaccompanied unless it is strictly unavoidable, ensure the use of facemasks everywhere and provide antibacterial gel based on 70% alcohol or facilitate hand washing to anyone who enters the department or stays in a waiting room, also ensure the use of masks for health personnel at the reception and consider plastic or acrylic barriers on the desks or receptions.^{11,14} The rescheduling will be done on a priority basis that relies mainly on clinical status and priority in the indication of each study, mainly when it is necessary change of guidance in the management, making a priority scale as shown in *Table 1*.

Transthoracic echocardiography in non-COVID-19 or non-suspected patients

The transthoracic echocardiogram remains the front-line study in the evaluation of patients with cardiovascular disease.^{11,14} Reprogramming will be done on a priority basis that relies on clinical status, when the indication is for follow-up, it is recommended to perform a limited echocardiographic study to resolve specific questions according to clinical suspicion or known heart disease, evaluating cardiac structures and their functionality to obtain the most relevant data for proper interpretation and decision making. They should always be performed by a certified echocardiographer, minimizing the need to repeat studies later,

limiting exposure time.^{5,15,16} The possibility of re-establishing the daily completion of all studies with their specific indications and in an extended manner should be evaluated as this pandemic develops, always assessing the risk of exposure of both personnel and patients.

Transesophageal echocardiogram

This echocardiographic modality implies a high risk of transmission because it is an aerosol-generating procedure, requiring complete personal protection of the operators, as well as its execution in an exclusive area preferably, with space between patients of at least one hour that allows for adequate ventilation and subsequent sanitization. It is highly recommended to carry out screening tests for COVID-19 prior to performing a transesophageal echocardiogram when is available in non-urgent priority patients. In patients with a negative test, the high percentage of false negatives according the type of test available in each location should be considered, which in general is not negligible, so a strict use of full protective equipment is recommended, as well as for urgent studies in operating and intervention rooms where it is not feasible to wait for a test.^{11,15}

The clinical scenarios in which TEE cannot be postponed include: valve prosthesis dysfunction, cardiac masses, endocarditis and its complications (abscesses pseudoaneurysms and fistulae). It is also feasible to change to another imaging modality with less risk of exposure to contagion, such as in patients planned to undergo electrical cardioversion, where the TEE can be replaced by computed tomography to exclude the presence of thrombi in the left ear.^{2,8}

For patients who will require short-term treatment, always basing their careful indication on the clinical stage and improving their survival in the midst of the pandemic, the different cardiological societies are recommending opting for minimally invasive and short-stay procedures, such as structural interventions including mitral and tricuspid valve repair and left atrial appendage closure with percutaneous occlusion devices, where transesophageal echocardiography has taken a leading role, and its use will undoubtedly increase as this pandemic evolves.^{8,14,15}

Table 1: Preferred indications according to clinical status for reprogramming studies.

Level of preference	Clinical status	Examples
High preference	Deterioration of functional class or new symptoms	Dyspnea, chest pain, syncope, arrhythmias, related neurological disorder
	Initiation or monitoring of therapies	Start or follow-up chemotherapy
	Follow-up of recent or urgent preoperative procedures	After heart surgery and post-implantation of intracardiac ventricular pacing, IDC or post ventricular assist device in case of suspected complications Urgent preoperative in patients with functional limitations
Medium preference	Known asymptomatic heart disease requiring follow-up by progression	Cardiomyopathies Severe valve disease Pulmonary hypertension Structural post-intervention follow-up
	Monitoring of therapy employed	Therapy for pulmonary hypertension Heart transplant follow-up Ventricular assist devices monitoring in stable patients
	Non-urgent preoperative assessment	Priority but not urgent non-cardiac surgery
Low preference	Routine follow-up for chronic cardiopathy	Arterial hypertension Stable ischemic heart disease Periodic evaluation of valvular prosthesis

Stress echocardiography

In a patient with suspected ischemic heart disease, stress echocardiography in its different modalities is an elective but essential examination for diagnosis. Exercise stress echocardiography (ESE) is a potential aerosol generating procedure due to the deep and rapid breathing generated during exercise, although the cycling protocol records fewer peak vents per minute, both should be avoided in the ascent and plateau phase of the pandemic; coronary CT angiography is preferred as an alternative for diagnosis when available.^{10,14} Any change of protocols should be evaluated by assessing each patient individually. Pharmacological stress echocardiography is a safer option, not considered as an aerosol generator and can be complemented with a careful clinical history and a questionnaire focused on assessing the functional capacity of the patient.^{11,13} When the performance of an ESE is strictly necessary it is recommended to previously perform SARS-CoV-2 PCR test, and examination should be

conducted in an exclusive area, with adequate ventilation with negative pressure if available, with automated blood pressure measurement and complete sanitation between each patients. Personal protective equipment is detailed in [Table 2](#). The use of a surgical mask or face shield is recommended for patients.¹⁴

Echocardiograms in COVID-19 confirmed patients

Echocardiographic examination should generally be deferred in patients confirmed with COVID-19 as long as possible and there are no markers of myocardial damage. 20% of cases with SARS-CoV-2 disease present with elevated high-sensitive troponin T, brain natriuretic peptide type B (Pro-BNP) and D-dimer as markers of myocardial damage.^{11,17} Damage to the cardiovascular system has been documented by direct viral injury on ACE 2 receptors entering the myocardium and vascular endothelium which produces myocarditis and even vasculitis, microthrombosis and macrothrombosis

have been found in recent post-mortem studies, reporting important disruption in the coagulation and fibrinolytic system, with evidence of disseminated intravascular coagulation. The presence of acute coronary syndrome, as the first manifestation of infection by COVID-19, usually occurs in patients at high risk of coronary disease; its presence has also been noted in patients hospitalized for respiratory disease which suggests that the viral infection causes instability of atherosclerotic plaques, associated with an inflammatory response and cytokine storm with underlying endothelial dysfunction. Another documented mechanism is myocardial damage by hypoxia secondary to respiratory failure or septic status, observing an hyperinflammatory response observed in patients in advanced stages of the disease, demonstrated by elevation of biomarkers and cytokines such as IL-6, TNF-alpha, IL-2 R and ferritin, which are even considered of poor prognosis. Recently and in isolated cases, stress cardiomyopathy (tako-tsubo) has been reported, although the mechanism of viral action is not well established, but possibly associated with endothelial dysfunction, cytokine storm and an underlying catecholamine wave.¹⁸⁻²⁰

During the pandemic, COVID-19 cases will continue to be a daily challenge for echocardiography services. It is crucial to perform the echocardiographic evaluation in the shortest time possible, preferably in less than 10 minutes, using echocardiography machines exclusively for these patients, and to cover the equipment with plastic sleeves to facili-

tate subsequent disinfection, is important to remove from the equipment used the electrocardiographic cables and any other accessory that could favor cross contamination between patients and operators, resulting images should be recorded, use simultaneous multiplanar views, make the measurements off-line and it is recommended to use even automated tools based on image recognition in the opinion of the operator, with the aim of reducing acquisition times of examination as part of a modified focused protocol.^{2,3,14} In the prone patient, consider as the only available apical 4-chamber view, and point it out in the echocardiographic report; recently Marvaki and collaborators have published a small work where it is proposed as an alternative to use the transesophageal transducer in pronounced and intubated patients in intensive care to obtain transthoracic images with results comparable or superior to the conventional transthoracic route with the advantage of acquiring multiplanar images of diagnostic quality but the disadvantage of requiring two operators for their acquisition.²¹ The main indications for TTE in patients confirmed with SARS-CoV-2 include: assessment of hemodynamic parameters up to 29% of cases and in those with major associated adverse cardiovascular events such as pulmonary embolism, heart failure, elevated biomarkers, acute coronary syndrome and myocarditis (up to 46%), the rest of the indications range from previous known heart disease, associated endocarditis, arrhythmias and cardioembolic events.¹⁷ The focused protocol POCUS (*Point*

Risk Level	Procedure	Required PPE
Intermediate risk (dropwise)	Transthoracic echocardiography/ pharmacological stress echocardiography	Surgical mouthpiece Face shield Cloth or disposable gown Gloves
High risk (by aerosols)	Transesophageal echocardiogram, stress with exercise	Face shield or protective glasses or goggles Mouthguards with filter class N95 or higher Hat or diving suit Disposable waterproof gown or coverall Boots or shoe covers Double pair of gloves

of care ultrasound) includes cardiac, pulmonary and vascular approaches, whose main indication and utility is widely demonstrated in the critical patient with hemodynamic instability, employing apical views, short and long parasternal axes as well as subcostal view, evaluating the following structures:

- Left ventricle: evaluate dimensions, global and segmental contractility to rule out myocarditis, acute ischemic coronary syndrome or cardiomyopathy.
- Right ventricle: evaluate dimensions and rule out dysfunction data.
- Valves: to evaluate the presence of regurgitation or stenosis and its degree of severity, to rule out pre-existing valve disease or acute dysfunction. Emphatically evaluate the presence or not of peak tricuspid regurgitation gradient with the intention of evaluating the possibility of elevated of pulmonary systolic pressure and estimate its value.
- Pericardium: to establish the presence of pericardial effusion and its hemodynamic repercussion.

The pulmonary echo approach will be performed by personnel trained in the technique, assessing the anterior, lateral and posterior areas of both lungs to rule out B lines, subpleural or pulmonary consolidation, pleural thickening or pleural effusion to differentiate pulmonary congestion of cardiac origin or parenchymal pulmonary involvement. The ultrasonographic vascular examination includes the evaluation of the inferior vena cava in subcostal view and/or the assessment of the jugular venous pulse to determine the blood volume status and an assessment of the venous system of the lower limbs, if there is a clinical suspicion of injury at this level, mainly to rule out deep vein thrombosis.^{11,16} Recent studies have shown that a modified focused protocol, despite being acquired in a short time, achieves adequate diagnostic accuracy in up to 70-80% of cases and allows for rapid decision making in respiratory triage and identification of those patients requiring extended echocardiographic evaluation at a later date.^{15,17} Echocardiographic findings in patients having COVID-19 have been described in stud-

ies with different designs, most with a small number of patients, however some of these findings have statistical significance as well as clinical and prognostic relevance. Right ventricular dilation with or without dysfunction is the most frequent echocardiographic abnormality found in 32 to 39% in different series, without finding significant differences in major comorbidities (diabetes, hypertension and known coronary heart disease). The physiopathological mechanism seems to be multifactorial including increased resistance and pulmonary pressures secondary to hypoxic vasoconstriction, thrombotic events, cytokine damage and direct viral injury. Right ventricular dilatation defined as a basal diameter greater than 41 mm measured in right ventricle focused apical 4-chamber view or a VD:VI ratio > 0.9 is strongly associated with increased hospital mortality in patients with VOC-19 (Figure 1).²² In addition to hypoxic vasoconstriction, right ventricular dysfunction is due to decreased lung volume, excessive positive pressure at the end of expiration, pneumonia, hypercapnia and the effect of alpha-agonist drugs. The frequently documented parameters of right ventricular dysfunction are: fractional area change, TAPSE, tricuspid lateral anular systolic tissue velocities (S') and decreased values of free wall strain values and have been recognized as independent predictors of mortality with statistical significance ($p < 0.001$), with the advantage for the 2D non Doppler strain (speckle tracking) of being angle independent in its acquisition, which positions it as the best tool to evaluate



Figure 1: Right ventricle focused apical 4-chamber view with right ventricular dilation in a patient with COVID-19. Courtesy: Dr. Juan A Calderón González.

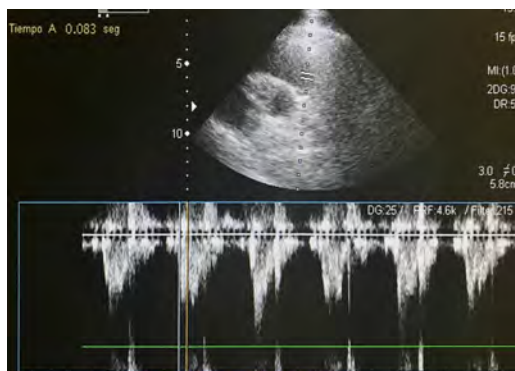


Figure 2: Shortened pulmonary flow acceleration time in a patient with COVID-19.

Courtesy: Dr. Alejandra Guzmán Ayón.

the right ventricular function demonstrated by Li and collaborators in a recently published study with a limited number of patients that established a cut-off value of less than -23% with a sensitivity and specificity of 94.4 and 64.7% respectively; however it will require further validation in future multicenter studies and with a larger number of patients. So far the recommendation is to combine the available parameters to determine right ventricular dysfunction.²³ A shortened pulmonary flow acceleration time (Figure 2) or the presence of a high peak tricuspid regurgitation gradient as a result of increased pulmonary pressure or pulmonary vascular resistance in the various series has also been documented. The presence of acute severe right ventricular dysfunction should also rise suspicion to rule out the presence of peripheral venous thromboembolism associated with pulmonary thromboembolism or even microvascular thrombosis, where paradoxical septal movement is often observed causing left ventricular D-shape morphology secondary to pressure overload, further contributing to the drop in cardiac output and blood pressure (Figure 3). The peak tricuspid regurgitation gradient is a difficult parameter to acquire in the critical patient and its has been reported as impossible to obtain an adequate spectrum to estimate the systolic pulmonary pressure in up to 65% in small studies. All the above point out that the evaluation of right ventricular dysfunction by echocardiography is essential for risk stratification in these patients. Left ventricular

systolic dysfunction has been associated with cytokine storm damage, being documented in only about 10% of cases and presenting in patients having troponin elevation > 50 ng/L up to 46%, a little less than half of patients with left ventricular dysfunction present regional wall motion abnormalities secondary to micro or macrovascular ischemic heart disease or stress cardiomyopathy associated with COVID-19 infection. Diastolic dysfunction is documented in up to 16% of patients that have varying degrees of elevation of filling pressures, even without data on left ventricular dysfunction. Valvular alteration and other findings occur in a non-significant percentage.¹⁷ Indications for a follow-up echocardiogram in patients having COVID-19 are mainly due to hemodynamic instability, cardiac deterioration, or progression of respiratory failure, and the most frequent finding is progressive decline of right ventricular function, due to the progression of lung damage by the mechanisms described above, and also in many cases due to microthrombosis or major vascular occlusion with D-dimer and fibrinogen elevation, associated or not with deep vein thrombosis, reported with high incidence in hospitalized patients suffering from COVID-19 infection.^{19,20}

In patients recovering from COVID who require an echocardiogram on an outpatient basis, the indication should be based on the prioritization of the examination, preferably requesting a negative test beforehand. If it is not available, try to perform the examination



Figure 3: Short axis parasternal with left ventricular D-shape in a patient with COVID-19.

Courtesy: Dr. Juan A. Calderón González.

in a designated area, after adequate sanitation, facilitating the least contact of the patient with other patients and medical staff, minimizing the circulation of personnel with subsequent strict sanitation and ventilation of the area and any equipment used, including hallways and bathrooms, in coordination with institutional cleaning and hygiene services, both for positive cases with active disease and for recovering patients who access the echocardiographic department.¹³

Personal protection measures and equipment

Adequate hand washing or disinfection with 70% alcohol-based antibacterial gel frequently and between patients remains the cornerstone of protection against virus transmission and should be equally strict in the period of reintroduction of services, it is recommended to adhere to the use of personal protective equipment according to the degree and nature of exposure and the degree of risk of the examination, exposure to drops and/or aerosols and whether the study is intermediate or high-risk as shown in *Table 2*, as well as maintaining distance between personnel and minimizing the risk of exposure to physicians in training and non-essential personnel. However, as this pandemic develops, measures to ensure reintegration into their face-to-face training program or hybrid approach should be reassessed, taking into account virtual teaching methods. Healthcare workers in vulnerable conditions, such as: those over 60 years of age, immunosuppressed, pregnant women, and other recognized comorbidities at risk in the pandemic, should be considered to avoid performing the highest risk procedures. Relaxation of protective measures will depend on many factors, including the prevalence and incidence of COVID-19 cases, at each facility and in the locality, including institutional policies.

Disinfection of equipment and designated areas

Likewise, it is imperative to carry out schedule sanitization with appropriate viricidal agents in waiting rooms, frequent disinfection of surfaces and floors, and to facilitate ventilation of all areas.⁵ Disinfection of the equipment used

with compatible solutions should be conducted by consulting the supplier's manual for each specific machine. It is recommended that the equipment be covered with plastic sleeves that allows handling of the probes and keyboard, thus facilitating disinfection with any sanitizing solutions, between one patient and another, in addition to better preserving the equipment.^{5,8} The cubicles for examination execution areas should be sanitized in a meticulous and frequent manner, respecting the time between studies to facilitate ventilation, include examination couches and extend it periodically to the interpretation offices or meeting rooms.^{13,24}

Reintroduction of teaching or training programs

Students should continue to be excluded from high-risk areas until determined by the appropriate academic authorities; residents and fellows in training may be reinstated in a gradual manner that minimizes exposure and should not participate in examinations of confirmed COVID-19 patients of recovering ones without a negative test, facilitate and emphasize the use of personal protection equipment and hygiene measures and equipment at all times.^{3,14} Continue or resume remote academic sessions using videoconference and reassess as this pandemic evolves.^{11,13}

CONCLUSIONS

The challenge continues with the reincorporation of all the cardiological departments in the middle of the pandemic as phases, in the echocardiographic department the classical indications of the different examinations will be gradually taken up again according to the prevalence of the disease by COVID-19 in each location and the degree of immunity of the population, with the same consideration for the use of personal protective equipment. The final objective will always be to try to offer a timely and effective care to cardiovascular diseases with any necessary protective measures to avoid viral transmission to patients and medical staff. Immersed in this objective, doctors will continue to attend to patients with COVID-19 in whom the echocardiographic findings so far point out of image modality as

an invaluable tool in initial assessment and follow-up, allowing a better hemodynamic evaluation that can, if necessary, dictate management adjustment or be used as an examination with prognostic value. It is still uncertain whether the change in the daily operation protocols to which medical professionals have been accustomed for several decades will be permanent, this will be determined by the prevalence of the disease, as well as by the guidelines that will provide future evidence-based research on the COVID-19 and SARS-CoV-2 spectrum. Based on this, it is important to emphasize that these recommendations may be dynamic in the future.

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Correspondence to:

Meredith del Carmen López Rincón

E-mail: merylohi@gmail.com

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Anexo 1: Symptom Questionnaire.

Name:

Date:

Age:

Gender:

1. Have you had any of the following (major) signs or symptoms in the last 10 days?

Cough Yes No

Fever Yes No

Shortness of breath* Yes No

* Serious detail

Headache* Yes No

* Consider irritability in < 5 years

2. Have you also had any of the following (minor) signs or symptoms?

Muscle or joint pain Yes No

Conjunctivitis Yes No

Runny nose Yes No

Sore Throat Yes No

Chest pain Yes No

Shivers Yes No

Loss of smell Yes No

Loss of taste Yes No

Yes No

3. Have you been in direct contact with a confirmed COVID-19 in the last two weeks?

If you responded to at least one of the major signs or symptoms and accompanied by one of the minor signs or symptoms, it is considered a **suspicious case**.

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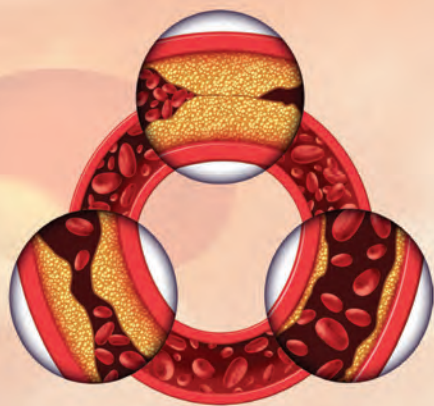


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 En el **manejo y prevención** de eventos **aterotrombóticos**

SALVA VIDAS



Revisar IPP:



FLUC-01AT-19
NO. DE ENTRADA: 173300202CS640

ALTIA

Senosiain.



LÍNEA CARDIO



Angiotrofin

Diltiazem

Glioten

Enalapril

Gliotenzide

Enalapril/Hidroclorotiazida

BRAXAN

Amiodarona

ISORBID

Dinitrato de isosorbida

Valvulan

Digoxina

MONOCORAT

Mononitrato de isosorbida

Vivitar

Espironolactona

CORASPIR

Acetil salicilato de lisina

PleWacorLP

Nifedipino 20 mg - Atenolol 50 mg



OKSEN®

OK EN HIPERTENSIÓN

Porque la **hipertensión** es un problema de salud global que daña órganos blanco y que tiene como consecuencia:

- › **Insuficiencia cardiaca**
- › **Daño renal**
- › **Retinopatía**
- › **Demencia vascular**

OKSEN Es la cápsula de contenido líquido que da el **OK en hipertensión**

**+ Telmisartán
+ Hidroclorotiazida**



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