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- Atrial infarction
- Kearns-Sayre syndrome: uncommon cause of atrioventricular block

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Referencias: 1. Setiawati A, Pohan T. Safety and Effectiveness of Candesartan and Candesartan/HCT Fixed Dose Combination in Patients with Hypertension. *Acta Medica Indonesiana -The Indonesian Journal of Internal Medicine* 2013; 45(3): 193-201. **2.** Bramlage P, Buhck H, Zemmrich C. Candesartan Cilexetil 32 mg/Hydrochlorothiazide 25 mg in Unselected Patients with High or Very High Cardiovascular Risk: Efficacy, Safety, and Metabolic Impact. Springer International Publishing Switzerland 2014: 1-9. **3.** Mugellini A, Nieswandt V. Candesartan plus hydrochlorothiazide: an overview of its use and efficacy. *Expert Opin. Pharmacother* 2012;13(18):2699-2709. **4.** Melian E. B., Jarvis B. Candesartan Cilexetil plus Hydrochlorothiazide Combination. A Review of its Use in Hypertension. *Drugs* 2002; 62 (5): 787-816. **5.** Ohman K.P., Milon H., Valnes K. Efficacy and Tolerability of a Combination Tablet of Candesartan Cilexetil and Hydrochlorothiazide in Insufficiently Controlled Primary Hypertension-Comparison with a Combination of Losartan and Hydrochlorothiazide. *Blood Pressure* 2000; 9: 214-220. **6.** Koenig W. Comparison of the Efficacy and Tolerability of Combination Tablets Containing Candesartan Cilexetil and Hydrochlorothiazide or Losartan and Hydrochlorothiazide in Patients with Moderate to Severe Hypertension Results of the CARLOS-Study1. *Clin Drug Invest* 2000; 19 (4): 239-246. **7.** Scott L. J., McCormack P. L. Olmesartan Medoxomil: A Review of its Use in the Management of Hypertension. *Drugs* 2006; 66 (9): 1239-1272. **8.** Precio Máximo al Público Junio 2016.

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CONTENTS / *CONTENIDO*

Cardiovascular and Metabolic Science

Original Research

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Radiofrequency catheter ablation of cardiac arrhythmias using only three-dimentional mapping systems

Ablación con catéter de radiofrecuencia de taquiarritmias usando sólo sistemas de mapeo tridimensional

Rogelio Robledo-Nolasco,* José Raymundo Leal-Díaz*

Keywords:
Catheter ablation, cardiac arrhythmias, without fluoroscopy, three-dimensional mapping.

Palabras clave:
Ablación con catéter, arritmia cardiaca, sin fluoroscopia, mapeo tridimensional.

ABSTRACT

The largest number of radiofrequency catheter ablation (RCA) procedures are performed with the help of X-rays. Ionizing radiation affects both, the patient and the electrophysiologist. Today it is a priority to reduce exposure to X-rays and this is possible with new technologies and techniques for RCA. **Objectives:** The objective of this report is to demonstrate the feasibility and safety of performing RCA of conventional and complex cardiac arrhythmias (CA) without using X-rays in a single center. **Material and methods:** Patients with different CA and with indication of RCA were included. All had an echocardiogram and the antiarrhythmic drugs were suspended 5 half-lives before the procedure. Two three-dimensional mapping systems were used. First a catheter was advanced to draw the path of the access vessels and then the cardiac cavities were reconstructed and the origin of the arrhythmia was located. RCA with conventional parameters were performed. **Results:** We included 14 patients with mean age of 46.4 ± 16.9 years, 7 (50%) women, 2 (14.3%) had heart failure. There were 11 (78.6%) common and 3 (21.4%) complex arrhythmias. In 10 (71.4%) patients, the Carto 3 system was used and in the rest the Ensite system. A mean of 334 ± 335 mapping points were performed, an irrigated catheter was used in 12 (85.7%) patients, 50 ± 82 ablation applications were performed, the duration of the procedure was 100 ± 24 minutes and 13 (92.8%) of the procedures were successful. No X-rays were used and there were no complications. **Conclusions:** It is feasible and safe to perform RCA of conventional or complex CA with a three-dimensional mapping system, without using X-rays and with 92.8% success rate.

RESUMEN

Introducción: *El mayor número de procedimientos de ablación con catéteres de radiofrecuencia (ACR) se realiza con la ayuda de rayos X. La radiación ionizante afecta tanto al paciente como al electrofisiólogo. Hoy en día, es una prioridad reducir la exposición a los rayos X y esto es posible con nuevas tecnologías y técnicas para el ACR.* ***Objetivos:*** *Demostrar la viabilidad y seguridad de realizar ACR de arritmias cardiacas (AC) convencionales y complejas sin utilizar rayos X en ningún centro.* ***Material y métodos:*** *Se incluyeron pacientes con diferentes AC y con indicación de ACR. A todos se les realizó un ecocardiograma y se les suspendió la medicación antiarrítmica cinco medias vidas antes del procedimiento. Se utilizaron dos sistemas de mapeo tridimensional. Primero se avanzó un catéter para trazar el trayecto de los vasos de acceso, y luego se reconstruyeron las cavidades cardiacas y se localizó el origen de la arritmia. Se realizó ACR con parámetros convencionales.* ***Resultados:*** *Incluimos 14 pacientes con una edad media de 46.4 ± 16.9 años, 7 (50%) mujeres, 2 (14.3%) tenían insuficiencia cardiaca. Hubo 11 (78.6%) arritmias comunes y tres (21.4%) complejas. En 10 (71.4%) pacientes se utilizó el sistema Carto 3 y en el resto el sistema Ensite. Se realizaron en promedio 334 ± 335 puntos de mapeo, se utilizó un catéter irrigado en 12 (85.7%) pacientes, se realizaron 50 ± 82 aplicaciones de ablación; la duración del procedimiento fue de 100 ± 24 minutos y 13 (92.8%) de los procedimientos tuvieron éxito. No se utilizaron rayos X y no hubo complicaciones.* ***Conclusiones:*** *Es factible y seguro realizar el ACR de la AC convencional o compleja con un sistema de mapeo tridimensional, sin utilizar rayos X y con una tasa de éxito de 92.8%.*

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INTRODUCTION

Radiofrequency catheter ablation (RCA) of tachyarrhythmias has proven effective and is widely performed worldwide. The use of X-rays has been necessary until a little over a decade ago.[1] Currently, X-rays are used to perform the conventional procedures of RCA, which are the largest number of all catheter ablations in the world. The radiation time in these procedures has been reduced by the technological improvement of the equipment of the catheters and the learning curve of the electrophysiologyts.[2] Despite the above, the harmful effects of radiation have been seen, both for the patient and for the operator and other personnel in the electrophysiology room. For the patient, harmful effects like dermatitis, burns or birth defects have been reported; while for the operators, the frequency of some types of cancer has increased.[3,4] In recent years, three-dimensional mapping in first place and intracardiac ultrasound, in second place, have evolved impressively, so that nowadays it is possible to perform RCA with nothing or minimal amounts of radiation.[4-9]The objective of this report is to demonstrate the feasibility and security of performing RCA with zero use of X-rays in a single medical center.

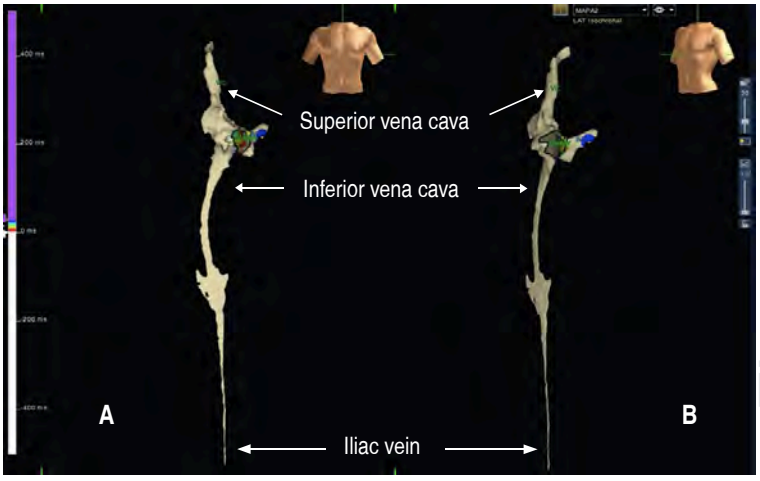

Figure 1: Panel **A**, anteroposterior view, panel **B**, left anterior oblique view. Reconstruction of the venous path from the iliac vein to the superior vena cava and the right atrium and coronary sinus. In a woman with a supraventricular tachycardia.

MATERIAL AND METHODS

Patients between 18 and 70 years old with tachyarrhythmias, undergoing radiofrequency ablation, were included. All patients signed their informed consent and the procedure was explained in detail. Most patients had no cardiac pathologies. Antiarrhythmic drugs were discontinued for a minimum of 5 half-lives prior to the procedure. Under mild sedation and local anesthesia with 2% Xylocaine venous or arterial right femoral punctures were performed by introducing two or three sheaths in the vein and one in the artery if the arrhythmia was located on the left side. A Bard polygraph (Boston Scientific) was used to perform the electrophysiological study and the Carto system (Biosense Webster, Inc.) or Ensite system (Ensite Velocity NavX, St. Jude Medical, St. Paul, MN, USA) was used to do three-dimensional mapping; in both cases the reference patches of the systems were placed in the patient in a conventional manner. When the Ensite system was used, a decapolar catheter was introduced and when we used the Carto system, an ablation catheter (Navistar or Smart Touch) was introduced first. With the first catheter inserted, the path of the vascular access to the heart (Inferior vena cava or abdominal and thoracic aorta) was drawn, then the right atrium together with the inferior vena cava and the tricuspid ring and the coronary sinus were reconstructed *(Figure 1)*. Once done the above, the decapolar catheter was placed into the coronary sinus and subsequently tetrapolar or a duodecapolar catheter was advanced for the study of arrhythmia. If the arrhythmia was on the left side, the arterial path, the aortic valve and ascending aorta were reconstructed with the ablation catheter. The same catheter was passed to the left ventricle and its anatomy was obtained, especially the mitral ring.

In case of a typical atrial flutter, a duodecapolar catheter «Halo» (Livewire Duo-Decapolar Electrophysiology Catheters) with 10 bipoles (2 mm paired spacing) separated by 1 cm distance was placed adjacent to the tricuspid annulus to record activation sequence; electrograms from the coronary sinus were recorded by a decapolar electrode and an irrigated catheter for ablation was placed within the inferior vena cava-tricuspid annulus (IVC-TA) isthmus. Successful ablation criteria

parameters were the end of the arrhythmia and bidirectional block of the IVT-TA isthmus; demostrated by an interval of 130 ms or more between both ends of the IVT-TA isthmus. In AV-nodal reentrant tachycardia (AVNRT), three catheters were introduced, one decapolar to the coronary sinus, one cuadripolar was placed in the His and the last one was the ablation catheter *(Figures 2 and 3)*. In the cases of accessory pathways, three catheters were used; one decapolar to the coronary sinus, a tetrapolar for the His or to the right ventricle and the ablation catheter *(Figure 4)*.

Statistical analysis

Categorical variables are reported as percentage (%) and continuous variables are reported as mean ± standar desviation. All analyses were performed using SPSS Statistics 25.

Figure 2: The arrows indicate the beginning of an AV-nodal reentrant tachycardia with a cycle of 322 milliseconds (186 beats per minute).

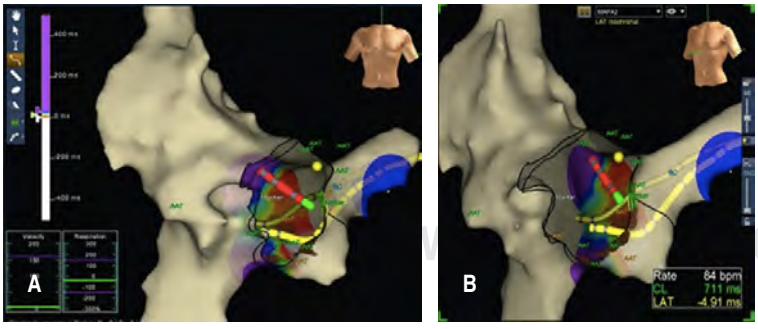

Figure 3: Panel **A**, anteroposterior view, panel **B**, left anterior oblique view of the reconstruction of the right atrium, tricuspid ring (black line outline) and in yellow point the His location. Decapolar electrode (yellow) inside the coronary sinus and the green tip catheter at the site of successful ablation.

Table 1: Clinical characteristics of the patients, n (%).

Age (years), (SD)	46.4 ± 16.9
Women	7 (50.0)
Hypertension	5 (35.7)
Diabetes	3 (21.4)
Coronary artery disease	0 (0)
Heart failure	2 (14.3)
Structural heart disease	3 (21.4)
Ejection fraction of left ventricle,(%)	58.6 ± 14.6
Cardiac arrhythmias	
- Atrial flutter	6 (42.8)
- Accessory pathways	3 (21.4)
- AVNRT	2 (14.3)
- Ventricular prematures beats	2 (14.3)
- Atypical atrial flutter	1 (7.1)

AVNRT = Atrioventricular nodal reentry tachycardia ablation, SD = standard deviation.

RESULTS

A total of 14 patients were included, aged 46.4 ± 16.9 years, 7(50%) women, 2(14.3%) had heart failure; the other demographic data are shown in *Table 1*. The indications for the ablation procedure were: in 11 (78.6%) patients, common tachyarrhythmias (6 typical Flutter, 3 accessory pathways and 2 AVNRT) and in 3 (21.4%) patients, complex tachyarrhythmias (2 ventricular premature beats and an atypical atrial flutter). In 10 (71.4%) patients the Carto 3 system was used and in the rest the Ensite system. With the chosen catheters, 334 ± 335 mapping points were performed on average, obtaining the necessary anatomy and the white zone to perform the ablation. For the ablation, an irrigated catheter was used in 12 (85.7%) patients, the number of ablation applications was 50 ± 82, the duration of the procedure was 100 ± 24 minutes and succesful ablation was obtained in 13(92.8%) patients; ablation in one patient with atypical flutter was failed *(Table 2)*. Zero minutes of radiation were used in all of the patients, there were no complications and two patients were pregnant; one in the first and another in the second pregnancy

trimesters. During the follow-up of 13.8 ± 4.0 months, no recurrences were documented and a patient who had a flutter ablation developed atrial fibrillation.

DISCUSSION

Currently, the cardiological field is responsible for indicating 45% of all studies or procedures where ionizing radiation is used.[10] Interventional cardiologists and electrophysiologists are exposed two to three times more to ionizing radiation than radiologists.[10] Usually, the average effective dose for patients undergoing these procedures is 17 mSv or 8.3 mGy per hour of fluoroscopy, with this dose there is a 0.5% higher risk of suffering from some types of fatal cancer.[11,12] There are currently several systems of three-dimensional mapping for the treatment of conventional or complex arrhythmias, such as Carto 3, Ensite and Rhytmia, with which it is possible to follow the recommendations of the American Collage of Cardiology. Today it is recommended that all electrophysiology laboratories adopt the «ALARA» principle (radiation doses «As Low As Reasonably Achievable»).[13] In our series of patients we use both Carto 3 and Ensite systems; both are equally effective, the latter allows for a more panoramic view even from the vascular puncture, allowing the drawing of vascular trayectories through which the different catheters are introduced. Stec et al.[14] reported 902 patients undergoing supraventricular tachycardia ablation, in 179 he used 0 X-rays, found no difference in procedure time, complications and success rate. In our patient group we used zero seconds of X-rays, the procedure time was 100 ± 24 minutes, our success rate was 92.8%, and we had no complications. The procedure time we report is similar to other publications, which range between 63.9 to 87 minutes.[2,14,15]

On the other hand, and with regard to pregnant patients with severe tachycardias, Demilakis et al,[15] documented that fetal exposure with lead aprons during the procedure was less than 1 mGy; despite this, it is not recommended to undergo electrophysiological studies and catheter ablation until after the 2nd trimester of pregnancy. In our series, two patients with pregnancy were included, one in the first and one in the second trimester; in both cases the indication of the procedure was the presence of severe hypotension during the episodes of tachycardia and in both cases the result was successful. It is currently possible to perform more complex arrhythmia ablation such as atrial fibrillation, ventricular or atrial tachycardias with three-dimensional mapping without using X-rays.[5,16-18]

Tabla 2: Electrophysiology study and ablation procedures n (%).

Carto 3 three-dimensional mapping system	10 (71.4)
Mapping points, SD	334 ± 335
Irrigated catheter	12 (85.7)
Number of de ablaciones	50 ± 82
Procedure time (minutes)	100 ± 24
Acute successful	13 (92.8)
Late successful	13 (100.0)
Complications	0 (0.0)
Follow-up (months)	13.8 ± 4.0

SD = standard deviation.

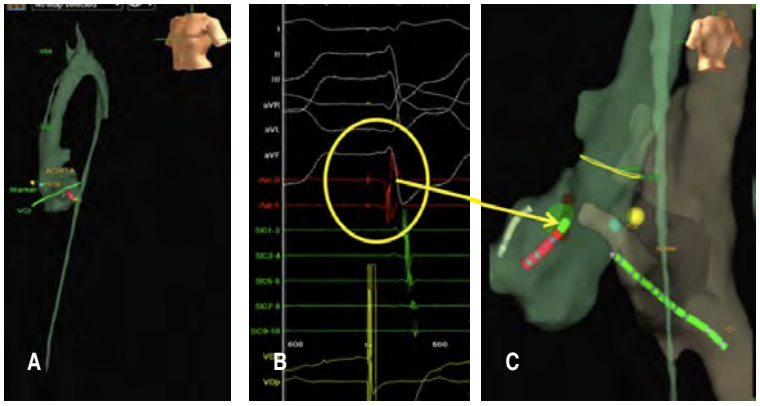

Figure 4: Panel **A**, left anterior oblique view of the aorta path (abdominal, thoracic ascending, aortic arch and descending) and aortic valve. In a patient with accessory pathway. Panel **B**, from top to bottom, electrocardiogram derivations, electrograms recording of the distal and proximal ablation catheter; registration of 5 coronary sinus electrograms and finally, right ventricle electrograms. The distal electrogram registers the location of the accessory pathway and where the ablation was successful. In panel **C**, there is the reconstruction of the aortic valve and coronary sinus that delimits the mitral ring and the green tip of the catheter is the ablation site.

CONCLUSIONS

In this case series it was demonstrated that it is feasible to perform conventional or complex catheter ablation of different tachyarrithmias with three-dimensional mapping systems, using 0 seconds of X-rays. This method of catheter ablation is safe since there were no complications and it was effective due to a success rate of 92.8% in the index procedure and during a follow-up of more than one year, there were no recurrences.

REFERENCES

1. Cappato R, Kuck KH. Catheter ablation in the year 2000. Curr Opin Cardiol. 2000; 15: 29-40.
2. Giaccardi M, Del Rosso A, Guarnaccia V, Ballo P, Mascia G, Chiodi L et al. Near-zero x-ray in arrhythmia ablation using a 3-dimensional electroanatomic mapping system: a multicenter experience. Heart Rhythm. 2016; 13: 150-156.
3. Perisinakis K, Damilakis J, Theocharopoulos N, Manios E, Vardas P, Gourtsoyiannis N. Accurate assessment of patient effective radiation dose and associated detriment risk from radiofrequency catheter ablation procedures. Circulation. 2001; 104: 58-62.
4. Smith IR, Rivers JT, Hayes J, Stafford W, Codd C. Reassessment of radiation risks from electrophysiology procedures compared to coronary angiography. Heart Lung Circ. 2009; 18: 191-199.
5. Ferguson JD, Helms A, Mangrum M, Mahapatra S, Mason P, Bilchick K et al. Catheter ablation of atrial fibrillation without fluoroscopy using intracardiac echocardiography and electroanatomic mapping. Circ Arrhythm Electrophysiol. 2009; 2: 611-619.
6. Koutalas E, Rolf S, Dinov B, Richter S, Arya A, Bollmann A et al. Contemporary mapping techniques of complex cardiac arrhythmias identifying and modifying the arrhythmogenic substrate. Arrhythm Electrophysiol Rev. 2015; 4 (1): 19-27.
7. Earley MJ, Showkathali R, Alzetani M, Kistler PM, Gupta D, Abrams DJ et al. Radiofrequency ablation of arrhythmias guided by non-fluoroscopic catheter location: a prospective randomized trial. Eur Heart J. 2006; 27 (10): 1223-1229.
8. Kottkamp H, Hugl B, Krauss B, Wetzel U, Fleck A, Schuler G et al. Electromagnetic versus fluoroscopic mapping of the inferior isthmus for ablation of typical atrial flutter: a prospective randomized study. Circulation. 2000; 102 (17): 2082-2086.
9. Kesek M, Wallenius N, Ronn F, Hoglund N, Jensen S. Reduction of fluoroscopy duration in radiofrequency ablation obtained by the use of a non-fluoroscopic catheter navigation system. Europace. 2006; 8 (12): 1027-1030.
10. Picano E, Vañó E. The radiation issue in cardiology: the time for action is now. Cardiovasc Ultrasound. 2011; 9: 35.
11. McFadden SL, Mooney RB, Shepperd PH. X-ray dose and associated risks from radiofrequency catheter ablation procedures. Br J Radiol. 2002; 75: 253-265.
12. Perisinakis KP, Damilakis J, Theocharopoulos N, Manions E, Vardas P, Gourtsoyiannis N. Accurate assessment of patient effective radiation dose and associated detriment risk from radiofrequency catheter ablation procedures. Circulation. 2001; 104: 58-62.
13. Anselmino M, Sillano D, Casolati D, Ferraris F, Scaglione M, Gaita F. A new electrophysiology era. J Cardiovasc Med. 2013; 14 (3): 221-227.
14. Stec S, Sledz J, Mazij M, Ras M, Ludwik B, Chrabaszcz M et al. Feasibility of implementation of a "simplified, no-X-ray, no-lead apron, two-catheter approach" for ablation of supraventricular arrhythmias in children and adults. J Cardiovasc Electrophysiol. 2014; 25: 866-874.
15. Damilakis J, Theocharopoulos N, Perisinakis K, Manios E, Dimitriou P, Vardas P et al. Conceptus radiation dose and risk from cardiac catheter ablation procedures. Circulation. 2001; 104: 893-897.
16. Scaglione M, Ebrille E, Di Clemente F, Gaita F. Catheter ablation of atrial fibrillation without radiation exposure using a 3d mapping system. J Atr Fibrillation. 2015; 7: 56-62.
17. Sadek MM, Ramirez D, Nery PB, Golian M, Redpath CJ, Nair GM et al. Completely nonfluoroscopic catheter ablation of left atrial arrhythmias and ventricular tachycardia. J Cardiovasc Electrophysiol. 2019; 30: 78-88.
18. Lyan E, Tsyganov A, Abdrahmanov A, Morozov A, Bakytzhanuly A, Tursunbekov A et al. Nonfluoroscopic catheter ablation of paroxysmal atrial fibrillation. Pacing Clin Electrophysiol. 2018; 4: 611-619.

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Original Research

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Distal transradial access for coronary angiography and percutaneous coronary intervention: an observational study in a Latin-American center

Acceso transradial distal para la angiografía coronaria y la intervención coronaria percutánea: un estudio observacional en un centro latinoamericano

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Keywords: Distal transradial access, coronary angiography, percutaneous coronary intervention.

Palabras clave: *Acceso transradial distal, angiografía coronaria, intervención coronaria percutánea.*

ABSTRACT

Introduction: The distal radial technique which consists of canalizing the radial artery through the anatomical snuffbox has recently emerged as an alternative arterial access for diagnostic and therapeutic coronary catheterization. This study aimed to evaluate the feasibility and safety of the distal transradial approach (dTRA) as a default route for coronary angiography (CAG) and percutaneous coronary intervention (PCI) in a Latin-American center. **Material and methods:** Between November 2017 and December 2018, 100 consecutive patients were enrolled in this single-center observational study. The distal radial artery was punctured with a 20, 21 or 22-gauge puncture needle, using a transfixion or anterior wall technique by four expert radial approach operators, 32% of the procedures were PCI. **Results:** The arterial crossover was presented in 19% of patients. The median puncture time and fluoroscopic time were 6.36 minutes and 16 minutes, respectively. Haemostasis median time was 180 minutes. A total of 12 puncture site complications occurred, including 11 minor hematomas and one major hematoma. No distal radial artery occlusion, perforation, pseudoaneurysm, or arteriovenous fistula occurred. **Conclusions:** Even the crossover and complications in our center dTRA is feasible and safe. In a near future this procedure could be a default route for elective CAG and interventions. Large randomized studies should be performed to support it.

RESUMEN

Introducción: *La técnica de acceso transradial distal que consiste en canalizar la arteria radial a través de la tabaquera anatómica, ha surgido recientemente como una vía arterial alternativa para el cateterismo coronario diagnóstico y terapéutico. Este estudio tuvo como objetivo evaluar la viabilidad y seguridad del abordaje transradial distal (ATRD) como un acceso predeterminado para la angiografía coronaria (AC) y la intervención coronaria percutánea (ICP) en un centro latinoamericano.* ***Material y métodos:*** *Entre noviembre de 2017 y diciembre de 2018, se inscribieron 100 pacientes consecutivos en este estudio observacional de un solo centro. La arteria radial distal se perforó con una aguja de punción de calibre 20, 21 o 22, utilizando una técnica de transfixión o pared anterior, por cuatro operadores expertos en el abordaje radial, 32% de los procedimientos fueron de ICP.* ***Resultados:*** *El crossover arterial se presentó en 19% de los pacientes. El tiempo medio de punción y el tiempo de fluoroscopia fueron 6.36 minutos y 16 minutos, respectivamente. El tiempo medio de hemostasia fue de 180 minutos. Se produjo un total de 12 complicaciones en el sitio de la punción, incluidos 11 hematomas menores y un hematoma mayor. No se produjo oclusión de la arteria radial distal, perforación, pseudoaneurisma o fístula arteriovenosa.* ***Conclusiones:*** *El ATRD es factible y seguro pese a las complicaciones observadas y a futuro, quizá sea la técnica electiva en los procedimientos invasivos arteriales electivos. Estudios aleatorizados más amplios se necesitan para respaldar esta técnica.*

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INTRODUCTION

Conventional transradial intervention is now considered the first intention technique for coronary access.[1,2] The principal advantages are the increase in safety due to the reduction of major bleeding complications, as well as an increase in the patient's comfort due to the immediate post-procedure mobilization.[3]

The safety of conventional transradial catheterization is mainly determined by the favourable anatomical relationship between the radial artery and the adjacent structures.[4,5] No important vein or nerve is located near the artery, which minimizes the chances of damaging these structures.[6,7] Due to the superficial trajectory of the radial artery, hemostasis can be easily performed with local compression. Due to adequate collateral blood flow from the ulnar artery or the interosseous artery, the hand perfusion is not in risk even an acute radial artery occlusion.[8,9]

Among the expected complications and limitations for future interventions the most important is the radial artery occlusion, which is estimated to occur in 10% of patients undergoing transradial intervention and it has been considered the «Achilles heel» of transradial intervention for patients who eventually require new coronary procedures due to the complexity of their cardiac disease. This complication is originated in the sheath insertion site due to endothelial damage, blood flow cessation, and secondary thrombosis, and has an early occurrence after transradial catheterization.[10,11]

The distal radial technique, which consists of canalizing the radial artery through the anatomical structure called snuffbox (anatomical snuffbox, radial fossa, fovea radialis), has recently emerged as an alternative arterial intervention for diagnostic and therapeutic coronary catheterization, allowing the conservation of the radial artery for classical transradial intervention in patients who, according to the complexity of their heart disease, require new coronary interventions.[12]

The radial fossa is a hollow space on the radial side of the wrist that becomes evident when the thumb is extended; it is limited by the extensor pollicis longus tendon of the thumb, the extensor pollicis brevis and the abductor pollicis longus tendons of the thumb. The radial artery crosses the surface formed by the scaphoid and trapezium *(Figure 1)*.[13] Distal artery access from the radial fossa was first described by Babunashvili and collaborators in 2011 with the aim of permeabilize the ipsilateral radial arteries with retrograde occlusion.[14] If the artery is well developed, this artery can be used as the entry site for 4, 5, 6, 7 or even 8 Fr catheters and sheaths.[15]

Another important characteristic of this technique is a proximal puncture of the short artery of the thumb and distally to the branch that irrigates the superficial palmar arch. This is because an occlusion at this site maintains anterograde flow towards the superficial palmar arch. This reduces the risk of development of retrograde thrombus in the proximal radial artery located in the forearm, a frequent finding in patients who develop radial artery occlusion due to traumatic punctures or traumatic hemostasis at the traditional radial puncture site. Flow towards the thumb is maintained by the superficial palmar arch, preventing ischemia and disability of the hand.[16-19]

The transradial distal technique intervention has been performed in Mexico since 2017. We

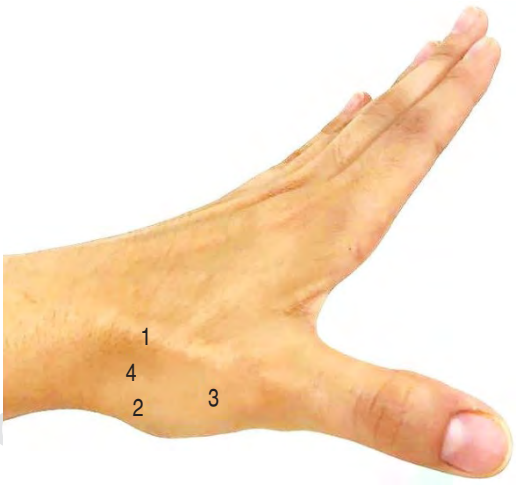

Figure 1: Dorsal view of the radial zone of the left wrist with anatomical references. 1 = extensor pollicis longus muscle tendon of the thumb; 2 = extensor pollicis brevis muscle tendon of the thumb; 3 = head of the first metacarpal; 4 = anatomical snuffbox.

have performed the present registry to describe the characteristics, complications, and benefits of this procedure on a consecutive series of patients in a Latin-American center.

MATERIAL AND METHODS

Study type and design

This is a prospective, observational, single-center study carried out at the National Medical Center November 20 in Mexico City. The protocol was reviewed and authorized by the local Safety, Statistics, and Bioethics Committees (Folio 34.2018) and registered in ClinicalTrials.gov (NCT03948165). Patient selection, procedures, follow-up, and data capturing were performed by the authors.

Prior assessment

Distal transradial access was performed on patients above 18 years of age, undergoing diagnostic and/or therapeutic coronary angiography, with palpable pulse at the level of the radial fossa, and these patients were also subjected to the following tests: Allen maneuver and Barbeau maneuver; a positive Allen test was an indication to perform the transradial access, while a type D Barbeau test was a contraindication for it. Also, all patients with the following conditions were excluded: cardiogenic shock within the previous 48 hours, anticoagulant contraindication, uncontrolled arterial hypertension, peripheral arterial disease, proximal radial artery diameter by duplex ultrasound < 1.8 mm, radial access used within the previous 6 weeks, proximal radial artery occlusion, and refusal of consent.

Preparation and medications

With prior consent signed by the patient and/or responsible person. The puncture site was infiltrated with 2% lidocaine (2-3 mL). 5,000 IU unfractionated heparin was administered intravenously after insertion of the distal radial sheath, and in case of requiring percutaneous coronary intervention, a dose of 80-110 IU/kg/hour was completed. In case of long procedures, activated clotting time (ACT) control was required, with values between 300-350 seconds. The following vasodilators were used initially as intra-arterial bolus: 200 μg of nitroglycerin (which was excluded in the case of hypotension) and 250 μg of levosimendan. After radial sheath removal by patent hemostasis, the heparin infusion was continued in case of evidence of intracoronary thrombus.

Distal radial artery cannulation

In the case of access through the left distal radial artery, the left arm was brought comfortably towards the patient's right side allowing a natural working position for the operator; and if access is through the right distal radial artery, this additional comparative position change was not necessary. Left or right, the hand and wrist were placed in hyperextension, exposing the radial fossa. The distal radial artery was punctured with specialized equipment, with a 20, 21 or 22-gauge puncture needle using a transfixion or anterior wall technique. A 0.025 inch, 46 cm hydrophilic guidewire was introduced in the system, followed by the 5, 6, 7 Fr hydrophilic arterial sheath or 5, 6 or 7 Fr Glidesheath Slender introducer (Terumo IS, Tokyo, Japan), after a small cut in the skin.

For the convenience of the operator, initial access is right distal transradial, in the case of not being able to achieve this access the first alternative was to migrate to a left distal transradial access; the causes associated with this were:

- Right radial artery occlusion.
- Underdeveloped right radial artery.
- Extreme right radial tortuosity.
- Sclerosis or calcifications.
- Lusoria artery.
- Previous failed attempt on right radial artery.
- Presence of arteriovenous short circuit in left arm.
- Previous use or foreseen future use of right radial artery for bypass graft.
- Patients with surgical revascularization who require left internal mammary artery graft angiography.
- Patient preference.
- Right-handed patients due to temporary post-procedure disability caused by the hemostasis process.

Coronary artery cannulation

Specialized 5Fr, 6Fr or 7Fr guide catheters or diagnostic catheters were used with appropriate curve according to the case, in order to provide maximum support during coronary angiography or angioplasty.

Table 1: Clinical characteristics of patients (N = 100).

Age	65.06 ± 24.5
Diabetes mellitus	43
Hypertension	73
Dyslipidemia	45
Prior coronary angioplasty	8
Active smoking	19
Clinical indication	
Stable chronic angina	54
Unstable angina	1
Myocardial infarction	9
Mitral valve disease	12
Aortic valve disease	15
Interatrial septal defect	5
Endocarditis	2
Pulmonary hypertension	2

The qualitative variables were expressed as n (%), while the quantitative variables were expressed as n (± 2 SD).

Table 2: Anatomical characteristics of the distal radial artery (N = 100).

Palpable proximal radial pulse	100
Palpable radial pulse in anatomical snuffbox	100
Allen test (seconds)	2.06 ± 0.5
Barbeau test	
A	88
B	11
C	1
D	0
Pre-procedure duplex ultrasound	
Proximal radial artery diameter (mm)	2.5 ± 0.7
Peak systolic velocity (cm/s)	33 ± 3.2
Peak diastolic velocity (cm/s)	11.45 ± 2.65
Distal radial artery diameter (mm)	2.28 ± 0.7

The qualitative variables were expressed as n (%), while the quantitative variables were expressed as n (± 2 SD).

Sheath removal, patent hemostasis, and hospital discharge

In all cases, the arterial sheath is removed after the removal of the diagnostic or guide catheter. Patent hemostasis is performed obtaining the pulse oximeter oscillatory curve by placing the external pneumatic compression band, adjusting the radial compression system in air millilitres (modified Barbeau maneuver). If there are no complications after the procedure, hospital discharge will be evaluated after 24 hours.

Statistical analysis

Non-probability sampling was performed according to the above-mentioned selection criteria. The descriptive analysis was carried out with measures of central and dispersion tendency according to the normality test. The categorical variables were reported as n (%) and the quantitative variables in interquartile ranges P50 (P25-P75) or as standard deviation (n [± 2 SD]). The Statistics Program SPSS 24.0 for Windows was used.

RESULTS

In the period between November 2017 and December 2018 a total of 100 patients were assigned for distal transradial access. Among the clinical characteristics of the population *(Table 1)*, the following stand out: the mean age was 65 years, with a 43% of diabetes mellitus, 73% hypertension, 45% dyslipidemia, 10% smokers, and 8% prior history of coronary angioplasty. The main indication for coronary angiography was stable chronic angina in 54%, followed by aortic valve disease (15%) and mitral valve disease (12%).

The anatomical characteristic of the radial artery *(Table 2)* in which the distal and proximal radial pulse were palpable was found in all the patients. The Allen test was positive in every case. The Barbeau test was type A in 88%, type B in 11%, and only one patient was type C.

For service logistics details the radial artery ultrasound was not performed on all the patients, but with a 30% sample an average proximal radial artery diameter of 2.5 ± 0.7

Table 3: Procedure characteristics (N = 100).

Ultrasound-guided puncture	11
Time to obtain the arterial access (seconds)	382 (46-5400)
Obtained access	
R-dTRA	74
L-dTRA	26
Arterial sheath	
5 Fr	9
6 Fr	39
Glidesheath Slender 6 Fr	40
Glidesheath Slender 7 Fr	12
Hydrophilic	98
Non-hydrophilic	2
Coronary guidewire	
Hydrophilic	76
Non-hydrophilic	24
Intermediate 0.014”	22
Floppy 0.014”	1
Extra support 0.014”	2
Arterial access crossover	19
Ipsilateral radial	6
Contralateral radial	2
Contralateral distal radial	1
Femoral	10
Number of catheters used	1.38 (1-3)
Maximum width used (Fr)	7
Diagnostic procedures	68
Interventional procedures	32
Fluoroscopy time (min)	16 (1-118)
Total radiation (air kerma) (mGy)	1798.12 (250-11989)

The qualitative variables were expressed as n (%), while the quantitative variables were expressed as P50 (P25-P75).
Abbreviations: R-dTRA = right distal radial artery, L-dTRA = left distal radial artery, Fr = French.

mm and an average distal radial artery diameter of 2.28 ± 0.7 mm were obtained, with a 0.22 mm difference. The average peak systolic velocity was 33 ± 3.2 cm/s and the average peak diastolic velocity was 11.45 cm/s.

Ultrasonographic guide was used to perform the distal radial arterial puncture in 11% of the cases, highlighting its use in the first quarter of cases *(Table 3)*. Of the one hundred patients who underwent distal radial access, 74% were on the right hand and 26% on the left hand. In most patients, 6 Fr Slender sheaths (Terumo IS, Tokyo, Japan) were used (40%), followed by 6 Fr sheaths (39%), 7 Fr Glidesheath Slender (12%), and 5 Fr Glidesheath Slender (9%). A hydrophilic sheath was used in 98% of the cases. The guidewire used to place the distal radial sheath was 0.025″ hydrophilic in 76% of patients, and in the rest (24%) predominantly intermediate 0.014″ coronary guidewires were used. Once distal transradial access was obtained and successfully cannulated with the arterial sheath, the need for arterial access crossover was presented in up to 19% of patients mainly due to radial artery vasospasm development, and therefore the most common crossover was to femoral artery access (10%) followed by ipsilateral radial artery (6%), contralateral radial artery (2%), and only one case to the contralateral distal radial artery. In most cases a single diagnostic catheter was used (68%), where 7 Fr was the maximum size used. Regarding the performed coronary procedure it was mostly a diagnostic coronary angiography, with only a 10% of coronary angioplasty, including resolution with dual coronary cannulation for chronic total occlusion in four patients and rotational atherectomy in one case. The average fluoroscopy time was 16 minutes mainly due to the complex coronary intervention including the resolution of total chronic coronary occlusions. The pneumatic compression device was the most used (98%) and the average air volume of the pneumatic band was 16.9 mL *(Table 4)*. The total hemostasis time was standardized to 3 hours. Immediately after finishing the procedure the proximal radial arterial pulse was present in 94% of cases. Hematoma occurred in 12% mainly of low grade, ecchymosis occurred in 16% also in low grade. There was pain at the radial puncture site immediately after the procedure in 47 patients, but it was low scale (1 to 3), and it decreased in the following 24 hours in 39%, remaining in low scale *(Table 5)*. Twenty four hours after the procedure, presence of palpable pulse on the intervened distal radial artery was reported in 65% of patients, and in the proximal radial artery in 89% of patients. Hematoma developed after 24 hours of the procedure in 7% of patients, and ecchymosis in 18%, both were of low grade.

DISCUSSION

This single-center, prospective and observational registry presents an experience in a Latin-

American center, as well as it shows the feasibility of coronary intervention by a distal transradial access.

A registry conducted by Jon-Won Lee shows that the procedure is safe and effective in diagnostic and therapeutic coronary catheterization with success rates of 95.5% for arterial puncture, 100% for coronary angiography and 98.9% for coronary angioplasty, with a time to obtain arterial access of 3.0 ± 2.8 minutes.

Complications were considered minor in 7.4%, with hematoma development in 1% and a single case of arterial dissection, observing adequate flow after one month follow-up; no radial artery occlusion, perforation, pseudoaneurysm or arteriovenous fistula were observed.[20] This study[20] also reports the first experience of a high-concentration centre and the results are comparable to those observed in our series, in which the most frequent complication was low grade hematoma in 9% and high grade hematoma in 3%.

Table 4: Immediate post-procedure variables.

Hemostatic device	
Pneumatic band	98
Compression bandage	2
Air volume (mL) in hemostatic device	16.9 (12-20)
Total radial hemostasis time (min)	180 (160-200)
Complications	
Hematoma	12
Grade I	6
Grade II	3
Grade III	2
Grade IV	1
Grade V	0
Ecchymosis	16
Grade I	6
Grade II	7
Grade III	2
Grade IV	1
Grade V	0
Radial pain	47
Numeric analog scale	1.47 (1-3)

The qualitative variables were expressed as n (%), while the quantitative variables were expressed as P50 (P25-P75).

Table 5: 24-hour post-procedure variables.

Pulse present in distal radial artery	65
Pulse present in proximal radial artery	89
Hematoma	10
Grade I	7
Grade II	2
Grade III	1
Grade IV	0
Grade V	0
Ecchymosis	18
Grade I	11
Grade II	4
Grade III	2
Grade IV	1
Grade V	0
Radial pain	39
Numeric analog scale	1.37 (1-5)

The qualitative variables were expressed as n (%), while the quantitative variables were expressed as P50 (P25-P75).

Within a one-year period, successful distal radial artery canalization was achieved 100 times. Although in the first cases the vascular ultrasound was used to support the puncture it was only used in the first patients, being part of the learning curve, likewise observing a drastic reduction in the time necessary to achieve a successful vascular access from 9 minutes in the first case to 34 seconds in the latter cases. This effect can be observed also in other series.[20,21]

The distal radial artery occlusion (RAO) rate was not observed in this study, despite the fact that the diameter of the distal radial artery is smaller than that of the forearm radial artery. Such a low RAO rate may be attributed to the anatomical configuration of the puncture site and due to the time of evaluation. This specific anatomical configuration can naturally limit the vascular compression needed to achieve hemostasis using hemostatic devices.

Further, echo-guided puncture was conducted in 11% of the patients in this study, it was largely applied for patients with small radial size and poor radial pulsation either from the beginning

or after a failed initial attempt. Although the success of puncture is mainly affected by operator expertise, frequent use of sonography may contribute to higher success rate of puncture and consequently may avoid multiple puncture attempts, which lead to a potential risk for RAO due to subsequent hematoma formation and/or radial artery dissection.

The main cause for access crossover was the development of radial artery vasospasm, femoral artery was the second access option and the ipsilateral radial artery was the third option. Although the 6 Fr Glidesheath Slender (Terumo IS, Tokyo, Japan) was the most used radial sheath, 5 and 6 Fr hydrophilic sheaths were also used. Diagnostic coronary procedure was the most performed. However, it was possible to perform complex coronary intervention including chronic total occlusions and rotational atherectomy (1.75 mm olive), procedures that have scarcely been reported through this access.

Neuropathy (numbness in the fingers) was observed in two patients (2%), a rate similar to that reported in a recent study.[6] Although the advantages of the dTRA in terms of vascular complications are clear, this specific issue should be noted. The branch of the superficial radial nerve is located in the snuffbox and can induce damage to the nerve, which rarely occurs in the forearm radial artery.

The refinement and development of distal transradial access can offer advantages to patients in the outcomes of angiography and coronary intervention, maintaining the convenience for the operator and decreasing the complications associated with the procedure.[8] Thus, a new possibility is opened up for vascular access which will benefit patients who require repeated arterial access throughout the course of their cardiovascular pathology.

CONCLUSIONS

Although it is a prospective observational study, it can be concluded that distal transradial access is feasible. With experienced operators and the appropriate materials it offers a safe arterial canalization for coronary angiography and percutaneous intervention. A randomized clinical trial must be carried out to demonstrate its relative safety compared with other arterial accesses.

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REFERENCES

1. Kiemeneij F, Laarman GJ. Percutaneous transradial artery approach for coronary stent implantation. Cathet Cardiovasc Diagn. 1993; 30 (2): 173-178.
2. Kiemeneij F, Laarman GJ, Odekerken D, Slagboom T, van der Wieken R. A randomized comparison of percutaneous transluminal coronary angioplasty by the radial, brachial and femoral approaches: the access study. J Am Coll Cardiol. 1997; 29 (6): 1269-1275.
3. Agostoni P, Biondi-Zoccai GG, De Benedictis ML, Rigattieri S, Turri M, Anselmi M et al. Radial versus femoral approach for percutaneous coronary diagnostic and interventional procedures: systematic overview and meta-analysis of randomized trials. J Am Coll Cardiol. 2004; 44 (2): 349-356.
4. Bedford RF, Wollman H. Complications of percutaneous radial-artery cannulation: an objective prospective study in man. Anesthesiology. 1973; 38 (3): 228-236.
5. Campeau L. Percutaneous radial artery approach for coronary angiography. Cathet Cardiovasc Diagn. 1989; 16 (1): 3-7.
6. Mizuguchi Y, Izumikawa T, Hashimoto S, Yamada T, Taniguchi N, Nakajima S et al. Efficacy and safety of the distal transradial approach in coronary angiography and percutaneous coronary intervention: a Japanese multicenter experience. Cardiovasc Interv Ther. 2020; 35 (2): 162-167. doi: 10.1007/s12928-019-00590-0.
7. Lotan C, Hasin Y, Mosseri M, Rozenman Y, Admon D, Nassar H et al. Transradial approach for coronary angiography and angioplasty. Am J Cardiol. 1995; 76 (3): 164-167.
8. Corcos T. Distal radial access for coronary angiography and percutaneous coronary intervention: A state-of-the-art review. Catheter Cardiovasc Interv. 2019; 93 (4): 639-644.
9. Valgimigli M, Gagnor A, Calabró P, Frigoli E, Leonardi S, Zaro T et al. Radial versus femoral access in patients with acute coronary syndromes undergoing invasive

management: a randomised multicentre trial. Lancet. 2015; 385 (9986): 2465-2476.
10. Avdikos G, Karatasakis A, Tsoumeleas A, Lazaris E, Ziakas A, Koutouzis M. Radial artery occlusion after transradial coronary catheterization. Cardiovasc Diagn Ther. 2017; 7 (3): 305-316.
11. Aoi S, Htun WW, Freeo S et al. Distal transradial artery access in the anatomical snuffbox for coronary angiography as an alternative access site for faster hemostasis. Catheter Cardiovasc Interv. 2019; 94 (5): 651-657.
12. Hamon M, Pristipino C, Di Mario C, Nolan J, Ludwig J, Tubaro M et al. Consensus document on the radial approach in percutaneous cardiovascular interventions: position paper by the European Association of Percutaneous Cardiovascular Interventions and Working Groups on Acute Cardiac Care and Thrombosis of the European Society of Cardiology. EuroIntervention. 2013; 8 (11): 1242-1251.
13. Jolly SS, Yusuf S, Cairns J, Niemelä K, Xavier D, Widimsky P et al. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): a randomised, parallel group, multicentre trial. Lancet. 2011; 377 (9775): 1409-1420.
14. Davies RE, Gilchrist IC. Dorsal (distal) transradial access for coronary angiography and intervention. Interv Cardiol Clin. 2019; 8 (2): 111-119.
15. Shah RM, Patel D, Abbate A, Cowley MJ, Jovin IS. Comparison of transradial coronary procedures via right radial versus left radial artery approach: a metaanalysis. Catheter Cardiovasc Interv. 2016; 88 (7): 1027-1033.
16. Cerda A, Del Sol M. Anatomical snuffbox and it clinical significance. A literature review. Int J Morphol. 2015; 33 (4): 1355-1360.
17. Babunashvili A, Dundua D. Recanalization and reuse of early occluded radial artery within 6 days after previous transradial diagnostic procedure. Catheter Cardiovasc Interv. 2011; 77 (4): 530-536.
18. Kaledin AL, Kochanov IN, Seletski SS, Arkharov IV, Burak T, Kozlov KL. Peculiarities of arterial access in endovascular surgery in elderly patients. Adv Gerontol. 2014; 27 (1): 115-119.
19. McNamara MG, Butler TE, Sanders WE, Pederson WC. Ischaemia of the index finger and thumb secondary to thrombosis of the radial artery in the anatomical snuffbox. J Hand Surg Br. 1998; 23 (1): 28-32.
20. Lee JW, Park SW, Son JW, Ahn SG, Lee SH. Real-world experience of the left distal transradial approach for coronary angiography and percutaneous coronary intervention: a prospective observational study (LeDRA). EuroIntervention. 2018; 14 (9): e995-e1003.
21. Kiemeneij F. Left distal transradial access in the anatomical snuffbox for coronary angiography (ldTRA) and interventions (ldTRI). EuroIntervention. 2017; 13: 851-857.

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Review

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Atrial infarction: a literature review

Infarto atrial: revisión de la literatura

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Keywords:
Infarction, atrium, atrial fibrillation, embolism and thrombosis.

Palabras clave:
Infarto, aurícula, fibrilación auricular, embolia y trombosis.

ABSTRACT

Atrial infarction is an often-missed entity that has been described in association with ventricular infarction or as an isolated disease, which is mainly caused by atherosclerosis. The electrocardiographic diagnostic criteria were proposed more than fifty years ago and have not yet been validated. The diagnosis is based on elevations and depressions of the PTa segment and changes in the P wave morphology. However, supraventricular arrhythmias such as atrial fibrillation are the most common finding and often predominate in the clinical presentation. Early recognition and treatment may prevent serious complications such as mural thrombosis or atrial rupture. Further studies need to be carried out in order to establish unified criteria for the diagnosis and the actual prevalence of this entity.

RESUMEN

El infarto atrial es una entidad frecuentemente olvidada, ha sido descrita en asociación con el infarto ventricular o de manera aislada y es causado principalmente por aterosclerosis. Los criterios diagnósticos electrocardiográficos fueron propuestos hace más de 50 años y aún no han sido validados. El diagnóstico se basa en el hallazgo de elevación o depresión del segmento PTa y de alteraciones en la morfología de la onda P; sin embargo, las arritmias supraventriculares como la fibrilación atrial son las más comunes y con frecuencia predominan en el cuadro clínico. Un rápido reconocimiento y tratamiento pueden ayudar a prevenir complicaciones graves como la trombosis mural o la ruptura auricular. Se necesitan más estudios para establecer criterios diagnósticos unificados y para conocer la prevalencia real de esta entidad.

INTRODUCTION

Ventricular infarction (VI) is a well known pathology that in most of the cases of atrial infarction (AI), covers all the attention of the clinical presentation. A wide variety of presentations can make the diagnosis of this pathology more difficult. Most of the times it is associated with ventricular ischemia, but in cases of hypertrophy, myocarditis, COPD (chronic obstructive pulmonary disease), pulmonary hypertension or muscular dystrophy, AI can be an isolated disease.[1,2] The two atria can be compromised, or only one of them, being the right atrium the most frequent one.[3]

Almost a century ago, Clerc et al. described the first case report documented in literature,[4] and in 1942 a case series was described by Cushing et al.[5] Until today, there are no unified criteria for the diagnosis of AI.

The presence of supraventricular arrhythmias, such as atrial fibrillation, wandering pacemaker, atrial tachycardia, and atrial premature complexes, might suggest the existence of AI in the context of an acute coronary syndrome, as only 20% of cases of isolated VI present supraventricular arrhythmias, differently occurs in AI, in which the incidence increases up to 70%.[6]

Not only arrhythmias are present in these patients, more threatening complications such as thrombosis, atrial wall rupture and heart failure decompensation, can lead to a high mortality.[2,7]

The purpose of this review is to bring attention to a frequently unnoticed disease.

Risk factors and pathophysiology

An exact incidence of AI in admitted patients with VI is unknown, autopsy studies had been

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broadly variable with incidences that range from 0.7% to 42%,[2] a bigger study conducted by Cushing et al, demonstrated that 31 of 182 cases of VI resulted in atrial ischemia, with an incidence of 17%, proven with autopsy examination.[5]

The main cause of AI, as in VI is atherosclerosis,[2,8-11] it has also been associated with other entities like COPD with cor pulmonale, elevated chamber pressure plus hypoxia, that is consequence of the pulmonary disease itself,[2,8,9] primary pulmonary hypertension,[2,8-10] muscular dystrophy and Friedreich's ataxia.[2,9]

Due to the thin atrial wall (2-3 mm), most AI are transmural,[2,8] they occur mainly in the right atrium and are more frequently found on the atrial appendages;[1-3,5,8-10] when the right coronary artery is occluded it does commonly in the first 2-3 cm, therefore compromising the atrial branches; interestingly in the study conducted by Cushing et al. occlusion of left coronary artery and its atrial branches occurred in 65% of cases, but the incidence of AI was still higher in the right atrium. This could be explained by the higher oxygen concentration in the left atrium, suggesting that there may be other mechanisms involved.[5,8]

Nevertheless, mostly of AI occur concurrently with VI,[1,2,5,8,11] in this context, left ventricle infarcts are more prevalent, probably explaining why in some series the left atrium is mostly compromised.[11]

The AI occurs when blood supplying arteries are occluded *(Figure 1)*, and some of its clinical and electrocardiographic (ECG) manifestations, like supraventricular tachycardias,[1,3,8,11,12] are explained by the compromise of structures such as the sinoatrial (SA) node and atrioventricular (AV) node, which are irrigated by branches of the main arteries that nourish the atria.

The ramus ostii cava superioris (ROCS) originates in 60% of people from the proximal right coronary artery (RCA), and in 40% from the proximal left circumflex artery (LCx); irrigating the SA node through its course along the atrium, passing across the interatrial groove forming the interatrial branches, towards its ending near the superior vena cava opening. The right and left intermediate and posterior atrial arteries, branches from the RCA and LCx respectively, anastomosing with the ROCS in the interatrial groove or over the atrium body. The AV node artery arises commonly from the RCA (87%), in 7% of cases from the LCx and in 10% from both. Due to the variability in atrial blood supply, the clinical and ECG findings are inconsistent.[8,13]

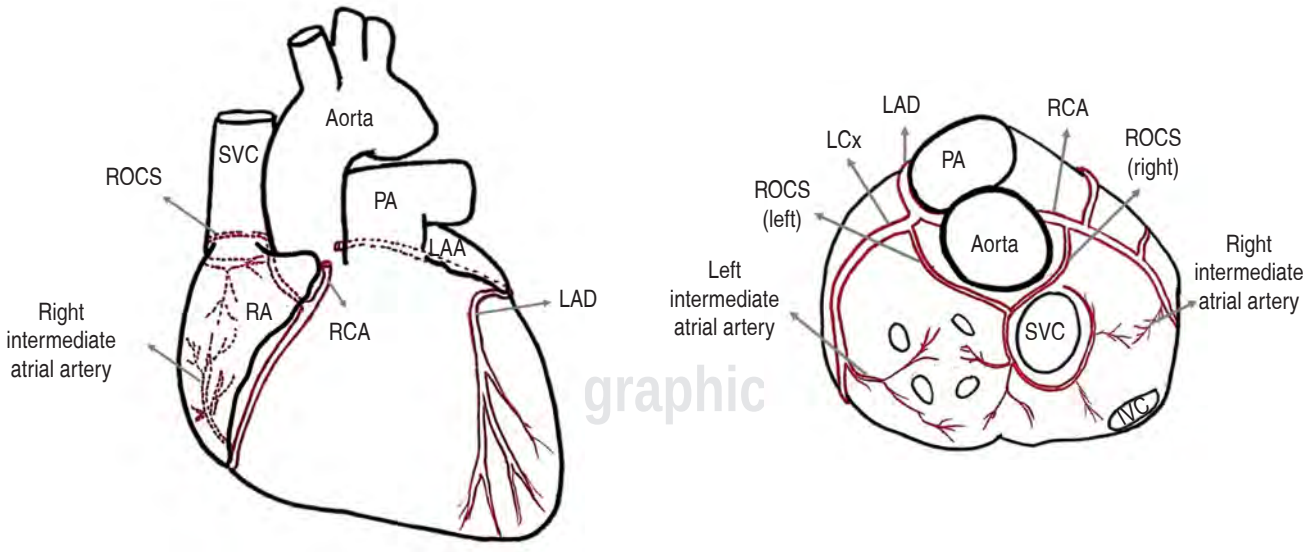

Figure 1: Atrium blood supply (SVC = superior vena cava, IVC = inferior vena cava, PA = pulmonary artery, RA = right atrium, LAA = left atrial appendage, RCA = right coronary artery, LAD = left anterior descending, LCx = left circumflex, ROCS = ramus ostii cava superioris).

Diagnosis

To this day, there are no unified criteria for the diagnosis of AI. The clinical presentation depends mostly on the area and extension of the affected myocardium.[8] In addition, ECG findings are subtle and nonspecific, making the diagnosis difficult.[14]

AI associated with VI is the most common type, especially with acute inferior and right VI;[15,16] however some cases of isolated AI have been described.[17] In 1991, Wong et al. concluded that if a patient presents angina, paroxysmal supraventricular arrhythmias, changes in the PTa segment and elevation of cardiac enzymes, without evidence of VI, an isolated AI is a probable diagnosis.[18]

In 1948, Hellerstein reported the first case of a patient that had an ante-mortem diagnosis of AI based on the ECG.[1] The ante-mortem diagnosis depends on the ECG findings, based on elevations and depressions of the PTa segment (representing atrial repolarization) and changes in the P wave; under normal conditions atrial repolarization in the ECG takes place at the same time as the ventricular depolarization (QRS complex), explaining why it is not usually seen in the ECG, as the QRS complex voltage is higher. Conversely, a diseased atrium has its repolarization (PTa segment) earlier in the ECG, therefore the changes can be identified in the PR segment. However, these changes are not always present in the ECG, this might be due to the low voltage generated by the atria and because these changes are generally masked by the underlying alterations in the ventricular depolarization.[2,11] Also PR segment prolongation and P wave axis changes have been reported.[19]

Supraventricular arrhythmias are the most common finding, ECG must be done especially after these episodes are over and the sinus rhythm is reestablished, in order to look for AI signs.[8,11]

In 1961, Liu et al. reported six cases of patients with AI that also had VI, in which the ante-mortem diagnosis was done and confirmed with an autopsy.

The electrocardiographic criteria proposed by Liu et al.[11] are shown in *figure 2*.

However, these major criteria have not been observed in subsequent studies and have not yet been validated.[20]

Recently, Yildiz et. al conducted a retrospective study that included patients with inferior-wall STEMI, finding PTa segment displacement only in a few patients with AI and not in patients without this entity. In the P-wave parameters analyzed, the P-wave duration was longer, and the amplitude was lower in inferior leads in patients with AI than in the control group. They suggest a P-wave duration of ≥ 95.5 ms in lead II for AI diagnosis.[21]

Changes in the PTa segment usually last between a few hours to a few days. It is believed that these changes improve with infarction treatment. Besides, it is also believed that PTa deviations occur before any other ECG alterations.[6]

Liu et al. suggested that AI must be suspected when a patient presents atrial arrhythmias and an associated VI. In one of the cases described by Liu et al, the VI diagnosis confirmed with an autopsy was not seen in the ante-mortem ECG, but the AI was in fact seen. This is why it is advised that in the presence of ECG changes suggestive of AI, an associated VI must be assumed and treated.[11]

The sensitivity or specificity of the PTa segment deviations for the AI diagnosis are unknown.[6]

The infarction location, in theory, would determine the PTa segment deviation:

- When there is an ischemia of the posterior wall: PTa segment is elevated in lead II and III, with a reciprocal depression in lead I *(Figure 3)*.
- If the ischemia is located on the anterior or anterolateral walls (including the right atrial appendage): PTa segment is elevated in lead I, with a reciprocal depression in lead II and III.[1]

Nevertheless, PTa segment deviations can also be present in pericarditis or sympathetic overstimulation,[22] and P wave abnormalities can also be seen in atrial enlargement and interatrial blocks.

Riera et al. published a case report in which they used vectocardiography as an additional diagnostic tool that helped determine atrial dilatation, showing notches in the P loop suggestive of AI, even though, no alterations were found in the complementary echocardiography done at this time.[17]

Bryce et al. concluded in 2017 that the presence of interatrial block is more common in patients with multi-vessel coronary disease *(Figure 4)*. They also suggested that this block is the result of persistent atrial ischemia.[22]

Echocardiography

There are limitations in the visualization of the atria by conventional echocardiography. Transesophageal echocardiography (TEE) is better for the evaluation of atrial wall motion and presence of thrombi.[2,9] In patients with inferior wall infarction with right ventricle compromise, the TEE might be useful in order to identify atrial ischemia.

In 1993, Vargas-Barron et al. described the following findings in TEE:[23,24]

- Akinesis of the right atrial free wall, despite left atrial contraction.
- Dilatation with spontaneous echo contrast effect in the right atrium.
- Thrombosis at the site of parietal akinesis.
- Lack of Doppler A wave across the tricuspid valve with normal mitral A wave.

Other findings include inversion of the normal interatrial septal convexity in patients with associated right ischemic ventricular dysfunction.[24]

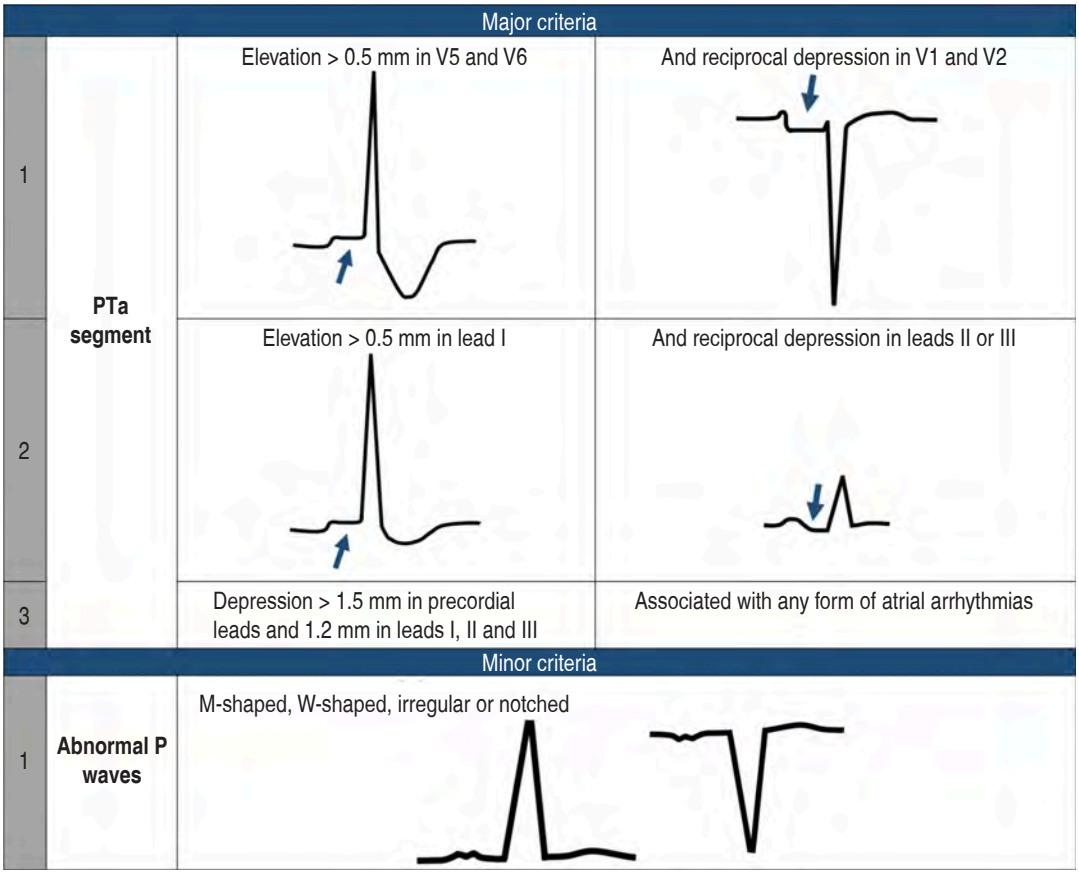

Figure 2: Electrocardiographic criteria proposed by Liu et al.

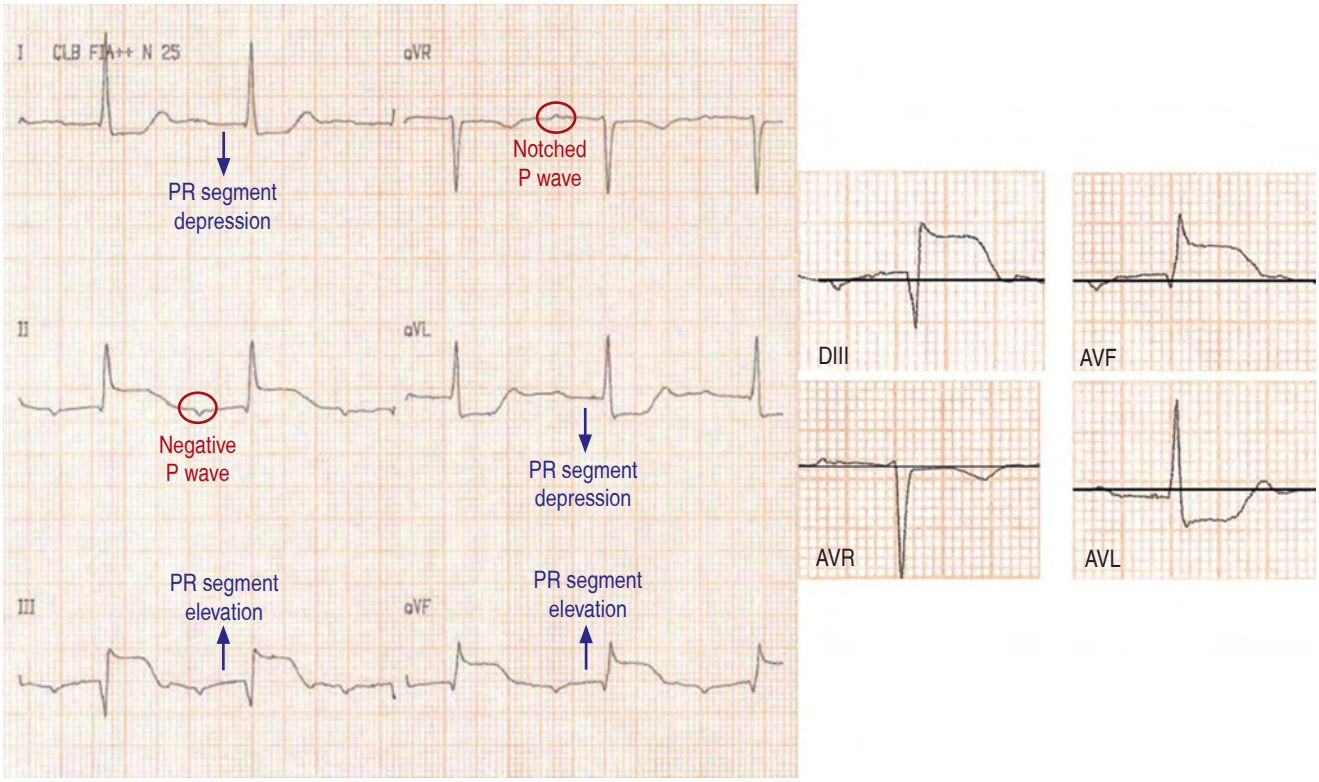

Figure 3: ECG showing PR segment elevation in lead III and aVF, PR segment depression in lead I and aVL, and P wave abnormalities with an associated ST segment elevation in the inferior leads.

Complications

Initially, some tachyarrhythmias might occur causing hemodynamic repercussion and cardiac failure decompensation.[1] Nielsen et al. carried out a study in 1992 finding that the presence of displacements in the PTa segment at the moment of admission in patients with VI helps predict the development of supraventricular arrhythmias the following days.[6]

The recognition of AI is important, due to the severity of its complications when left untreated:

- **Arrhythmias:** atrial fibrillation, atrial flutter, premature atrial complexes, paroxysmal atrial tachycardia, sinus tachycardia, sinus arrest, wandering pacemaker, nodal rhythm, sinus bradycardia and atrioventricular blocks have been described.[25] These typically start and end suddenly. They have an incidence of 61-74%, and are more frequent than in VI alone.[1,2,6,16] The presence of morphological changes in the P wave could be a predictor of new onset atrial fibrillation.[20]
- **Mural thrombosis with thromboembolic episodes:** intramural thrombus has an incidence of 80-84%[26] and might lead to a pulmonary embolism, which is more common because of the higher incidence of right AI, or to a systemic embolism (e.g. towards the brain).[1,2,17] Transmural ischemia usually leads to thrombus formation.[27] However, Lanjewar et al. reported the case of an AI which occurred due to a thrombus in the right atrium appendage in a patient with thyrotoxicosis and atrial fibrillation, with normal coronary arteries.[28]
- **Atrial wall rupture:** signs of cardiac tamponade must always be kept in mind. In 1994, Orcajo et al. reported the case of a female patient who presented sudden death due to a right atrial rupture, with

no electrocardiographic criteria for AI. They described an incidence of atrial wall rupture of 4.5%, with a clinical presentation similar to the ventricular rupture, the role of an early diagnosis and treatment is vital in order to save the patient's life. Other authors suggest that atrial rupture could cause death more slowly than ventricular rupture, citing that some patients can survive more than 24 hours, providing a longer time to perform a surgical repair.[7] In 2007, Rose et al. described the case of a patient with left VI, who deteriorated and later died, and whose autopsy revealed a left atrial wall rupture.[10]

- **Loss of atrial kick:** it generates a decrease in cardiac output with hemodynamic repercussion, ending up in a cardiogenic shock. Nevertheless, it is not believed that an isolated AI can cause acute cardiac failure.[9]
- **Left atrial enlargement:** an experimental study done by Aguero et al. revealed that pigs in which left AI was induced, had higher degree of left atrial dilation in resonance images and ischemic mitral regurgitation than those in which circumflex atrial branch was not occluded.[29]

It is believed that the addition of atrial ischemia to a VI implies a worse prognosis and higher morbimortality.[24]

Treatment

There are no additional treatment recommendations in the management of VI with suspected atrium compromise, the goals of treatment are coronary reperfusion and returning or maintaining sinus rhythm.[1,2,8,9,11,12] Even Liu et al. recommend treating isolated AI findings like VI,[2,11] as it could be ventricular compromise without electrocardiographic changes.[6,11]

If supraventricular tachycardias are present, some recommend rate control with beta blockers,[2,6,8,9] considering cardioversion in case of instability.[8]

Anticoagulation should be considered, taking into account that intramural atrial thrombus are commonly found,[1-3,9,11] and systemic or pulmonary embolism must be prevented.[1,2,11]

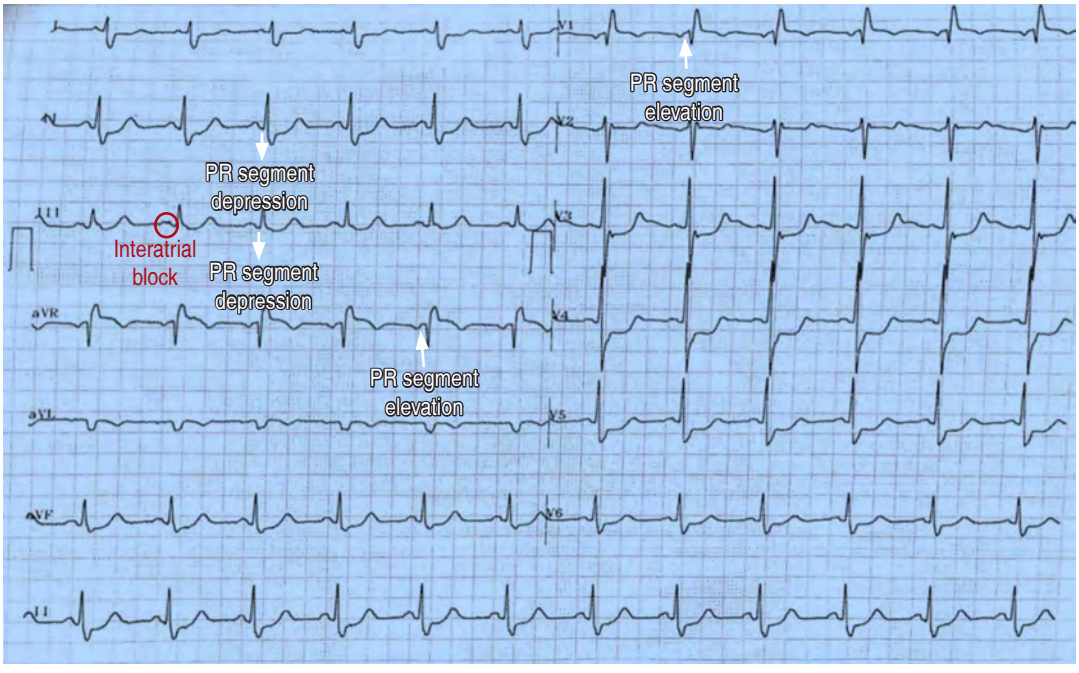

Figure 4: ECG of a patient with ventricular infarction due to left main coronary artery occlusion, also presenting complete bundle branch block, PTa segment alterations in V1 and aVR and interatrial block in lead III.

In case of suspected rupture of the atrial wall (e.g. cardiac tamponade), a prompt surgical repair should be carried out.[2]

CONCLUSIONS

AI is a frequently unnoticed disease because it commonly occurs in the context of VI, nevertheless it can present as an isolated disease with important complications, being a prognostic determinant for patients, thus needing to be recognized.

Its main risk factor is atherosclerosis and it develops when atrium arteries are occluded. Clinical and electrocardiographic findings are inconsistent, making the diagnosis difficult and explaining why there are no yet unified diagnostic criteria. It should be suspected in patients with myocardial ischemia, supraventricular arrhythmias, changes in the P wave and PTa segment displacement. Management is based in achieving coronary reperfusion, maintaining sinus rhythm and preventing or treating complications.

REFERENCES

1. Hellerstein HK. Atrial infarction with diagnostic electrocardiographic findings. Am Heart J. 1948; 36 (3): 422-430.
2. Lazar EJ, Goldberger J, Peled H, Sherman M, Frishman WH. Atrial infarction: diagnosis and management. Am Heart J. 1988; 116 (4): 1058-1063.
3. Vargas-Barrón J, Romero-Cárdenas A, Roldán FJ, Vázquez-Antona CA. Acute right atrial and ventricular infarction. Rev Esp Cardiol. 2007; 60 (1): 51-66.
4. Clerc A, Levy R. Infarctus auriculaire: tachyarrhythmia terminale. Bull Mem Soc Med Hop Paris. 1925; 41: 1603-1607.
5. Cushing EH, Feil HS, Stanton EJ, Wartman WB. Infarction of the cardiac auricles (atria): clinical, pathological, and experimental studies. Br Heart J. 1942; 4 (1-2): 17-34.
6. Nielsen FE, Andersen HH, Gram-Hansen P, Sørensen HT, Klausen IC. The relationship between ECG signs of atrial infarction and the development of supraventricular arrhythmias in patients with acute myocardial infarction. Am Heart J. 1992; 123 (1): 69-72.
7. Alonso-Orcajo N, Izquierdo-García F, Simarro E. Atrial rupture and sudden death following atrial infarction. Int J Cardiol. 1994; 46 (1): 82-84.
8. Lu MLR, De Venecia T, Patnaik S, Figueredo VM. Atrial myocardial infarction: a tale of the forgotten chamber. Int J Cardiol. 2016; 202: 904-909.
9. Mendes RGG, Evora PRB. Atrial infarction is a unique and often unrecognized clinical entity. Arquivos Brasileiros de Cardiologia. 1999; 72 (3): 333-342.
10. Rose KL, Collins KA. Left atrial infarction: a case report and review of the literature. Am J Forensic Med Pathol. 2010; 31 (1): 1-3.
11. Liu CK, Greenspan G, Piccirillo RT. Atrial Infarction of the Heart. Circulation. 1961; 23 (3): 331-338.
12. Horan LG, Flowers NC. Right ventricular infarction: specific requirements of management. Am Fam Physician. 1999; 60 (6): 1727-1734.
13. James TN, Burch GE. The atrial coronary arteries in man. Circulation. 1958; 17 (1): 90-98.
14. Stewart WJ. Atrial Myocardial infarction: a neglected stalker in coronary patients. J Am Coll Cardiol. 2017; 70 (23): 2890-2892.
15. Neven K, Crijns H, Gorgels A. Atrial infarction: a neglected electrocardiographic sign with important clinical implications. J Cardiovasc Electrophysiol. 2003; 14 (3): 306-308.
16. Shakir DK, Arafa SOE. Right atrial infarction, atrial arrhythmia and inferior myocardial infarction form a missed triad: a case report and review of the literature. Can J Cardiol. 2007; 23 (12): 995-997.
17. Riera ARP, Barros RB, Sousa Neto AFSE, Raimundo RD, Abreu LC, Nikus K. Extensive anterior myocardial infarction ... and something else? Arq Bras Cardiol. 2019; 112 (6): 803-806.
18. Wong AK, Marais HJ, Jutzy K, Capestany GA, Marais GE. Isolated atrial infarction in a patients with single vessel disease of the sinus node artery. Chest. 1991; 100 (1): 255-256.
19. Sivertssen E, Hoel B, Bay G, Jörgensen L. Electrocardiographic atrial complex and acute atrial myocardial infarction. Am J Cardiol. 1973; 31 (4): 450-456.
20. van Diepen S, Siha H, Fu Y, Westerhout CM, Lopes RD, Granger CB et al. Do baseline atrial electrocardiographic and infarction patterns predict new-onset atrial fibrillation after ST-elevation myocardial infarction? Insights from the assessment of pexelizumab in acute myocardial infarction trial. J Electrocardiol. 2010; 43 (4): 351-358.
21. Yıldız SS, Keskin K, Avsar M, Cetinkal G, Sigirci S, Aksan G et al. Electrocardiographic diagnosis of atrial infarction in patients with acute inferior ST-segment elevation myocardial infarction. Clin Cardiol. 2018; 41 (7): 972-977.
22. Alexander B, MacHaalany J, Lam B, van Rooy H, Haseeb S, Kuchtaruk A et al. Comparison of the extent of coronary artery disease in patients with versus without interatrial block and implications for new-onset atrial fibrillation. Am J Cardiol. 2017; 119 (8): 1162-1165.
23. Vargas-Barron J, Romero-Cardenas A, Keirns C, Sanchez-Ugarte T, Guerrero-Pesqueira F, Rijlaarsdam M et al. Transesophageal echocardiography and right atrial infarction. J Am Soc Echocardiogr. 1993; 6 (5): 543-547.
24. Vargas-Barrón J, López-Meneses M, Roldán FJ, Romero-Cárdenas A, Keirns C, Espinola-Zavaleta N et al. The impact of right atrial ischemia on inferior myocardial infarction with extension to right ventricle: transesophageal echocardiographic examination. Clin Cardiol. 2002; 25 (4): 181-186.
25. Kyriakidis M, Barbetseas J, Antonopoulos A, Skouros C, Tentolouris C, Toutouzas P. Early atrial arrhythmias

in acute myocardial infarction. Role of the sinus node artery. Chest. 1992; 101 (4): 944-947.
26. Gardin JM, Singer DH. Atrial infarction. Importance, diagnosis, and localization. Arch Intern Med. 1981; 141 (10): 1345-1348.
27. Cunningham KS, Chan KL, Veinot JP. Pathology of isolated atrial infarction: case report and review of the literature. Cardiovasc Pathol. 2008; 17 (3): 183-185.
28. Lanjewar DN, Ramraje S, Lanjewar SD. Right atrial appendage thrombus with atrial infarct in a case of thyrotoxicosis: an autopsy report. Indian J Pathol Microbiol. 2010; 53 (3): 532-534.
29. Aguero J, Galan-Arriola C, Fernandez-Jimenez R, Sanchez-Gonzalez J, Ajmone N, Delgado V et al. Atrial Infarction and Ischemic Mitral Regurgitation Contribute to Post-MI Remodeling of the Left Atrium. J Am Coll Cardiol. 2017; 70 (23): 2878-2889.

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An uncommon cause of atrioventricular block in young patients: Kearns-Sayre syndrome

Una causa infrecuente de bloqueo auriculoventricular en pacientes jóvenes: síndrome de Kearns-Sayre

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Keywords: Kearns-Sayre syndrome, chronic progressive external ophthalmoplegia, blepharoptosis, heart block, mitochondrial myopathy.

Palabras clave: *Síndrome de Kearns-Sayre, oftalmoplejía externa crónica progresiva, blefaroptosis, bloqueo cardiaco, miopatía mitocondrial.*

ABSTRACT

Kearns-Sayre syndrome (KSS) is a rare cause of complete atrioventricular (AV) block in young patients. This disorder is caused by mitochondrial DNA (mtDNA) deletions, and unlike other mitochondrial diseases, involvement of the cardiac conduction system is frequent. KSS is characterized by the triad of progressive external ophthalmoplegia, pigmentary retinopathy and cardiac conduction system disturbances, with an onset before 20 years of age. We present a case of complete AV block due to this rare condition, which was diagnosed with a muscular biopsy taken at the time of pacemaker implant.

RESUMEN

El síndrome de Kearns-Sayre (SdKS) es una causa infrecuente de bloqueo auriculoventricular (AV) en personas jóvenes. Este desorden es causado por deleciones del ADN mitocondrial (ADNmt), y a diferencia de otras enfermedades mitocondriales, el compromiso del sistema de conducción eléctrica cardiaca es frecuente. El SdKS se caracteriza por la triada de oftalmoplejía progresiva externa, retinopatía pigmentaria y alteraciones en la conducción eléctrica cardiaca, con síntomas que, por lo general, inician antes de los 20 años de edad. Presentamos un caso de bloqueo AV completo debido a esta rara condición, la cual se diagnosticó mediante una biopsia muscular tomada al momento del implante de marcapasos.

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INTRODUCTION

Atrioventricular block (AV) in young adults is infrequent, with non-ischemic heart disease (mainly myocarditis) accounting for a significant percentage of patients. Nonetheless, most patients don't have structural anomalies or underlying diseases readily identifiable, and ultimately undergo pacemaker implant without a clear diagnosis.[1]

Kearns-Sayre syndrome (KSS) is a specific mitochondrial myopathy caused by large-scale deletion of mitochondrial DNA (mtDNA) which is thought to occur somatically during early embryogenesis in the majority of cases. It typically presents as external progressive ophtalmoplegia, pigmentary rethinopathy and various degrees of AV block, usually before 20 years of age.[2] Although rare (estimated prevalence of 1.6 per 100.000 adults), cardiac involvement is the most important factor in prognosis and cardiac conduction disturbances have an unpredictable rate of progression to complete AV block.[3,4] Mortality has been reported in up to 20% of patients, hence an early diagnosis could potentially modify prognosis.[5]

We present a case of a patient with blepharoptosis, paralysis of the extraocular muscles and complete heart block, in which a diagnosis of KSS was made with a muscular biopsy taken at the time of permanent pacemaker implant.

CASE PRESENTATION

A 22-year-old male with a previous history of bilateral blepharoptosis and external progressive ophtalmoplegia presented to the emergency

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department for syncope which was preceded by several hours of dizziness and diaphoresis. He reported a reduction in his exercise capacity over the previous 4 months, and presyncope 2 weeks before the present event.

On examination, his heart rate was 38 bpm. There was no respiratory distress and heart and respiratory sounds were normal. Neurologic examination revealed a conscious, alert and oriented patient with complete bilateral ophtalmoplegia and blepharoptosis *(Figure 1)* without involvement of the lower cranial nerves and preserved extremity movement and sensibility. His initial electrocardiogram (ECG) revealed a complete AV block with a junctional escape rhythm *(Figure 2)*. He had been previously examined by a neurologist as an outpatient, with magnetic resonance imaging (MRI) of the brain revealing brainstem and thalamus atrophy with prominent sulcus. A previously performed spinal tap reported increased protein concentration. No other members of his family had similar symptoms.

Figure 1: Bilateral blepharoptosis. Although the patient is fully awake, significant ptosis of the upper eyelids is observed. The patient had difficulty with his everyday activities due to loss of vision caused by his bilateral ptosis.

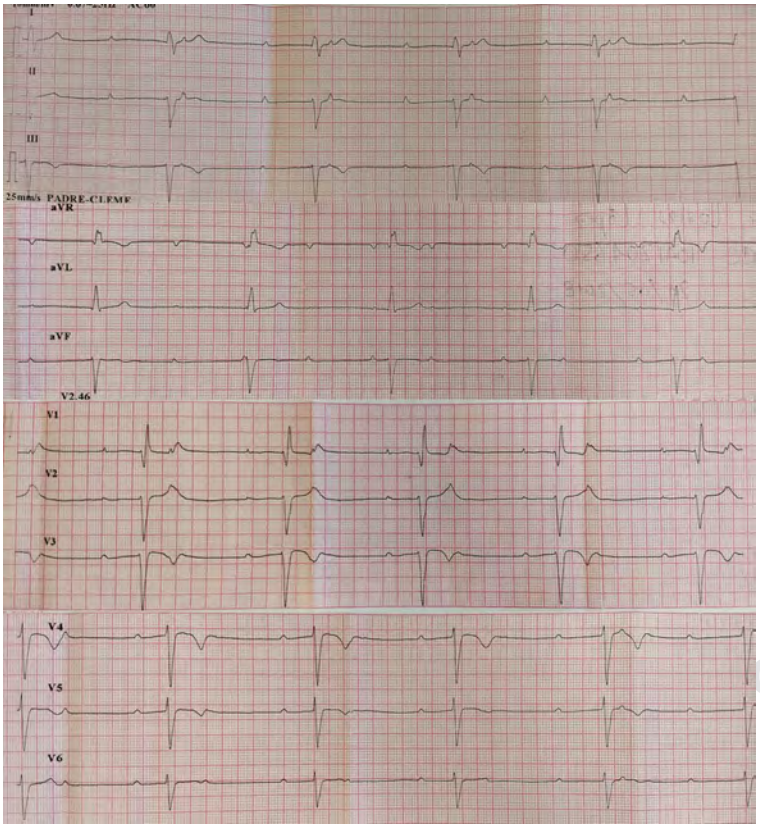

Figure 2: Initial ECG demonstrating complete heart block with a junctional escape rhythm.

Due to his complete heart block, the patient was scheduled for dual-chamber pacemaker implant. Given his clinical presentation, a mitochondrial myopathy was suspected and a muscle biopsy from his pectoralis major muscle was taken during the procedure. Light microscopy reported the presence of atrophic muscle fibers with ragged red muscle fibers. There were no inflammatory infiltrates, increase in endomysial collagen or glycogen deposits. High resolution optical microscopy reported subsarcolemic and intermyofibrillar mitochondrial accumulation, most of which were increased in size while others were swollen, with abnormal rigid crests or in circular arrangement. Paracrystallin inclusions («parking lot» type) and electrodense bodies were identified. These findings were all compatible with a mitochondrial myopathy *(Figure 3)*. Based on his clinical presentation (bilateral blepharoptosis, external progressive ophtalmoplegia and complete heart block), his brain MRI findings and the results of his muscle biopsy, a diagnosis of Kearns-Sayre syndrome was made and coenzyme Q10 supplementation was initiated. Six months after pacemaker implant, the patient has had improvement in his exercise capacity and no further syncope.

DISCUSSION

Kearns-Sayre syndrome (KSS) is a specific mitochondrial myopathy characterized by progressive external ophtalmoplegia, pigmentary retinopathy and cardiac conduction system

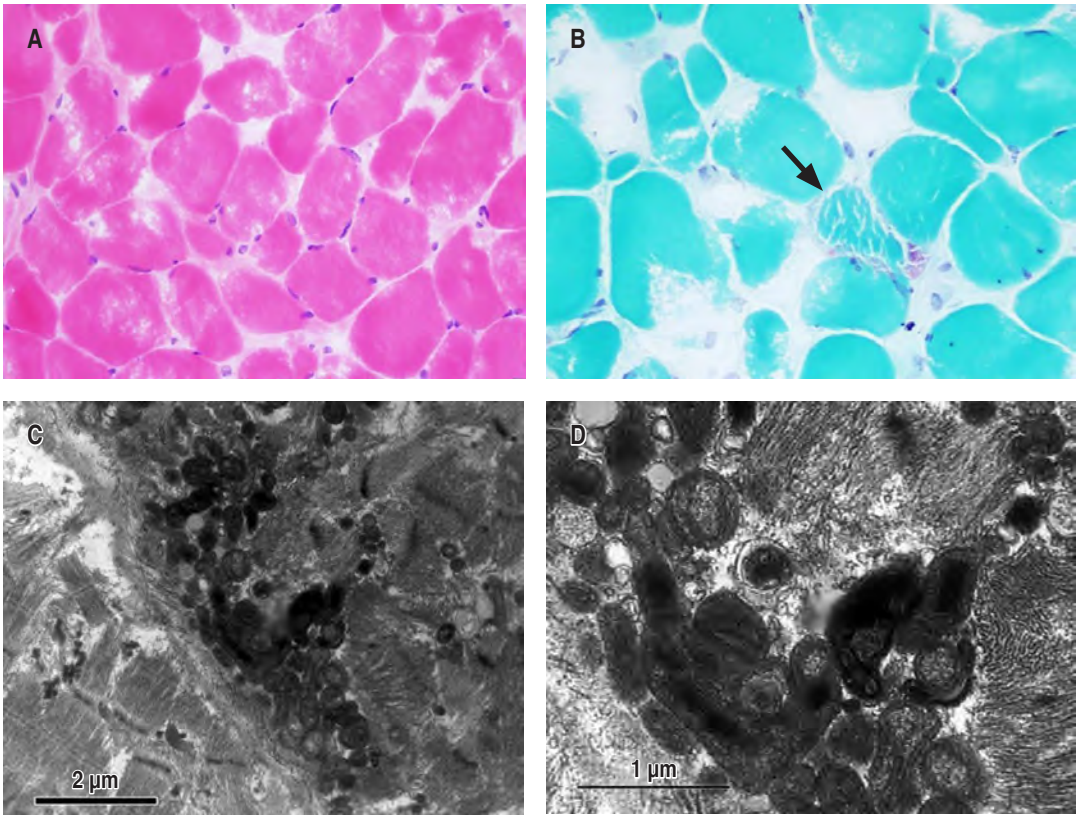

Figure 3:

Muscle biopsy: **A)** Hematoxilin-eosin muscular study without remarkable findings. **B)** Trichrome staining (arrow points subsarcolemmal sarcomere). **C and D)** High resolution microscopy (note swollen mitochondria with paracrystalline inclusions).

disturbances. Although it is a mitochondrial disease, it is rarely due to maternal inheritance and most cases are caused by de-novo large-scale deletions (1.3 to 10 kb) of mitochondrial DNA (mtDNA), which occur somatically in the early embryogenesis period resulting in impaired cellular oxidative phosphorylation. Symptom onset occurs before 20 years of age, and patients usually exhibit cerebellar ataxia, heart block, increased cerebrospinal fluid protein concentration, short stature and multiple endocrine conditions including diabetes mellitus, hypoparathyroidism or Addison disease.[2,5] As in our case, ophthalmic manifestations in KSS precede cardiac complications and the presence of these may be sufficient to suspect the syndrome and actively search for cardiac involvement and confirmation of the diagnosis.[6] Clinical course is progressive, with mortality occurring between the third and fourth decade of life, usually due to cardiovascular events (sudden death).[2,7]

In addition to KSS, several other syndromes have been described in patients with mtDNA mutations, including Leber hereditary optic neuropathy (LHON); mtDNA-associated Leigh syndrome (LS); neuropathy, ataxia and retinitis pigmentosa (NARP); mitochondrial encephalopathy, lactic acidosis and stroke-like episodes (MELAS), and myoclonic epilepsy with ragged-red fibres (MERRF). In fact, mitochondrial diseases have an estimated prevalence of 9.2 to 16.5 in 100,000 adults, with asymptomatic mtDNA mutations occurring 1 in 200 to 250 persons.[8] While cardiac conduction system anomalies are uncommon in other mitochondrial diseases, cardiac manifestations (including syncope, heart failure and cardiac arrest) occur in as many as 50% of patients with KSS. Magnetic resonance imaging has demonstrated frequent subclinical cardiac involvement, even in patients with normal echocardiograms.[2,7] In fact, cardiac involvement is the most important factor in prognosis, with conduction disturbances frequently involving the distal His bundle and bundle branches.[9] KSS patients undergoing electrophysiological studies typically show normal sinus node

recovery times and AH intervals but prolonged HV intervals.[10] These conduction disorders can rapidly and unpredictably progress to complete AV block which is associated with a high mortality (up to 20%) due to fatal arrhythmias associated with severe bradycardia (that is, bradycardia induced torsade des pointes).[8,11] Other electric alterations such as QT prolongation or ventricular polymorphic tachycardia in the absence of QT prolongation and or bradycardia have been reported, suggesting that not only bradycardia may be the only mechanism responsible for cardiac mortality.[12,13] Whether or not patients with KSS may benefit from a cardiac implantable defibrillator rather than a pacemaker, or the possible use of an electrophysiological study to document inducible arrhythmias is yet to be determined.[14,15] No specific criteria have been developed to clearly identify this subset of patients and there is uncertainty on how frequently patients should be evaluated for cardiac conduction disease. However, early adoption of a strategy to search for cardiac conduction alterations, including ECG, Holter and eventually electrophysiological study could have a role in modifying the prognosis of the disease. In our patient, we believe syncope was caused exclusively by his complete AV block, since there were clear previous symptoms of reduced cardiac output (exertional dyspnea) and no other electrocardiographic relevant findings suggestive of an alternative arrhythmic condition. After pacemaker implantation, his cardiovascular symptoms improved.

Although genetic testing was not available in this case, his clinical presentation along with the results of his muscle biopsy (such as myofibrillar separation due to proliferation of swollen and abnormal mitochondria) make KSS highly possible. As in our case, high clinical suspicion is needed, and muscle biopsy can be undertaken during pacemaker implantation, thus allowing for a prompt diagnosis. Interestingly, in our case ophthalmologic evaluation did not reveal pigmentary rethinopathy. Since classic criteria for the diagnosis of pigmentary retinopathy are not present in all patients,[16] and varying retinal compromise can occur particularly in early stages of the disease regardless of the degree of extraocular compromise, it is possible that they were not seen during ophthalmologic evaluation.[17] The use of full-field electroretinography is considered the traditional standard in diagnosis of pigmentary retinopathy, since it can detect changes in the retinal electrical response in response to light stimulus even when the retina appears to be normal. Unfortunately, it was not performed in our patient.

CONCLUSIONS

AV block is a relatively uncommon condition in young patients, and as such less frequent causes must be kept in mind. We present a case of KSS with typical extracardiac phenotypic findings that are highly suggestive of this specific mitochondrial disorder. Pacemaker implantation provides a unique opportunity to perform muscle biopsy, allowing for correct diagnosis of this condition.

REFERENCES

1. Baritussio A, Ghosh Dastidar A, Frontera A, Ahmed N, De Garate E, Harries I et al. Diagnostic yield of cardiovascular magnetic resonance in young-middle aged patients with high-grade atrio-ventricular block. Int J Cardiol. 2017; 244: 335-339.
2. Kabunga P, Lau AK, Phan K, Puranik R, Liang C, Davis RL et al. Systematic review of cardiac electrical disease in Kearns-Sayre syndrome and mitochondrial cytopathy. Int J Cardiol. 2015; 181: 303-310.
3. Remes AM, Majamaa-Voltti K, Karppa M, Moilanen JS, Uimonen S, Helander H et al. Prevalence of large-scale mitochondrial DNA deletions in an adult Finnish population. Neurology. 2005; 64 (6): 976-981.
4. Yesil M, Bayata S, Postaci N, Arikan E. Progression of conduction system disease in a paced patient with Kearns-Sayre syndrome. Clin Cardiol. 2009; 32 (6): E65-E67.
5. van Beynum I, Morava E, Taher M, Rodenburg RJ, Karteszi J, Toth K et al. Cardiac arrest in Kearns-Sayre syndrome. JIMD Rep. 2012; 2: 7-10.
6. Ramcharan CR. Heart block, ptosis, and diagnostic funduscopic examination: problems of the heart seen through the eyes. Can J Cardiol. 2018; 34 (5): 690. e1-690.e3.
7. Galetta F, Franzoni F, Mancuso M, Orsucci D, Tocchini L, Papi R et al. Cardiac involvement in chronic progressive external ophthalmoplegia. J Neurol Sci. 2014; 345 (1-2): 189-192.
8. Krishna MR. Kearns sayre syndrome: looking beyond a-v conduction. Indian Pacing Electrophysiol J. 2017; 17 (3): 78-80.
9. Gobu P, Karthikeyan B, Prasath A, Santhosh S, Balachander J. Kearns Sayre syndrome (KSS) - a rare cause for cardiac pacing. Indian Pacing Electrophysiol J. 2011; 10 (12): 547-550.

10. Agrawal H, Ekhomu O, Choi HW, Naheed Z. Natural history of conduction abnormalities in a patient with Kearns-Sayre syndrome. Pediatr Cardiol. 2013; 34 (4): 1044-1047.
11. Young TJ, Shah AK, Lee MH, Hayes DL. Kearns-Sayre syndrome: a case report and review of cardiovascular complications. Pacing Clin Electrophysiol. 2005; 28 (5): 454-457.
12. Karanikis P, Korantzopoulos P, Kountouris E, Dimitroula V, Patsouras D, Pappa E et al. Kearns-Sayre syndrome associated with trifascicular block and QT prolongation. Int J Cardiol. 2005; 101 (1): 147-150.
13. Oginosawa Y, Abe H, Nagatomo T, Mizuki T, Nakashima Y. Sustained polymorphic ventricular tachycardia unassociated with QT prolongation or bradycardia in the Kearns-Sayre syndrome. Pacing Clin Electrophysiol. 2003; 26 (9): 1911-1912.
14. Rashid A, Kim MH. Kearns-Sayre syndrome: association with long QT syndrome? J Cardiovasc Electrophysiol. 2002; 13 (2): 184-185.
15. Imamura T, Sumitomo N, Muraji S, Mori H, Osada Y, Oyanagi T et al. The necessity of implantable cardioverter defibrillators in patients with Kearns-Sayre syndrome - systematic review of the articles. Int J Cardiol. 2019; 279: 105-111.
16. Pruett RC. Retinitis pigmentosa: clinical observations and correlations. Trans Am Ophthalmol Soc. 1983; 81: 693-735.
17. Kozak I, Oystreck DT, Abu-Amero KK, Nowilaty SR, Alkhalidi H, Elkhamary SM et al. New observations regarding the retinopathy of genetically confirmed Kearns-Sayre syndrome. Retin Cases Brief Rep. 2018; 12 (4): 349-358.

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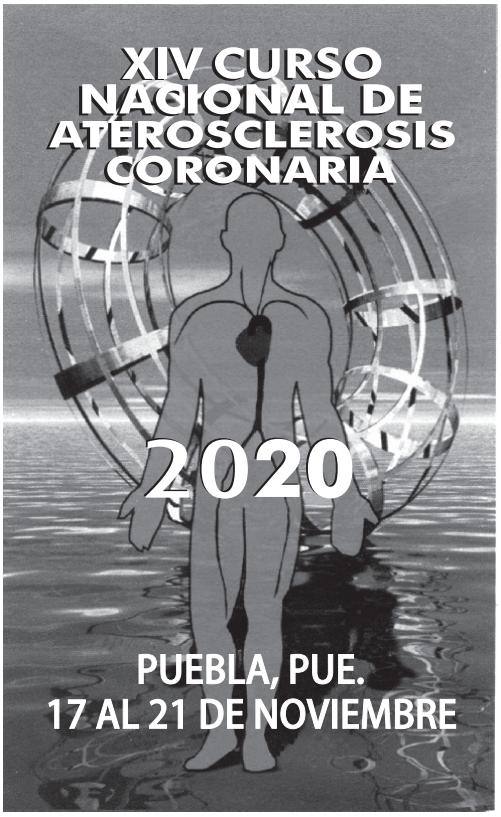

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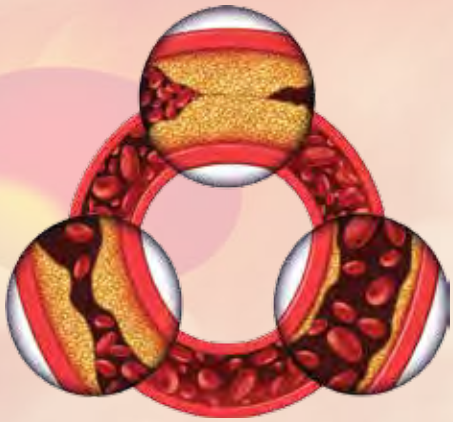

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