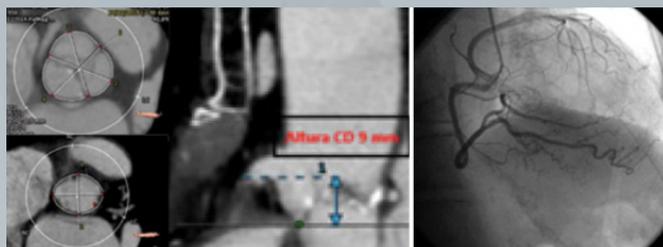




ARGENTINIAN JOURNAL OF INTERVENTIONAL CARDIOLOGY

January - March 2022 | Year 13 | Number 1



Editorial

Growth of RACI from 2017 through 2021

Rodríguez AE

Review article

Percutaneous coronary intervention for left main coronary artery disease

Power DA et al.

Original articles

Transient percutaneous balloon occlusion vs uterine artery embolization as coadjuvants in the management of placenta accreta spectrum disorders during C-section

Riolo FM et al.

Association between variations in the combination of lidocaine and the prevalence of arterial spasm in procedures performed via radial access

Hernández M et al.

Clinical cases

TAVI in patient with low and anomalous origin of left main coronary artery. Case report

Menéndez M et al.

Valve-in-Valve due to prosthetic tricuspid valve stenosis

Acevedo R et al.

Endovascular revascularization of central veins and subsequent cardiac catheterization for hemodialysis in a patient with exhaustion of conventional vascular accesses

Voos Budal Arins M, Álvarez A

Bilateral iliofemoral deep vein thrombosis in patient with interrupted inferior vena cava

Gonzalez V et al.

Letter from the President

Letter from the President of CACI

Cisneros M

Indexado en





ARGENTINIAN JOURNAL OF INTERVENTIONAL CARDIOLOGY

January - March 2022 | Year 13 | Number 1

Editor en Jefe

Alfredo E. Rodríguez
Cardiología Intervencionista Sanat.
Otamendi / Las Lomas, Bs. As., Arg.

Editores Asociados

Alejandro Barbagelata FAHA, FSCAI
Duke University School of Medicine,
Estados Unidos

Arturo Fernández Murga
Inst. de Cardiología SRL / Clin.
Mayo, Tucumán

Ruben Piraino
Sanat. Delta, Rosario, Prov. de Santa
Fe, Arg.

Antonio Pocióvi
Cardiología Intervencionista, Inst.
Fleming, CABA, Arg.

Gastón Rodríguez-Granillo
Clínica La Sagrada Familia,
CABA, Arg.

Gregg Stone
Mount Sinai, New York
Consejo de Redacción

José Alonso
Htal. Garrahan, CABA

Rosana Ceratto
ENERI Dr. Pedro Lylyk, CABA

Alejandro Cherro
Clin. Sagrada Familia / Adven-
tista de Belgrano, IMC, Hosp.
Privado de la Merced, CABA y
Gran Bs. As.

Santiago Coroleu
Inst. de Cardiología de Santiago
del Estero, Santiago del Estero

Javier Courtis
Inst. Oulton, Clin. Romagosa, Clin.
de la familia, Córdoba

Jesús Damsky Barbosa
Htal. Pedro de Elizalde, CABA

Alejandro Delacasa
Htal. Interzonal Dr. Oscar Allende /
Inst. Radiológico, Mar del Plata

Ariel Durán
Htal. de Clínicas, Mdeo, Uruguay

Carlos Fernández Pereira
Sanat. Otamendi y Miroli /
Las Lomas Bs. As., Argentina

Alejandro Goldsmit
Sanat. Güemes, CABA

Marcelo Halac
Sagrada Familia, Htal. Italiano, CABA

Hugo Londero
Sanatorio Allende Nueva
Córdoba, CABA

Carlos Miranda
FLENI, CABA

Alejandro Peirone
Htal. Privado de Córdoba /
Htal. de Niños, Córdoba

Sergio Sierre
Htal. Nacional de Pediatría
JP Garrahan, CABA

Pablo Stutzbach
Las Lomas, Bs. As.

León Valdivieso
Fundación Favolor, CABA

Héctor Vetulli
Sanat. Otamendi y Miroli, CABA

José Vicario
Sanat. Garay, Santa Fe

Jorge Wisner
Centro de Educación Médica e
Investigaciones Clínicas, CABA

Secretaría Científica
Carla Agatiello
Htal. Italiano de Bs As, CABA

Amalia Descalzo
Clin. La Sagrada Familia, CABA

Juan Mieres
Sanat. Otamendi y Miroli,
Las Lomas Bs. As.

Asesores Nacionales
José Amadeo G. Álvarez
Hospital Británico CABA

Carlos Álvarez Iorio
Instituto del Corazón Bahía Blanca

Jorge Belardi
Instituto Cardiovascular Buenos
Aires, CABA

Hernán Cohen Arazi
Instituto Cardiovascular
Lezica, Lomas de San Isidro

Luis De la Fuente
Instituto Argentino de
Diagnóstico y Tratamiento, CABA

Horacio Faella
Hospital de Niños, CABA

Jorge Leguizamón
Clínica Bazterrica, CABA

Pedro Lylyk
Eneri, CABA

Esteban Mendaro
Hospital Naval, CABA

Oscar Mendiz
Fundación Favolor, CABA

Alejandro Palacios
Trinidad Palermo, CABA

Juan Parodi
Trinidad San Isidro, Prov. Bs. As.

Omar Santera
Clínica Provincial de Merlo, Prov.
Bs. As.

Carlos Stzefman
Sanatorio Güemes, CABA

Alberto Tamashiro
Hospital Posadas, Prov. Bs. As.

David Vetcher
Bioparx, Prov. Entre Ríos

Asesores Internacionales
John Ambrose
UCSF Fresno Medical Education
Program, EE.UU.

David Antoniucci
Universidad de Florencia, Florencia,
Italia

Antonio Colombo
Hospital San Raffaele, Milán,
Italia

Costantino Constatini
Hospital Cardiológico Costanti-
ni, Curitiba, Brasil

Giuseppe De Luca
Eastern Piedmont University,
Novara, Italia

Carlo Di Mario
Careggi University Hospital,
Florencia, Italia

Fausto Feres
Instituto Dante Pazzanese de
Cardiología, São Paulo, Brasil

Eulogio García
Centro Integral de Enfermedades
Cardiovasculares, Madrid, España

Eberhard Grube
Cardiology and Angiology Sieg-
burg Heart Centre, Alemania

Luis Guzmán
Southside Regional Medical Center,
Virginia, EEUU

Ziyad Hijazi
Sida Medicine, Doha, Qatar

Mark Hlatky
HRP Redwood Blvd Stanford,
California, EE.UU.

Adnan Kastrati
Deutsches Herzzentrum Mün-
chen, Munich, Alemania

Pedro Lemos
Hospital Israelita Albert Einstein,
San Pablo, Brasil

Carlos Macaya
Hospital Clínico San Carlos, Madrid,
España

Roxana Mehran
Cardiovascular Institute at Mount
Sinai School of Medicine, NY, EE.UU.

Marie Claude Morice
Hôpital Privé Jacques Cartier-
Massy, Francia

César Moris
Hospital Universitario Central,
Asturias, España

Kern Morton
UC Irvine Medical Center, Long
Beach, EE.UU.

Igor Palacios
Harvard University, Boston,
EE.UU.

Seung-Jung
Park Instituto del Corazón, Cen-

tro Médico Asan, Seúl, Corea
del Sur

Flavio Ribichini
Hospital Universitario de Verona,
Italia

Antonio Serra
Hospital de Sant Pau, Barcelona,
España

Patrick Serruys
Imperial College London, Rotterdam,
Netherlands

Samin K. Sharma
Instituto Cardiovascular Zena
y M.A. Wiener y Centro M.-J. y
H.R. Kravis, NY, EE.UU.

Gregg Stone
Mount Sinai, New York

Marco Valgimigli
Inselspital Universitätsspital Bern,
Bern, Suiza

Traductor
Alejandro Fernández

Representante CACI
Ernesto M. Torresani

Representante Carrera UBA-CACI
Guillermo Migliaro

Relaciones Institucionales CACI
Lic. Carolina Pallavicini

Secretaría de Edición
Anabel Chesini

Administración y Finanzas CACI
CPN Claudio Losada

Miembro Honorario
Liliana Grinfeld +

CACI BOARD OF DIRECTORS 2022-2023

Presidente

Martin Cisneros Soria

Vicepresidente

Juan José Fernández

Secretario

Marcelo Halac

Prosecretario

Miguel Ángel Larribau

Tesorera

Amalia Descalzo

Protesorero

Alfredo Bravo

Secretario Científico

Carlos Fernández Pereira

Secretario Gremial

Maximiliano Giraudo

Vocales Titulares

Humberto Bassani Molinas

Carla Agatiello

Mario Fernández

Alejandro D. Fernández

Vocales Suplentes

Raúl Salernó

Marcelo Agüero

Claudio Cejas

Victoria Libertí

Comisión Fiscalizadora

Titular: Alejandro Palacios

Suplente: Alejandro Cherro

Delegados provinciales

Buenos Aires

Andrés Pascua

CABA

Eliás Ernesto Fabio Muñoz

Catamarca

Hugo Daniel Barrionuevo

Chubut

Alberto Lagioia

Córdoba

Mariano Rubio

Corrientes

Adolfo G. López Campanher

Entre Ríos

Emanuel Guillermo Luchessi

Formosa

Alejandra Soledad Vega

Jujuy

Matías Farfán Soria

La Pampa

Juan Fernando Álvarez Sevillano

La Rioja

Javier Descalzi

Mendoza

Gustavo Eduardo Irueta

Misiones

Ernesto Duarte

Neuquén y Río Negro

Diego Lavaggi

Salta

Jerónimo D. Heredia Mantrana

San Juan

Daniel Lerga Almenzar

San Luis

Carlos Mendoza

Santa Cruz

Corina Biagioni

Santa Fe

Oscar Esteban Birollo

Santiago del Estero

Federico Gabriel Baldivieso

Tierra del Fuego

Ana Paula Mollón

Tucumán

Gustavo Terán

En representación del Consejo de Pe-

diatría: Dr. Rolando Gómez.

En representación del Consejo de He-

modinamia de la Sociedad Argentina

de Cardiología (SAC): el director de dicho

Consejo para el período 2021/2023

En representación del Comité de He-

modinamia de la Federación Argenti-

na de Cardiología (FAC): el presidente de

dicho Comité para el período 2021/2023.

CACI



ARGENTINIAN COLLEGE
OF INTERVENTIONAL
CARDIOLOGIST



PUBLICACIONES
LATINOAMERICANAS S.R.L.

Argentinian Journal of Interventional Cardiology

Quarterly publication. © CACI | ISSN: 2250-7531

Registry in the Intellectual Property in process. All rights reserved. This publication shall not be disclosed, disseminated or reproduced entirely or partially through any electronic or mechanical means including photographs, recordings, and any other present or future information systems without the express written consent of the Copyright holder. Owner: Argentinian College of Interventional Cardiologists (CACI) | Viamonte 2146 6th floor | C1056ABH CABA - Argentine
Tel/fax: 54 11 4952-2117 | E-mail address: revista@caci.org.ar | www.revistacaci.org.ar

Producción editorial y gráfica

Publicaciones Latinoamericanas s.r.l.

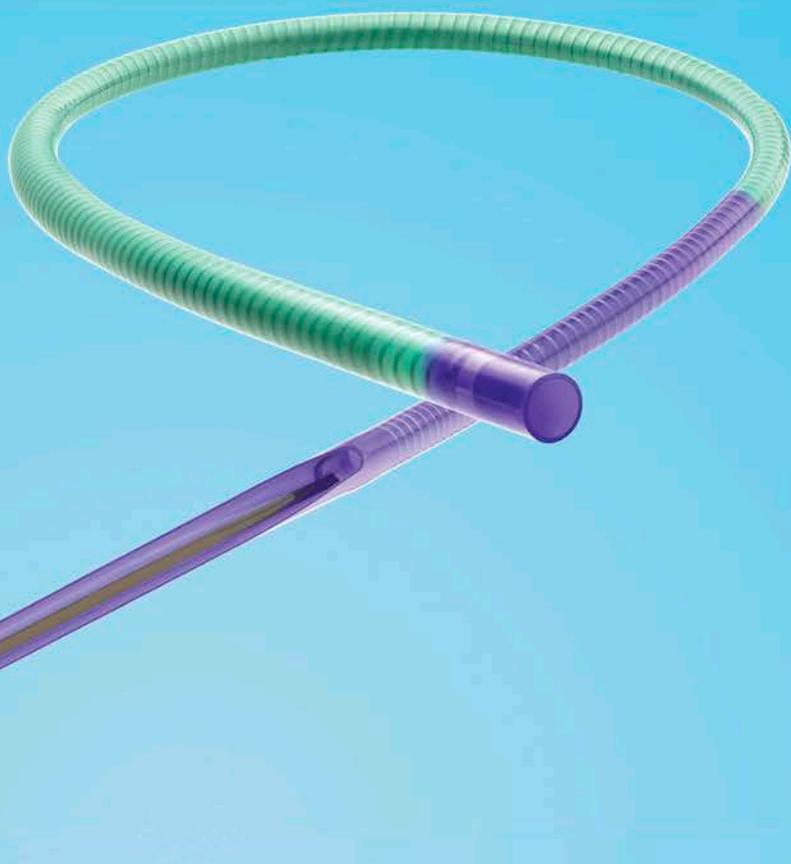
Piedras 1333 | (C1240ABC) Ciudad Autónoma de Buenos Aires | Argentina

Tel/fax (5411) 5217-0292

E-mail: info@publat.com.ar | http://www.publat.com.ar

UNA EXTENSIÓN DE USTED

Telescope™
Extensión de
Catéter Guía



EL DESEMPEÑO QUE DESEA PARA SU PRÁCTICA CLÍNICA COMPLEJA

Las Intervenciones Coronarias Percutáneas - PCI de hoy en día se están tornando cada vez más complejas. En los casos difíciles, las extensiones de catéter guía proporcionan un soporte de respaldo y mejoran el acceso a lesiones distales.

SUPERIOR CAPACIDAD DE ENTREGA

La fortaleza del Pushwire y el segmento de Coil Distal reforzado mejoran el desempeño.

TECNOLOGÍA SMOOTHPASS

La Tecnología SmoothPass incluye tres componentes que trabajan en forma conjunta para lograr un avance sin complicaciones de los dispositivos intervencionistas.

LA PUNTA MÁS BLANDA

Nuestra punta de polímero blando extruido TruFlex™ brinda flexibilidad y respuesta de deflexión.

Punta TruFlex™
de 2-mm



Summary

Sumario

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):5. <https://doi.org/10.30567/RACI/202201/0005-0005>

EDITORIAL / EDITORIAL

11

Crecimiento de la revista RACI en el período 2017 a 2021
Growth of the RACI magazine in the period 2017 to 2021

Rodríguez AE

REVIEW ARTICLE / ARTÍCULO DE REVISIÓN

12

Percutaneous coronary intervention for left main coronary artery disease

Intervencionismo percutáneo en la enfermedad del tronco común izquierdo

Power DA y cols.

ORIGINAL ARTICLES / ARTÍCULOS ORIGINALES

16

Oclusión percutánea transitoria con balones vs. embolización de las arterias uterinas como coadyuvantes en los trastornos adherenciales placentarios durante la cesárea

Transient percutaneous balloon occlusion vs. uterine artery embolization as a coadjuvant in placental adherence disorders during cesarean section

Riolo FM y cols.

21

Asociación entre variaciones en la combinación de lidocaína y prevalencia de espasmo arterial en procedimientos por acceso radial

Association between variations in the combination of lidocaine and prevalence of arterial spasm in procedures for radial access

Hernández M y cols.

CASE REPORTS / CASOS CLÍNICOS

26

TAVI en paciente con nacimiento bajo y anómalo de coronaria izquierda. Reporte de caso

TAVI with anomalous origin of coronary arteries. Case report

Menéndez M y cols.

30

Valve in valve por estenosis protésica tricuspídea

Transcatheter tricuspid valve in valve implantation for surgical prosthesis stenosis

Acevedo R y cols.

33

Revascularización endovascular de venas centrales y posterior colocación de catéter para hemodiálisis en un paciente con agotamiento de accesos vasculares

Endovascular revascularization of central veins and subsequent catheter placement for hemodialysis in a patient with exhausted vascular access

Voos Budal Arins M, Álvarez A.

38

Trombosis venosa profunda iliofemoral bilateral en paciente con interrupción de vena cava inferior

Bilateral iliofemoral deep vein thrombosis in a patient with interruption of the inferior vena cava

Gonzalez V y cols.

LETTER FROM THE PRESIDENT / CARTA DEL PRESIDENTE

39

Carta del Presidente de CACI

Letter from the President of CACI

Cisneros M

RULES OF PUBLICATIONS

REGLAMENTO DE PUBLICACIONES

40



BioSud

DESDE 1991

Desde 1991 colaborando en mejorar la calidad de vida de los pacientes en base al servicio, la innovación y la ética



- Sistema Mitraclip
- Stent Xience Alpine
- Stent Mimético Supera
- Cierre Percutaneo Proglide
- Sistema de Protección Cerebral Emboshield
- Stent Carotídeos
- Sistema de diagnóstico FFR y OCT + acc.

- Divisor de flujo p64-mw y p48-MW
- Divisor de flujo recubierto p64-MW-HPC y p48-MW-HPC
- Stent Cerebral pConus 2
- Stent cerebral recubierto pConus 2 HPC
- Sistema de trombectomia mecánica Preset

- Balón coronario liberador de farmaco Selution
- Balón periférico liberador de farmaco Selution

- Filtro de vena cava Option
- Dispositivo de Trombectomia venosa Cleaner + acc
- Aguja de punción 18 GA
- Guía amplatz recta y curva Worker



- Líneas de inyección de contraste
- Líneas de monitoreo de presión
- Llaves manifold de 2 vías
- Llaves manifold de 3 vías

- Sistema de inyección de contraste

- Introdutores femorales y radiales Braidin
- Catéter diagnóstico hidrofílico Angiopointer
- Microcateter coronario Instantpass Series
- Microcateter periférico Instantpass Series
- Catéter guía March

Paraguay 1126 C.A.B.A. | +54 011 5274-3031 | biosud@biosud.com.ar | www.biosud.com.ar

Canon

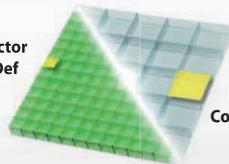
CANON MEDICAL SYSTEMS ARGENTINA S.A.



Alphenix
Redefine Intervention

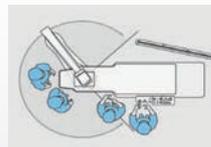


Detector Hi-Def



Detector Convencional

Exclusivo Detector Hi-Def, único en el mercado, para visualizar anatomías complejas con un nivel de detalle nunca antes visto.



Arco en C con 5 ejes de movimiento para un acceso total al paciente. Flexibilidad semejante a un sistema de sujeción techo.

DoseRite

Soluciones integrales de gestión de dosis, para reducir, visualizar e informar la dosis del paciente.

 **Nabratín**
Clopidogrel 75 mg



EL PODER
DEL CAMBIO

 Línea
Cardiometabólica

Presentación:
• 75 mg x 30 comp. recubiertos

PAMI

IOMA

descuento
OBRAS
SOCIALES

 pap
Asociación de Profesionales

 RAFFO



PRESENTAMOS EL NUEVO SISTEMA DE
Válvula Aórtica Percutánea
VITAFLOW

- ✓ Diseño de celdas abiertas que facilitan el acceso coronario
- ✓ Pollera interior y exterior que brinda mejor sellado y evita leak
- ✓ Estructura autoexpansible de Nitinol con alta fuerza radial
- ✓ Sistema de liberación electrónico controlado

 MTG GROUP

 MicroPort CardioFlow

Solicite más información a
customer@mtg-group.com.ar
mtg-group.com.ar

Analytical summary

Sumario analítico

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):9-10. <https://doi.org/10.30567/RACI/202201/0008-0010>

EDITORIAL / EDITORIAL

CRECIMIENTO DE LA REVISTA RACI EN EL PERÍODO 2017 A 2021

Alfredo E. Rodríguez

If we study the Argentine Journal of Interventional Cardioangi-ology (RACI) Google analytics and compare the last 5 years we will see the growing interest this journal has created within our medical specialty both in and out of our country. Interest has probably even spread to other medical specialties associated with ours, though not necessarily focused on percutaneous coronary interventions.

If we analyze the last 5 years using the same yearly period from March through October corresponding to the three annual issues of RACI we will see a significant growth in the number of users and visits to the journal official website.

REVIEW ARTICLE / ARTÍCULO DE REVISIÓN

PERCUTANEOUS CORONARY INTERVENTION FOR LEFT MAIN CORONARY ARTERY DISEASE

David A. Power, Anastasios Roumeliotis, Javed Suleman, George D. Dangas

Left main coronary artery (LMCA) disease is associated with significant morbidity and mortality, primarily related to the large amount of myocardium it subtends. The medical management of left mainstem disease has been associated with dismal outcomes approaching 50% mortality at 5 years. Coronary artery bypass graft (CABG) surgery historically emerged as the standard of care for the revascularization of LMCA disease. Recently, percutaneous coronary intervention (PCI) has been established as an alternative to CABG for LMCA disease. Advancements in stent design, implantation technique, and pharmacotherapy, have occurred over time. Large randomized controlled trials comparing CABG to PCI for LMCA disease have recently been published in various settings. There have been ongoing efforts to reconcile certain disparate trial results. Herein, we summarize the data behind LMCA revascularization and place the NOBLE and EXCEL trials in clinical context alongside current societal guidelines.

ORIGINAL ARTICLES / ARTÍCULOS ORIGINALES

TRANSIENT PERCUTANEOUS BALLOON OCCLUSION VS UTERINE ARTERY EMBOLIZATION AS COADJUVANTS IN THE MANAGEMENT OF PLACENTA ACCRETA SPECTRUM DISORDERS DURING C-SECTION

Federico Martín Riolo, Andrés Enrique Dini, Gustavo Alberto Tamashiro, Derwin Plazas Alvarez, Jorge Orlando Cortez Yáñez, Miguel Osvaldo Villegas

Adjuvant treatment through endovascular procedure for the management of placenta accreta is useful because it has low morbidity and mortality rates. The therapeutic objective is the embolization and occlusion of uterine arteries by optimizing and reducing the risk of complications associated with C-section with preservation of the uterus or subsequent hysterectomy. A total of 38 patients with a diagnosis of placenta accreta were admitted to the hemodynamics unit of our center between January 2012 and January 2020. After C-section and prior to the hysterectomy 28 of these patients were treated with gelatin sponge embolization of the uterine arteries. Transient percutaneous balloon occlusion of the uterine arteries was performed in 10 patients. The outcomes of our center are presented here.

ASSOCIATION BETWEEN VARIATIONS IN THE COMBINATION OF LIDOCAINE AND THE PREVALENCE OF ARTERIAL SPASM IN PROCEDURES PERFORMED VIA RADIAL ACCESS

Marcos Hernández, Sebastián Amicone, Sofía Algañaraz, Carolina Fernández

Introduction. Currently in endovascular procedures, mainly the coronary ones, the use of radial arterial access is predominant as it has replaced the femoral access that is now spared for specific indications only or due to the impossibility of performing the former. One of the complications that the operator most often faces when using the radial artery is spasm, which complicates the procedure and sometimes even prevents completing the diagnostic study and/or therapeutic procedure.

Objectives. 1- To assess the relationship between the administration of Lidocaine / Lidocaine + Diltiazem / Lidocaine + Nitroglycerin (prior to performing cardiac catheterization procedures) and the prevalence of radial artery spasm in adult patients. 2- To assess the presence of radial artery spasm based on sex, age group, BMI, cardiovascular risk factors, comorbidities, and pharmacological treatment at the time of the study.

Material and methods. An experimental, analytical, cross-sectional study was conducted including adult patients with an indication for left heart catheterization and/or angiography of lower extremities or neck vessels treated with cine coronary arteriography, angiography of the neck vessels, angiography of lower extremities and/or angioplasty via radial access. Patients were treated with Lidocaine, Lidocaine + Diltiazem or Lidocaine + Nitroglycerin 5 minutes before starting the procedure.

Results. Of the complications described, arterial spasm occurred in 21 patients only (25.3%), more often in women (30.8%) compared to men (20.5%). The most affected age group was > 70 years (33.3%) and patients with overweight (66.7%). Significantly less prevalence of spasms was found in the Lidocaine + Nitroglycerin group (10.7%) compared to the Lidocaine + Diltiazem group (32.1%; $P = .028$) and the Lidocaine group (33.3%; $P = .025$). Over 50% were on regular statin medication, ACEI-ARAI, aspirin, clopidogrel, and beta-blockers. The most common comorbidity was peripheral disease while the cardiovascular risk factors were dyslipidemia, sedentary lifestyle, and hypertension.

Conclusion. The prevalence of radial artery spasm through the use of Lidocaine 2% + Nitroglycerin in doses of 200 mcg, administered subcutaneously via radial access is lower compared to the prevalence reported with the administration of Lidocaine alone or Lidocaine + Diltiazem.

CASE REPORTS / CASOS CLÍNICOS

TAVI IN PATIENT WITH LOW AND ANOMALOUS ORIGIN OF LEFT MAIN CORONARY ARTERY. CASE REPORT

Marcelo Menéndez, Alejandro Lezcano Bournissent, Tomás Cúneo

Introduction. TAVI (trans aortic valve implantation) is a widely disseminated, well-tolerated intervention with a short hospital stay. It is indicated in patients with severe symptomatic aortic stenosis. Patients with abnormally low birth from the coronary artery ostium are at additional risk, as the flow of the coronary arteries can be compromised when the prosthesis is implanted. Objective. Case report of TAVI in a patient who presented a low birth of the coronary artery ostium.

Method. In this study we present a clinical case of a patient with severe aortic stenosis who was a candidate for TAVI who presented low birth of the coronary arteries, who underwent balloon sizing.

Conclusion. TAVI in patients with low coronary ostium is a great technical challenge. Pre-planning and using gestures such as "balloon sizing" are essential to achieve the success of this intervention.

VALVE-IN-VALVE DUE TO PROSTHETIC TRICUSPID VALVE STENOSIS

Ramiro Acevedo, Pablo Pollono, Ignacio Rifourcat, Fernando Fuertes, Diego Grinfeld

Prosthetic tricuspid valve stenosis is an entity whose resolution is complex due to the patients' multiple comorbidities. Endovascular treatment using prosthetic valves designed for implantation in the aortic position recently has been described.

This is the case of a patient with prosthetic tricuspid valve stenosis resolved through valve-in-valve transcatheter aortic valve replacement (VIV-TAVR).

ENDOVASCULAR REVASCLARIZATION OF CENTRAL VEINS AND SUBSEQUENT CARDIAC CATHETERIZATION FOR HEMODIALYSIS IN A PATIENT WITH EXHAUSTION OF CONVENTIONAL VASCULAR ACCESSES

Marcel Voos Budal Arins, Antenor Álvarez

Objective. Exhaustion of conventional vascular accesses (ECVA) in patients with end-stage renal disease is associated with higher morbidity and mortality rates. Consequently, maintenance of existing VA sites is of utmost importance for hemodialysis. We describe a technique used for the endovascular revascularization of central veins and subsequent catheter placement regarding hemodialysis in a patient with exhaustion of conventional vascular accesses.

Methods. This is the case of a patient with exhausted vascular access and requirement for emergency dialysis. Endovascular revascularization of central veins and subsequent catheter placement for hemodialysis were successfully performed.

Results. The patient still remains on hemodialysis at the follow-up without any complications being reported.

Conclusion. Endovascular revascularization of central veins for hemodialysis is a known and accepted technique that can extend the use of VAs in complex patients over time.

BILATERAL ILIOFEMORAL DEEP VEIN THROMBOSIS IN PATIENT WITH INTERRUPTED INFERIOR VENA CAVA.

Verónica Gonzalez, Alan Sommi, Carlos Giuliani, Fabio Muñoz

The inferior vena cava (IVC) develops from 5 different venous systems in a complex embryological process. Problems with the IVC give way to developmental abnormalities that can be associated, or not, with cardiac malformations and account for almost half of all venous malformations. They may go unnoti-

ced clinically. However, they can generate blood stasis and the corresponding formation of thrombosis. In this publication we present a case of bilateral iliofemoral deep vein thrombosis in a patient with interrupted IVC and azygos and hemiazygos continuation, and its resolution.

LETTER FROM THE PRESIDENT / CARTA DEL PRESIDENTE

LETTER FROM THE PRESIDENT OF CACI

Martín Cisneros

We have recently initiated a new management in our beloved college, a new board of directors takes over that—as the other boards that have come before us— will do everything in its power to bring benefits and advantages to our members and medical society alike.

Our focus will be on promoting team effort. Therefore, with the work, collaboration, and commitment that all of you will bring forward in the coming years the progress and improvements we long for are guaranteed.

Growth of the RACI from 2017 through 2021

Crecimiento de la revista RACI períodos 2017 a 2021

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):11. <https://doi.org/10.30567/RACI/202201/0011-0011>

If we study the *Argentine Journal of Interventional Cardioangiology (RACI)* Google analytics and compare the last 5 years we will see the growing interest this journal has created within our medical specialty both in and out of our country. Interest has probably even spread to other medical specialties associated with ours, though not necessarily focused on percutaneous coronary interventions.

If we analyze the last 5 years using the same yearly period from March through October corresponding to the three annual issues of *RACI* we will see a significant growth in the number of users and visits to the journal official website.

This growth is evident going from 3540 users in 2017 to 8322 users in 2021, a 58% increase in the number of users, which is somehow similar to the increase seen in the number of sessions from 5066 in 2017 to 10 464 in 2021.

Year after year this increase can be seen in the number of sessions and in the number of new users who join us (Figure). We should remind our readers that the Argentine College of Interventional Cardioangiology (CACI) only has somewhere around 600 active members including those who are students at CACI, that is, it is obvious that there are many more readers compared to affiliate members.

The number of affiliate members to each scientific society should be taken into consideration if we are to compare our journal to other cardiology journals in our country.

We should mention that this growth remained stable throughout this entire period: 21% in 2018 vs 2017; 10.5% in 2019 vs 2018; 23% in 2020 vs 2019, and 22% in 2021 vs 2020

Each issue of our journal is simultaneously published in Spanish and English since 2020.

A total of 50% of the users come from our country, 25% from the region, and the remaining 25% from the United States of America. Regarding users, our journal is invariably well positioned among the leading 3 counties. Also, the presence of our journal is felt in countries like France, Spain, and over the last few years China, which is consistent with the moment when we decided to publish our journal in both English and Spanish languages.

In conclusion our journal ongoing growth is the direct consequence of the quality of the manuscripts submitted, the simultaneous English edition of all the articles published in our journal, and the growing number of citations *RACI* currently has.

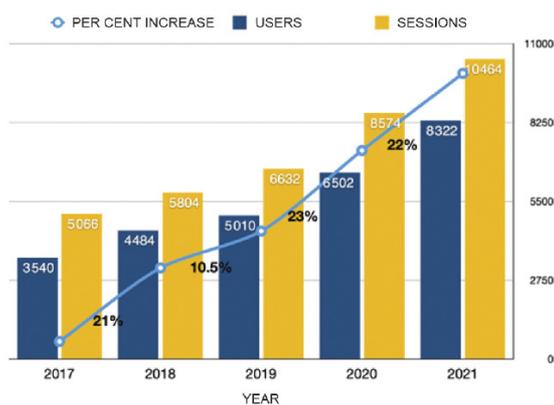


Figure 1.

This issue includes original articles, case reports, and also a review article on the left main coronary artery submitted to us by Mount Sinai Working Group (New York, NY, United States) lead by Dr. George Dangas, MD.

Among the articles that can be visited through our website with their corresponding DOI we will find a review paper on coronary lithotripsy submitted to us by the MedStar Institute Working Group (Washington D.C., United States) lead by Dr. Ron Waksman, MD. This article will be available in the upcoming second issue of the journal (2Q 2022).

Throughout these years we have published reviews and editorials from some of the world's most cited interventional cardiology experts in our specialty.

It is our responsibility and that of the entire Editorial Board to keep feeding the growth of our journal.

Alfredo E. Rodríguez MD, PhD, FACC, FSCAI

Editor-in-chief

Argentine Journal of Interventional Cardioangiology (RACI)

Percutaneous coronary intervention for left main coronary artery disease

Intervencionismo percutáneo en la enfermedad del tronco común izquierdo

David A. Power MD¹, Anastasios Roumeliotis MD^{1,2}, Javed Suleman MD¹, George D. Dangas MD PhD¹

ABSTRACT

Left main coronary artery (LMCA) is associated with significant morbidity and mortality, primarily related to the large amount of myocardium it subtends. The medical management of left mainstem disease has been associated with dismal outcomes approaching 50% mortality at 5 years. Coronary artery bypass graft (CABG) surgery historically emerged as the standard of care for the revascularization of LMCA disease. Recently, percutaneous coronary intervention (PCI) has been established as an alternative to CABG for LMCA disease. Advancements in stent design, implantation technique, and pharmacotherapy, have occurred over time. Large randomized controlled trials comparing CABG to PCI for LMCA disease have recently been published in various settings. There have been ongoing efforts to reconcile certain disparate trial results. Herein, we summarize the data behind LMCA revascularization and place the NOBLE and EXCEL trials in clinical context alongside current societal guidelines.

Keywords: *unprotected stenosis of left main coronary artery, complex lesions, SYNTAX score, multiple vessels, drug-eluting stents, stents.*

RESUMEN

La enfermedad de tronco de coronaria izquierda (TCI) se asocia a una mortalidad y morbilidad importantes, principalmente porque compromete una cantidad enorme de miocardio. El manejo médico de la enfermedad del TCI se asocia a resultados funestos con tasas de mortalidad del 50% al cabo de 5 años. Tradicionalmente, la cirugía de revascularización coronaria (CABG) ha sido su tratamiento estándar. Recientemente, la intervención coronaria percutánea (ICP) se ha establecido como una alternativa a la CABG para su tratamiento. El paso del tiempo ha traído consigo avances tanto en el diseño de los *stents*, como en las técnicas de implantación, así como en la farmacoterapia. Recientemente, se han publicado extensos ensayos clínicos controlados y aleatorizados comparando CABG frente a ICP para el tratamiento de la enfermedad del TCI en diferentes escenarios clínicos. En varias ocasiones se han intentado reconciliar resultados dispares procedentes de estos ensayos. En este artículo se resumen los datos que hay detrás de la revascularización del TCI y se ponen los ensayos NOBLE y EXCEL en contexto clínico dentro del marco establecido por las actuales guías de práctica clínica elaboradas por las diferentes sociedades médicas.

Palabras claves: *estenosis no protegida de tronco de coronaria izquierda, lesiones complejas, score de SYNTAX, múltiples vasos, stents liberadores de fármacos, stents.*

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):12-15. <https://doi.org/10.30567/RACI/202201/0012-0015>

INTRODUCTION

The left main coronary artery (LMCA) supplies blood to approximately 75% of the total myocardium. While LMCA disease (LMCAD) accounts for less than 5% of lesions on routine coronary angiography, the large area of muscle subtended illustrates its significance as a target for revascularization¹. Historically, coronary artery bypass graft surgery (CABG) was considered the gold standard therapy for LM stenosis. More recently, however, percutaneous coronary intervention (PCI) has been considered as a viable alternative treatment option for select patients².

Over the last decade, advances in stent technology, implantation technique, intravascular imaging and antiplatelet pharmacotherapy have helped PCI to emerge as an alternative for selected patients with LMCAD. To date, randomized trials directly comparing the two revascularization strategies have demonstrated non-inferiority of PCI in comparison to CABG with regards to major adverse cardiac and ce-

rebrovascular events². Furthermore, multiple observational registries have reported excellent short- and long-term outcomes in LMCAD patients treated with PCI³. Additional prospective registries throughout the 2010's revealed disparate results, prompting the initiation of multicenter randomized control trials to compare the two strategies.

THE FIRST GENERATION DES ERA

Early clinical trials for left main coronary artery disease initially examined CABG versus PCI with predominantly 1st generation drug eluting stents (DES). Four of the most notable randomized trials of this era included SYNTAX, PRE-COMBAT, Boudriot et al., and LEMANS⁴⁻⁷. The Synergy Between PCI with Taxus and Cardiac Surgery (SYNTAX) trial was a multicenter randomized control trial comparing CABG versus PCI in 1,800 patients for a composite MACCE (major adverse cardiac and cerebrovascular events) outcome of death, stroke, myocardial infarction (MI) or repeat revascularization. The PCI arm of SYNTAX notably utilized the now obsolete Paclitaxel DES. Analysis of the LMCAD subgroup (n=705) revealed no significant differences between PCI or CABG for either mortality (12.8% vs. 14.6%; p=0.53) or MACCE (36.9% vs. 31%, p=0.12) at 5-year follow up. Compared to PCI, CABG patients in SYNTAX had some what higher rates of stroke. Notably, CABG did provide a significant survival benefit in patients with extensive triple vessel coronary disease⁶.

Building from the lessons of the SYNTAX trial, the Premier of Randomized Comparison of Bypass Surgery Ver-

1. The Zena and Michael A. Wiener Cardiovascular Institute, Icahn School of Medicine at Mount Sinai, New York City, NY, 10029

2. Harvard Medical School, Mount Auburn Hospital Department of Medicine, 330 Mount Auburn Street, Cambridge, MA, 02138, USA

✉ Corresponding authors: *George D. Dangas MD, PhD. Zena and Michael A Wiener Cardiovascular Institute, Icahn School of Medicine at Mount Sinai, New York City, NY, 10029. United States. Tel: 212-241-7014. Fax: 212-241-0273.*

The authors declared no conflicts of interest whatsoever.

sus Angioplasty Using Sirolimus-Eluting Stent in Patients with Left Main Coronary Artery Disease (PRECOMBAT) study was a randomized control trial of 600 patients undergoing PCI or CABG for unprotected LMCAD in South Korea. Similar to SYNTAX, it was designed as a non-inferiority study with a primary MACCE endpoint. No differences in 1 year mortality (5.7% vs. 7.9%; $p=0.32$) or MACCE (17.5% vs. 14.3%; $p=0.26$) were detected between PCI versus CABG respectively⁶.

Boudriot et al. examined 201 patients with LMCAD randomized to PCI or CABG for a primary MACE outcome of death, MI or repeat revascularization. The combined primary endpoint at 1-year follow-up for PCI versus CABG was 19% and 13.9% respectively ($p=0.19$)⁴. Finally, the Left Main Coronary Artery Stenting (LE MANS) trial enrolled a small number of patients ($n=105$) with unprotected LMCAD to either PCI or CABG with long term follow up. At 10 years, there were no differences in the secondary outcome of MACCE (death, myocardial infarction, target vessel revascularization or stroke) between revascularization strategies. The primary outcome of LE MANS was a difference in left ventricular ejection fraction and was neither statistically nor clinically significant⁷.

Taken together, the relatively small number of patients with LMCAD included in individual randomized trials, generally short term follow-up time frame and the use of 1st generation DES necessitated other contemporary randomized trials to examine the role of PCI with 2nd generation DES versus CABG for LMCAD.

THE SECOND GENERATION DES ERA

The simultaneous publication of the EXCEL (Evaluation of XIENCE versus Coronary Artery Bypass Surgery for Effectiveness of Left Main Revascularization) and NOBLE (Nordic-Baltic-British left main revascularization trial) randomized trials in 2016 gave apparently discordant results to the topic of LM CAD revascularization with second generation drug-eluting stents (DES)^{8,9}. Both trials had a non-inferiority design, attempting to demonstrate that PCI was not significantly worse than the control treatment, CABG.

In brief, the NOBLE trial was a prospective, randomized control trial carried out across 36 centers throughout Europe comparing PCI to CABG. The trial randomized 1,201 patients to either revascularization strategy (PCI, $n=598$; CABG, $n=603$) with a primary outcome of MACCE comprising all-cause mortality, stroke, non-procedural MI (peri-procedural MI was excluded) and repeat revascularization. The findings from NOBLE indicated that CABG was superior to PCI (MACCE 19% vs. 28%; HR=1.58; 95% CI: 1.24-2.01; $p<0.01$). There were no differences between CABG and PCI groups in terms of all-cause mortality (9% vs. 11%; 95% CI: 0.67-1.74; $p=0.84$)⁸.

On the other hand, the EXCEL trial was a prospective, randomized, open label, non-inferiority trial of 1,905 patients undergoing either CABG or PCI with low or intermediate anatomical complexity. At an average of 3 years follow up, there was no significant difference between CABG and PCI in terms of the primary MACE outcome of cardiac death, stroke, MI or revascularization (14.7% vs. 15.4%; HR=1.00; 95% CI: 0.79-1.26; $p=0.98$ for superiority). There were no differences in all-cause-mortality at 3-years (5.9% vs. 8.2%; HR=1.34; 95% CI: 0.94-1.91; $p=0.11$)⁹.

In order to reconcile these apparently contradicting trial results it is crucial to outline their major methodological differences. First, the EXCEL trial used the SCAI (Society of Cardiac Angiography and Intervention) definition for periprocedural MI after both PCI and CABG, whereas NOBLE excluded all periprocedural MI events¹⁰⁻¹¹.

Secondly, while the NOBLE trial provides a direct comparison between CABG and PCI for the treatment of left main disease across a wide spectrum of angiographic complexity, the population included in the EXCEL trial had an overall intermediate-low anatomical complexity. It can be construed, therefore, that EXCEL may have a higher level of external generalizability given the current ESC and ACC/AHA guidelines that strongly recommend CABG for LMCAD revascularization amongst high SYNTAX populations and become more equivocal between revascularization strategies as SYNTAX scores are in the intermediate-low range¹¹.

Third, the stent platforms used in the two trials were different. Biolimus-eluting biodegradable stents were used exclusively in the NOBLE trial while fluoropolymer-based cobalt-chromium Everolimus eluting stents were used in the EXCEL trial. Inherent device differences may exist between stent platforms.

Finally, the primary end points were different between the two trials. The primary endpoint of NOBLE was MACCE (death, MI, stroke and repeat revascularizations), while in EXCEL, repeat revascularization was not included in the composite endpoint (death, MI and stroke). Hence, the use of different stents, MI definitions, primary outcome differences and anatomical complexity accounts for the observed differences; otherwise results are actually quite concordant.

SYNTAX AND ANATOMICAL COMPLEXITY

The 5-year follow up of both NOBLE and EXCEL confirmed the previous findings for both studies^(12,13). Looking to the long term data from another notable revascularization trial, Park *et al.*, revealed the 10-year follow up of the PRECOMBAT cohorts, finding no significant difference in the primary outcome of MACCE (composite of death from any cause, myocardial infarction, stroke, or ischemia-driven target-vessel revascularization)¹⁴. The landmark SYNTAX Extended-Survival Study also demonstrated no difference in overall all-cause mortality between PCI and CABG in patients with LM disease not accompanied by multivessel disease. With the exception of the NOBLE trial, all previous studies have shown a significant association between cardiovascular death and the extent of multivessel disease (typically measured using the SYNTAX score). The EXCEL trial 5 year follow up study showed a mortality benefit in favor of CABG over PCI (9.9% vs. 13.0%; HR=1.38; 95% CI: 1.03-1.85), mostly of non-cardiovascular origin.

As a result of the afore mentioned data, it appears that the advantage of CABG in LM coronary revascularization perhaps relates more to the presence of triple vessel disease or comorbidities such as diabetes, rather than the pure presence of LMCAD. Furthermore, a meta-analysis of six randomized trials examining PCI and CABG from over 4,500 patients demonstrated a lower relative risk of mortality with PCI in low SYNTAX score, equivocal results between both strategies for intermediate SYNTAX scores and lower risk of mortality with CABG in high SYNTAX scores¹⁵.

	LEMANS ⁵	SYNTAX (Left Main Study) ⁶	Boudriot et al. ⁴	PRECOMBAT ⁷	NOBLE ⁸	EXCEL ⁹
Publication year	2007	2010	2011	2011	2016	2016
Study design	RCT	RCT sub-analysis (pre-specified)	RCT	RCT	RCT	RCT
Number of patients	105	705	201	600	1201	1905
Length of follow up	2 years	1 year	1 year	1 year	5 years	3 years
Stent generation	1 st Gen DES & BMS	1 st Gen DES	1 st Gen DES	1 st Gen DES	2 nd Gen DES	2 nd Gen DES
Diabetes % (PCI/CABG)	19%/17%	28%/30%	40%/33%	34%/30%	15%/15%	30%/28%
Outcome of interest (components)	MACCE: CV death, MI, stroke, repeat revascularization, ISR	MACCE: Death, stroke, MI, repeat revascularization	MACCE: CV death, MI, TVR	MACCE: Death, MI, stroke, TVR	MACCE: Death, MI, stroke, repeat revascularization	MACCE: Death, Stroke, MI
Results	PCI non-inferior to CABG	PCI non-inferior to CABG (non-randomized)	PCI inferior to CABG	PCI non-inferior to CABG	PCI inferior to CABG	PCI non-inferior to CABG
Methodological issues	Secondary endpoint	Pre-specified sub-analysis	CABG superiority driven by repeat revascularization;	Wide non-inferiority margins	Outcome driven by MI and repeat revascularization	Impact of periprocedural MI on early outcomes

BMS: bare metal stent. CABG: coronary artery bypass graft surgery. CV: cardiovascular. DES: drug eluting stent. MACCE: major adverse cardiac and cerebrovascular events. MACE: major adverse cardiac events, MI: myocardial infarction, PCI: percutaneous coronary intervention, RCT: randomized controlled trial, TVR: target vessel revascularization.

The most recent European Society of Cardiology guideline recommendations on the optimal treatment approach to LMCA disease were published in 2018 and were primarily based on the secondary analyses of the SYNTAX trial and the early results of the EXCEL trial. The most recent update from the European Society of Cardiology recommends CABG in all patients with stable LMCAD and low predicted surgical mortality (Class I, LOE B). In LMCAD patients with low anatomical complexity (SYNTAX score: 0-22) PCI was indicated with a high level recommendation (IA) while in those with an intermediate score (SYNTAX score: 23-32) PCI should be considered as a treatment option (IIA, LOE B). PCI was not recommended (IIIB, LOE B) in cases with high SYNTAX score >32¹⁶⁻¹⁷.

The recommendations for PCI for LMCA disease across SYNTAX score tertiles from the 2014 American College of Cardiology/American Heart Association focused update for the diagnosis and management of patients with stable ischemic heart disease are currently Class IIa if SYNTAX score is low, Class IIb if SYNTAX score is intermediate, and Class III if SYNTAX score is high¹⁸. Overall, isolated LM disease, or LM disease in combination with lesions of lower complexity can be safely and successfully treated via PCI.

LEFT MAIN LESION LOCATION AND STENT IMPLANTATION TECHNIQUE

In addition to factors such as anatomical complexity, ventricular reserve and comorbid diabetes that have been well described, much attention should focus on lesion location and stenting technique. Distal lesions of the LM bifurcation treated with PCI have been associated with inferior cardiovascular outcomes compared to ostial and body disease. This probably reflects the higher lesion complexity and unique technical difficulties encountered during interventions on the distal segment of the LM coronary artery.

A secondary analysis from the 3-year follow up of the EXCEL trial examined the comparative efficacy of PCI and CABG according to the location of the LM lesion. While no differences between PCI or CABG were reported for lesions in the ostium or the shaft, patients in the PCI arm with a distal LM lesion experienced a higher incidence of ischemia-driven revascularization (13.0% vs. 7.2%; $p=0.0001$). In a post-hoc analysis of the EXCEL trial, PCI with a 1-stent provisional stenting (PS) technique was associated with lower rates of the composite endpoint of death,

MI or stroke at 3-years as compared to a 2-stent approach (14.1% versus 20.7%; adjusted HR=0.55; 95% CI: 0.35-0.88; $p=0.01$). These results were primarily driven by decreased rates of ischemia-driven revascularization in the PS group compared to the 2-stent group (7.2% vs. 16.3%; $p=0.001$)¹⁹. Despite the afore mentioned post-hoc analyses, the benefit of PS in ULMD has recently been questioned in the DKCRUSH-V (Double Kissing Crush versus Provisional Stenting for Left Main Distal Bifurcation Lesions) randomized trial.

DK-CRUSH-V randomized patients with ULMD to either a 2 stent DK-CRUSH technique or PS. At one year follow up, the DK crush strategy resulted in reduced rates of target lesion failure compared to a PS strategy (10.7% vs. 5.0%; HR=0.42; 95% CI: 0.21-0.85; $p=0.02$), although the study was under-powered to assess hard outcomes. Several 2-stent techniques are currently available to treat bifurcation lesions, but how these techniques compare with one another is still debated²⁰.

The DKCRUSH-III (Comparison of double kissing crush versus Culotte stenting for unprotected distal left main bifurcation lesions) trial compared the 2-stent DK-CRUSH technique to a 2-stent Culotte technique for LM bifurcation lesions. Patients treated with a Culotte technique had significant higher 1-year MACE rate compared to DK-CRUSH group (16.3% vs. 6.2%), mainly driven by increased TVR²¹. These results clearly indicate that not all 2-stent strategies are equal, however the choice of 2-stent vs. 1-stent technique remains unclear²².

The European Society of Cardiology (ESC) has reflected these results in its recent recommendations advocating for the DK-Crush technique to be preferred over provisional T stenting (Class IIb, LOE B)¹⁶. However, the unique multi-step methodology employed for the DK-CRUSH-V trial may limit its broader adaptation in clinical practice.

CONCLUSION

Left main CAD represents an important and demonstrably complex target for revascularization. PCI appears to be a safe and feasible alternative to CABG as demonstrated by the non-inferiority of major trials according to hard outcomes for select patient populations. Importantly, low anatomical complexity as defined by SYNTAX scores is perhaps the most critical element in favor of PCI for LM disease. Rather than dogmatically applying one-stent (provisional) or

two-stent techniques to left main disease, either technique can be pragmatically employed according to specific anatomical settings.

On the other hand, patients with high anatomical complexity as defined according to the SYNTAX score are better served with CABG. As PCI techniques and stent platforms de-

velop further to improve patient care, randomized controlled trials comparing PCI versus CABG will continue to suffer from an inevitable lag time bias. Clinical research will continue to be necessary in order to delineate the role for LM PCI in patient subsets with co-morbid diabetes, reduced left ventricular function and other conditions

REFERENCES

- Collet C, Capodanno D, Onuma Y, et al. Left main coronary artery disease: pathophysiology, diagnosis, and treatment. *Nature Reviews Cardiology* 2018;15:321-331.
- Ramadan R, Boden WE, Kinlay S. Management of Left Main Coronary Artery Disease. *Journal of the American Heart Association*;7:e008151.
- Chieffo A, Tanaka A, Giustino G, et al. The DELTA 2 Registry: A Multicenter Registry Evaluating Percutaneous Coronary Intervention With New-Generation Drug-Eluting Stents in Patients With Obstructive Left Main Coronary Artery Disease. *JACC Cardiovasc Interv* 2017;10:2401-2410.
- Boudriot E, Thiele H, Walther, T et al. Randomized comparison of percutaneous coronary intervention with sirolimus-eluting stents versus coronary artery bypass grafting in unprotected left main stem stenosis. *J Am Coll Cardiol* 2011;57:538-45.
- Buszman PE, Buszman PP, Banasiewicz-Szkróbka I, et al. Left Main Stenting in Comparison With Surgical Revascularization: 10-Year Outcomes of the (Left Main Coronary Artery Stenting) LE MANS Trial. *JACC Cardiovasc Interv* 2016;9:318-327.
- Park S-J, Kim Y-H, Park D-W, et al. Randomized Trial of Stents versus Bypass Surgery for Left Main Coronary Artery Disease. *New England Journal of Medicine* 2011;364:1718-1727.
- Serruys PW, Morice M-C, Kappetein AP, et al. Percutaneous Coronary Intervention versus Coronary-Artery Bypass Grafting for Severe Coronary Artery Disease. *New England Journal of Medicine* 2009;360:961-972.
- Mäkikallio T, Holm NR, Lindsay M, et al. Percutaneous coronary angioplasty versus coronary artery bypass grafting in treatment of unprotected left main stenosis (NOBLE): a prospective, randomised, open-label, non-inferiority trial. *The Lancet* 2016;388:2743-2752.
- Stone GW, Sabik JF, Serruys PW, et al. Everolimus-Eluting Stents or Bypass Surgery for Left Main Coronary Artery Disease. *New England Journal of Medicine* 2016;375:2223-2235.
- Ruel M, Farkouh ME. Why NOBLE and EXCEL Are Consistent With Each Other and With Previous Trials. *Circulation* 2017;135:822-824.
- Stankovic G, Milasinovic D. EXCELLing in Left Main Intervention. *Circulation: Cardiovascular Interventions* 2018;11:e007363.
- Holm NR, Mäkikallio T, Lindsay MM, et al. Percutaneous coronary angioplasty versus coronary artery bypass grafting in the treatment of unprotected left main stenosis: updated 5-year outcomes from the randomised, non-inferiority NOBLE trial. *The Lancet* 2020;395:191-199.
- Stone GW, Kappetein AP, Sabik JF, et al. Five-Year Outcomes after PCI or CABG for Left Main Coronary Disease. *New England Journal of Medicine* 2019;381:1820-1830.
- Park D-W, Ahn J-M, Park H et al. Ten-Year Outcomes After Drug-Eluting Stents Versus Coronary Artery Bypass Grafting for Left Main Coronary Disease. *Circulation* 2020;141:1437-1446.
- Giacoppo D, Colleran R, Cassese S, et al. Percutaneous Coronary Intervention vs Coronary Artery Bypass Grafting in Patients With Left Main Coronary Artery Stenosis: A Systematic Review and Meta-analysis. *JAMA Cardiology* 2017;2:1079-1088.
- Knuuti J, Wijns W, Saraste A, et al. 2019 ESC Guidelines for the diagnosis and management of chronic coronary syndromes: The Task Force for the diagnosis and management of chronic coronary syndromes of the European Society of Cardiology (ESC). *European Heart Journal* 2020;41:407-477.
- Montalescot G, Sechtem U, Achenbach S, et al. 2013 ESC guidelines on the management of stable coronary artery disease: the Task Force on the management of stable coronary artery disease of the European Society of Cardiology. *Eur Heart J* 2013;34:2949-3003.
- Fihn SD, Blankenship JC, Alexander KP, et al. 2014 ACC/AHA/AATS/PCNA/SCAI/STS Focused Update of the Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease. *Circulation* 2014;130:1749-1767.
- Kandzari DE, Gershlick AH, Serruys PW, et al. Outcomes Among Patients Undergoing Distal Left Main Percutaneous Coronary Intervention. *Circulation: Cardiovascular Interventions* 2018;11:e007007.
- Chen X, Li X, Zhang JJ et al. 3-Year Outcomes of the DKCRUSH-V Trial Comparing DK Crush With Provisional Stenting for Left Main Bifurcation Lesions. *JACC Cardiovasc Interv* 2019;12:1927-1937.
- Chen SL, Xu B, Han YL, et al. Clinical Outcome After DKCrush Versus Culotte Stenting of Distal Left Main Bifurcation Lesions: The 3-Year Follow-Up Results of the DKCRUSH-III Study. *JACC Cardiovasc Interv* 2015;8:1335-1342.
- Power D, Roumeliotis A, Reisman A, et al. TCT CONNECT-305 Impact of Lesion Location on Cardiovascular Outcomes of Patients Undergoing Percutaneous Coronary Intervention With Drug-Eluting Stents for Unprotected Left Main Coronary Artery Stenosis. *Journal of the American College of Cardiology* 2020;76:B131-B132.

Transient percutaneous balloon occlusion vs uterine artery embolization as coadjuvants in the management of placenta accreta spectrum disorders during C-section

Oclusión percutánea transitoria con balones *vs.* embolización de las arterias uterinas como coadyuvantes en los trastornos adherenciales placentarios durante la cesárea

Federico Martín Riolo¹, Andrés Enrique Dini¹, Gustavo Alberto Tamashiro¹, Derwin Plazas Alvarez¹, Jorge Orlando Cortez Yáñez¹, Miguel Osvaldo Villegas¹

ABSTRAC

Adjuvant treatment through endovascular procedure for the management of placenta accreta is useful because it has low morbidity and mortality rates. The therapeutic objective is the embolization and occlusion of uterine arteries by optimizing and reducing the risk of complications associated with C-section with preservation of the uterus or subsequent hysterectomy. A total of 38 patients with a diagnosis of placenta accreta were admitted to the hemodynamics unit of our center between January 2012 and January 2020. After C-section and prior to the hysterectomy 28 of these patients were treated with gelatin sponge embolization of the uterine arteries. Transient percutaneous balloon occlusion of the uterine arteries was performed in 10 patients. The outcomes of our center are presented here.

Keywords: placenta accreta, obstetric and gynecologic emergencies, postpartum hemorrhage, transcatheter embolization, intravascular balloon.

RESUMEN

El tratamiento coadyuvante por intervencionismo endovascular en los trastornos adherenciales placentarios es considerado un procedimiento útil debido a su baja morbilidad y mortalidad. El objetivo terapéutico es la embolización y/u oclusión de las arterias uterinas optimizando y disminuyendo el riesgo de complicaciones asociadas a la cesárea, con conservación del útero o con posterior histerectomía. Entre enero del 2012 a enero del 2020 fueron admitidos en el Servicio de Hemodinamia de nuestra Institución 38 pacientes con diagnóstico de acretismo placentario; 28 de ellas, luego de la cesárea y previo a la histerectomía, fueron sometidas a embolización con esponja de gelatina de las arterias uterinas. En 10 pacientes se realizó la oclusión transitoria percutánea con balones de las arterias uterinas. Se presentan los resultados de nuestra experiencia.

Palabras clave: placenta accreta, emergencias obstétricas y ginecológicas, hemorragia posparto, embolización endovascular, balón endovascular.

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):16-20. <https://doi.org/10.30567/RACI/202201/0016-0020>

INTRODUCTION

Placenta accreta is a serious complication during pregnancy that can be associated with massive bleeding during and after delivery with the potential risk for the patient's life.[1] Currently, the rate of accretism is 1 for every 1000 deliveries (0.04% to 0.9%) [2]. Accretism is the most common indication for peripartum hysterectomy due to the increase of C-sections seen over the last 50 years.[3] It has become the leading cause of emergency hysterectomy.[4] However, the most common cause of postpartum bleeding is uterine atony. C-section and hysterectomy to treat accretism have been recommended since 1972. A total of 38 patients with a diagnosis of placenta accreta were admitted to the unit of hemodynamics of our center between January 2012 and January 2020 to be treated with percutaneous balloon occlusion of uterine arteries and/or embolization after the C-section and prior to hysterectomy. These are the results of our experience.

ENDPOINT

This represents our experience with the endovascular treatment of 30 patients with placenta accreta spectrum disorders treated with scheduled C-section. We will be describing the endovascular techniques used, the immediate results reported, and the in-hospital follow-up.

MATERIAL AND METHODS

Cross-sectional, descriptive, and observational study conducted from January 2012 through January 2020. A total of 38 patients with a diagnosis of placenta accreta were admitted to the unit of hemodynamics of our center. Each case was approached by a multidisciplinary team including obstetricians, neonatologists, urologists, anesthesiologists, and interventional cardiologists who were experts in the management of patients in their 34th-35th gestational week. Procedures were performed on an eligibility and scheduled basis. Ultrasound-guided prenatal diagnosis was achieved in all the patients. When the ultrasound was inconclusive an MRI was performed in 3 of these patients.

First, the urology unit inserted the ureteral catheters into the patient who was, then, transferred to the hybrid cath lab where the patient was treated with the Seldinger technique under local anesthesia. Two 6-Fr introducer sheaths were placed in both common femoral arteries retrogradely and then followed by the infusion of a bolus of 2500 IU of

1. Servicio de Hemodinamia. Hospital Nacional "Profesor Alejandro Posadas", El Palomar, Buenos Aires, Argentina

✉ Correspondencia: Miguel Osvaldo Villegas. Coletta 483. B2804AZG Campana. Buenos Aires, Argentina. Tel.: 11-4469-9206. miguelvillegas@gmail.com

Los autores no declaran conflictos de intereses

Recibido: 30/09/2021 | Aceptado: 14/12/2021

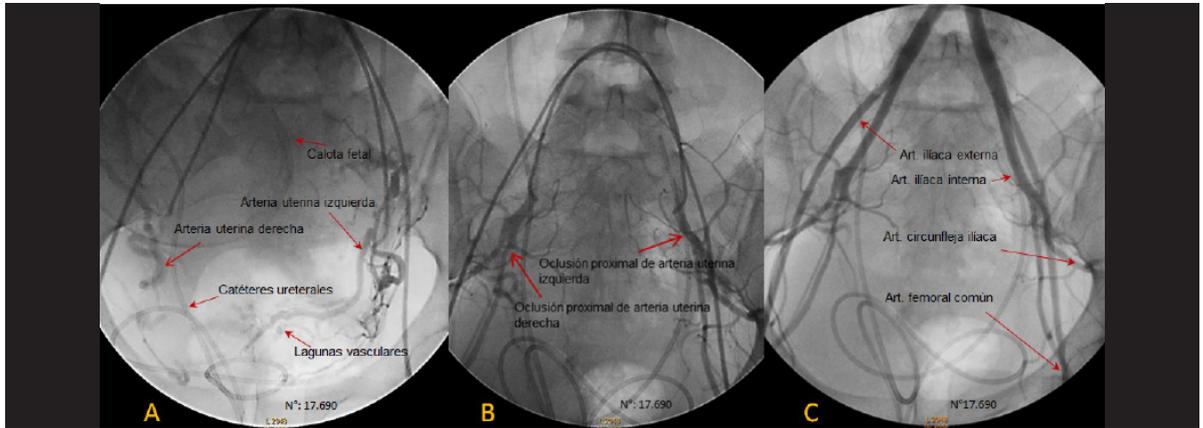


Figura 1. A. Angiografía selectiva de ambas arterias uterinas. Se visualiza la tortuosidad de sus recorridos, la presencia de lagunas vasculares, la dominancia de la arteria uterina izquierda y el borde del cráneo fetal con presentación céfálica. B. Angiografía post embolización con Spongostán®. Angiografía selectiva de las arterias hipogástricas. C. Angiografía final. Se visualiza la permeabilidad del eje iliaco-femoral, de la arteria circunfleja iliaca y la embolización exitosa de ambas arterias uterinas

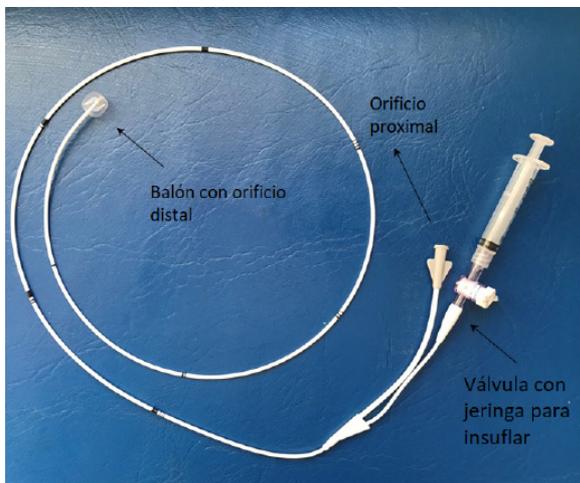


Figura 2. Catéter balón Wedge 6 Fr (ARROW®, Arrow International, Inc. 2400 Bernville Road Reading, USA) con orificio distal.

sodium heparin. Both introducer sheaths were connected to pressurized permanent cleaning with a heparinized physiological solution (2500 IU of sodium heparin in 500 mL of physiological solution) during the entire procedure at an acceptable rate to prevent access site thrombosis due to the, sometimes, extended surgical times.

The anesthesiology unit then administers general anesthesia with the corresponding intubation and connection to a ventilator.

Using the AP projection, using radiography, and with an average dose administered, 2 5-Fr Cobra angiographic catheters were mounted on a 0.035 in guidewire. Using the crossover technique at L4 level both catheters were placed next to both uterine arteries and then advanced towards the hypogastric artery anterior branch. Sometimes the contralateral oblique projection was used to select the uterine artery (25° to 40°) and see the partition between the anterior and posterior branches of the hypogastric artery. A baseline angiography was performed to assess the patient's uterine vascular anatomy.

Patients from group #1 (n = 28 - 73%) were treated with embolization. Patients from group #2 (n = 10 - 26%) were treated with temporary balloon occlusion of the uterine arteries. In group #1, once the insertion of the catheters has been confirmed into the uterine arteries Tegaderm and Lino dress-

TABLE 1. Characteristics of the population.

Number of patients (n)	n=38
Age (years)	32.3±5.6 (22- 42)
Gestational weeks	34.47±3.35
Previous pregnancies	4.3±1.7
1 pregnancy	5.26% (2/38)
2 a 3 pregnancies	21.05% (8/38)
4 o + pregnancies	73.68% (28/38)
Previous C-sections	2.8±1.4
None	5.26% (2/38)
1 C-section	10.53% (4/38)
2 a 3 C-sections	57.9% (22/38)
4 o + C-sections	26.32% (10/38)
Previous miscarriages	0.68±0.9
No miscarriages	55.26% (21/38)
1 miscarriage	31.58% (12/38)
2 a 3 miscarriages	10.53% (4/38)
4 miscarriages	2.63% (1/38)
Previous deliveries	0.55±1.35
	26.32 % (10/38)

sings are used for catheter fixation and immobilization. Afterwards, the C-section is performed by the obstetrics team. The newborn is examined by the neonatologist and later hospitalized. Prior to the hysterectomy, embolization with gelatin sponge is performed (Spongostan® Curamedical B.V., Amsterdam, The Netherlands). Once the surgical act is completed the patient is extubated, and a control angiography is performed to confirm the patency of both iliofemoral axes.

In group #2, using a 180 cm-long 0.014 in guidewire, the Cobra catheters are exchanged for 6-Fr balloon wedge-pressure catheters (ARROW®, Arrow International, Inc. 2400 Bernville Road Reading, PA, United States) with distal orifice that will be inflated after starting the hysterectomy (Figure 2). Once the procedure is completed both the catheters and the introducer sheaths are removed. The patient is then extubated and transferred to the ICU where she will remain for the next 24 hours to be eventually transferred to the obstetrics ward. Table 1 shows the characteristics of the population treated.

RESULTS

The ultrasound revealed the presence of total occlusive placenta previa in 52.64% of the patients (20/38), anterior pre-

TABLE 2. Comparative results of both techniques used.

	(Group #1) Embolization of uterine arteries with Spongostan®	(Group #2) Transient occlusion of both uterine arteries with balloons
No. of patients (n)	n=28	n=10
Volume of contrast (ml)	187±114	30±10
Intraoperativetransfusions of RBCUs	1±1.2	1.5±1.7
Postoperativetransfusions of RBCUs	39.28% (11/28) did not receive any RBCUs 53.57% (15/28). receive between 1 y 2 RBCUs 7.14% (2/28). received ≥3 RBCUs	70% (7/10) did not receive any RBCUs 30% (3/10) received between 1 and 2 RBCUs
Overall radiation (rad)	Overall radioscopy time: 15.4±9.7 minutes 0.12 Gy = 12 rad	Overall radioscopy time: 4.8 minutes 0.039 Gy = 3.9 rad
Drop in hemoglobin levels after hysterectomy (%)	23.7%	21.6%
Hospital stay after C-section (days)	9.9±7.4	6.13±2.47
Complications associated with the hemodynamicsprocedure	1 patient died with thrombosis of both lower limbs and DIC. 1 patient showed occlusion in her right external iliac artery that required angioplasty with stenting. 1 patient required re-embolization due to incomplete early embolization.	No hubo

via in 28.95% (11/38), posterior previa in 5.26% (2/38), anteroposterior in 5.26% (2/38), marginal previa in 5.26% (2/38), and lateral left previa in 2.63% (1/38).

The angiography of uterine vessels performed revealed the presence of a dominant uterine artery in 76.31% of the patients (29/38) being the left uterine artery in 44.73% of the cases (17/38), and the right uterine artery in 31.57% of the patients (12/38). In the remaining cases it was codominant in 23.70% of the patients (9/38). The dominant uterine artery was embolized in a patient since the contralateral one could not be selected, which required 2 intraoperative RB-CUs. No correlation between the anatomical distribution of the arteries and the location of the placenta was seen.

The Apgar test score in the newborns was 9-10 in 78.95% (30/38), 9-9 in 10.53% (4/38), 8-9 in 5.26% (2/38), 6-10 in 2.63% (1/38), and 6-7 in 2.63% (1/38). The newborns were not affected by general anesthesia, and the mother had no complications whatsoever.

Both arteries were embolized in 71% of the patients (27/38), the left uterine artery (dominant) in 1 patient because the right artery could not be selected in 2.6% of the cases (1/38), and only occluding balloons were used in both arteries in 16.6% of the patients (10/38).

A total hysterectomy was performed in 97.37% of the patients (37/38). Conservative treatment was used in a patient with uterine preservation.

The mean radiography time in groups #1 and #2 before the C-section (fetal radiation) was 3.9 minutes (+/- 1.5) with an average dose of 0.032 Gy = 3.23 rads. The overall radiography time was 14.2 minutes (+/-10) with an average dose of 0.11 Gy = 11 rads (table 2).

The mean volume of contrast used was 179 mL (+/-117). The contrast agent used was Ioversol (Optiray® - Mallinckrodt Inc., St Louis, MO, United States) in 92.1% of the cases (35/38) while Triyosom® (Gobbi Novag S.A, Bs.As., Argentina) was used in 3 patients (7.9%). None of the patients treated developed contrast-induced nephropathy (table 2).

Regarding the intraoperative transfusion requirements, 42.10% of the patients (16/38) did not require transfusion of hemoderivatives, 18.42% (7/38) required 2 RBCUs, 15.79% (6/38) required 1 RBCU, 7.89% (3/38) 4 RBCUs, 5.26% (2/38) 2 RBCUs, and 1 patient required 6 RBCUs (2,63%). In 7.89% of the patients (3/38) the Cell-Saver red blood cell recirculation system (Haemonetics Cell-Saver 5)

was used to recirculate 300 mL of blood in these patients, which is equivalent to a single red blood cell unit (table 2).

A total of 10 patients were treated with coadjuvant therapy with balloon wedge-pressure catheters in both uterine arteries. The mean volume of contrast used in these patients was 30 mL (+/-10). No radiographies were obtained after the C-section. A total of 5 patients did not require the transfusion of hemoderivatives during the procedure or during the hospital stay. Two patients required a single red blood cell unit intraoperatively, 2 patients required 2 red blood cell units, and 1 patient required 3 units.

The levels of hemoglobin prior to the surgical act were 11.03 (+/-1.1). These levels dropped 23.49% at the follow-up with, on average, lowest hemoglobin levels of 8.44 (+/- 1.9). The patients had mean hemoglobin levels of 10.01 (+/- 1.47) at discharge, which would account for the 9.2% drop reported compared to admission levels without any clinical signs.

Balloon group: previous Hb levels (11.74 +/-1.1), lowest Hb levels (9.21+/-0.49), Hb at discharge (11.02+/-1.84). Reduced Hb levels after treatment: 21.6%.

Embolization group: Previous Hb levels (10.86+/-1.08), lowest Hb levels (8.28+/-2.09), Hb at discharge (9.8+/-1.3). Reduced Hb levels after treatment: 23.7%.

During admission and after the C-section, 47.37% of the patients (18/38) did not require transfusions, 21.06% (8/38) received 1 RBCU, 23.68% (9/38) 2 RBCUs, and 7.89% (3/38) 3 or more RBCUs.

A total of 92.10% of the patients (35/38) were hospitalized 4 days (+/-1.9) before the C-section waiting for fetal maturity. A total of 4 patients remained at the hospital for over 2 weeks also waiting for fetal maturity. After the procedure, 84.21% of the patients (32/38) were hospitalized for 6.5 +/- 2.66 days until they were discharged. The remaining 15.79% (6/38) had complications that extended the hospital stay for 2 to 4 more weeks. Table 2 summarizes the comparative results of both techniques.

COMPLICATIONS

Only 1 patient required re-embolization due to bleeding after the hysterectomy (incomplete embolization).

The obstetrics unit performed new surgeries in 3 patients (7.9%): the laparotomy evacuation of hemoperitoneum without decompensation in 2 patients, and surgery due to hypovolemic shock in 1 patient (2.63%). All patients responded well to the surgical procedures performed. One patient had a longer hospital stay due to a concomitant in-hospital pneumonia.

One patient (2.63%) died due to arterial thrombosis of both lower limbs. Thrombectomy using Fogarty catheter was attempted twice with poor clinical course and shock associated with disseminated intravascular coagulation (DIC). Because of the prolonged time we believe that catheters remained inserted into both iliac arteries with an approximate hysterectomy time of nearly 5 hours.

Vesical reconstruction due to severe infiltration was performed in 1 patient (2.63%). During the immediate puerperium and the hospital stay 1 patient developed acute arterial ischemia in her right lower limb. The angiography performed confirmed the occlusion of the right external iliac artery that was treated with stent implantation. The patient's clinical course was favorable.

DISCUSSION

Brown et al. performed the first embolization back in 1979. The maternal mean age was 34 years, and the mean parity, 2.5. The maternal morbidity and mortality rates sit at around 60% and 7%, respectively. The rate of perinatal complications is higher particularly due to the short gestational age of the fetus.[5]

Antenatal diagnosis is key regarding clinical management. In most cases it is ultrasound guided. To prevent emergency C-section and minimize complications performing the C-section between week 34 and week 35 is advised [6].

Maternal death in the placenta accreta setting can occur despite optimal planning, surgical care, and the transfusion of hemoderivatives. Using a multidisciplinary approach and a high-complexity center reduces the maternal and neonatal morbidity and mortality rates.

The risk of accretism is directly associated with the number of previous C-sections performed.[7] The higher rate of accretism reported at the follow-up was confirmed in patients in whom 2 or 3 C-sections had previously been performed. We should mention that 44.7% (17/38) of the total number of patients had suffered previous miscarriages with eventual curettage, which may have been an additional contributing factor.

Up to 90% of the patients with placenta accreta require blood transfusions, and 40% over 10 red blood cell units. Maternal mortality has been reported in 7% of these patients associated with surgical and/or conservative treatment, but not with the endovascular procedure performed. [8] A total of 42.1% of the patients (16/38) required intraoperative blood transfusions at the follow-up of whom only 1 patient required 6 units while 44.7% (17/38) needed between 1 and 3 red blood cell units. One patient eventually died (2.63%).

The bladder is an extrauterine organ most frequently involved in the presence of percreta and is associated with significant morbidity and mortality rates.[9] One patient required vesical reconstruction with good disease progression. In selected cases and when fertility is desired conservative treatment can be used. Ours was a multiparity population.

Only 1 patient required conservative treatment without any complications being reported.

Balloon occlusion of iliac arteries is still a matter of discussion. In a controlled and retrospective study of 69 patients, Shrivastava et al. [10] could not confirm fewer bleedings in the cesarean-hysterectomies performed with intra-arterial balloons (n = 19). However, the control group without balloon (n = 50) showed selection bias (18%; n = 9 patients had not been treated with a previous C-section), less risk of accretism, and fewer chances of bleeding, which attenuated the benefit anticipated in the study group.

The simultaneous and temporal occlusion technique of both hypogastric arteries proved to be a highly effective treatment to prevent massive bleeding in placenta accreta and reduced the maternal morbidity and mortality rates significantly.[11] In an observational study conducted at Hospital Santojani in Buenos Aires, Argentina that included a total of 44 patients, 94.4% of these were embolized bilaterally. Gelatin sponge (Spongostan®) was used in all cases with satisfactory outcomes in 97.15% of the patients (n = 34) and unsatisfactory outcomes in 1 of these patients (2.85%) [12].

According to the current studies on the preoperative placement of intravascular balloon catheters this treatment is feasible for the management of placenta accreta and particularly useful for the management of placenta percreta.[13] Our heart team decided to use coadjuvant therapy with balloons following our non-inferiority experience in the results reported regarding the embolization of both uterine arteries.

The catheters advance under fluoroscopy guidance is associated with fetal exposure to radiation. It has been reported that during this procedure the fetus is exposed to nearly 3 to 6 rads of radiation into the uterus. A child's risk of developing cancer after fetal radiation exposure > 10 rads is around 0.5%[14,15] In our case, it was 3.23 rads without any differences being reported between both groups.

The hemodynamics procedure can be easily performed within 30 min with less than 5 to 8 minutes of fluoroscopy time. An exposure dose of 2 rads/min of fluoroscopy resulted in 10 to 16 rads of radiation exposure to the pelvis and the fetus [16]. Our overall radiography time was 15.4 minutes (+/-9.7) with mean levels of 12 rads in the embolization group and 4.8 min in the percutaneous balloon occlusion group with mean levels of 3.9 rads.

To solve the problem of fetal radiation there is a case report that says that catheters should be placed after the C-section has been performed. The interventional radiologist should rapidly prepare the embolization where the presence of abundant bleeding was seen.[17] Further studies are needed to establish techniques and determine more accurate indications for embolization without fetal exposure to radiation.

CONCLUSIONS

The multidisciplinary approach is key in both scheduled and emergency procedures. The obstetrician is the one responsible for coordinating physicians from different medical specialties. Endovascular treatment as coadjuvant therapy in the management of placenta accreta spectrum disorders is useful reducing the maternal morbidity and mortality rates. Based on our own results, we believe that the selective temporary occlusion of both uterine arteries is advised. Less maternal radiation, fewer contrast agents used, shorter cath lab times, and lack of complications have been associated with

embolization. Transfusion requirements were almost the same with both techniques. No differences were reported re-

garding more bleeding or intraoperative bleeding complications or at the in-hospital follow-up.

REFERENCES

1. R. Faranesh, R. Shabtai, S. Eliezer, and S. Raed, Suggested approach for management of placenta percreta invading the urinary bladder, *Obstetrics and Gynecology*, vol. 110, no. 2, pp. 512–515, 2007
2. S. Wu, M. Kocherginsky, J. U. Hibbard. "Abnormal placentation: twenty-year analysis," *American Journal of Obstetrics and Gynecology*, vol. 192, no. 5, pp. 1458–1461, 2005.
3. B. E. Hamilton, J. A. Martin, S. J. Ventura, P. D. Sutton, and F. Menacker, "Births: preliminary data for 2004," *National vital Statistics Reports*, vol. 54, no. 8, pp. 1–17, 2005.
4. G. Daskalakis, E. Anastasakis, N. Papanтониou, S. Mesogitis, M. Theodora, and A. Antsaklis, "Emergency obstetric hysterectomy," *Acta Obstetrica et Gynecologica Scandinavica*, vol. 86, no. 2, pp. 223–227, 2007.
5. T. H. Hung, W. Y. Shau, C. C. Hsieh, T. H. Chiu, J. J. Hsu, and T. T. Hsieh, "Risk factors for placenta accreta," *Obstetrics and Gynecology*, vol. 93, no. 4, pp. 545–550, 1999.
6. J. M. O'Brien, J. R. Barton, and E. S. Donaldson, "The management of placenta percreta: conservative and operative strategies," *American Journal of Obstetrics and Gynecology*, vol. 175, no. 6, pp. 1632–1638, 1996.
7. Silver RM, Landon MB, Rouse DJ, Leveno KJ, Spong CY, Thom EA, et al. Maternal morbidity associated with multiple repeat cesarean deliveries. National Institute of Child Health and Human Development Maternal-Fetal Medicine Units Network. *Obstet Gynecol* 2006;107:1226–32.
8. O'Brien JM, Barton JR, Donaldson ES. The management of placenta percreta: conservative and operative strategies. *Am J Obstet Gynecol* 1996;175:1632–8.
9. D. Levine, C. A. Hulka, J. Ludmir, W. Li, and R. R. Edelman, "Placenta accreta: evaluation with color Doppler US, power Doppler US, and MR imaging," *Radiology*, vol. 205, no. 3, pp. 773–776, 1997.
10. Shrivastava V, Nageotte M, Major C, Haydon M, Wing D. Case-control comparison of cesarean hysterectomy with and without prophylactic placement of intravascular balloon catheters for placenta accreta. *Am J Obstet Gynecol* 2007;197:402.e1-5.
11. Oclusión endovascular temporal de arterias hipogástricas para el tratamiento del acretismo placentario A. Rodríguez Saavedra, G. Samaja, M. Acosta, J. Lukekik, N. urday, A. Vega *Revista Argentina de Cardioangiología Intervencionista* 2015;6(4):204-206.
12. Tratamiento del acretismo placentario: experiencia de un hospital público de Buenos Aires G. Dionisio, L. Puerta, N. Ruiz, S. Brandeburgo, C. Etcheverry, P. Olmedo, R. Luca, C. Simancas, R. Kevorkian, S. Centeno. *Revista Argentina de Cardioangiología Intervencionista* 2016;7(3):136-140.
13. Eur J Obstet Gynecol Reprod Biol. 2014 Aug;179:36-41. doi: 10.1016/j.ejogrb.2014.05.007. Epub 2014 May 21. Prophylactic use of intravascular balloon catheters in women with placenta accreta, increta and percreta. Cali G1, Forlani F2, Giambanco L1, Amico ML1, Vallone M3, Puccio G4, Alio L1.
14. Placenta accreta: comparison of cases managed with and without pelvic artery balloon catheters. Levine AB, Kuhlman K, Bonn J *J Matern Fetal Med*. 1999 Jul-Aug; 8(4):173-6.
15. Cousins C. Medical radiation and pregnancy. *Health Phys*. 2008 Nov; 95(5):551-3.
16. Huda W, Stone R: *Review of Radiation Physics* (ed 2). Philadelphia, PA: Lippincott Williams & Williams, 2003, p 165.
17. Hae Jeng Lim, Ju Yeong Kim, Young Dae Kim, Jee Yoon Park, Joon-Seok Hong. Intraoperative uterine artery embolization without fetal radiation exposure in patients with placenta previa totalis: Two case reports. *Gynecol Obstet Sci* 2013; 56 (1): 45-49.

Association between variations in the combination of lidocaine and the prevalence of arterial spasm in procedures performed via radial access

Asociación entre variaciones en la combinación de lidocaína y prevalencia de espasmo arterial en procedimientos por acceso radial

Marcos Hernández¹, Sebastián Amicone¹, Sofía Algañaraz¹, Carolina Fernández¹

ABSTRACT

Introduction. Currently in endovascular procedures, mainly the coronary ones, the use of radial arterial access is predominant as it has replaced the femoral access that is now spared for specific indications only or due to the impossibility of performing the former. One of the complications that the operator most often faces when using the radial artery is spasm, which complicates the procedure and sometimes even prevents completing the diagnostic study and/or therapeutic procedure.

Objectives. 1- To assess the relationship between the administration of Lidocaine / Lidocaine + Diltiazem / Lidocaine + Nitroglycerin (prior to performing cardiac catheterization procedures) and the prevalence of radial artery spasm in adult patients. 2- To assess the presence of radial artery spasm based on sex, age group, BMI, cardiovascular risk factors, comorbidities, and pharmacological treatment at the time of the study.

Material and methods. An experimental, analytical, cross-sectional study was conducted including adult patients with an indication for left heart catheterization and/or angiography of lower extremities or neck vessels treated with cine coronary arteriography, angiography of the neck vessels, angiography of lower extremities and/or angioplasty via radial access. Patients were treated with Lidocaine, Lidocaine + Diltiazem or Lidocaine + Nitroglycerin 5 minutes before starting the procedure.

Results. Of the complications described, arterial spasm occurred in 21 patients only (25.3%), more often in women (30.8%) compared to men (20.5%). The most affected age group was > 70 years (33.3%) and patients with overweight (66.7%). Significantly less prevalence of spasms was found in the Lidocaine + Nitroglycerin group (10.7%) compared to the Lidocaine + Diltiazem group (32.1%; $P = .028$) and the Lidocaine group (33.3%; $P = .025$). Over 50% were on regular statin medication, ACEI-ARAI, aspirin, clopidogrel, and beta-blockers. The most common comorbidity was peripheral disease while the cardiovascular risk factors were dyslipidemia, sedentary lifestyle, and hypertension.

Conclusion. The prevalence of radial artery spasm through the use of Lidocaine 2% + Nitroglycerin in doses of 200 mcg, administered subcutaneously via radial access is lower compared to the prevalence reported with the administration of Lidocaine alone or Lidocaine + Diltiazem.

Keywords: lidocaine, nitroglycerin, diltiazem, radial artery, spasm.

RESUMEN

Introducción. Actualmente en los procedimientos endovasculares, principalmente los coronarios, predomina la utilización del acceso arterial radial, desplazando cada vez más al acceso femoral, el cual queda reservado para indicaciones específicas o imposibilidad de realizar por el primero. Una de las complicaciones que con más frecuencia el operador se enfrenta ante la manipulación de la arteria radial es el espasmo, que dificulta en gran medida y a veces impide completar el estudio diagnóstico y/o terapéutico.

Objetivos. 1- Evaluar la relación entre la administración de lidocaína / lidocaína + diltiazem / lidocaína + nitroglicerina (previo a la realización de procedimientos de cateterismo cardiovascular) y la prevalencia de espasmo arterial radial en pacientes adultos. 2- Evaluar la presencia de espasmo arterial radial según sexo, grupo etario, IMC, factores de riesgo cardiovascular, comorbilidades y tratamiento farmacológico al momento del estudio.

Materiales y métodos. Se realizó un estudio experimental, analítico, de corte transversal, en el cual se incluyeron pacientes adultos con indicación de cateterismo cardíaco izquierdo y/o angiografía de miembros inferiores o vasos de cuello, a quienes se les realizaron procedimientos de cinecoronariografía, angiografía de vasos de cuello, angiografía de miembros inferiores y/o angioplastias de coronarias por acceso radial. A los pacientes incluidos se les administró 5 minutos antes de iniciar el procedimiento lidocaína, lidocaína + diltiazem o lidocaína + nitroglicerina.

Resultados. De las complicaciones descritas, solo se presentó el espasmo arterial en 21 pacientes (25,3%), más frecuente en mujeres (30,8%) que en hombres (20,5%). El grupo etario más afectado fue >70 años (33,3%) y con sobrepeso (66,7%).

El grupo que presentó significativamente menor prevalencia de espasmos fue el de lidocaína + nitroglicerina (10,7%) en relación al grupo de lidocaína + diltiazem (32,1%; $p=0,028$) y al grupo de lidocaína (33,3%; $p=0,025$).

Más del 50% contaba con medicación habitual de estatinas, IECA-ARAI, betabloqueantes, aspirina y clopidogrel. La comorbilidad más frecuente fue la enfermedad periférica, y de los factores de riesgo cardiovascular, dislipemia, sedentarismo e hipertensión arterial.

Conclusión. La prevalencia de espasmo arterial radial con el uso de lidocaína 2% + nitroglicerina en dosis de 200 µg, administrada de forma subcutánea en el canal radial, resulta menor que la registrada con la administración de lidocaína sola o lidocaína + diltiazem.

Palabras clave: lidocaína, nitroglicerina, diltiazem, arteria radial, espasmo.

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):21-25. <https://doi.org/10.30567/RACI/202201/0021-0025>

INTRODUCTION

Traditionally we know that since the first time the cardiovascular system was approached via radial access back in 1948⁽¹⁾—at the time only to monitor invasive arterial pressure—this route of access has been widely used and perfected within the field of cardiac interventional procedures to the point that, to this date, it is access route of choice,⁽²⁻⁶⁾

and has displaced the femoral access widely used before.^(7,8)

This tendency has been gaining traction for several reasons, among them, the lower rate of bleeding complications reported, its use in patients who require anticoagulant and antiplatelet agents like GPIIb/IIIa, and the shorter time by these patients need to stay at the hospital.⁽⁹⁻¹¹⁾ It is also a good alternative for patients with occlusive disease, tortuosity, and aneurysms in the aorto-ilio-femoral axis, particularly in elderly patients.^(11,12)

The radial artery consists of concentric smooth muscle layers and has a high density of adrenergic alpha-1 receptors that can cause arterial spasm, which is one of the most common complications when using it as an access route to perform maneuvers with catheters. Arterial spasm is defined as the difficulty and/or entrapment and/or pain when moving

1. Servicio Hemodinamia del Hospital Municipal "Pedro Orellana", Trenque Lauquen, Provincia de Buenos Aires, Argentina.

✉ Correspondencia: Marcos Hernández. hermarcos@gmail.com

Los autores no declaran conflictos de intereses

Recibido: 23/06/2021 | Aceptado: 27/08/2021

TABLE 1. Comparison of the prevalence of radial artery spasm among patients with different drug administration.

Comparación	Cases (%)	p
Lidocaine + NTG vs. Lidocaine + Diltiazem	3 (10.7) / 9 (32.1)	p=0.028*
Lidocaine + NTG vs. Lidocaine	3 (10.7) / 9 (33.3)	p=0.025*
Lidocaine vs. Lidocaine + Diltiazem	9 (33.3) / 9 (32.1)	p=0.461

Source: own elaboration.

*Note: $p < 0.05$ were considered statistically significant.

the catheter and/or introducer sheath that obstructs and/or complicates the procedure.^(13,14)

In the medical literature available there are several studies like the SPASM 1, 2, and 3, the studies conducted by Vuurmans and Hilton and Deftereos et al., that compared different groups of drugs and strategies to reduce this risk to a minimum.⁽¹⁵⁻¹⁸⁾

However, even in highly experienced centers, the rate of radial spasm goes from 10% to 30% of all procedures performed through this access, a situation especially uncomfortable for the patient that is associated with a risk of procedural failure, and even with the need to cross over to the femoral access.^(15,19,20,23-25)

In most endovascular procedures performed via radial arterial access, the early step is the administration of lidocaine as the local anesthetic before starting the procedure. In time it became necessary to coadjuvate this drug to reduce the risk of spasm even further. It is at this point when numerous studies start combining drugs such as nitrites, opioids, benzodiazepines, and calcium channel blockers through different routes of administration—subcutaneous, oral, sublingual, IV, and intra-arterial—in an attempt to avoid this painful complication for patient and operator.^(9,14,16,18,20-25)

This study main objective was to assess the association between the administration of drug combinations (Lidocaine / Lidocaine + Diltiazem / Lidocaine + Nitroglycerine) before cardiac catheterization, as well as the prevalence of radial artery spasm in patients from the unit of hemodynamics at Hospital Municipal “Pedro Orellana”, City of Trenque Lauquen, Buenos Aires, Argentina from October 2019 through February 2020.

The study specific endpoint was to assess the presence of radial artery spasm based on sex, age group, body mass index (BMI), cardiovascular risk factors, comorbidities, and pharmacological treatment of patients during the time of the study.

MATERIALS AND METHODS

Design and study population. Experimental, analytical, cross-sectional study including adult patients with an indication for left heart catheterization and/or angiography of lower extremities or neck vessels treated with cine coronary arteriography, angiography of the neck vessels, angiography of lower extremities and/or angioplasty via radial access at the unit of hemodynamics from Hospital Municipal “Pedro Orellana”, City of Trenque Lauquen, Buenos Aires, Argentina between October 2019 and February 2020.

The exclusion criteria were hypersensitivity or known adverse events to Lidocaine, Diltiazem, and Nitroglycerine, positive or abnormal Allen test (lack of capillary refill for more than 10 seconds after the simultaneous compression of the radial and cubital arteries followed by the release of the cubital artery), non-palpable pulse, patients with AV fistulae of the upper extremities for dialysis or eligible for dialysis, pa-

TABLE 2. Rate of radial artery spasm based on age group.

Age group	Cases (%)
31 a 40 years	2 (9.5)
41 a 50 years	3 (14.3)
51 a 60 years	4 (19.0)
61 a 70 years	5 (23.8)
≥ 71 years	7 (33.3)

Source: own elaboration. Note 1: percentage was estimated on the overall number of patients with complications associated cardiac catheterization (n=21). Note 2: due to radial artery spasm 2 women (of 71 and 78 years) crossed over to the femoral access.

tients in cardiogenic shock or with acute respiratory failure, patients with end-stage acute renal failure or chronic kidney disease, and patients with an ongoing acute myocardial infarction.

Surgical techniques. The patients included in the study were treated with the following medication through the wrist anterior region corresponding to the radial access after pulse was controlled with a 22 mm x 0.6 mm subcutaneous needle, and 5 minutes before starting the procedure:

- Lidocaine 2% 2cc subcutaneous via radial artery (Group #1 or control group).
- Lidocaine 2% 2cc (subcutaneous via radial artery) + Diltiazem 5 mg (intra-arterial) (Group #2).
- Lidocaine 2% 2cc + Nitroglycerine (NTG) 200 µg subcutaneous via radial artery (Group #3).

Patients were randomized in each of the 3 drug groups. All procedures were performed by the same operator.

Afterwards, an Abocath 20G needle and the Jelco® IV Catheter Radiopaque (Smith Medical) were used to puncture the radial artery with a 0.018 in hydrophilic coated floppy guidewire (Terumo Medical Corporation) using the Seldinger technique. Once the arterial access was conquered, a 6-Fr Radiofocus hydrophilic introducer sheath (Terumo Medical Corporation) was used. Before insertion, the introducer sheaths were soaked in a heparinized physiological solution. A total of 5000 IU of sodium heparin were injected through the introducer sheath for diagnostic purposes followed by 10 000 IU for the angioplasties.

Cardiac catheterizations were performed using a 6-Fr Judkins right 3.5 catheter, and a Judkins left 4.0 catheter (ConcierGE® Merit Medical Systems). The 6-Fr Amplatz catheter (ConcierGE® Merit Medical Systems) was required in 1 patient only since the origin of coronary arteries complicated selective cannulation. To perform the angiography of the neck vessels, a 5-Fr Simmons 2 catheter was used (ConcierGE® Merit Medical Systems). To perform the angiography of the lower extremities a 6-Fr 125 mm multipurpose catheter was used (ConcierGE® Merit Medical Systems.) A 0.035 in Wholley guidewire (Terumo Medi-Tech Inc.) was used in all procedures to reach the ascending aorta.

At the beginning and end of each procedure, 2 to 3 mL of blood were drawn through the collateral of the introducer sheath to prevent distal embolization. Afterwards, the introducer sheath was removed at the cath lab, compressive bandage was applied with an elastic wrist band for 60 minutes with partial decompression after 30 minutes, and cath lab follow-up for the next 4 hours. The introducer sheath was removed from the femoral punctures 2 hours into the procedure with a 5-hour follow-up. Once the procedure was completed, all patients were discharged from the hospital.

TABLE 3. Comorbidities and cardiovascular risk factors in patients with radial artery spasm.

	Cases (%)	
Comorbidity	Peripheral disease	9 (42.9)
	Previous acute myocardial infarction	4 (19.0)
	Previous cerebrovascular events	4 (19.0)
	Previous angioplasty	2 (9.5)
	Congestive heart failure	2 (9.5)
	Carotid disease	2 (9.5)
	Mild-moderate-stage renal failure	2 (9.5)
	Cardiovascular risk factors	Dyslipidemia
Sedentary lifestyle		15 (71.4)
Arterial hypertension		13 (61.9)
Smoking		8 (38.1)
Diabetes mellitus		4 (19.0)

Source: own elaboration.

Note #1: percentage was estimated on the overall number of patients with complications associated cardiac catheterization (n = 21).

Note #2: due to radial artery spasm 2 women crossed over to the femoral access. One of them had peripheral disease only while the other had also suffered from a previous acute myocardial infarction and mild-to-moderate chronic kidney disease. Regarding the cardiovascular risk factors, 1 patient had all the factors described on the table while the other one was a non-smoker.

Techniques used for data curation. The following study variables were included in a database:

- Age (in years).
- Sex (F/M).
- BMI: Low weight/Normal weight/Overweight/Obesity.
- Type of drug: Lidocaine / Lidocaine + Diltiazem / Lidocaine + NTG.
- Presence and type of complication associated with the cardiac catheterization procedure: radial artery spasm/Hematomas > 3 cm in diameter and/or access site bleeding/local ischemia or embolic events.
- Presence and type of comorbidities.
- Cardiovascular risk factors.
- Pharmacological treatment patients were on at the time of the study.

Statistical method. The complication reported during cardiac catheterization (radial artery spasm) was described as a 2-state nominal qualitative variable (presence/absence) and then compared statistically among the 3 pharmacological groups (Lidocaine / Lidocaine + Diltiazem / Lidocaine + NTG) using the Bayesian approach to compare proportions. Noninformative beta prior distributions and 50 000 iterations were used. The statistical software package RStudio was used, and *P* values < .05 were considered statistically significant.

RESULTS

We studied a total 83 adult patients with an indication for left heart catheterization and/or angiography of the lower extremities or neck vessels treated with cardiac catheterization via radial access using Lidocaine alone in 32.5% of the cases (n = 27), Lidocaine + Diltiazem in 33.75% (n = 28), and Lidocaine + NTG in 33.75% of the patients (n = 28).

The patients' mean age was 65.7 years (SD, 12.3) from 33 to 91 years.

A total of 53% of the cases (n = 44) were male patients with a mean age of 64.8 years (SD, 12.3) from 33 to 87 years. The remaining 47% cases (n = 39) were female patients with a mean age of 66.7 years (SD, 12.3) from 43 to 91 years

Procedural complications associated with cardiac catheterization were reported in 25.3% of the patients (n = 21) in whom only radial artery spasm was described. No hematomas, access site swelling or thrombosis were reported.

Population with radial artery spasm

Radial artery spasm was reported in 33.3% of the patients from the control group (Lidocaine), 32.1% of the patients treated with Lidocaine + Diltiazem, and 10.7% of the patients treated with Lidocaine + NTG. The prevalence of radial artery spasm was significantly lower in patients treated with Lidocaine + NTG compared to the group of patients treated with Lidocaine + Diltiazem or Lidocaine alone. No significant differences were reported between the administration of Lidocaine and the administration of Lidocaine + Diltiazem (see table 1).

Radial artery spasms occurred in 30.8% of women (n = 12) and 20.5% (n = 9) of men.

Regarding the presence of radial artery spasm based on age group, the age of 57.1% of the patients was above 60. Patients > 71 years were more common (33.3%) followed by the group of patients from 61 to 70 years (23.8%) (see table 2).

Regarding the BMI, 66.7% of the patients (n = 14) were overweight, 19% (n = 4) were obese, and 14.3% (n = 3) had normal weight. There were no patients with low weight.

Regarding comorbidities, 42.9% of the patients had peripheral disease followed by previous acute myocardial infarction and previous cerebrovascular events. The incidence rate of both these events was 19% (see table 2). No events associated with myocardial revascularization surgery, chronic stable angina pectoris or aortic disease were reported.

Regarding the cardiovascular risk factors, the predominant factors were dyslipidemia (76.2%), sedentary lifestyle (71.4%), and arterial hypertension (61.9%) (see table 3).

Regarding the pharmacological drugs received by the patients during the study, the most common of all were statins (66.7%), and ACEI and/or ARAI (61.9%) followed—with the same rate reported of 52.4%—by beta-blockers, acetylsalicylic acid (ASA), and clopidogrel (see table 4).

DISCUSSION

Manipulating the radial artery is a free ticket for the appearance of complications, particularly spasm, due to the great concentric smooth muscle component involved. We should not forget the unfavorable anatomy we can encounter at the cath lab. The objective of this study was to compare different combinations of Lidocaine to establish which are associated with a lower prevalence of radial artery spasms.

The aforementioned characteristic of the radial artery together with its high density of alpha-adrenergic receptors has led to testing different drugs in different combinations and protocols to minimize the appearance of spasm.^(9,20,22-25)

Several predisposing factors have been suggested that happen to be consistent with our findings such as feminine sex, overweight, pan-vascular disease: peripheral arterial disease, previous myocardial infarction, and past medical history of cerebrovascular events, age (> 70 years), presence of cardiovascular risk factors like dyslipidemia, sedentary lifestyle, arterial hypertension, smoking, and diabetes mellitus being the former 3 the most common of all.

TABLE 4. Pharmacological treatment during the study in patients with radial artery.

Treatment	Cases (%)
Statins	14 (66.7)
ACEI-ARA II	13 (61.9)
Beta-blockers	11 (52.4)
Acetylsalicylic acid (ASA)	11 (52.4)
Clopidogrel	11 (52.4)
Oral hypoglycemic medication	8 (38.1)
Proton pump inhibitors (PPI) – Ranitidine	6 (28.6)
Calcium channel blockers	5 (23.8)
Diuretics	4 (19.0)
Levothyroxine	4 (19.0)
Cilostazol	3 (14.3)
Nitrates	1 (4.8)
Amiodarone	1 (4.8)
Selective serotonin reuptake inhibitors (SSRI)	1 (4.8)
Benzodiazepines	1 (4.8)
Insulin	1 (4.8)

Source: own elaboration.

Note #1: percentage was estimated on the overall number of patients with complications associated cardiac catheterization (n = 21).

Note #2: due to arterial artery spasm 2 women crossed over to the femoral access. Both patients were on ACEI-ARAI, ASA, and cilostazol. Also, one of them was on statins, beta-blockers, oral hypoglycemic drugs, and ranitidine, and other on calcium channel blockers and insulin.

Over half of the patients with radial artery spasm were on statins, ACEI and/or ARAII, beta-blockers, ASA, and clopidogrel during the study.

In the studies conducted by Ruiz-Salmerón R.J. et al. that compared the administration of phentolamine and verapamil, and previous oral sedation with Diazepam, the presence of spasms was less common in the latter group.⁽⁹⁾

On the other hand, Mont'Alverne et al. conducted a study of 50 patients who were categorized into 2 different groups: one group was treated with Diltiazem and the other one with placebo. No spasms were reported in the former group.⁽²²⁾

Coppola et al. compared the administration of nitroglycerine alone, sodium nitroprusside alone, and the combination

of both. Based on their results, the administration of both reduced radial artery spasm by 9.5% compared to groups that used these drugs separately.⁽²⁰⁾

In the study conducted by Ouadhour et al., the subcutaneous administration of Lidocaine was compared to the administration of Lidocaine + Nitroglycerine. It concluded that in the group that used this latter drug combination, the prevalence of spasm was 2.4% only.⁽²³⁾

Therefore, we see that in our study 2 drugs like Diltiazem and Nitroglycerine were used which, associated with Lidocaine gave good results since the prevalence of spasm found in all the procedures performed was 25.3% (n = 21), a value that is within the range described by the current medical literature (10% to 30%).

The prevalence of spasm in groups treated with Lidocaine alone and Lidocaine + Diltiazem was > 30% with values of 33.3% and 32.1%, respectively; on the other hand, while in the group treated with Lidocaine + NTG, the prevalence of spasm was 10.7%, after comparing Lidocaine alone to other drug combinations, it seems obvious that Lidocaine + NTG has the lowest prevalence of spasms among the patients.

CONCLUSION

The prevalence of radial artery spasm with the use of Lidocaine 2% + Nitroglycerine in doses of 200 mcg administered subcutaneously via radial access is significantly lower compared to the administration of Lidocaine + Diltiazem or Lidocaine alone.

Ethical considerations. This study was approved by Hospital Municipal Pedro Orellana ethics committee (Trenque laúquen, Buenos Aires, Argentina) in full observance of all national and international regulations. All the patients were informed on the characteristics and utility of the study, as well as on the procedures that would be performed. All questions asked were duly answered. All patients included in the study gave their written informed consent.

REFERENCES

1. Radner S. Thoracic aortography by catheterization from the radial artery; preliminary report of a new technique. *Acta Radiol* 1948;29:178-80.
2. Sachdev S, Saha S. Transradial Approach to Cardiovascular Interventions: An Update. *International Journal of Angiology* 2014; 23:77-83.
3. Jolly SS, Yusuf S, Cairns J, 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;377:1409-20.
4. Romagnoli E, Biondi-Zoccai G, Sciahbasi A, et al. Radial versus femoral randomized investigation in ST-segment elevation acute coronary syndrome: the RIFLE-STEACS study. *Journal American College of Cardiology* 2012;60:2481-9.
5. Goicolea FJ, Ocaranza R. Abordaje transradial para la angioplastia primaria. ¿Necesidad o funambulismo? *Rev Esp Cardiol* 2004;57:720-1.
6. Hildick-Smith DJ, Walsh JT, Lowe MD, Shapiro LM, Petch MC. Transradial coronary angiography in patients with contraindications to the femoral approach: an analysis of 500 cases. *Cathet Cardiovasc Intervent* 2004;61:60-6.
7. Kiemeneij F, Laarman GJ. Percutaneous transradial artery approach for coronary stent implantation. *Cathet Cardiovasc Diagn* 1993;30:173-8.
8. Campeau L. Percutaneous radial artery approach for coronary angioplasty. *Cathet Cardiovasc Diagn* 1989;16:3-7.
9. Ruiz-Salmerón R. J, Mora R, Vélez-Gimón M, et al. Radial Artery Spasm in Transradial Cardiac Catheterization. Assessment of Factors Related to Its Occurrence, and of Its Consequences During Follow-up. *Revista Española de Cardiología* 2005;58:504-11.
10. Hetherington SL, Adam Z, Morley R, et al. Primary percutaneous coronary intervention for acute ST-segment elevation myocardial infarction: changing patterns of vascular access, radial versus femoral artery. *Heart* 2009;95:1612-8.
11. Jolly S, Amlani S, Hamon M, Yusuf S, Phil D, Mehta S. Radial versus femoral access for coronary angiography or intervention and the impact on major bleeding and ischemic events: A systematic review and meta-analysis of randomized trials. *American Heart Journal* 2009;157(1):132-40.
12. Elgharib NZ, Shah UH, Coppola JT. Trans-radial vs femoral approach for coronary angiography and intervention in patient above 75 years of age. *Cathet Cardiovasc Intervent* 2008;72:629-35.
13. He GW, Yang CQ. Characteristics of adrenoreceptors in the human radial artery: clinical implications. *J Thorac Cardiovasc Surg* 1998;115:1136-41.
14. Kiemeneij F, Vajifdar BU, Eccleshall SC, Laarman GJ, Siagboom T, Van der Wieken R. Evaluation of a spasmolytic cocktail to prevent radial artery spasm during coronary procedures. *Cathet Cardiovasc Intervent* 2003; 58:281-4.
15. Varenne O, Jégou A, Cohen R, et al. Prevention of arterial spasm during percutaneous coronary interventions through radial artery: the SPASM study. *Catheter Cardiovasc Interv* 2006;68(2):231-5.
16. Rosencher J, Chaib A, Barbou F, et al. How to Limit Radial Artery Spasm During Percutaneous Coronary Interventions: The Spasmolytic Agents to Avoid Spasm During Transradial Percutaneous Coronary Intervention.

- tions (SPASM3) Study. *Catheterization and Cardiovascular Interventions* 2014;84:766-71.
17. Vuurmans T, Hilton D. Brewing the right cocktail for radial intervention. *Indian Heart J* 2010;62(3):221-5.
 18. Deftereos S, Giannopoulos G, Raisakis K, et al. Moderate Procedural Sedation and Opioid Analgesia During Transradial Coronary Interventions to Prevent Spasm. *JACC: Cardiovascular Interventions* 2013;6:267-73.
 19. Chen CW, Lin CL, Lin TK, et al. A simple and effective regimen for prevention of radial artery spasm during coronary catheterization. *Cardiology*. 2006;105(1):43-7.
 20. Coppola J, Patel T, Kwan T, Sanghvi K, Srivastava S, Shah S, Staniloae C. Nitroglycerin, nitroprusside, or both, in preventing radial artery spasm during transradial artery catheterization. *J Invasive Cardiol* 2006;18:155-8.
 21. Hwa Ho H, Haider Jafary F, Jau Ong P. Radial artery spasm during transradial cardiac catheterization and percutaneous coronary intervention: incidence, predisposing factors, prevention, and management. *Cardiovascular Revascularization Medicine* 2012;13:193-5.
 22. Mont'Alverne Filho JR, Assad JA, Zago Ado C, et al. Comparative study of the use of diltiazem as an antispasmodic drug in coronary angiography via the transradial approach. *Arq Bras Cardiol* 2003;81:59-63.
 23. Ouadhour A, Sideris G, Smida W, Logeart D, Stratiev V, Henry P. Usefulness of subcutaneous nitrate for radial access. *Catheter Cardiovasc Interv* 2008;72:343-6.
 24. Acevedo R, Solerno R, Pedroni P, et al. Estudio de la utilidad del lorazepam en la prevención del espasmo radial asociado a procedimientos coronarios ESLORA. *Revista Argentina de Cardioangiología Intervencionista* 2021;12(1):44-48.
 25. Goldsmit A, Baucero G, Szejfman C, Bettinotti M. Utilidad del clorhidrato de nalbufina en la prevención del espasmo de la arteria radial. *Rev Argent Cardioangiol* 2010;1:19-23.

TAVI in patient with low and anomalous origin of left main coronary artery. Case report

TAVI en paciente con nacimiento bajo y anómalo de coronaria izquierda. Reporte de caso

Marcelo Menéndez¹, Alejandro Lezcano Bournisset¹, Tomás Cúneo¹

ABSTRACT

Introduction. TAVI (trans aortic valve implantation) is a widely disseminated, well-tolerated intervention with a short hospital stay. It is indicated in patients with severe symptomatic aortic stenosis. Patients with abnormally low birth from the coronary artery ostium are at additional risk, as the flow of the coronary arteries can be compromised when the prosthesis is implanted.

Objective. Case report of TAVI in a patient who presented a low birth of the coronary artery ostium.

Method. In this study we present a clinical case of a patient with severe aortic stenosis who was a candidate for TAVI who presented low birth of the coronary arteries, who underwent balloon sizing.

Conclusion. TAVI in patients with low coronary ostium is a great technical challenge. Pre-planning and using gestures such as "balloon sizing" are essential to achieve the success of this intervention.

Keywords: TAVI, balloon sizing, aortic stenosis.

RESUMEN

Introducción. TAVI (trans aortic valve implantation) es una intervención ampliamente difundida, bien tolerada, y de corta estadía hospitalaria. Está indicada en pacientes con estenosis aórtica severa sintomática. Los pacientes con nacimiento anormalmente bajo del ostium de las arterias coronarias presentan un riesgo adicional, ya que se puede comprometer el flujo de las mismas cuando se implanta la prótesis.

Objetivo. Reporte de caso de TAVI en paciente que presentó un nacimiento bajo del ostium de las arterias coronarias.

Método. En este estudio presentamos un caso clínico de un paciente con estenosis aórtica severa candidato a TAVI que presentó nacimiento bajo de las arterias coronarias, al cual se le realizó balloon sizing.

Conclusión. TAVI en pacientes con ostium coronario bajo es un gran desafío técnico. La planificación previa con análisis exhaustivo por TAC multislice y como método adicional la utilización de balloon sizing son fundamentales para lograr el éxito de esta intervención.

Palabras clave: TAVI, balloon sizing, estenosis aórtica.

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):26-29. <https://doi.org/10.30567/RACI/202201/0026-0029>

INTRODUCTION

Transcatheter aortic valve implantation (TAVI) consists of the transcatheter implantation of an aortic valve. This procedure is indicated in patients with symptomatic severe aortic stenosis. At the beginning it was used in inoperable patients, but in time its indication grew and now it is used in high-risk surgical patients,[1] and lately even in intermediate-risk surgical patients.[2] Recent studies confirm satisfactory results even in low-risk surgical patients.[3] TAVI is a widely used, well-tolerated procedure that has a high rate of success, few complications, and a short hospital stay.

Patients with low and anomalous origin of coronary ostia are particularly challenging because this condition can compromise the blood flow coming from coronary arteries after valve implantation. Several techniques can be used to prevent this complication like securing flow inside the coronary arteries with a guidewire or a stent, using the balloon sizing method, selecting the right valve, and other.[4]

This is the case report of a woman with severe aortic stenosis who was eligible for TAVI with low and anomalous origin of coronary arteries.

OBJECTIVES

Case report of a TAVI procedure performed in a high-surgical risk female patient with symptomatic severe aortic stenosis and low and anomalous origin of coronary arteries.

CASE REPORT

This is the case of an 88-year-old woman with a past medical history of arterial hypertension, dyslipidemia, chronic anemia, and breast cancer at the age of 63 that was treated with radio and chemotherapy. The physical examination performed at the cardiology unit revealed clinical signs of dyspnea (functional class II/III). Also, the presence of an intensity 5/6 aortic systolic heart murmur with reduced R2 radiating towards the carotid arteries.

The following additional imaging modalities were performed:

- Electrocardiogram (ECG): RS, PR interval, 0.20 seconds; HR, 70 bpm, left ventricular overload (LVO).
- Doppler echocardiogram: severe aortic stenosis, gradient peak of 75 mmHg, mean gradient of 45 mmHg, AVA, 0.71; LVEF, 65% without motility disorders.
- Computed tomography (CT) scan: heavily calcified tricuspid aortic valve, valve area, 357.4 mm²; valvular perimeter, 67.8 mm; valvular calcification score, 1777; sinotubular junction perimeter, 25.5 mm; sinuses of Valsalva

1. Departamento de Cardiología Intervencionista, Sanatorio Plaza, Rosario, Argentina

✉ Correspondencia: Tomás Cúneo. Departamento de Cardiología Intervencionista, Sanatorio Plaza, Dorrego 1550, Rosario, Argentina. Tel 341 6422645

Los autores no declaran conflictos de intereses

Recibido: 28/10/2021 | Aceptado: 14/01/2022

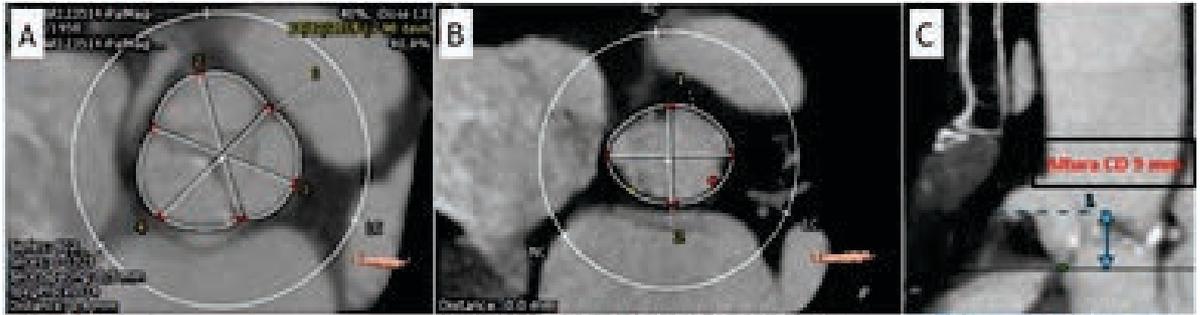


Figure 1. A - B) CT scan image of a calcified tricuspid aortic valve. C) Anomalous origin of the left main coronary artery from the right sinus.

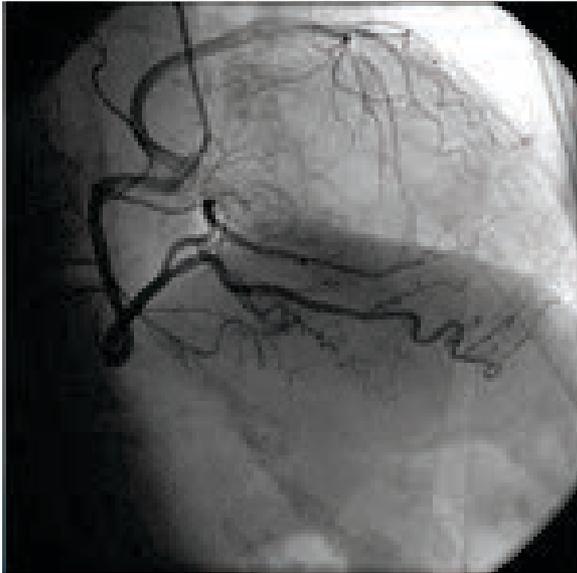


Figure 2. Cine coronary arteriography showing the anomalous origin of the left main coronary artery from the right coronary sinus with retroaortic path. Artery without significant findings.

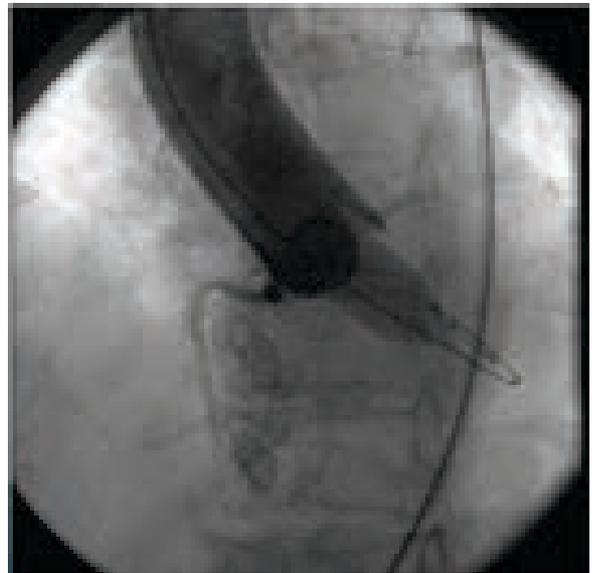


Figure 3. Balloon sizing with a 20 mm x 40 mm balloon and aortic valvuloplasty.

va, 24.9 mm. Preserved bilateral femoral arterial accesses. The images confirm the presence of an anomalous origin of the left main coronary artery from the right sinus. Height of right coronary ostium, 9 mm; (Fig. 1).

- Cine coronary arteriography: Anomalous origin of the left main coronary artery from the right sinus with retroaortic path. Coronary artery without significant injuries (Fig. 2).
- Doppler echocardiography of neck vessels: patent carotid and vertebral arteries without significant injuries.
- Laboratory: Hematocrit, 35; Hb, 12; uremia, 25; creatinine levels, 0.68; platelet count, 273 000.
- Edmonton Frail Scale score 6-7 (vulnerable).
- STS score (8), and EuroSCORE II (3.43%)

After discussing the case with the heart team, it was decided to perform TAVI. The right femoral access was used followed by the pre-closure technique after transcatheter implantation. Right radial access was used to place a pigtail catheter inside the noncoronary sinus to assess the positioning of the valve. The AL1 guide catheter was advanced from the femoral access towards the valvular plane. The valve was crossed using a 0.035 in straight guidewire. The pigtail catheter was used for exchange purposes. Then, a 0.035 in Safari high-support extra small guidewire was advanced and the pigtail catheter was removed. Afterwards, the balloon sizing method was used with aortogram guidance with a 20 mm x 40 mm balloon and aor-

tic valvuloplasty was performed with cardiac pacing from the guidewire into the LV (Fig. 3). The transcatheter aortic valve ACURATE neo™ - Aortic Valve System (Boston Scientific, United States) was eventually implanted (Fig. 4).

The bedside Doppler echocardiography performed revealed the correct positioning of the valve without, no traces of paravalvular leak, and a peak gradient of 10 mmHg. Also, pressure pullbacks with the pigtail catheter were performed with pullback from the LV towards the aorta without a significant gradient. Finally, a thoracic aortogram confirmed the presence of patent coronary arteries. The procedure ended when catheters, guidewires, introducer sheaths, and percutaneous vascular closure devices (ProGlide, Abbott, United States) were pulled back from the femoral access.

The patient's progression was favorable, and she was immediately referred to the hospital coronary unit. She was discharged 48 hours after the procedure. AAS, and clopidogrel were prescribed at discharge. The patient remained asymptomatic at the 3-month follow-up performed outpatiently. The control Doppler echocardiography confirmed the proper positioning of the aortic valve without any significant gradients or traces of paravalvular leak.

DISCUSSION

TAVI is a minimally invasive transcatheter procedure for aortic valve implantation in patients with symptomatic severe

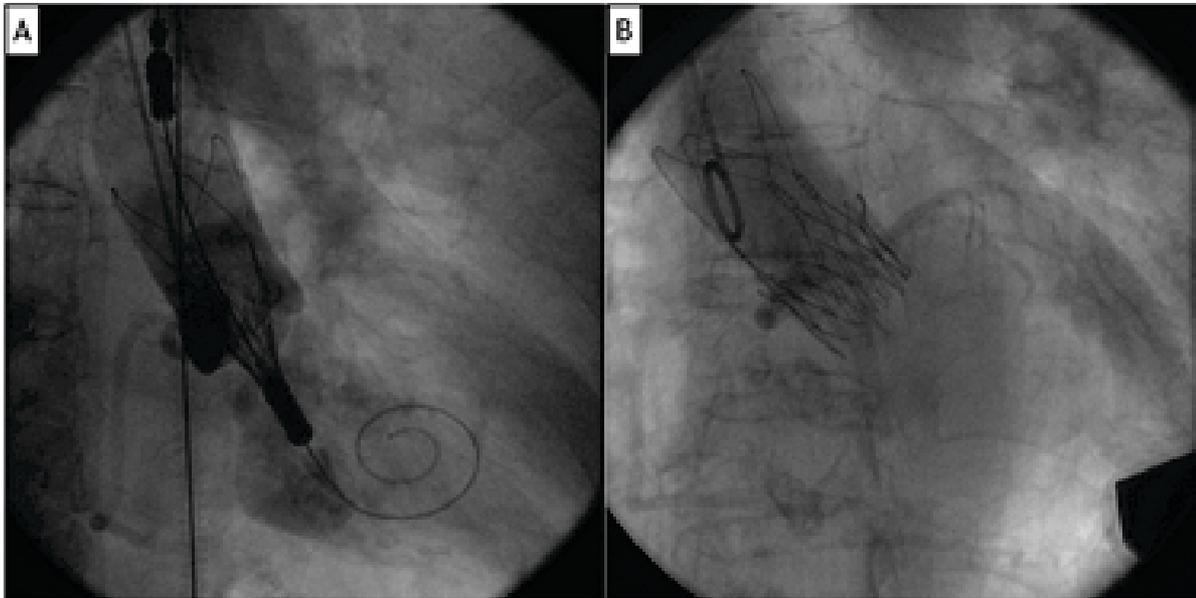


Figure 4. A) Transcatheter aortic valve implantation of self-expanding valve. B) Final aortogram of implantation without paravalvular leak, competent valve, and patent coronary arteries.

re aortic stenosis. Although TAVI is well-tolerated, patients with low origin of coronary ostia are tremendously challenging. This condition can lead to the occlusion of native coronary arteries during the procedure, a serious complication with high morbidity and mortality rates (40.9% after 30 days). In this case, the mechanism of coronary occlusion (CO) would be the occlusion of coronary ostium due to valves that are poorly positioned—high apposition—or valves properly positioned in patients with a low origin of coronary ostium. Other mechanisms of occlusion are displaced heavily calcified leaflets towards the coronary ostium, and aortic dissection, among others.[5]

The risk factors predisposing to coronary occlusion after TAVI are the low origin of left main coronary artery (> 12 mm), sinus of Valsalva > 30 mm, valve-in-valve procedure, VTC distances > 4 mm (virtual distance between the valve to be implanted and the origin of coronary ostium), severe calcification with a large calcium node in the left cusp (bicuspid), extreme oversizing, self-expanding valve, lack of CABG, and feminine sex.[6]

Several techniques have been described to prevent coronary artery occlusion. The balloon sizing method is one of them. It consists of performing an aortic valvuloplasty before valve implantation to confirm that leaflet displacement after balloon inflation has not occluded the coronary ostia.[7]

Despite all this, it is essential to conduct a thorough study using a multislice CT scan with correct measurements of the origin of coronary ostia, the perimeter and diameter of the annulus, the diameter of the sinuses of Valsalva, and the sinotubular junction to determine the type and size of the transcatheter valve that will eventually be implanted. The-

re are other techniques that can be used to prevent such occlusion from happening during the procedure. One of them is the preemptive cardiac catheterization of coronary artery with a guide catheter, the distal advance of a 0.014 in guidewire followed by stent deployment into the coronary artery while waiting for implantation in case of coronary occlusion post-TAVI.[8]

Finally, in this case the ACURATE neo self-expanding valve was used. A valve that can be used with a distance between the ostium coronary ostium and the annular plane ≥ 8 mm, and with a favorable distribution of leaflet calcification. This is possible because the stents of the upper crown attach to the native aortic valve leaflets keeping them away from coronary ostia. Also, the configuration of the stents guarantees easy coronary access for future coronary procedures.[9,10]

CONCLUSION

TAVI in patients with low origin of coronary ostia is tremendously challenging. Previous planning is essential for procedural success. It requires a proper selection of the valve, and use of coadjuvant methods like the balloon sizing method to reduce any complications that may occur.

Conflicts of interest: None reported.

Funding: None whatsoever.

Informed consent: The patient signed the corresponding written informed consent form to participate in this study and authorized us to publish her data.

REFERENCES

1. Smith C, Leon M, Mack M, et al. Transcatheter versus Surgical Aortic-Valve Replacement in High-Risk Patients. *N Engl J Med* 2011;364(23):2187-98.
2. Leon M, Smith C, Mack M, et al. Transcatheter or Surgical Aortic-Valve Replacement in Intermediate-Risk Patients. *N Engl J Med* 2016;374(17):1609-20.
3. Mack M, Leon M, Thourani V, et al. Transcatheter Aortic-Valve Replacement with a Balloon-Expandable Valve in Low-Risk Patients. *N Engl J Med* 2019;380(18):1695-1705.
4. Barbanti M, Sgroi C, Immè S, et al. Usefulness of contrast injection during balloon aortic valvuloplasty before transcatheter aortic valve replacement: a pilot study. *EuroIntervention* 2014;10(2):241-7.
5. Okuyama K, Jilaihawi H, Makkar RR. Leaflet length and left main coronary artery occlusion following transcatheter aortic valve replacement. *Catheter Cardiovasc Interv* 2013;82(5):E754-759.
6. Ribeiro HB, Webb JG, Makkar RR, et al. Predictive factors, management, and clinical outcomes of coronary obstruction following transcatheter aortic valve implantation: insights from a large multicenter registry. *J Am Coll Cardiol* 2013;62(17):1552-62.
7. Krishnaswamy A, Kapadia SR. Optimizing Valve Sizing in Balloon-Expandable Transcatheter Aortic Valve Replacement. *JACC Cardiovasc Interv* 2018;11(17):1706-09.
8. Yamamoto M, Shimura T, Kano S, et al. Impact of preparatory coronary protection in patients at high anatomical risk of acute coronary obstruction during transcatheter aortic valve implantation. *Int J Cardiol* 2016;217:58-63.
9. Möllmann H, Hengstenberg C, Hilker M, et al. Real-world experience using the ACURATEneo prosthesis: 30-day outcomes of 1,000 patients enrolled in the SAVI TF registry. *EuroIntervention* 2018;13(15):e1764-e1770.
10. Kim WK, Hengstenberg C, Hilker M, et al. Transcatheter aortic valve implantation with the ACURATEneo valve: indications, procedural aspects and clinical outcomes. *EuroIntervention* 2020;15(18):e1571-e1579.

Valve-in-Valve due to prosthetic tricuspid valve stenosis

Valve in valve por estenosis protésica tricuspídea

Ramiro Acevedo¹, Pablo Pollono¹, Ignacio Rifourcat¹, Fernando Fuertes¹, Diego Grinfeld¹

ABSTRACT

Prosthetic tricuspid valve stenosis is an entity whose resolution is complex due to the patients' multiple comorbidities. Endovascular treatment using prosthetic valves designed for implantation in the aortic position recently has been described.

This is the case of a patient with prosthetic tricuspid valve stenosis resolved through valve-in-valve transcatheter aortic valve replacement (VIV-TAVR).

Keywords: valve in valve implantation, tricuspid valve, tricuspid valve disease.

RESUMEN

La estenosis que se desarrolla en una válvula protésica en posición tricuspídea es una entidad cuya resolución es compleja debido a las múltiples comorbilidades que estos pacientes presentan. El tratamiento endovascular de la misma utilizando prótesis diseñadas para ser implantadas en posición aórtica es una técnica de reciente descripción.

Presentamos el caso de una paciente portadora de estenosis protésica tricuspídea resuelta mediante reemplazo valvular transcáteter valve in valve.

Palabras claves: implante valve in valve, válvula tricúspide, enfermedad tricuspídea.

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):30-32. <https://doi.org/10.30567/RACI/202201/0030-0032>

CASE REPORT

This is the case of a 56-year-old woman with a past medical history of tricuspid valve replacement at the age of 33 due to infectious endocarditis treated with anticoagulation due to atrial flutter, and ligation of esophageal varices due to bleeding. The patient showed clinical signs of chronic right heart failure. EKG findings: severe right atrial dilatation (48 cm²), and severe stenosis of the prosthetic tricuspid valve (mean gradient: 12 mmHg). The remaining parameters fell into the reference values.

Tricuspid valve implantation via endovascular approach was decided due to the high surgical risk involved.

The procedure was performed under conscious sedation. The right femoral vein was punctured, and a hemostasis introducer was placed using Seldinger technique. Afterwards, a hydrophilic guidewire (Laurate, Merit, Utah, United States) was advanced towards the left pulmonary artery that would be eventually exchanged using a Cobra 2 catheter (Impress, Merit, Utha, United States) for a high-support guidewire (Lunderquist, Cook Medical, Bjaeverskov, Denmark). Using the prosthetic valve annulus previously implanted as a reference, a 23 mm Edwards Sapiens 3 valve (Edwards Lifesciences, California, United States) was implanted in the tricuspid position released under a pacemaker of high-intensity power-frequency electric field setting. The injection of contrast material into the right atrium confirmed the passage of contrast towards the right ventricle, an unseen phenomenon at the beginning of the procedure. Regarding the readings of the pressure meter, a mean pressure of 31 mmHg before device implantation was confirmed in the right atrium followed by 27 mmHg readings after implantation. The pulmonary artery confirmed mean pressure levels of 16 mmHg

before implantation, and 28 mmHg after implantation. The control EKG performed revealed no paravalvular leak, and a mean tricuspid gradient of 7 mmHg.

The patient's clinical course was favorable without complications during the hospital stay. She was released from the hospital 48 hours after implantation

DISCUSSION

Tricuspid stenosis (TS) is an unusual disease whose etiology is often rheumatic disease. Another important cause is degeneration affecting the biological prostheses surgically implanted in the tricuspid position in this case due to pannus formation and calcification at the base of the leaflets added to commissural fusion (1).

A biological prosthetic valve is said to have significant TS when the mean transvalvular gradient is ≥ 10 mmHg. Clinical signs are lower limb swelling, jugular ingurgitation, hepatomegaly, ascites, and exertional dyspnea. These signs are indicative of chronic right heart failure, and low cardiac output syndrome. Multiorgan failure can occur in advanced stages with the development of liver cirrhosis, renal failure, and protein-losing enteropathy. (2,3)

According to former studies, 75% to 85% of the patients treated with surgical tricuspid valve replacement with biological prosthetic valves are free from a second procedure for the next 8 to 10 years. This rate drops even further to 60% after 15 years (4). The surgical treatment of this condition is associated with a high mortality rate since these patients have multiple comorbidities, which adds to the complexity involved in a new sternotomy (5,6).

The management of valvular heart disease in the tricuspid position via endovascular approach using heart valves to treat aortic stenosis is an off-label procedure. Its short- and mid-term efficacy and safety profile has already been confirmed by several studies (2,4). As mentioned before, in the case of our patient, the endovascular approach was decided by the heart team while taking into account the patient's multiple comorbidities.

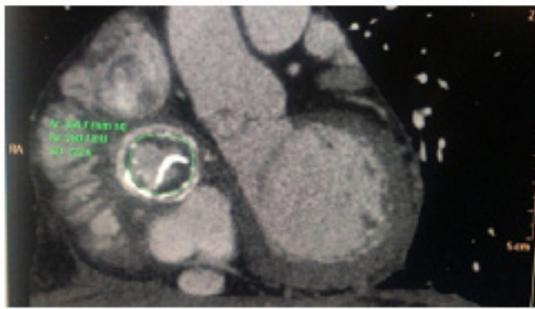
Regarding the implantation technique used, the impor-

1. Staff Médico. Servicio de Hemodinamia. IDYTAC - Hospital Español. La Plata, Buenos Aires, Argentina

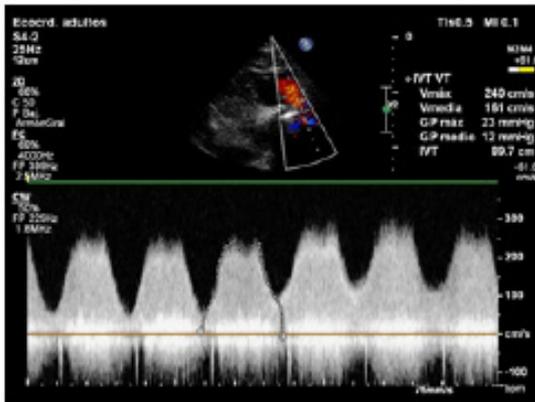
✉ Correspondencia: Ramiro Acevedo. ramiroacevedo_86@hotmail.com

Los autores no declaran conflictos de intereses

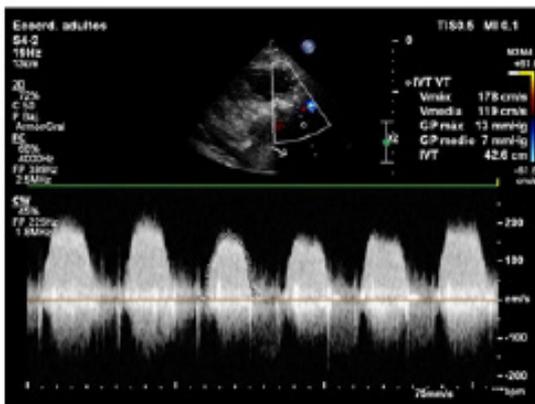
Recibido: 23/11/2021 | Aceptado: 14/12/2021



A



B



C

Figura 1. A. Reconstrucción multiplanar en tomografía multicorte de válvula tricúspide protésica evidenciando signos de degeneración valvular con engrosamiento valvar y calcificación. B. Vista del tracto de salida del ventrículo derecho en la que se evidencia gradiente transvalvular medio tricúspideo de 12 mmHg previo a la colocación de la prótesis valvular. C. Vista del tracto de salida del ventrículo derecho en la que se evidencia gradiente transvalvular medio tricúspideo de 7 mmHg posterior al implante de la prótesis valvular en posición tricúspidea.

tance of surgically fixing the balloon-expandable valve to the suture ring of the implanted valve to prevent displacement has been described. Also, looking for greater coaxiality between the 2 prosthetic valves regarding implantation. Angiographic images should be obtained perpendicularly to the prosthesis to optimize torsion. Also, the ventricular pacemaker of high-intensity power-frequency electric field helps minimize the movement of the surgical prosthetic valve annulus (7,8).

Regarding the size of the prosthetic valve, we should mention that they are named after their outer diameter. However, for the valve-in-valve technique the important thing is the valve internal diameter, which varies from one manufac-

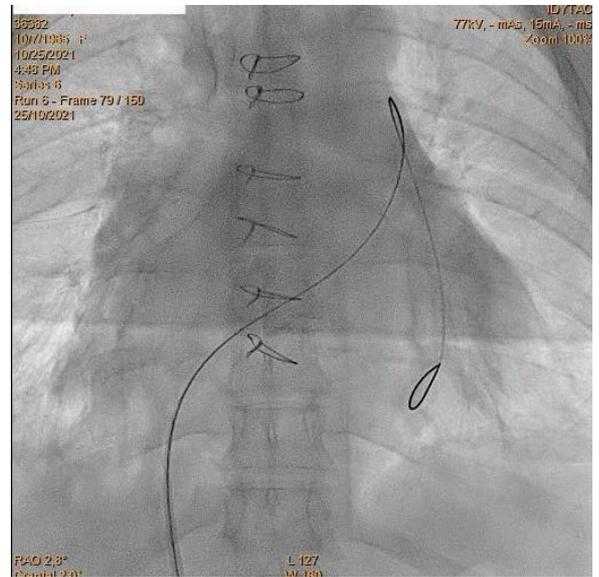


Figura 2. Progresión de cuerda 0,035" de alto hasta rama segmentaria de arteria pulmonar izquierda.

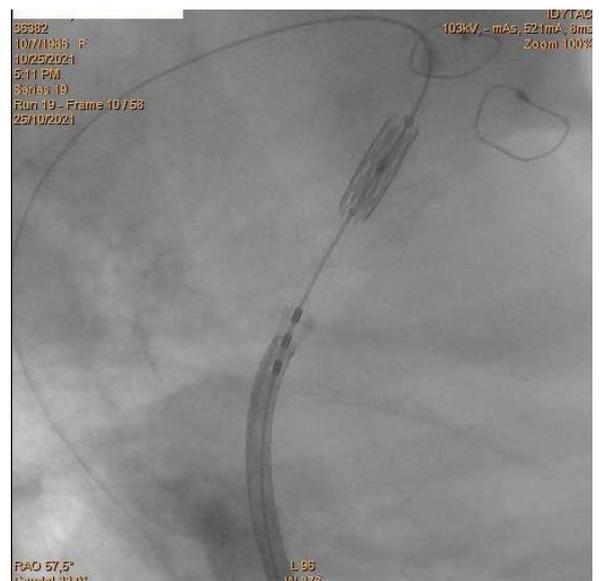


Figura 3. Alineación de dispositivo en proyección derecha-caudal, tomando como referencia el marco de la válvula implantada por vía quirúrgica.

turer to the next. Calcified or voluminous valves, pannus, and the prosthetic valve different sizes vary based on the valve internal diameter, which is why assessment through computed tomography scan is advised (7). Devices implanted inside valves of small diameters (≤ 27 mm) often show high gradients after implantation (2).

Regarding the hemodynamic phenomena seen after VIV-TAVR, reduced mean tricuspid gradient, increased right ventricular end-diastolic pressure, increased right ventricular systolic pressure, increased pulmonary artery mean pressure, increased pulmonary capillary wedge pressure, and lower mean right atrial pressure have been reported. The latter is the one with the fewest significant changes reported. Another parameter we should mention is the pulmonary artery pulsatility index whose formula describes the right ventricular systolic function (pulmonary artery systolic pressure - pulmonary artery diastolic pressure)/mean right atrial



Figura 4. Post implante de válvula Edwards Sapiens 3™ en posición tricuspídea.

REFERENCES

- Hirata K, Tengan T, Wake M, et al. Bioprosthetic tricuspid valve stenosis: a case series. *European Heart Journal* 2019;3:1-8.
- McElhinney D, Aboulhosn J, Dvir D, et al. Mid-Term Valve-Related Outcomes After Transcatheter Tricuspid Valve-in-Valve or Valve-in-Ring Replacement. *JACC* 2019;73:148-57.
- Patel K, Sadeghi S, Aboulhosn J. Invasive Hemodynamic Characteristics in Patients Undergoing Transcatheter Tricuspid Valve-in-Valve Implantation for Treatment of Tricuspid Stenosis. *World J Pediatr Congenit Heart Surg* 2020;11(4):411-6.
- McElhinney D, Cabalka A, Aboulhosn J, et al. Transcatheter Tricuspid Valve-in-Valve Implantation for the Treatment of Dysfunctional Surgical Bioprosthetic Valves An International, Multicenter Registry Study. *Circulation* 2016;133:1582-93.
- Bernal J, Morales D, Revuelta C, et al. Reoperations after tricuspid valve repair. *Journal of Thoracic Cardiovascular Surgery* 2005;130:498-503.
- Zack CJ, Fender EA, Chandrashekar P, et al. National trends and outcomes in isolated tricuspid valve surgery. *J Am Coll Cardiol* 2017;70(24):2953-60.
- Webb J, Wood D, Ye J, et al. Transcatheter Valve-in-Valve Implantation for Failed Bioprosthetic Heart Valves. *Circulation* 2010;121:1848-57.
- Álvarez-Fuente M, Haas N, del Cerro M. Edwards valve-in-valve implantation in tricuspid position. *Cardiology in the Young* 2017;27:1633-6.

pressure (3). In the case of our patient, the mean transvalvular gradient dropped 5 mmHg (13 mmHg and 8 mmHg before and after implantation, respectively), the pulmonary artery pulsatility index improved, and mean pulmonary artery pressure improved > 25 mmHg. This may be indicative of left ventricular misadaptation to the increased preload.

CONCLUSION

Tricuspid stenosis is a phenomenon due to the inevitable deterioration of biological prosthetic valves. Hemodynamically, it is characterized by increased right atrial pressure, increased systemic venous pressure, and decreased cardiac output due to the reduced preload of both the right and the left ventricles. In the case that was presented here and of a high-risk surgical patient, endovascular approach was decided. After valve implantation, the hemodynamic parameters improved as the direct measurements of pressures in the right heart chambers and pulmonary artery confirmed. The control EKC performed found no traces of paravalvular leak. The patient's clinical course improved significantly at the outpatient follow-up.

Endovascular revascularization of central veins and subsequent cardiac catheterization for hemodialysis in a patient with exhaustion of conventional vascular accesses

Revascularización endovascular de venas centrales y posterior colocación de catéter para hemodiálisis en una paciente con agotamiento de accesos vasculares

Marcel Voos Budal Arins¹, Antenor Álvarez¹

ABSTRACT

Objective. Exhaustion of conventional vascular accesses (ECVA) in patients with end-stage renal disease is associated with higher morbidity and mortality rates. Consequently, maintenance of existing VA sites is of utmost importance for hemodialysis. We describe a technique used for the endovascular revascularization of central veins and subsequent catheter placement regarding hemodialysis in a patient with exhaustion of conventional vascular accesses. **Methods.** This is the case of a patient with exhausted vascular access and requirement for emergency dialysis. Endovascular revascularization of central veins and subsequent catheter placement for hemodialysis were successfully performed.

Results. The patient still remains on hemodialysis at the follow-up without any complications being reported.

Conclusion. Endovascular revascularization of central veins for hemodialysis is a known and accepted technique that can extend the use of VAs in complex patients over time.

Keywords: vascular access, hemodialysis, endovascular.

RESUMEN

Objetivo. El agotamiento de los accesos vasculares (AV) en pacientes con enfermedad renal en etapa terminal se asocia con una mayor morbilidad y mortalidad. En consecuencia, el mantenimiento de los AV existentes es de suma importancia para la hemodiálisis. Describimos una técnica de revascularización endovascular de venas centrales y posterior colocación de catéter para hemodiálisis en una paciente con agotamiento de accesos vasculares.

Métodos. Reportamos una paciente con agotamiento de accesos vasculares y requerimiento de diálisis de urgencia. Se efectuó revascularización endovascular de venas centrales y posterior colocación de un catéter transitorio para hemodiálisis de forma exitosa.

Resultados. La paciente se encuentra en hemodiálisis post-procedimiento sin complicaciones.

Conclusión. La revascularización endovascular de venas centrales para hemodiálisis es una técnica conocida y aceptada que puede extender en el tiempo la utilización de accesos vasculares en pacientes complejos.

Palabras clave: acceso vascular, hemodiálisis, endovascular.

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):33-34. <https://doi.org/10.30567/RACI/202201/0033-0034>

INTRODUCTION

The gradual increased number and age of the population on dialysis runs parallel to the advances made in nephrological care, and makes us to wonder whether the number of patients with exhaustion of conventional vascular accesses will increase with the passing of time. Exhaustion of conventional vascular accesses for dialysis is rare. However, in their routine practice, most dialysis centers will eventually encounter patients with very few options and in poor condition.¹ Patients who have been on dialysis through catheters for many years often show stenosis or occlusion of their central veins. Also, patients on dialysis through native or prosthetic vascular accesses often show exhaustion of the veins in the upper extremities. In these patients, vascular access is fairly limited, and if their current access fails the patients' chances of eventually being unable to receive dialysis grow.² This is the case of a woman with exhaustion of conventional vascular accesses who required emergency dialysis. The patient was successfully

treated with andovascular revascularization of the central veins followed by the placement of a transient hemodialysis catheter.

CASE REPORT

This is the case of a 58-year-old woman with stage 5 kidney disease who has been on dialysis for a number of years. The patient has a past medical history of thrombosed native and prosthetic vascular accesses in both upper extremities, and multiple central venous catheters at both jugular and subclavian level. Also, the patient's 2 femoral veins have already been used for this purpose too.

The Doppler echocardiography performed revealed the presence of an occlusion in both internal jugular veins, and fe-

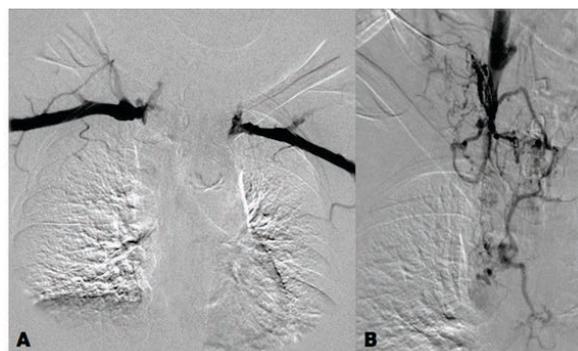


Figura 1.

1. Cardioangiólogo Intervencionista UBA-CACI. Hemodinamia Integral, Centro de Cardiología Intervencionista y Terapéutica Endovascular Periférica. Santiago del Estero Capital, Santiago del Estero, Argentina

✉ Correspondencia: Marcel Voos Budal Arins. 9 de Julio 580. Santiago del Estero, Argentina. CP 4200. Celular: +5491144082595. marcelvoos@gmail.com

Los autores no declaran conflictos de intereses

Recibido: 02/10/2021 | Aceptado: 23/11/2021

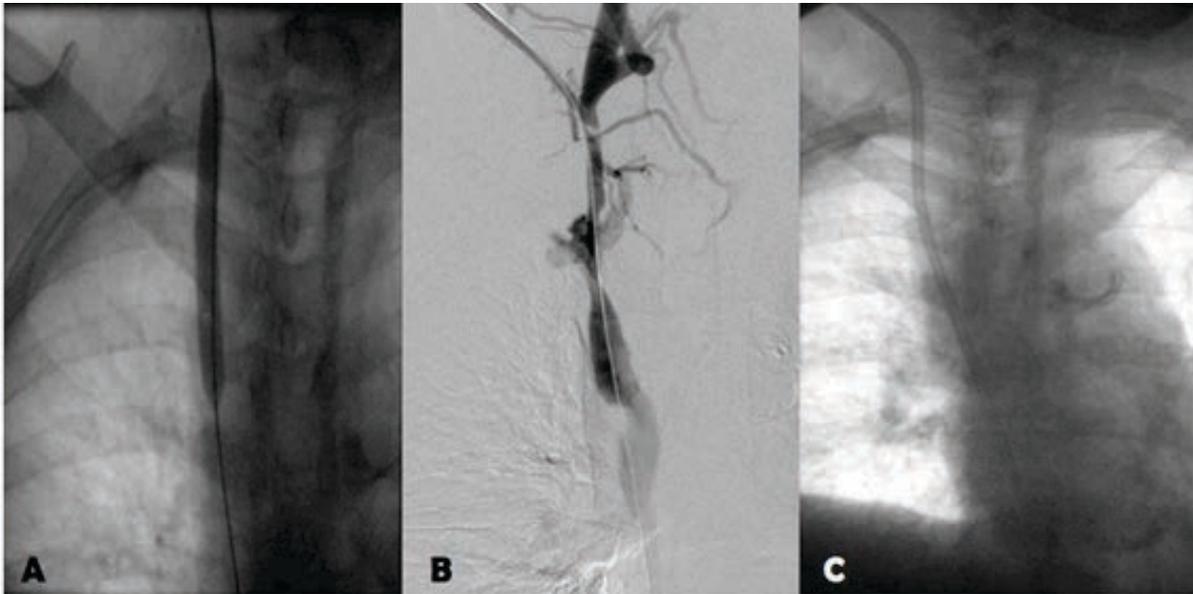


Figura 2.

moral veins. The phlebography performed revealed the presence of an occlusion at the right confluence of the subclavian and internal jugular veins, innominate left venous trunk, and superior vena cava (figure 1A). Since an emergency dialysis was required, an ultrasound-guided puncture of a patent segment was performed that confirmed the reduced caliber of the right internal jugular vein using a 18 G Abbocath catheter. Then, a phlebography performed through the catheter confirmed the occlusion of the right internal jugular vein (figure 1B). Afterwards, an 8-Fr introducer sheath was inserted with support from a 5-Fr 2 Cobra catheter and a 0.035 in hydrophilic guidewire. The occlusion located at right internal jugular vein and superior vena cava level was crossed uneventfully and the guidewire was advanced towards the inferior vena cava. Then, the hydrophilic guidewire was exchanged for a 300 cm Amplatz extra-support guidewire. To allow the passage of the transient hemodialysis catheter, the balloon used in the angioplasty had 8 mm in diameter and 400 mm in length (figure 2A). Finally, the recanalization of the vessel was achieved (figure 2B). Afterwards, a transient 12-Fr Arrow catheter was placed 20 cm above the right atrium without any complications being reported (figure 2C).

RESULTS

No procedural complications have been reported to this date. The patient remains on postoperative hemodialysis with good fluid dynamics through the catheter placed.

REFERENCES

1. Inston N, Khawaja A, Mistry H, Jones R, Valenti D. Options for end stage vascular access: Translumbar catheter, arterial-arterial access or right atrial graft? *J Vasc Access* 2019;1129729819841153.
2. Rahman S, Kuban JD. Dialysis Catheter Placement in Patients With Exhausted Access. *Tech Vasc Interv Radiol* 2017;20(1):65-74.
3. Excerpts from the United States Renal Data System 1996 Annual Data Report. *Am J Kidney Dis* 1996;28(3 Suppl 2):S1-165.
4. Shakarchi JA, Nath J, McGrogan D, et al. End-stage vascular access failure: can we define and can we classify? *Clin Kidney J* 2015;8(5):590-3.
5. Vachharajani TJ, Agarwal AK, Asif A. Vascular access of last resort. *Kidney Int* 2018;93(4):797-802.

DISCUSSION

The rate of patients with exhaustion of conventional vascular accesses is low. Estimating the prevalence of the problem is not easy, and there is no mortality data associated with this entity.³ The percentage of patients with exhaustion of conventional vascular accesses requiring a procedure is also hard to tell. Shakarchi et al. proved that only 2 patients from a cohort of 97 patients referred due to complex vascular access actually had complete exhaustion of conventional vascular accesses.⁴ The arrival of new technologies and the chances of recovering vascular accesses using complex endovascular techniques for the management of patients considered untreatable can prevent these accesses from deteriorating to a point where these patients can be in a life-threatening situation.⁵

CONCLUSION

We reported the case of a patient with exhaustion of conventional vascular accesses who required emergency dialysis. The patient was treated successfully via endovascular access through a central venous angioplasty that allowed the advancement of a transient hemodialysis catheter towards the right atrium. The endovascular revascularization of central veins for dialysis is a well known and accepted technique that can extend the life of vascular accesses in complex patients.

Bilateral iliofemoral deep vein thrombosis in patient with interrupted inferior vena cava

Trombosis venosa profunda iliofemoral bilateral en paciente con interrupción de vena cava inferior.

Verónica Gonzalez^{1,2,3}, Alan Sommi^{1,2,4}, Carlos Giuliani^{1,2}, Fabio Muñoz^{1,2,3}

ABSTRACT

The inferior vena cava (IVC) develops from 5 different venous systems in a complex embryological process. Problems with the IVC give way to developmental abnormalities that can be associated, or not, with cardiac malformations and account for almost half of all venous malformations. They may go unnoticed clinically. However, they can generate blood stasis and the corresponding formation of thrombosis. In this publication we present a case of bilateral iliofemoral deep vein thrombosis in a patient with interrupted IVC and azygos and hemiazygos continuation, and its resolution.

Keywords: interrupted inferior vena cava, deep vein thrombosis, thrombectomy, catheter-directed thrombolysis, COVID-19.

RESUMEN

La vena cava inferior (VCI) se desarrolla gracias a la contribución de cinco sistemas venosos en un proceso embriológico complejo. Sus alteraciones dan paso a anomalías del desarrollo, las cuales pueden o no asociarse a malformaciones cardíacas y representan aproximadamente la mitad del total de malformaciones venosas. Pueden ser clínicamente silentes. Sin embargo, se postula que podrían generar estasis sanguínea propiciando la formación de trombosis. En esta publicación presentamos un caso de trombosis venosa profunda iliofemoral bilateral en una paciente con interrupción de VCI y continuación por sistema áyigos-hemíáyigos, y su resolución.

Palabras clave: interrupción de vena cava inferior, trombosis venosa profunda, trombectomía, trombolisis dirigida por catéter, COVID-19.

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):35-38. <https://doi.org/10.30567/RACI/202201/0035-0038>

CASE REPORT

This is the case of a 45-year-old obese woman admitted due to bilateral iliofemoral deep vein thrombosis (DVT) of a 4-day clinical course with ultrasound evidence of compromise to the common femoral and superficial veins, and bilateral deep veins with spread towards both iliac axes and IVC. Due to the epidemiological context under which the patient is admitted to the hospital, a nasopharyngeal swab is performed that tests positive for COVID-19. The patient's clinical course is interpreted as an asymptomatic infection with the following lab results at admission: platelet count, 455 000 mcL; CRP, 39.8mg/L; ferritin, 115.4 ng/mL; and D-dimer levels, 1.2 mg/L (reference levels < 0.2 mg/L).

Anticoagulant therapy with low-molecular-weight heparin (LMWH) is started, but disease progresses despite the therapy administered. For that reason, she is referred to our center on day 7 for endovascular resolution.

Phlebography via right anterior jugular venous access is performed (ultrasound guided puncture). A multipurpose catheter is advanced that reveals the presence of an interrupted IVC in its hepatic segment with drainage of suprahepatic veins into the right atrium (figure 1). Both femoral veins

are punctured, which reveals the presence of bilateral iliofemoral thrombosis spreading towards the infrarenal segment of the inferior vena cava. Drainage through the azygos-hemiazygos venous system—which seem dilated—is performed.

Catheter-directed thrombolysis (CDT) is performed using the FOUNTAIN® INFUSION SYSTEMS catheter (Merit Medical, United States) from both accesses with the infusion of rtPA in doses of 0.5 mg/h plus sodium heparin in anticoagulation doses for 48 hours total.

After the period of treatment established, the patient showed a clear improvement of her clinical signs and symptoms. A new phlebography is performed that confirms the presence of partial residual thrombosis in right common iliac, external, and bilateral femoral veins with images compatible with severe stenosis of the left common iliac vein. Venous drainage through the azygos system is performed that reveals the presence of a severe obstruction at the origin of this vein. Successful thrombus aspiration is performed using an 8-Fr Judkins Right guide catheter with dilatation of the ostial obstruction of the azygos route using two 6.0 mm x 40 mm and 8.0 mm x 60 mm peripheral balloons (Admiral Xtreme™ PTA balloon catheter, Medtronic, Minneapolis, United States). The obstruction of the common iliac vein is dilated. Angiographic control confirms the proper drainage of both iliofemoral axes through the azygos system towards the superior vena cava (Figure 2).

The patient remains on anticoagulant therapy and a magnetic resonance angiography is performed 1 week later to assess the patency of the target vessels (Figure 3). A new occlusion in the left common iliac vein is confirmed, and an angioplasty of this vessel is performed with self-expanding venous stent implantation (VENOVOTM Venous Stent System Bard (Peripheral Vascular Inc., Tempe, AZ, United States) (Figure 4).

1. Servicio de Intervencionismo Periférico y Terapias Endovasculares, Sanatorio Güemes, CABA.
2. Servicio de Hemodinamia, Sanatorio Finochietto, CABA.
3. Servicio de Hemodinamia, Hospital Juan A. Fernández, CABA.
4. Servicio de Hemodinamia, Hospital Ramos Mejía, CABA.

✉ Correspondencia: Verónica Gonzalez. Tel.: (011) 1534230758. veronicaegon@gmail.com.

Los autores no declaran conflictos de intereses

Recibido: 18/08/2021 | Aceptado: 12/01/2022

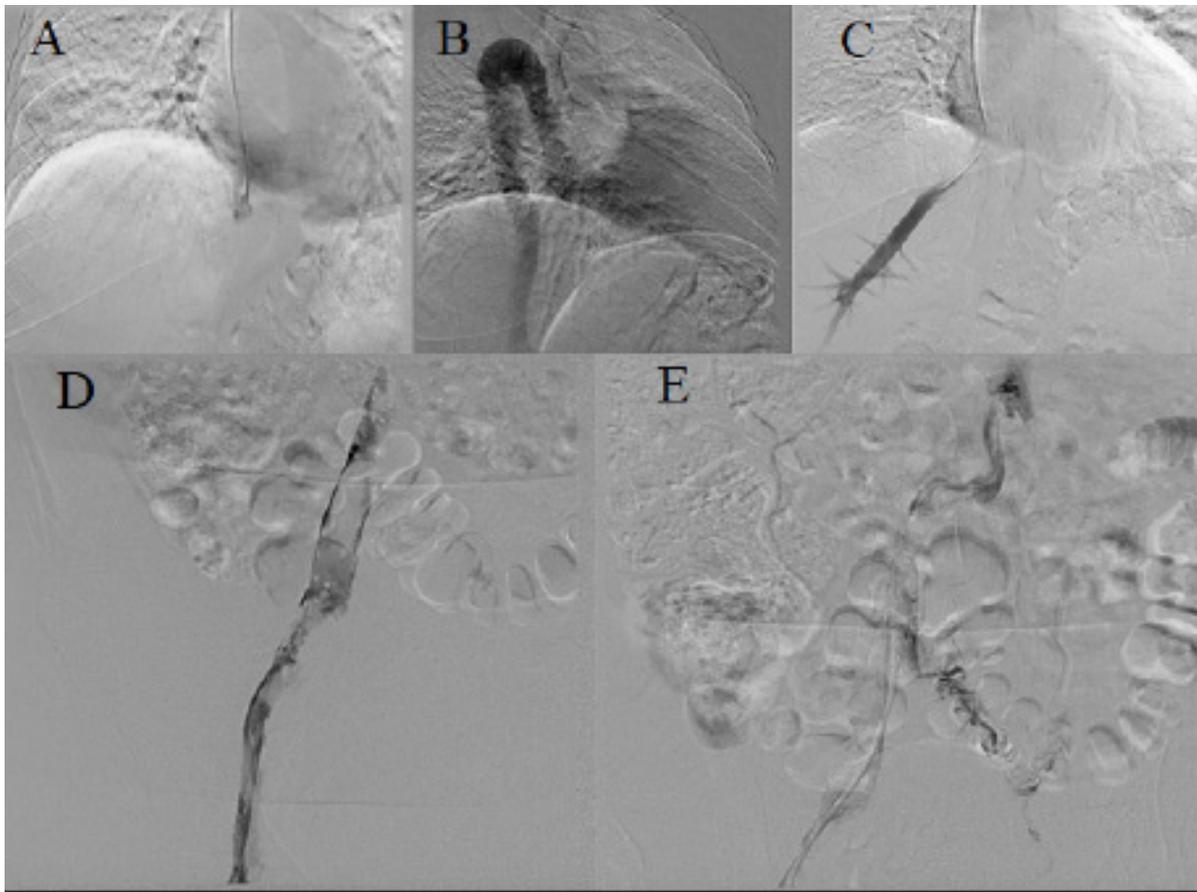


Figure 1. Diagnostic angiography showing the interruption of the IVC in its hepatic segment (A), and the direct drainage of suprahepatic veins (C); thrombosis of the iliofemoral axis and infrarenal segment of the IVC (D and E); venous drainage through the azygos and hemiazygos system (B y E).

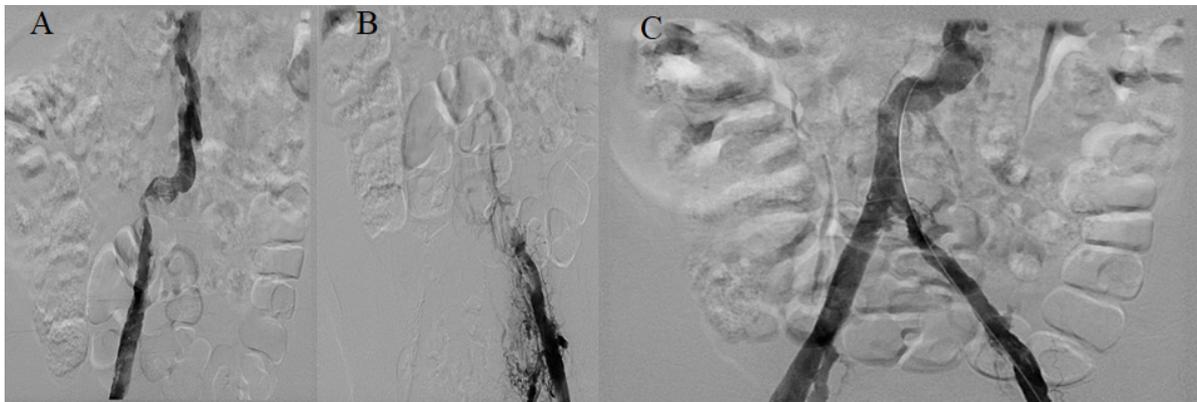


Figure 2. Phlebography after treatment with thrombolytic agents revealing the presence of partial residual iliofemoral thrombosis with severe obstruction at the origin of the azygos vein (A), obstruction of the left common iliac vein (B), and angiographic control after balloon angioplasty (C).

Ten (10) months after treatment the patient did not relapse. New phlebographic control was performed that confirmed the patency of both the target venous system and the stent implanted. (Figure 5)

DISCUSSION:

Blood from the venous system reaches the right atrium through the superior and inferior venae cavae. The azygos-hemiazygos system receives venous blood from both the thorax and the abdomen connecting both systems, which is sometimes a circulation alternative.

From the embryological standpoint these anatomical structures mostly originate at the cardinal venous system that includes the anterior and posterior cardinal veins, the common cardinal vein, and the subcardinal veins. The formation of these anatomical structures is completed during the development, anastomosis or involution of the different segments involved, something that occurs between gestational weeks 4 and 8.

The inferior vena cava can be divided into different segments based on their origin: *suprabepatic segment* (right vitelline vein), *hepatic renal segment* (anastomosis of the right vitelline vein, and the subcardinal vein), *suprarenal segment* (right subcardinal vein), *renal segment* (right sub-supracar-

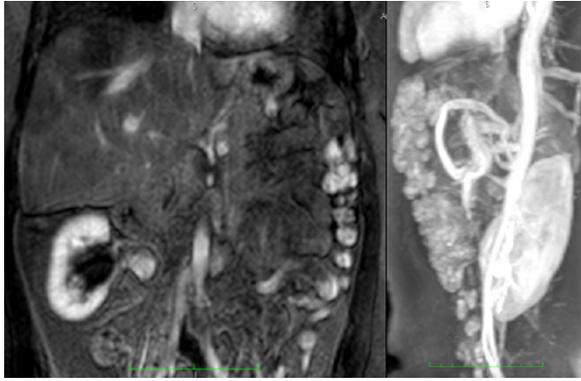


Figure 3. Magnetic resonance angiography after treatment revealing the patency of the azygos vein and the reiterated occlusion of the left common iliac vein.

dinal anastomosis), and *infrarenal segment* (right supracardinal vein). Finally, the terminal segment of the IVC and both iliac veins originate at the posterior cardinal vein.⁽¹⁾

Developmental disorders can cause anatomical anomalies such as:

- Double IVC: persistence of both supracardinal veins. Frequency, 0.2% to 3%. The left component often drains into the left renal vein.
- Left IVC: persistence of left supracardinal vein associated with the regression of its contralateral equivalent. Frequency, 0.2% to 0.5%.
- Interruption of the IVC infrarenal segment with suprarenal preservation: pathological development of the cardinal posterior veins and supracardinal veins.
- Abnormalities of the left renal vein: variation in the persistence or regression of the 2 embryological components of the left renal collar.
- Circumcaval ureter: abnormality of the right supracardinal system (0.07%).
- Interruption of the IVC hepatic segment with continuation through the azygos system.

The latter abnormality is due to the lack of anastomosis of the right vitelline vein and subcardinal vein with the corresponding regression of the right subcardinal vein making blood drain directly into the right supracardinal vein. Its incidence rate in the overall population is 0.6% as an isolated finding. However, this rate increases dramatically when it is found together with other developmental disorders like visceral heterotaxy, mainly the polysplenia syndrome. The hepatic segment is not really absent, but instead drains directly into the right atrium together with suprahepatic veins. Therefore, venous drainage occurs alternatively through the azygos-hemiazygos system being the typical finding a dilated azygos vein present in the CT imaging at the entrance of the SVC and the retrocrural space.⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾⁽⁵⁾

These venous malformations are often asymptomatic. However, different series already published reveals predisposition towards the development of thromboembolic disease due to venous insufficiency. The interruption of the IVC has been described in nearly 5% of all DVTs without an apparent cause in patients < 30 years.⁽⁴⁾⁽⁶⁾

The management of deep venous thrombosis has been studied for years trying to establish whether anticoagulation alone or associated with CDT or pharmacoinvasive thrombectomy would have better results minimizing



Figure 4. Final image of the angiography of the left common iliac vein with venous deployment of self-expanding stent.

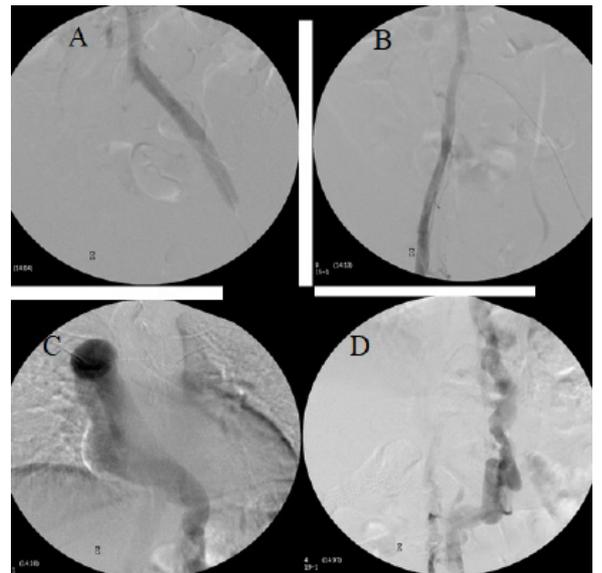


Figure 5. Control phlebography 10 months after the procedure that confirms the patency of the stent implanted into the common iliac vein and left external vein (A); patency and preserved flow of right iliac branches, infrarenal inferior vena cava (B), and azygos-hemiazygos system (C and D).

post-thrombotic syndrome (PTS), pulmonary thromboembolism (PTE), and keeping venous patency in the short- and long-term.⁽⁷⁾

Several randomized clinical trials and meta-analyses have demonstrated that in the presence of iliofemoral thrombosis the combination of thrombolytic and anticoagulant agents reduced the development of PTS since it reduced the thrombotic burden even more with a variable rate of bleeding.⁽⁸⁾⁽⁹⁾⁽¹⁰⁾

Following in these footsteps, the CAVENT trial randomized 209 patients with iliofemoral DVT occurring within the 21 days after symptom onset to receive anticoagulant therapy alone or in combination with CDT with the infusion of alteplase for a maximum of 96 hours. An ARR of 14.4% of post-thrombotic syndrome was reported at the follow-up for a NNT of 7 patients to prevent a single event of PTS with a low rate of bleeding.

A meta-analysis conducted by Wang Li et al. that compared CDT to anticoagulation for the management of iliofemoral DVT confirmed an odds ratio of 0.38 (95%CI, 0.26–0.55) for the development of PTS favorable to CDT. Also, patency with this treatment was even higher after 6 months (OR, 4.76; 95%CI, 2.14–10.56).⁽¹¹⁾

Mechanical thrombectomy (MT) associated, or not, with the infusion of lytic agents (pharmaco-mechanical thrombectomy) is performed with different devices which—through a process of suction, rotation, rheolytic thrombectomy, ultrasound or a combination of these—reduce the thrombotic burden.⁽¹²⁾ Examples of these are the Angiojet system (Boston Scientific), and EKOS lysis catheter (BTG). The development of this technique is based on the hypothesis that shorter procedural times, lower doses of lytic agents or the nonuse of these agents associated with the thrombectomy methods implemented would reduce even further the thrombotic burden and yield better results in the prevention of PTS with a

lower rate of bleeding. To this point, evidence is controversial with great heterogeneity in the studies conducted so far.

The meta-analysis published by Wang et al. that assessed the results of MT in the management of DVT concluded that this treatment with or without CDT proved to be safe and effective with a satisfactory rate of lysis, a low rate of recurring thrombosis and complications, good long-term results, and a low rate of PTS. On the other hand, a rate of re-thrombosis in the short- and long-term of 11.9% and 10.7%, respectively, was reported which may have to do with endothelial damage. The rate of PTS at the follow-up was 15.1% similar to that of CDT.⁽¹³⁾

Based on the evidence studied to this date, we can conclude that regardless of the method used we should be aggressive in the management of iliofemoral DVT to prevent PTS and pulmonary embolism, as well as any serious complications associated with the clinical course such as phlegmasia cerulea dolens.

REFERENCES

- Oliveira JD, Martins I, Oliveira and Martins ;Congenital systemic venous return anomalies to the right atrium review; *Insights into Imaging* 10:115 (2019). <https://doi.org/10.1186/s13244-019-0802-y>.
- (2) Bass JE, Redwine MD, Kramer LA, Huyh PT, Harris JH Jr. Spectrum of Congenital Anomalies of the Inferior Vena Cava: Cross-sectional Imaging Findings; *Radiographics* May-Jun 2000;20(3):639-52. doi:10.1148/radiographics.20.3.g00ma09639.
- Mandato Y, Pecoraro C, Gagliardi G, Tecame M. Azygos and hemiazygos continuation: An occasional finding in emergency department. *Radiology Case Reports* 2019;14:1063-8.
- Skeik N, Wickstrom KK, Schumacher CK, Sullivan TM. Intrahepatic Inferior Vena Cava Agenesis with Bilateral Renal Vein Thrombosis. *Ann Vasc Surg* 2013;27:973.e19e973.e23. <http://dx.doi.org/10.1016/j.avsg.2012.10.030>.
- Moss and Adams' Heart Disease in infant, Children and Adolescent; *Cap* 36; pág 911-33; 9na edición.
- Yen-Lin Chee, Culligan DJ, Watson HG. Inferior vena cava malformation as a risk factor for deep venous thrombosis in the young. *Br J Haematol* 2001;Sep;114(4):878-80.doi: 10.1046/j.1365-2141.2001.03025.x.
- Qais Radaideh, Neel M Patel, Nicolas W Shammás. Iliac vein compression: epidemiology, diagnosis and treatment. *Vasc Health Risk Manag* 2019;May 9;15:115-122.doi: 10.2147/VHRM.S203349.
- ToneEnden, Ylva Haig, Nils-Einar Kløw, et al., on behalf of the CaVenT Study Group. Long-term outcome after additional catheter-directed thrombolysis versus standard treatment for acute iliofemoral deep vein thrombosis (the CaVenT study): a randomised controlled trial. *Lancet* 2012;379:31-8.
- Engelberger RP, Spirk D, Willenberg T, et al. Ultrasound-Assisted Versus Conventional Catheter-Directed Thrombolysis for Acute Iliofemoral Deep Vein Thrombosis. *Circ Cardiovasc Interv* 2015;8:e002027. DOI: 10.1161/CIRCINTERVENTIONS.114.002027
- Vedantham S, Goldhaber SZ, Julian JA, et al., for the ATTRACT Trial Investigators. Pharmacomechanical Catheter-Directed Thrombolysis for Deep-Vein Thrombosis. *N Engl J Med* 2017;377:2240-52.
- Wang Li, Zhang Chuanlin, Mu Shaoyu, Chao Hsing Yeh, Chen Liqun, Zhang Zeju. Catheter-directed thrombolysis for patients with acute lower extremity deep vein thrombosis: a meta-analysis. *Review Article Rev Latino-Am. Enfermagem* 2018;26:e2990
- Wang W, Sun R, Chen Y, Liu C. Meta-analysis and systematic review of percutaneous mechanical thrombectomy for lower extremity deep vein thrombosis. Elsevier Inc. <https://doi.org/10.1016/j.jvsv.2018.08.002>.
- Engelberger RP, Spirk D, Willenberg T, et al. Ultrasound-Assisted Versus Conventional Catheter-Directed Thrombolysis for Acute Iliofemoral Deep Vein Thrombosis. *Circ Cardiovasc Interv* 2015 Jan;8(1):e002027.

Letter from the President of CACI

Carta del Presidente de CACI

Revista Argentina de Cardioangiología Intervencionista 2022;13(1):39. <https://doi.org/10.30567/RACI/202201/0039-0039>

Dear colleagues and friends

We have recently initiated a new management in our beloved college, a new board of directors takes over that —as the other boards that have come before us— will do everything in its power to bring benefits and advantages to our members and medical society alike.

Our focus will be on promoting team effort. Therefore, with the work, collaboration, and commitment that all of you will bring forward in the coming years the progress and improvements we long for are guaranteed.

There is no doubt that, to this date, scientific development is our most important asset. We are fully committed to strengthening this road we have been successfully walking for quite some time. A clear example of this is the groundbreaking recognition achieved by our specialty and medical journal. Therefore, we wish to encourage all of you to keep submitting manuscripts and scientific material for publication. It will be shared by colleagues from around the world in both English and Spanish, and eventually increase —year after year— the visibility and impact factor of our journal

Dr. Martín Cisneros
President of CACI

Publication Guidelines of the *Revista Argentina de Cardioangiología Intervencionista*

Reglamento de Publicaciones de la *Revista Argentina de Cardioangiología Intervencionista*

The *Revista Argentina de Cardioangiología Intervencionista (RACI)* is a quarterly journal published by the Argentinian College of Interventional Cardiologists (CACI). Its goal is to spread scientific and educational material on this medical specialty. Distribution is nation wide and open-access and is targeted at interventional cardiologists, clinical and pediatric cardiologists, radiologists, neurologists, operators, and other specialists. The publication is both digital (www.caci.org.ar) and in print.

The editorial principles of the journal are based on the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals and have been written by the International Committee of Medical Journal Editors - ICMJE in its most recent iteration available online at www.icmje.org.

For editorial reasons starting with issue #2, volume 9, year 2018 the graphic elements of the journal (figures, tables, and pictures) will be published in two colors only (blue and black). Readers who wish the full-color edition will need to pay an additional US\$200.

The articles submitted to the journal shall be originals. The Editorial Committee will study the papers submitted and confirm whether they follow the Publication Guidelines established by the journal. The Director, and/or Associate Directors will be responsible for submitting these papers for the external blind peer review process. This means that the authors do not know the reviewers' name and the reviewers do not know the name of other reviewers. This policy established by RACI follows the same criteria implemented by the Review and Editorial Committee of the *Journal of the American College of Cardiology (JACC)*, the highest impact factor cardiology journal. The Editorial Committee will make the final publication decision in accordance with the conclusions drawn by blind peer reviewers. Similarly, the Editorial Committee can introduce grammar related editorial changes according to the publication needs of the journal always after obtaining prior consent from the authors. Review articles and editorials will be subject to the same review process. Editorials are often required by the Editorial Committee as well. After the first review, the articles can be accepted in the same form they were initially submitted; minor reviews are those pertaining to articles with significant contributions that still have some minor limitations that need to be corrected or proof read before its eventual publication; major reviews are those pertaining to articles that are unfit for publication as originally submitted to the journal. In any case, the Editorial Committee can consider new submissions called *de novo* submissions as long as the article is modified substantially; the rejection of the article occurs when both the reviewers and the

Editorial Committee deem the article unfit for publication in the RACI journal.

In special cases of diagnostic and/or treatment consensus achieved by CACI and related scientific societies combined, such consensus will be supervised by the latter and being the Editorial Committee fully aware. Only then this consensus can be published exceptionally by the official journals of both societies simultaneously.

INSTRUCTIONS TO AUTHORS AND GUIDELINES FOR MANUSCRIPT SUBMISSION

All authors and members from the Editorial Committee shall declare any conflicts of interest associated with the publications

Each article shall be presented with a first page that should include: (a) title (both informative and precise); (b) the complete names of the authors and centers involved in the writing of the manuscript; (c) a short version of the title for the runner head; (d) the total amount of words contained in the paper excluding the references; (e) the name and full address, fax, and e-mail address of the corresponding author. The second page will include the abstract in Spanish and English with 3-6 keywords at the end of both abstracts with terms from the Index Medicus term list (Medical Subject Headings - MeSH). The third page will carry the content of the manuscript (see Preparation of the manuscript) including a new page per section. All pages will be numbered from the title page.

The paper (text, tables, and figures) will be submitted electronically to the following e-mail address revista@caci.org.ar with a note signed by all authors (see model in website) with the name of the section the manuscript belongs to, and a clear statement that the contents of the manuscript have never been published before.

Those appearing as authors of the article need to have contributed to the study or writing of the manuscript and will be liable for the content published.

A maximum of eight (8) authors shall be allowed in each paper and they must follow the authorship standards established by the IMCJE. Each manuscript received is examined by the Editorial Committee and one or two external reviewers. Afterwards, the lead author will be notified on the acceptance (with or without corrections and changes) or rejection of the manuscript. After the article has been approved for publication, RACI has the copyright for its total or partial reproduction.

SECTIONS (See Preparation of the manuscript)

Original articles

These are scientific or educational papers of original basic or

clinical studies. Requisites: a) general text, up to 5000 words including references; b) abstract, up to 250 words; c) tables + figures, up to 8; d) authors, up to 10.

Brief communications

The studies published under this section follow the same criteria established for original articles, but do not have enough patients to be considered as such.

Review articles

These are articles on relevant issues on the specialty requested by the Editorial Committee to renown authors (whether foreign or domestic). They can be written by different types of doctors (no more than 3 different authors). Requisites: the same ones established for the publication of original articles.

Continuing medical education

These are articles on the rational and protocolized management of the different circumstances that can occur in the routine clinical practice. They are reviewed and agreed previously with subject matter experts and include a flow chart on the diagnostic and therapeutic management of the disease. The following requisites have been established by the Editorial Committee. Requisites: a) general text, up to 2500 words excluding the references; b) abstract, up to 150 words; c) tables + figures, up to 6; d) references, up to 20; e) authors, up to 4.

Clinical case

This is the description of a clinical case of unusual characteristics with its diagnostic and therapeutic management, and final resolution. It needs to include a brief reference search. Requisites: a) general text, up to 1200 words; b) abstract, up to 100 words; c) tables + figures, up to 4; d) references, up to 10; e) authors, up to 5.

How did I approach it?

Under the title “How did I approach it?” the authors will be presenting a challenging case and a description of their management. The title needs to be included at the beginning of the text, for instance, “How did I treat an aneurysm in the left anterior descending coronary artery?” Then the authors’ names, last names, specialties, and working centers should be included as well. Corresponding author, address, and e-mail will be included as well. All authors need to declare their conflicts of interest. If they do not have any they need to say so. Text, figures, and references will follow the same criteria established for the clinical case.

Interventional cardiology images

The publication of images describing exceptional cases that the Editorial Committee and external reviewers consider significant for the journal will be accepted for publication. They will need to be followed by an explanatory text and a brief summary of the clinical history. Requisites: a) general text, up to 300 words; b) 2 original figures only; c) references, up to 3; d) authors, up to 5.

Research protocols

The publication of research protocols—preferably multicenter—will be accepted and published by the journal

as special articles as long as these protocols do not include the study partial or total results.

Editorials

They are analyses and/or comments on relevant issues on the specialty or general cardiology field in relation with our specialty and always upon request by the Editorial Committee to a subject matter expert. Similarly, comments on issues unrelated to an article in particular can be requested by the Editorial Committee. Requisites: a) general text, up to 2000 words; b) references, up to 40.

Letters to the editor

This is an opinion on an article published in the last issue of the journal that requires the arbitrage of the members of the Editorial Committee. Requisites: a) text, up to 250 words; b) one table and/or figure can be published; c) references, up to 5. Only letters submitted within a month following the print edition of the issue of the journal where the original article was published will be accepted.

PREPARATION OF THE MANUSCRIPT

The article will be written in Spanish language using a Microsoft® Word text processor and saved under the *.doc file extension. The size of the page will be A4 or letter with double-spacing, 25 mm margins, fully justified text, and 12-point Times New Roman or Arial font. Pages will be numbered consecutively starting with the cover. The manuscript (original article) needs to follow the so-called IMRAD structure: Introduction, Material and method, Results, and Discussion (see the ICMJE Publication Guidelines). Also, it will include Title, Abstract, Conflicts of Interest, and References. At the end of each original article, before the references, it should be done as a Table of the relevant points of the work that will be called Summary of Highlights. In 4 or 5 sentences authors should introduce the purpose of the study presented. The previous data published and the additional information provided by authors in their work, highlighting major contributions and final statements. At the end of references a acknowledgements for others people involved in the study together with a supplementary appendix when necessary should be added.

The metric system will be the standard system of measurement used with comas to write the decimals. All clinical, hematologic, and chemical parameters will be expressed in units of measure from the metric system and/or IU. Only common abbreviations will be used except for the title and the abstract. The first time these abbreviations are used they will be preceded by the whole term except for the use of standard units of measure.

Tables must be presented in individual sheets and they need to be numbered consecutively with Arabic numbers (0, 1, 2, etc.) according to the order in which they were quoted in the text with a short title for each and every one of them. All of the non-standardized abbreviations of the table need to be explained and developed. Explanatory notes will be placed at the foot of the table using the following symbols in this sequence: *, †, ‡, §, ¶, **, ††, ‡‡, etc.

Figures need to be submitted in TIFF, PSD or JPEG for-

mat and each figure will be submitted in a separate file with a resolution of 300 dpi in its final format. Each of them will be numbered consecutively together with the explanatory legend in a separate file. The normal size of the photographs will be 127 mm x 173 mm. Titles and detailed explanations will be included in the text of the legend, not the illustration.

References will be numbered consecutively with Arabic numbers between brackets. All of the authors will be included if they are six or fewer; if there are more authors involved, the third one will be followed by the expression «, et al.». The titles of the journals will be shortened based on the style used in Index Medicus. These are a few examples:

1. *Registro de Procedimientos Diagnósticos y Terapéuticos efectuados durante el período 2006-2007. Colegio Argentino de Cardioangiólogos Intervencionistas (CACI). Disponible en <http://www.caci.org.ar/addons/3/158.pdf>. Consultado el 01/01/2009. (Página Web.)*
2. *Magid DJ, Wang Y, McNamara RL, et al. Relationship between time of day, day of week, timeliness of reperfusion, and in-hospital mortality for patients with acute ST-segment elevation myocardial infarction. JAMA 2005;294:803-812. (Revistas en inglés.)*
3. *Aros F, Cuñat J, Marrugat J, et al. Tratamiento del infarto agudo de miocardio en España en el año 2000. El estudio PRIAMHO II. Rev Esp Cardiol 2003;62:1165-1173. (Revistas en español).*

Válvula Cardíaca Transcatéter balón expandible

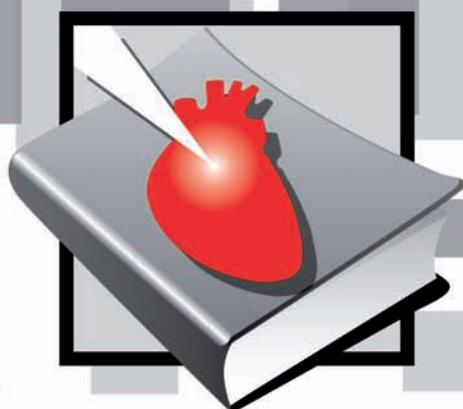
- Stent de aleación Níquel Cobalto para mayor fuerza radial y mejor radiopacidad.
- Válvula Tricúspide de Pericardio Bovino.
- Sellado interno con PET, bajo perfil y resistente a la perforación.
- Falda externa de PET para minimizar PVL.
- Myval Standard Sizes: 20 mm, 23 mm, 26 mm, 29 mm
Myval Intermediate Sizes: 21,5 mm, 24,5 mm, 27,5 mm
Myval XL Sizes: 30,5 mm, 32 mm



UniFarma S.A. / www.unifarma.com.ar / Tel.: 5218-0600/ E-mail: tecmed@unifarma.com.ar

PRIMER VADEMECUM ONLINE

EXCLUSIVO DE NUESTRA ESPECIALIDAD CON MATERIAL COMPLETO, ACTUALIZADO E INCLUSIVO DE LOS INSUMOS



CACI VADEMECUM

COLEGIO ARGENTINO DE CARDIOANGIÓLOGOS INTERVENCIONISTAS

¡ACCEDA DESDE NUESTRO SITIO WEB!

WWW.CACI.ORG.AR

SHOCKWAVE | IVL

Making waves



SIPROTEC

NetSur

iVascular[®]
therapies for living

Myval[™]

Brosmed
embrace life

VARI^XIO

KIRAN^{*}
A Division of TRIVITRON Healthcare

54 11 3949 6155

www.netsur-sa.com

