ISSN 2250-7531 ISSN 2313-9307 (on line)

CACI
Argentinian College of Interventional Cardiologists

Argentinian Journal of Interventional Cardiology

Enero - Marzo 2024 | Año 15 | Número 1

Editorial

Editorial comment
Fernández Pereira C

Original article

Secondary branch patency in coronary angioplasty of bifurcation lesions with the provisional stent technique: clinical and angiographic follow-up
Supicciatti AG et al.

Clinical cases

Percutaneous closure of atrial septal defect with a fenestrated device in a high-risk patient. Report of the first case in Argentina
Lange JM et al.

Percutaneous mitral valve-in-valve implantation
Kim A et al.

Stent collapse during hybrid revascularization of extensive iliofemoral occlusive disease
Voos Budal Arins M et al.

Management of bilateral type II endoleaks following endovascular repair of abdominal aortic aneurysm: a case report and literature review
Danduch L et al.

Endovascular treatment of aorto-atrial fistula.Complication and resolution
Bernal Calle MJ et al.

Carta del Presidente

Letter from the President of CACI
Fernández J

Indexed in
latindex doi Google Scholar meducatium REDIB

Argentinian Journal of Interventional Cardiology

Enero - Marzo 2024 | Año 15 | Número 1

Editor en Jefe
Carlos Fernández Pereira
Sanat. Otamendi y Miroli, Las Lomas Bs. As., Clínica IMA, Adrogué

Editores Asociados
Alejandro Barbagelata FAHA, FSCAI
Duke University School of Medicine, Estados Unidos
Arturo Fernández Murga
Inst. de Cardiología SRL / Clín. Mayo, Tucumán
Rubén Piraino
Sanat. Delta, Rosario, Prov. de Santa Fe, Arg.
Antonio Pocoví
Cardiología Intervencionista / Sanatorio Trinidad Mitre, CABA
Gastón Rodríguez-Granillo
Clínica La Sagrada Familia, CABA
Gregg Stone
Cardiovascular Research Foundation / Universidad de Columbia, Estados Unidos

Consejo de Redacción
Carla Agatiello
Hospital Italiano, CABA
Marcelo Agüero
Funcacorr, Corrientes
José Alonso
Htal. Garrahan, CABA
Federico Blanco
Hospital Argerich, CABA
Alejandro Cherro
Sanatorio Adventista de Belgrano, IMC, Hosp. Privado de la Merced, CABA y Gran Bs. As.
Jesús Damsky Barbosa
Htal. Pedro de Elizalde, CABA
Alejandro Delacasa
Htal. Interzonal Dr. Oscar Allende / Sanat. Belgrano / Clínica Pueyrredón /Inst. Radiológico, MDQ
Ariel Durán
Htal. de Clínicas, Mdeo, Uruguay
Guillermo Eisele
CEMIC, CABA
Alejandro D. Fernández
Htal. Italiano, CABA
Arturo Fernández Murga
Inst. de Cardiología SRL / Clínica Mayo, Tucumán
Alejandro Goldsmit
Sanatatorio Güemes, CABA
Ana Mollon
Clínica Güemes Luján, Pcia Bs As
Alejandro Peirone
Htal. Privado de Córdoba/ Htal. de Niños, Córdoba
Raúl Solernó
Hospital El Cruce Pcia Buenos Aires
Pablo Stutzbach
Las Lomas, Bs. As.
Héctor Vetulli
Sanat. Otamendi y Miroli, CABA
José Vicario
Sanat. Garay, Santa Fe
Marcel VoosBudal
Inst. de Cardiología de Santiago del Estero, Santiago del Estero

Secretaría Científica
Amalia Descalzo
Htal. Pte.Perón, Avellaneda, Pcia. Bs As.
Maximiliano Garmendia
Htal. Italiano de Bs As, CABA
Matías Rodríguez Granillo
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 Bs. As., CABA
Claudio Cigalini
HPR Rosario, Santa Fe
Luis De la Fuente
Instituto Argentino de Diagnóstico y Tratamiento, CABA
Horacio Faella
Hospital de Niños, CABA
Jorge Leguizamón
Clínica Bazterrica, CABA
Hugo Londero
Sanatorio Allende, Córdoba, CABA
Pedro Lylyk
Eneri, CABA
Oscar Mendiz
Fundacion Favaloro, CABA
Alejandro Palacios
Trinidad Palermo, CABA
Juan Parodi
Trinidad San Isidro, Prov. Bs. As.
Matias Sztejfman
Sanatorio Güemes, CABA
David Vetcher
Bioparx, Prov. Entre Ríos
Miguel Villegas
Hospital Posadas, Prov. Bs. As.

Asesores Internacionales
Julien Adjedj
Cardiologue interventionnel, Institut Arnault Tzanck, Saint-Laurent-du-Var, Francia
John Ambrose
UCSF Fresno Medical Education Program, EE.UU.
Raúl Arrieta
Cardiopatías Congénitas, Instituto do Coração–InCor, Sao Paulo Brasil.
Giuseppe Biondi-Zoccai
Università Sapienza. Italia
Antonio Colombo
Cardiac Cath Lab and Interventional Cardiology Unit, EMO GVM Centro Cuore, Columbus and San Hospital San Raffaele, Milán, Italia
Costantino Constatini
Hospital Cardiológico Costantini, 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 Siegburg Heart Centre, Alemania
Luis Guzmán
Southside Regional Medical Center, Virginia, EEUU
Ziyad Hijazi
Sidra Medicine, Doha , Qatar
Mark Hlatky
HRP Redwood Blvd Stanford, California, EE.UU.
Adnan Kastrati
Deutsches Herzzentrum München, 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 Morís
Hospital Universitario Central, Asturias, España
Kern Morton
UC Irvine Medical Center, Long Beach, EE.UU.
Jeffrey Moses
Columbia University, USA
Igor Palacios
Harvard University, Boston, EE.UU.
Mariano Palena
Policlínico Abano Terme, Padova, Italia
Seung-Jung Park
Park Instituto del Corazón, Centro 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.
Marco Valgimigli
Inselspital Universitätsspital Bern, Berna, Suiza

Representante CACI
Ernesto M. Torresani
Representante Carrera UBA-CACI
Guillermo Migliaro
Relaciones Institucionales CACI
Lic. Carolina Pallavicini
Secretaría de Edición
Ezequiel Rivero
Administración y Finanzas CACI
CPN Claudio Losada
Miembros Honorarios
Liliana Grinfeld +
Alfredo E. Rodríguez

CACI BOARD OF DIRECTORS 2024-2025

Presidente
Juan José Fernández
Vicepresidente
Alfredo Dante Bravo
Secretario
Miguel Ángel Larribau
Prosecretario
Marcelo Elías Halac
Tesorera
Amalia María Ema Descalzo
Protesorero
Mario Andrés Fernández
Secretario Científico
Alejandro Diego Fernández
Secretario Gremial
Maximiliano Giraudo
Vocales Titulares
Raúl Solernó
*Juan Francisco Arellano*t
Juan Eustaquio Manos
Juan Fernando Álvarez Sevillano
Vocales Suplentes
Rubén Kevorkián
Gustavo Alejandro Lev
María José Cabrera Ferreyra
Daniel Eduardo Ballarino
Comisión Fiscalizadora
Titular: *Antonio Alberto Pocoví*
Suplente: María Celia Alicia Bayón
Delegados provinciales
Buenos Aires
Julio Andrés Pascua
CABA
Agustín Girassolli
Catamarca
Lorena Villagra
Chaco
Mariana Correa
Chubut
Juan Eustaquio Manos
Córdoba
Mariano Carlos Rubio
Entre Ríos
Martín Rodolfo Hermida
Formosa
Marisa Malvina Acosta
Jujuy
Diego Alejandro Rodríguez
La Pampa
Leonardo Pedro Novaretto
La Rioja
Javier Oscar Descalzi
Misiones
Carlos Alberto Babi
Neuquén y Río Negro
Diego Miguel Lavaggi
Salta
Jorge Emilio Limpias
San Juan
Juan Daniel Sebastián Lerga Almenzar
San Luis
Francisco Elías Canllo
Santa Cruz
Corina Biagioni
Santa Fe
Esteban Martín Quarchioni
Santiago del Estero
Cristian Jesús Rodríguez
Tierra del Fuego
Marcelo José Cardone
Tucumán
Jorge Alejandro Carminatti

En representación del **Consejo de Pediatría**: *Dr. Alejandro Román Peirone.*
En representación del **Consejo de Hemodinamia de la Sociedad Argentina de Cardiología (SAC)**: *Dr. Cristian M. Garmendia.*
En representación del **Comité de Hemodinamia de la Federación Argentina de Cardiología (FAC)**: *Dr. Maximiliano Rossi.*

CACI
Colegio Argentino de Cardioangiólogos Intervencionistas

Publicaciones Latinoamericanas S.R.L.

Revista Argentina de Cardioangiología Intervencionista

Publicación trimestral. © **CACI** | ISSN: **2250-7531**

Registro de la Propiedad Intelectual en trámite. Reservados todos los derechos. Ninguna parte de esta publicación puede ser reproducida en forma o medio alguno, electrónico o mecánico, incluyendo fotocopias, grabaciones y otros sistemas de información presentes o futuros sin la autorización por escrito del titular del Copyright.

Propietario: Colegio Argentino de Cardiangiólogos Intervencionistas (CACI) | Viamonte 2146 piso 6º Piso | C1056ABH CABA - Argentina

Tel/fax: 54 11 4952-2117 | E-mail: 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

Boston Scientific
Advancing science for life™
75,000 PACIENTES Y CONTANDO
Hay 75.000 razones por las que los médicos deciden intervenir en casos de embolia pulmonar con EKOS. Ningún otro dispositivo utilizado para tratar la EP se ha estudiado tanto como EKOS. Es un procedimiento de 15 minutos mínimamente invasivo y de bajo riesgo. EKOS ha sido el tratamiento intervencionista de elección para los pacientes que padecen EP.
Por esto somos EKOS.

NEFAZAN®
CLOPIDOGREL

Presentaciones:
75 mg x 15 y 30 comprimidos recubiertos

Eficacia comprobada en prevención secundaria de:

- Síndrome coronario agudo con elevación y sin elevación del segmento ST.
- Accidente cerebrovascular.
- Enfermedad arterial periférica.

+ info
0800-333-3532 / www.elea.com

Elea
Adelante con tu vida

---

hydra

CE 1434

Válvula Aortica Transcateter

Diseñada para optimizar el tratamiento en pacientes con estenosis aortica severa.

- Auto-expandible, supra-anular, pericardio bovino.
- 2 marcadores para mejor implante y liberación de los leaflets.
- Celdas de mayor tamaño para catéterizar senos coronarios (catéter hasta 15F).
- 3 tamaños: 22, 26, 30mm, entrando anulus nativos de 17-27mm.
- Sistema de liberación flexible, 14/15F, con in-line sheath, recapturable y reposicionable.

SMT

Sahajanand Medical Technologies Ltd.
Tel: +54 9 11 49174134 / +54 9 11 40288945 / Sitio web: www.smtpl.com
E-mail: german.rossi@smtpl.com / leonardo.bustos@smtpl.com

smtlatam
smtlatam
smt-latam

Las ilustraciones son únicamente representaciones del artista y no deben considerarse dibujos o fotografías de ingeniería. Esta información no reemplaza el consejo médico del doctor/médico. Hydra es fabricado por Vascular Innovations Co., Ltd, Tailandia, una empresa del grupo SMT. Hydra es una marca comercial de Vascular Innovations Co., Ltd. ©2024 Sahajanand Medical Technologies Limited - Todos los derechos reservados. Las especificaciones están sujetas a modificaciones, revisiones y mejoras.

DEBENE S.A.

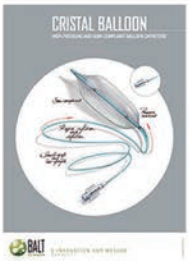
La mejor calidad en alta complejidad

Representante exclusivo para la Argentina

MERITMEDICAL

balt
inspiring innovation

Prestige Plus
Peripheral Coil System



Antezana 70, (CP1414)
Buenos Aires, Argentina
Tel.: (+5411) 4514-9966
11 5325-7052
info@debene.com
www.debene.com

CACI

NUEVA SECCIÓN:

CACI TE CUENTA

Los invitamos a visitar nuestra página web donde encontrará una nueva actualización bibliográfica cada día

¡Los esperamos en caci.org.ar!

VISITENOS

¡Síganos en nuestras redes sociales y manténgase informado!

Summary

Sumario

EDITORIAL / EDITORIAL

010

Editorial comment
Comentario editorial
Fernández Pereira C

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

012

Secondary branch patency in coronary angioplasty of bifurcation lesions with the provisional stent technique: clinical and angiographic follow-up
Permeabilidad del ramo secundario en angioplastia coronaria de lesiones en bifurcación con la técnica Stent Provisional: seguimiento clínico y angiográfico
Supicciatti GA et al.

CLINICAL CASES / CASOS CLÍNICOS

017

Percutaneous closure of atrial septal defect with a fenestrated device in a high-risk patient. Report of the first case in Argentina
Cierre percutáneo de comunicación interauricular con dispositivo fenestrado en paciente de alto riesgo. Reporte del primer caso en Argentina
Lange JM et al.

020

Percutaneous mitral valve-in-valve implantation
Implante percutáneo de valve in valve mitral
Kim A et al.

023

Colapso de *stent* durante revascularización híbrida de enfermedad oclusiva iliofemoral extensa
Stent collapse during hybrid revascularization of extensive iliofemoral occlusive disease
Voos Budal Arins M et al.

026

Stent collapse during hybrid revascularization of extensive iliofemoral occlusive disease: a case report and literature review
Colapso de stent durante revascularización híbrida de enfermedad oclusiva iliofemoral extensa : reporte de un caso y revisión bibliográfica
Danduch L et al.

030

Tratamiento endovascular de fístula aortoatrial. Complicación y resolución
Endovascular treatment of aorto-atrial fistula. Complication and resolution
Bernal Calle MJ et al.

LETTER FROM THE PRESIDENT / CARTA DEL PRESIDENTE

033

Letter from the President of CACI
Carta del Presidente del CACI
Fernández J

034

RULES OF PUBLICATIONS
REGLAMENTO DE PUBLICACIONES

Analytical summary

Sumario analítico

EDITORIAL / EDITORIAL

EDITORIAL COMMENT

Fernández Pereira C

After 12 years of excellent editorial leadership by Dr. Alfredo Rodríguez, we enthusiastically assume the challenge of leading the Argentinian Journal of Interventional Cardiology (RACI), a highly esteemed publication among those who practice interventional cardiology.

I appreciate the trust placed in me by the outgoing president of CACI, Dr. Martín Cisneros, and the new president, Dr. Juan Fernández. Both of them have notably attended and actively participated in numerous scientific meetings and ongoing discussions aimed at fair compensation in our specialty. We thank all former members and new additions to the Editorial Board, whose collaboration and commitment to RACI Journal will be much welcomed.

Sad news has recently shaken our field: Alain Cribier, the pioneer who performed the world's first percutaneous aortic valve implantation (TAVI) in 2002, passed away at the age of 79 on February 19, 2024.

Dr. Cribier had served as the Head of Cardiology at University of Rouen Charles Nicolle Hospital, in France.

ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

SECONDARY BRANCH PATENCY IN CORONARY ANGIOPLASTY OF BIFURCATION LESIONS WITH THE PROVISIONAL STENT TECHNIQUE: CLINICAL AND ANGIOGRAPHIC FOLLOW-UP

Supicciatti GA et al.

Coronary bifurcation lesions account for 15% to 20% of all percutaneous coronary interventions (PCI). Treating these lesions remains a significant challenge for interventional cardiologists due to higher procedural costs, higher complication rates, and poorer outcomes compared to PCI for simple coronary lesions. In the era of drug-eluting stents (DES), several trials have compared provisional stenting (PS), a simple strategy, with complex 2-stent strategies; however, the optimal technique remains a controversial issue. Regardless of the strategy chosen, the initial procedural success regarding these lesions has been low due to its association with a risk of side branch occlusion. This study aims to analyze the characteristics of bifurcation lesions treated with provisional stenting, identify predictors of secondary branch patency related to various technical aspects or steps during the intervention, and assess, through angiographic follow-up, the incidence of lesion restenosis and the need for revascularization.

CLINICAL CASES / CASOS CLÍNICOS

PERCUTANEOUS CLOSURE OF ATRIAL SEPTAL DEFECT WITH A FENESTRATED DEVICE IN A HIGH-RISK PATIENT. REPORT OF THE FIRST CASE IN ARGENTINA

Lange JM et al.

Atrial septal defects (ASD) are associated with complications such as pulmonary arterial hypertension (PAH) and left ventricular diastolic dysfunction (LVDD). Closure of complicated ASD is linked to adverse events; among the treatment options we can find the fenestrated patch or percutaneous fenestrated device (FASDD). We report a case of closure of complicated ASD due to PAH using a FASDD, with residual flow persistence immediately and at 6 months, and PAH improvement. FASDDs are an option in patients with complicated ASD.

PERCUTANEOUS MITRAL VALVE-IN-VALVE IMPLANTATION

Kim A et al.

This female patient had a history of multiple pathologies and severe symptomatic mitral regurgitation with a mitral bioprosthesis secondary to infective endocarditis. After solving the infectious condition with antibiotic treatment, the patient experienced marked deterioration in her quality of life due to dyspnea caused by valve disease.

Due to the high risk of surgical reintervention, the chosen alternative was a valve-in-valve mitral procedure with a percutaneous balloon-expandable Myval Ø30.5-mm valve (Meril). The implantation, performed under general anesthesia and guided by transesophageal echocardiography, was successful, without complications. The patient progressed favorably and was discharged 48 hours after the procedure. At the 30-day follow-up, the patient showed significant clinical improvement, and the Doppler echocardiogram confirmed a well-inserted and functional prosthesis.

STENT COLLAPSE DURING HYBRID REVASCULARIZATION OF EXTENSIVE ILIOFEMORAL OCCLUSIVE DISEASE: A CASE REPORT AND LITERATURE REVIEW

Voos Budal Arins M et al.

Combined revascularization with endovascular and open surgery is widely used. This hybrid strategy (HS) treats complex anatomies in high-risk patients. Guidelines recommend open surgery (OS) or hybrid approaches to treat iliofemoral occlusion (IO). While OS is associated with excellent long-term patency outcomes, it is also linked to high morbidity. HS is an alternative with lower morbidity and shorter hospital stay.

We report a case of self-expandable stent collapse during HS for IO in a high-risk patient, followed by expansion and realignment using a balloon-expandable stent.

MANAGEMENT OF BILATERAL TYPE II ENDOLEAKS FOLLOWING ENDOVASCULAR REPAIR OF ABDOMINAL AORTIC ANEURYSM: A CASE REPORT AND LITERATURE REVIEW

Danduch L et al.

A patient underwent endovascular repair of an abdominal aortic aneurysm with aortoiliac endoprosthesis implantation. During follow-up, bilateral type II endoleaks originating from lumbar branches led to aneurysm sac growth, prompting embolization of those branches with coils. Subsequent angiographic follow-up showed no further growth of the aneurysm sac.
We present this case due to the current controversy regarding the management of type II endoleaks, adding by a brief literature review on the topic.

ENDOVASCULAR TREATMENT OF AORTO-ATRIAL FISTULA. COMPLICATION AND RESOLUTION

Bernal Calle MJ et al.

Aorto-atrial fistulae can potentially cause refractory heart failure.
A 47-year-old man presented a 6-month history of lower limb edema, ascites, and progressive dyspnea. Right-to-left heart catheterization revealed a right aorto-atrial fistula. The fistula was successfully closed, but, ten days later, the patient showed signs of heart failure due to device embolization. He was readmitted to the Department of Hemodynamics for fistula closure and removal of the embolized device.
Endovascular closure of aorto-atrial fistulae is an effective procedure that is less invasive than surgery.

LETTER FROM THE PRESIDENT / CARTA DEL PRESIDENTE

LETTER FROM THE PRESIDENT OF CACI

Fernández J

Dear colleagues, In this brief overview, I want to convey my regards and welcome the new Board of Directors for 2023-2025 along with Vice-President-elect Dr. Alfredo Bravo, who will occupy my current position by the end of 2025.
I also want to express my gratitude to Dr. Alfredo Rodríguez for his commitment and dedication during his tenure as Editor of the CACI Journal. He will be succeeded by Dr. Carlos Fernández Pereira (who is part of the same group, thus providing continuity).
Since I took office on December 16, several events have unfolded. I will try to summarize them:
Unfortunately, we witnessed the passing of two founding fathers of interventional cardiology worldwide: Dr. David Antonucci and Dr. Alain Cribier.

Editorial comment

Comentario editorial

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):10-11. https://doi.org/10.30567/RACI/202401/0010-0011

After 12 years of excellent editorial leadership by Dr. Alfredo Rodríguez, we enthusiastically assume the challenge of leading the Argentinian Journal of Interventional Cardiology (RACI), a highly esteemed publication among those who practice interventional cardiology.

I appreciate the trust placed in me by the outgoing president of CACI, Dr. Martín Cisneros, and the new president, Dr. Juan Fernández. Both of them have notably attended and actively participated in numerous scientific meetings and ongoing discussions aimed at fair compensation in our specialty. We thank all former members and new additions to the Editorial Board, whose collaboration and commitment to RACI Journal will be much welcomed.

Sad news has recently shaken our field: Alain Cribier, the pioneer who performed the world's first percutaneous aortic valve implantation (TAVI) in 2002, passed away at the age of 79 on February 19, 2024.

Dr. Cribier had served as the Head of Cardiology at University of Rouen Charles Nicolle Hospital, in France.

Born in Paris in 1945, he studied at University of Paris, where he eventually specialized in cardiology. Initially drawn to cardiovascular surgery, he later committed to interventional cardiology due to its vast possibilities.

It was in Rouen where, in 1986, Dr. Cribier conducted the first of several pioneering procedures: the first cases of balloon valvuloplasty for the treatment of calcified aortic valve stenosis[1], published in a leading medical journal: The Lancet[2].

As a consequence, he became renowned worldwide; however, in a great show of intellectual honestly, he acknowledged a significant limitation of valvuloplasty: the high rate of mid-term restenosis.

The evolution of this procedure led him to initiate, in the 1990s, a new research program on a percutaneous heart valve. His focus shifted towards valve restenosis, looking to find a procedure to keep the valve open after balloon valvuloplasty. This resulted in the idea of using a bioprosthesis to prevent valve restenosis after balloon valvuloplasty. The challenge was to find the right device.

The first step was taken in 1989, when Henning-Rud Andersen first implanted a valve mounted on a balloon-expandable catheter—an original model—inside the aorta of pigs, using a handmade mesh that included a porcine valve. The results, finally published in 1992[3] after being rejected by several journals, did not immediately lead to human applications.

Concurrently, Dr. Cribier helped establish a company dedicated to developing and marketing percutaneous aortic valve replacement technology.

He further solidified his reputation when, on April 16, 2002, he performed the first TAVI procedure on a 57-year-old patient referred to Rouen after being deemed inoperable due to cardiogenic shock. Dr. Cribier and his team correctly believed that the percutaneous technique could very well be the only solution. They reached procedural success through an antegrade transeptal approach. This first case[4], published in Circulation, had profound global impact.

The patient's recovery was remarkable: immediately after valve implantation, color returned to his face, and he started speaking. Such was Dr. Cribier's own account of the procedure[5]. However, the patient had experienced several cardiac arrests before entering the cath lab, where he then had to be resuscitated again.

After Dr. Cribier's initial success, more cases followed. The journey began almost 40 years ago, with the early days of balloon aortic valvuloplasty; then, 20 years ago, we saw the first TAVI procedure. Today, thanks to Cribier's pioneering work, TAVI is the current standard of care for severe aortic stenosis.

On another note, on March 5 of this year, David Antoniucci, a prominent interventional cardiologist from Florence (Italy) who authored numerous trials, passed away. David was featured as speaker in several congresses organized by the Interventional Cardiology Research Center (CECI), where he also performed live coronary and carotid angioplasty procedures, as well as TAVI cases, with great knowledge and technical skill.

He was the first physician in Italy to introduce primary angioplasty in cases of myocardial infarction (MI)[6]: in the early 1990s, in Florence, he created the Careggi model for cardiovascular care, which was met with admiration by some and skepticism by others. Ambulances operated around the clock; these efforts came at great personal sacrifice[7]. Today, this seems to be the standard, but at the time opinions ranged from envy to disapproval.

Following the trend of implementing new techniques, David set forth to refine balloon angioplasty in cases of acute MI through conventional stenting. In this case too, any trace of doubt was overcome by the positive outcomes described in the FRESCO study[8], with a decrease in the rates of restenosis, reocclusion, and reinfarction.

David led another study related to acute MI: a multicenter, randomized trial comparing the use of abciximab[9] in stent angioplasty vs. non-use of abciximab in high-thrombotic-risk patients. This trial included our participation as an Argentine site.

Finally, David actively participated in the ISAR REACT 5 study of ticagrelor vs. prasugrel in patients with acute coronary syndromes (ACS) with or without ST-segment elevation[10]. As a result, the incidence of death, MI, or stroke was lower among those who received prasugrel. His last lecture in Buenos Aires referred to this study.

To conclude, I want to add a comment on two interesting recently published trials: the PREVENT and the DanGer Shock studies. In the PREVENT study[11] (conducted in Korea and published in Lancet), after angioplasty of culprit lesions in patients with ACS and chronic coronary syndrome, any untreated non-culprit lesion with ≥50% angiographic diameter stenosis was assessed functionally using fractional flow reserve (FFR). Additionally, non-flow-limiting intermediate lesions (FFR >0.80) were analyzed using intracoronary imaging techniques such as grayscale intravascular ultrasound (IVUS), radiofrequency IVUS, a combination of grayscale IVUS and near-infrared spectroscopy (NIRS), or optical coherence tomography (OCT), at the discretion of the treating interventional cardiologist. In this study, involving patients with non-flow-limiting vulnerable plaque, the combination of preventive angioplasty and optimal medical therapy led to a decrease in major adverse cardiac events during the long-term follow-up, compared with medical therapy alone. These striking findings offer new perspectives on angioplasty in high-risk vulnerable plaque.

The other study, DanGer Shock, presented by Dr. Jacob Eifer Møller at ACC.24 Late-Breaking Clinical Trials last April in Atlanta and simultaneously published in the NEJM[12], states that routine use of Impella CP in patients who have suffered acute MI with cardiogenic shock reduces mortality at 180 days by 12.7%, compared with the control group (45.8% vs. 58.5%; p=0.04), albeit with higher vascular complications.

This controlled, randomized trial on cardiogenic shock with 360 participants at 14 centers in Denmark, Germany, and the UK between 2013 and 2023 (DanGer Shock) is the first study with a mechanical circulatory support device showing a survival benefit in MI-related cardiogenic shock patients.

Dr. PhD. Carlos Fernández Pereira FACC, FESC, FSCAI
Editor-in-chief Revista Argentina de Cardioangiología Intervencionista (RACI)

REFERENCES

1. *A Cribier, T Savin, N Saoudi, et al. Percutaneous transluminal aortic valvuloplasty using a balloon catheter. A new therapeutic option in aortic stenosis in the elderly. Arch Mal Coeur Vaiss. 1986 Nov;79(12):1678-86. PMID: 3105479*
2. *Cribier A, Savin T, Saoudi N, et al. Percutaneous transluminal valvuloplasty of acquired aortic stenosis in elderly patients: an alternative to valve replacement? Lancet 1986;1:63-7.*
3. *Andersen HR, Knudsen LL, Hasenkam JM. Transluminal implantation of artificial heart valves. Description of a new expandable aortic valve and initial results with implantation by catheter technique in closed chest pigs. Eur Heart J 1992;13:704-8.*
4. *Cribier A, Eltchaninoff H, Bash A, et al. Percutaneous transcatheter implantation of an aortic valve prosthesis for calcific aortic stenosis: first human case description. Circulation 2002;106:3006-8.*
5. *Alain Cribier. Development of transcatheter aortic valve implantation (TAVI): A 20-year odyssey. Archives of Cardiovascular Disease 2012;105:146-152.*
6. *Bolognese L, Reccia MR, Sabini A. Contribuciones italianas a la historia del tratamiento del infarto agudo de miocardio. Minerva Cardiol Angiol 2024;72:32-40.*
7. *Antoniucci D, Santoro GM, Bolognese L, et al. Angioplastia coronaria primaria para el infarto agudo de miocardio asociado con disfunción ventricular izquierda grave. Resultados en 50 pacientes. G Ital Cardiol 1995;25:1265-71.*
8. *Antoniucci D, Santoro GM, Bolognese L, et al. A clinical trial comparing primary stenting of the infarct-related artery with optimal primary angioplasty for acute myocardial infarction: results from the Florence Randomized Elective Stenting in Acute Coronary Occlusions (FRESCO) trial. J Am Coll Cardiol. 1998 May;31(6):1234-9. doi: 10.1016/s0735-1097(98)00097-7. PMID: 9581713.*
9. *Antoniucci D, Rodríguez A, Hempel A, et al. A Randomized Trial Comparing Primary Infarct Artery Stenting with or Without Abciximab in Acute Myocardial Infarction. JACC Vol. 42, No. 11, 2003 Abciximab in AMI December 3, 2003:1879-85.*
10. *Schüpke S, Neumann FJ, Menichelli M, et al. ISAR-REACT 5 Trial Investigators. N Engl J Med. 2019 Oct 17;381(16):1524-1534. doi: 10.1056/NEJMoa1908973. Epub 2019 Sep 1. PMID: 31475799 Clinical Trial.*
11. *Seung-Jung Park, Jung-Min Ahn , Do-Yoon Kang, et al Preventive percutaneous coronary intervention versus optimal medical therapy alone for the treatment of vulnerable atherosclerotic coronary plaques (PREVENT): a multicentre, open-label, randomized controlled trial. PREVENT Investigators. Lancet. 2024 Apr 4: S0140-6736(24)00413-6. doi: 10.1016/S0140-6736(24)00413-6.*
12. *Møller J.ED, Engstrøm T, Jensen LO, et al. Microaxial Flow Pump or Standard Care in Infarct-Related Cardiogenic Shock.Published April 7, 2024. N Engl J Med 2024;390:1382-1393DOI: 10.1056/NEJMoa2312572.Vol. 390 No. 15.*

Secondary branch patency in coronary angioplasty of bifurcation lesions with the provisional stent technique: clinical and angiographic follow-up

Permeabilidad del ramo secundario en angioplastia coronaria de lesiones en bifurcación con la técnica Stent Provisional: seguimiento clínico y angiográfico

Giuliana Andrea Supicciatti (ORCID 0009-0006-1166-7224)[1], Guillermo Javier Pacheco[1], María José Cabrera Ferreyra[1], Hugo José Londero[1], Nicolás Zaderenko[1]

ABSTRACT

Coronary bifurcation lesions account for 15% to 20% of all percutaneous coronary interventions (PCI). Treating these lesions remains a significant challenge for interventional cardiologists due to higher procedural costs, higher complication rates, and poorer outcomes compared to PCI for simple coronary lesions. In the era of drug-eluting stents (DES), several trials have compared provisional stenting (PS), a simple strategy, with complex 2-stent strategies; however, the optimal technique remains a controversial issue. Regardless of the strategy chosen, the initial procedural success regarding these lesions has been low due to its association with a risk of side branch occlusion. This study aims to analyze the characteristics of bifurcation lesions treated with provisional stenting, identify predictors of secondary branch patency related to various technical aspects or steps during the intervention, and assess, through angiographic follow-up, the incidence of lesion restenosis and the need for revascularization.

Keywords: (MeSH): angioplasty, stents, bifurcation, DES.

RESUMEN

Las lesiones coronarias en bifurcación representan del 15% al 20% de las intervenciones coronarias percutáneas (ICP). El tratamiento de estas lesiones sigue siendo un desafío considerable para los cardiólogos intervencionistas debido a que se asocian con mayores costos del procedimiento, mayores tasas de complicaciones y peores resultados en comparación con la ICP de lesiones coronarias simples. En la era de los stents liberadores de fármacos (DES), se han publicado varios ensayos que comparan una estrategia simple como la técnica Stent Provisional (SP) con estrategias complejas de 2 stents; sin embargo, persisten las controversias sobre la elección correcta de la técnica e, independientemente de la estrategia, el éxito inicial del procedimiento en este tipo de lesiones ha sido más bajo, asociado con el riesgo de oclusión de la rama lateral. A partir de este estudio se pretenden analizar las características de las lesiones en bifurcación tratadas con técnica Stent Provisional, determinar predictores de permeabilidad del ramo secundario referidos a diferentes aspectos técnicos o pasos durante la intervención y evaluar con seguimiento angiográfico la incidencia de reestenosis de la lesión y la necesidad de nueva revascularización.

Palabras clave: (MeSH): angioplastia, stents, bifurcación, DES.

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):12-16. https://doi.org/10.30567/RACI/202401/0012-0016

INTRODUCTION

Coronary bifurcation lesions account for 15% to 20% of all percutaneous coronary interventions (PCI)[1]. By definition, these lesions involve the exit of a secondary branch whose patency must be preserved due to its impact on clinical outcomes, given its size and the extent of its irrigation to the myocardium[2]. These lesions take on various forms of presentation, depending on plaque distribution and the number of bifurcation components involved. The Medina classification is currently the most widely accepted categorization in the field of interventional cardiology, due to its simplicity and practical utility. It is based on the identification of three bifurcation components: the proximal main vessel (PMV), distal main vessel (DMV), and the side branch (SB). Following this sequence, the classification assigns a binary value (1, 0) depending on whether the aforementioned bifurcation segments are involved or not. Accordingly, there are seven possible morphologies, including a subgroup termed "true bifurcations," where significant disease is present in at least one component of the main vessel (MV) and in the SB. These are {1,1,1}, {1,0,1}, {0,1,1}[2]. However, beyond the Medina classification, there are other characteristics that define a bifurcation lesion and make each case unique. The first aspect is the significance of the SB (its size in relation to the main vessel). Another aspect to consider, with technical implications, is lesion length at the SB level, which can be focal—only affecting the ostium—or extend over a greater length. Also relevant is the angle between the SB and the MV, and so are the ultrasound characteristics of the bifurcation (plaque distribution and carina morphology). After stenting in the MV, depending on all these features, the SB may experience dynamic changes leading to greater stenosis than before or even complete vessel occlusion[3-5].

Treating these lesions remains a significant challenge for interventional cardiologists due to higher procedural costs, higher complication rates, and poorer outcomes compared to PCI for simple coronary lesions. When deciding on the treatment of bifurcation lesions, there are numerous techniques available, categorized as either simple or complex, with varying degrees of difference and levels of adoption (provisional stenting, Culotte, Crush, Minicrush, T-stenting with minimal protrusion, etc.)[6].

In the era of drug-eluting stents (DES), several published trials have compared provisional stenting (PS), a simple technique, with complex systematic 2-stent strategies; however, the optimal technique remains a controversial issue. Regardless of the strategy chosen, the initial procedural success regarding these lesions has been low, due to its association with a risk of side

1. Sanatorio Allende. Córdoba, Argentina.

✉ Corresponding author: *Supicciatti Giuliana Andrea. giulianasupi@gmail.com*

No conflicts of interest whatsoever

Received: 08/02/2024 | Accepted: 17/04/2024

branch occlusion. Furthermore, long-term outcomes are linked to a high rate of reintervention[7,8].

The term "simple" applied to a technique or strategy refers to techniques where a stent is placed in the MV, and SB stenting happens only after an unsuccessful outcome of the initial approach. This technique is called provisional stenting, stepwise technique, or stepwise approach. Similarly, we can define as "complex" a strategy where two stents are the initial consideration (two-stent technique) or cases of PS that derive in SB stenting. All published randomized studies show superiority of the simple or stepwise strategy over complex techniques[9,10].

As mentioned earlier, in a simple or SP strategy, the SB is treated in case of significant stenosis and antegrade flow involvement, as opposed to systematically. Regarding the technique, an angioplasty guidewire is used towards the MV. Recommendations then suggest the use of a second guidewire towards the SB, even without significant lesion in this vessel, since its origin may be compromised by plaque and/or carina displacement during MV treatment. If necessary, balloon predilation of the MV may be considered. In some studies, SB predilation has been proven counterproductive because it may cause a proximal dissection that subsequently complicates the crossover. However, there is controversy on this point, and some teams predilate the SB without any subsequent major crossover difficulties. Regarding the choice of stent for the MV, an attempt should be made to adjust it to the diameter of the distal MV. Additionally, the chosen stent must be long enough to cover the bifurcation correctly. If there is a marked difference in diameter between the proximal and distal segments, it may be necessary to perform post-dilation with a larger-diameter balloon at the proximal segment of the stent (POT: proximal optimization technique) to correct malapposition. Once the stent is implanted in the MV, if the SB result is acceptable, the treatment is completed. If the SB result is suboptimal, a new angioplasty guidewire should be used to cross towards that branch, and angioplasty should be performed on the SB ostium. While performing such SB dilation using the kissing balloon technique (simultaneously using a balloon in the MV and a balloon in the SB) has been considered essential, various studies have shown that systematical use of kissing balloon (KB) in these cases, regardless of the result in the SB, does not provide any advantage. If balloon dilation of the SB results in an acceptable outcome, treatment can be concluded. If a good SB result is not achieved, SB stenting will be considered. Experts have described that, with the single-stent technique, final KB dilation does not seem to provide any benefit. In the case two-stent implantation, the recommendation is to always conclude treatment with simultaneous dilation in both branches[12-14].

Based on this study, our aim is to analyze the characteristics of bifurcation lesions treated with the SP technique, determine predictors of SB patency related to various technical aspects or procedural steps, and evaluate the incidence of lesion restenosis and need for repeat revascularization through angiographic follow-up.

MATERIALS AND METHODS

This observational and retrospective study included 45 patients who underwent bifurcation angioplasty with PS at the Department of Hemodynamics and Catheterization Interventions of Sanatorio Allende, Cerro branch, from July 1, 2017, to July 1, 2022.

Clinical data were collected from the digitalized medical records system, and angiographic and procedural data were obtained from the Department's electronic database.

Bifurcated lesions were defined according to the previously described Medina classification.

The single-stent bifurcation lesion angioplasty technique, also referred to as PS, was defined as treating the main branch with a stent and then treating the side branch only in cases of significant stenosis and flow difficulty, as opposed to systematically.

The kissing balloon technique was defined as simultaneously inflating a balloon in the MV and another at the SB origin.

The POT technique was defined as post-dilation with a larger-diameter balloon in the proximal segment of the stent to correct malapposition. It is used when there is a significant difference in diameter between the proximal and distal segments of the vessel.

Researchers assessed various technical aspects of angioplasty, correlating them with side branch patency, percentage of restenosis, and need for treated vessel repeat revascularization through angiographic follow-up three months after the initial intervention.

Statistical methodology

Data collected from medical records and angiographic studies were used to create an Excel database that was then used for statistical processing. For quantitative variables, measures of central tendency and dispersion (mean and standard deviation [SD]) were calculated. For categorical variables, absolute and percentage distributions were calculated. The chi-square test was applied to correlate categorical variables. In all cases, the significance level used was 0.05. The software used for statistical processing was InfoStat (v.2020). Results are presented as graphs or tables as appropriate.

Inclusion criteria:

- Patients of both sexes.
- Angioplasty of *de novo* coronary bifurcation lesions using the PS technique.
- Bifurcation lesions with a SB diameter greater than 2 mm.
- PCI for silent ischemia, stable/unstable angina, or myocardial infarction.

Exclusion criteria:

- Intended use of 2 or more stents.
- Left main coronary artery bifurcation lesions.
- Need to discontinue antiplatelet therapy before 6 months have passed.
- Patients without angiographic follow-up after 3 months post-intervention.

RESULTS

During the study period, a total of 2107 coronary angiographies were conducted; 998 of them were performed on angioplasties and, of those, 159 were performed on bifurcation lesion angioplasties. Finally, 45 of those were performed on bifurcation lesions treated using the PS technique. That was the analyzed patient sample (**Figure 1**).

Most of these patients were men, about 82% of the total. Regarding age, the mean was 60.1 years (SD = 12.6), with ages ranging from 39 to 92 years. As for comorbidities, 51% of patients were hypertensive, 44% were smokers, and 33% were diabetic (**Table 1**).

TABLE 1. General characteristics of the sample (n = 45).

Variables	Values
Age (in years) - mean (SD)	60,1 (12.6)
Sex - n (%)	
Women	8 (18%)
Men	37 (82%)
Comorbidities - n (%)	
Hypertension	23 (51%)
Smoking	20 (44%)
Prior MI	12 (27%)
Diabetes	15 (33%)
Prior PCI	12 (27%)

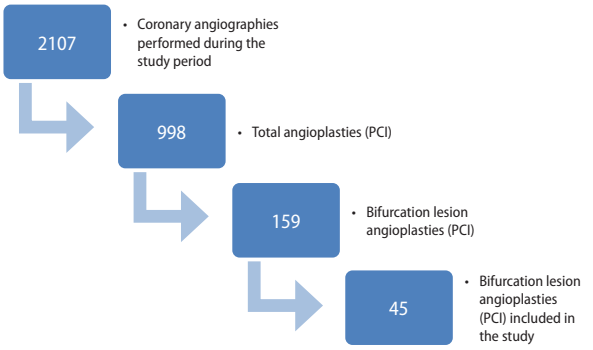


Figure 1. *Number of bifurcation lesion angioplasties according to the inclusion criteria.*

The most frequent clinical presentations were ST-segment elevation acute coronary syndrome (STEACS), 38%, and exertional angina, 27%. The access sites were, in similar proportions, the transradial and transfemoral: 49% and 51%, respectively. In the vast majority of patients (80%), the bifurcation lesion was located in the left anterior descending artery with the diagonal branch.

According to the Medina classification of coronary bifurcation lesions, 67% were type 1,1,1 and 24% were type 1,1,0 (**Figure 2**).

Twenty percent (9) of patients had their SB protected with a guidewire. When correlating SB protection with a guidewire with vessel patency at the end of the procedure and at follow-up, there was a significant difference in SB patency at the end of the procedure (**Table 2**). All patients without guidewire protection had SB patency, while, among those who received protection, the patency rate was 89% (11% experienced SB occlusion).

In 11% (5) of patients, the SB was predilated with a balloon. When correlating SB predilation with patency, there was a significant difference at the end of the procedure, where all patients without SB predilation had patency, while, among those with predilation, the patency rate was 80% (**Table 3**).

As regards guidewire crossover to the SB, it was observed in 38% (28) of the total patients. Ninety-four percent of patients who underwent guidewire crossover to the SB had SB patency both at the end of the procedure and at follow-up. The difference with patients who did not undergo crossover was not significant.

Additionally, the kissing balloon technique was used at the end of the procedure on 36% (29) of patients. There was no significant correlation between the final use of the kissing balloon technique and SB patency, neither at the end of the procedure nor at follow-up. Forty-nine percent of patients were reassessed because they experienced chest pain. Eighteen percent of cases underwent target lesion revascularization, and 16% had STEACS (**Figure 3**).

The average time elapsed until the follow-up study was 11.2 months (SD = 9.8), ranging from 3 months to a maximum of 38 months.

Finally, during the angiographic follow-up, out of all the patients, only one had restenosis with total intrastent occlusion of the main vessel, and another one had moderate neointimal proliferation. The first patient underwent myocardial revascularization surgery. The remaining patients did not experience significant MV restenosis. Regarding the SB, only 4% (2) patients had complete SB occlusion. Of the 96% who had SB patency, 44% (19) patients had severe involvement (equal to or greater than 70%). None of them required repeat target-lesion revascularization.

DISCUSSION

Coronary bifurcation lesions vary widely, with a wide range of bifurcation angles and MV and SB diameters. As a philosophy, "simplifying the complex" has been supported by several clinical trials demonstrating that the PS technique is associated with better clinical outcomes compared with a routine two-stent approach. However, for the first time ever, the DKCRUSH II trial reported a reduced restenosis rate using the DK-CRUSH (double kissing-crush) technique with two stents in true bifurcations (Medina 1,1,1 or Medina 0,1,1), compared with the PS technique[15].

Among patients in whom the PS technique was used, the optimal SB treatment remains uncertain. An unresolved issue is whether final KB dilation should be performed. In the Nordic-Baltic Bifurcation Study III, patients with bifurcation lesions in whom the PS technique was used were randomized to final KB dilation or not. At the 8-month follow-up, there were no significant differences in terms of restenosis and major adverse cardiac events[14]. In our study, there were no significant differences either in terms of BS patency with and without final KB dilation. Another question regarding the technique is whether SB balloon angioplasty is necessary, especially in less complex bifurcation lesions. The COBIS III study analyzed 2194 patients with bifurcation lesions who underwent PCI using the PS technique. Of them, 23.2% underwent SB balloon angioplasty; these patients had more complex lesions, mostly true bifurcations (Medina 1,1,1 or 0,1,1). In this group, the percentage of SB stenosis was lower after the procedure. However, there were no significant differences in the primary endpoint of target-lesion failure at the 5-year follow-up compared with those who did not undergo SB balloon angioplasty[16]. After analyzing this point in our work, we found a significant difference regarding the SB patency at the end of the procedure: there was SB patency in all patients who underwent SB balloon dilation compared with 20% occlusion in those who underwent balloon angioplasty. This could be due to the fact that the patients who underwent SB balloon angio-

TABLE 2. SB occlusion and patency according to SB protection.

Variables	Categories	SB guidewire				p-value
		No (n = 36)		Yes (n = 9)		
		Number of patients	Percentage	Number of patients	Percentage	
SB occlusion after MV stenting	No	35	97%	8	89%	0.278
	Yes	1	3%	1	11%	
SB patency at the end of the procedure	No	0	0%	1	11%	**0.043**
	Yes	36	100%	8	89%	
SB patency at follow-up	No	1	3%	1	11%	0.278
	Yes	35	97%	8	89%	

TABLE 3. SB occlusion and patency according to SB predilation.

Variables	Categories	SB predilation				p-value
		No (n = 40)		Yes (n = 5)		
		Number of patients	Percentage	Number of patients	Percentage	
SB occlusion after MV stenting	No	39	98%	4	80%	0.073
	Yes	1	3%	1	20%	
SB patency at the end of the procedure	No	0	0%	1	20%	**0.004**
	Yes	40	100%	4	80%	
SB patency at follow-up	No	1	3%	1	20%	0.073
	Yes	39	98%	4	80%	

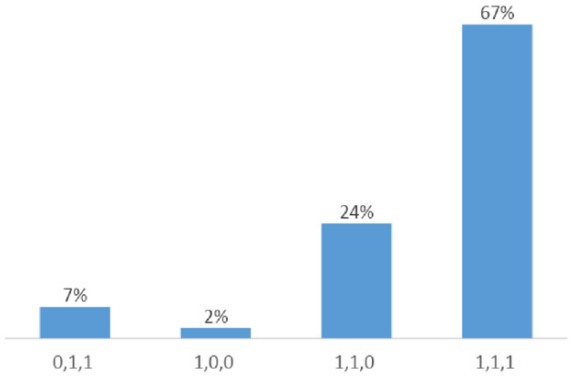


Figure 2. *Distribution of the sample according to lesion type (n = 45).*

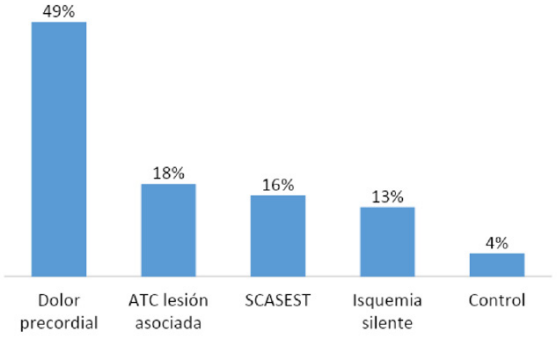


Figure 3. *Distribution of the sample according to reason for reassessment (n = 45).*

plasty had more complex bifurcated lesions that were true bifurcations according to the Medina classification.

Regarding POT, it is particularly important in those patients who undergo final KB dilation to avoid geometric distortion of the proximal segment of the stent in the MV[17]. Currently, the vast majority of studies recommend routine POT after MV stenting to correct stent underdeployment and malapposition[18]. In our study, POT was performed in 48% of patients; however, there were no differences in terms of SB patency or lesion restenosis at follow-up compared with patients who did not undergo POT.

Even though it still is subject to great debate, the provisional stenting technique continues to be the preferred strategy in most cases of bifurcation lesion. This technique allows for a flexible start to the procedure, i.e., it is based on the results. While some studies have shown less restenosis with the two-stent strategy, this method was not superior to the PS technique in terms of adverse cardiovascular events and it increased procedure time, contrast use, radiation dose, and costs[15].

CONCLUSION

Based on our site's experience with coronary angioplasty in bifurcation lesions using the PS technique, patients who underwent some kind of intervention in the SB (protection with guidewire, predilation, or crossover), experienced a higher rate of occlusion. Most patients were reassessed with angiography after reporting chest pain; however, the rates of restenosis were minimal, and none of them required repeat target-lesion revascularization.

REFERENCES

1. *Latib A, Colombo A. Enfermedad de las bifurcaciones: ¿quésabemos, qué debemoshacer? Am Coll Cardiol Cardiovasc Interv2008;1:218–226.*
2. *Medina A, Suárez de Lezo J, Pan M. A new classification of coronary bifurcation lesions. Rev Esp Cardiol 2006;59(2):183.*
3. *Suárez de Lezo J, Medina A, Martín P, et al. Predictores de daño de la rama lateral ostial durante la colocación de stent provisional de lesiones de bifurcación coronaria que no involucranelorigen de la rama lateral: un estudioultrasonográfico. EuroIntervención 2012;7(10):1147–54.*
4. *Vassilev D, Gil RJ, Koo BK, et al. Los determinantes del compromiso de la rama lateral después de la colocación de stent enelvaso principal enlesiones de bifurcación coronaria. Kardiol Pol 2012;70(10):989–97.*
5. *Hildick-Smith D, de Belder A, Cooter N, et al. Un ensayoaleatorizado de stent liberador de fármacos simple versus complejo para lesionesenbifurcación: El estudiobritánico de bifurcación coronaria: estrategiasantiguas, nuevas y enevolución (BBC ONE). Circulation. 2010;121 :1235-1243.*
6. *Iakovou I, Ge L, Colombo A. Contemporany stent treatment of coronary bifurcations. J Am Coll Cardiol. 2005;46:1446-1445.*
7. *Colombo A, Bramucci E, Sacca S, et al. Estudioaleatorizado de la técnica de aplastamientofrente a la colocación de stent provisional en la rama lateral enbifurcacionescoronariasverdaderas:elestudio CACTUS (Bifurcacionescoronarias: aplicación de la técnica de aplastamiento con stents liberadores de sirolimus). Circulation.2009;119:71–78.*
8. *Sawaya FJ, Lefevre T, Chevalier B, et al. Contemporary approach to coronary bifurcation lesion tratment. J Am Coll CardiolIntv2016;9:1861-78.*
9. *Behan MW, Holm NR, Curzen NP et al. Simple or complex stenting for bifurcation coronary lesions: a patient-level pooled-analysis of the Nordic Bifurcation Study and the British Bifurcation Coronary Study. Circ Cardiovasc Interv. 2011;4 (1):57-64.*
10. *Levine GN, Bates ER, Blankenship JC, et al. 2011 accf/aha/scai guideline por percutaneous coronary intervention: A report of the american college of cardiology foundation/american heart association task force on practice guidelines and the society for cardiovascular angiography and interventions. Circulation. 2011.*
11. *Suárez de Lezo J, Medina A, Martin P, et al. Predictors of ostial side branch damage during provisional stenting of coronary bifurcations lesions nor involving the side branch origin: An ultrasonographic study. EuroIntervention 2011.*
12. *Gwon HC, Hahn JY, Koo BK et al. Final kissing ballooning and long-term clinical outcomes in coronary bifurcation lesions treated with 1-stent technique: results from the COBIS registry. Heart. 2012;98(3):225–31.*
13. *Niemelä M, Kervinen K, Erglis A, et al. Randomized comparison of final kissing balloon dilatation versus no final kissing balloon dilatation in patients with coronary bifurcation lesions treated with main vessel stenting: the Nordic-Baltic Bifurcation Study III. Circulation. 2011;123(1):79–86.*
14. *Giustino G, Stone GW. Provisional Stenting of Coronary Bifurcations: When to Treat the Side Branch. J Am Coll Cardiol. 2021:65-7.*
15. *Zhang J-J, Ye F, Xu K, et al. Multicentre, randomized comparison of two-stent and provisional stenting techniques in patients with complex coronary bifurcation lesions: the DEFINITION II trial. European Heart Journal. 2020:2523-2536*
16. *Lee CH, Nam CW, Cho YK, et al. 5 year-outcome of simple crossover stenting in coronary bifurcation lesions, compared with side branch opening. JACC Asia 2021;1:53-64.*
17. *Burzzotta F, Lassen JF, Lefevre T, et al. Percutaneous coronary intervention for bifurcation coronary lesions: The 15(th) consensus document from de European Bifurcation Club. EuroIntervention2021;16:1307-17.*
18. *Abdalla Filho R, Goncalves G, Pinton FA, Alves da Costa R. Angioplasty in coronary bifurcation: Provisional stent technique. J TranscatIntervent 2021;29:eA202014.*

Percutaneous closure of atrial septal defect with a fenestrated device in a high-risk patient. Report of the first case in Argentina

Cierre percutáneo de comunicación interauricular con dispositivo fenestrado en paciente de alto riesgo. Reporte del primer caso en Argentina

Juan Manuel Lange[1], Paula Virginia Guiroy[1], Juan Héctor Guiroy[1], Iara Taragano[1], Jesús Damsky Barbosa[1,2]

ABSTRACT

Atrial septal defects (ASD) are associated with complications such as pulmonary arterial hypertension (PAH) and left ventricular diastolic dysfunction (LVDD). Closure of complicated ASD is linked to adverse events; among the treatment options we can find the fenestrated patch or percutaneous fenestrated device (FASDD). We report a case of closure of complicated ASD due to PAH using a FASDD, with residual flow persistence immediately and at 6 months, and PAH improvement. FASDDs are an option in patients with complicated ASD

Keywords: atrial septal defect, pulmonary hypertension, percutaneous closure, fenestrated device.

RESUMEN

La comunicación interauricular (CIA) se asocia a complicaciones, como la hipertensión pulmonar arterial (HAP) y la disfunción diastólica del ventrículo izquierdo (DDVI). El cierre de la CIA complicada se asocia a eventos adversos, el parche fenestrado o dispositivo percutáneo fenestrado (DPF) son opciones de tratamiento. Presentamos el cierre de una CIA complicada por HAP con DPF con persistencia del flujo residual inmediatamente y a los seis meses con mejoría de la HAP. Los DPF son una opción en pacientes con CIA complicadas.

Palabras clave: comunicación interauricular, hipertensión pulmonar, cierre percutáneo, dispositivos fenestrados.

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):17-19. https://doi.org/10.30567/RACI/202401/0017-0019

INTRODUCTION

ASD accounts for 8-10% of all cases of congenital heart disease (CHD)[1]. PAH is one of its complications[2]. Unfortunately, in adult patients, PAH is not the only frequent complication: there are also LVDD and increased left ventricular filling pressure, leading to pulmonary edema and right ventricular dysfunction once the ASD is completely occluded[3]. ASD closure is contraindicated in adult patients with mean pulmonary artery pressure (mPAP) >20 mmHg and pulmonary vascular resistance (PVR) >5 Wood units. Surgical strategies like the fenestrated patch/device technique are a good alternative in the medium term for these high-risk patients[4, 5]. In manual fenestrations, the amount of residual shunt created can be excessive or occluded. Therefore, preformed fenestrated ASD closure devices are an alternative because their residual shunting is predictable. We report the case of a patient with complicated ASD due to PAH who underwent percutaneous closure with a FASDD.

CASE REPORT

The patient was a 50-year-old woman, 96 kg (211 lb), diagnosed with symptomatic *ostium secundum* ASD, New York Heart Association (NYHA) functional class III dyspnea, 94% saturation in ambient air, and 85% saturation on exertion.

A transesophageal echocardiographic evaluation revealed an ASD with a 20-mm major static diameter bidirectional shunt and a 39-mm diameter atrial septum. The posteroinferior and posterior edges were 3 mm and 2 mm, respectively, with flexible constitution. Both ventricles had preserved function, and there was no LVDD. There was right ventricular dilation: the Z-score was 2.0[6].

The hemodynamic assessment and the first ASD occlusion test are included in **Table 1.** mPAP was 63% of the systemic blood pressure, even when the PVR was 4.6 uW/m^2. The pulmonary vascular resistance/systemic vascular resistance (PVR/SVR) ratio was 0.7, with a 95.5% systemic blood saturation in ambient air without other causes of desaturation. Consequently, researchers assumed the presence of PAH. In spite of that, a Qp/Qs of 1:1.3 led to the suggestion of elevated pulmonary pressure (hyperdebit). In the ASD occlusion test, mPAP remained the same and Qp/Qs decreased along with PVR, but the values for the latter were still out of the normal range. Left pulmonary vein pressure and left atrial pressure remained at pre-test values.

The patient underwent medical treatment for heart failure and PAH; she was prescribed sildenafil 25 mg twice daily for three months. Then, repeat catheterization was performed to assess the ASD. PVR had decreased to 2.95 uW/m^2. Given this new situation and anatomical feasibility, ASD closure with a fenestrated device was considered.

1. Instituto Cardiovascular Chaco. Chaco, Argentina.
2. Hospital Pedro Elizalde, CABA, Argentina.

✉ Corresponding author: *Juan Manuel Lange. Instituto Cardiovascular Chaco. Resistencia, Chaco, Argentina. juanmanuellange@gmail.com*

No conflicts of interest whatsoever.

Received: 06/03/2024 | Accepted: 17/04/2024

TABLE 1. First hemodynamic assessment.

	Pressure mmHg FiO_2 21%	O_2 saturation % at FiO_2 21%	Pressure mmHg Occlusion test	O_2 saturation % in occlusion test at FiO_2 21%
SVC	9	82.7	9	78.2
mPAP	39	82.7	40	86.2
sPAP	59		69	
dPAP	29		34	
LA	9		10	
LPP	8	98.6	10	
sAo	90	95.9	94	96.7
mAo	62		62	
dAo	50		46	
PVR uW/m_2	4.6		3.2	
SVR uW/m_2	6.7		11.7	
PVR/SVR	0.7		0.27	
mPP/mAoP	0.63		0.64	
Qp/Qs		1:1.2	1:1.1	
Qp	6.6		10	
Qs	8.0		9.2	
Frecuencia cardíaca lpm	80		83	
OC ml/min/m2	105			

SVC: superior vena cava. mPAP: mean pulmonary artery pressure. sPAP: systolic pulmonary artery pressure. dPAP: diastolic pulmonary artery pressure. LA: left atrium. LPP: left pulmonary pressure. sAo: systolic aortic pressure. mAo: mean aortic pressure. dAo: diastolic aortic pressure. PVR: pulmonary vascular resistance. SVR: systemic vascular resistance. mPP/mAoP: mean pulmonary pressure/mean aortic pressure ratio. OC: oxygen consumption. bpm: beats per minute.

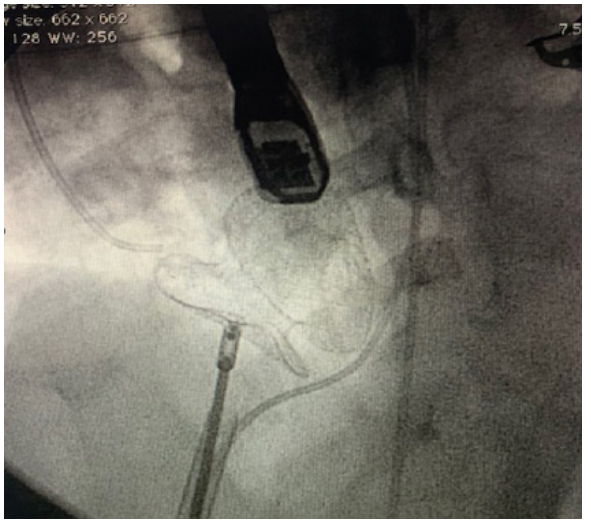


Figure 1. *Angiographic image of the fenestrated occlusion device, FASDD. Before device deployment, control by means of transesophageal echocardiography (TEE).*

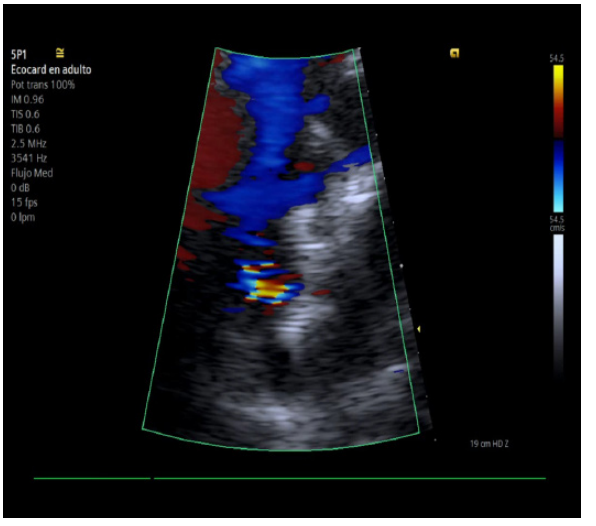


Figure 2. *TEE image. Color Doppler image of the implanted prosthesis and the flow through its fenestration.*

In the cath lab, the stop-flow diameter with a 34-mm AGA® balloon was 24 mm. The implanted device was an OCLUTECH® FASDD with a 27-mm stent,a 42-mm left disc, and 6-mm fenestration (**Figure 1**).

There were no mechanical or arrhythmic complications. There was a residual shunt of 6 mm left-to-right through the prosthesis. An echocardiography at 24 hours showed preserved biventricular systolic and diastolic function with a normally implanted device. There was a 5.6-mm left-to-right residual shunt in the device.

Six months after the ASD closure procedure, the patient was NYHA functional class II, with 97% saturation in ambient air. A transthoracic echocardiography revealed a 16.5-mmHg mPAP and a 14.1-mmHg pulmonary diastolic pressure. Device implantation was normal, and there was a 3.0-mm shunt in the device **(Figure 2).** The patient had no complications neither at one month after the cardiac catheterization nor during the six-month follow-up. She underwent another right-heart catheterization was 6.3 months after the closure procedure under local anesthesia with ambient air; the mPAP was 17 mmHg and the PVR was 1.7 uW/m^2.

DISCUSSION

This is a case of closure of complicated ASD due to PAH using a FASDD that progressed without complications and with good tolerance over the medium-term follow-up.

PVR was 4.6 uW/m^2; fortunately, the hemodynamic profile changed after three months of sildenafil treatment, and researchers considered closure of the high-risk ASD. Ayman *et al.* used a homemade fenestration ASD device to treat complicated ASD in eight consecutive elderly patients. The indication for fenestration was primarily PAH, right ventricular dysfunction in two patients, and LVDD in one patient. The homemade fenestration in the conventional ASD closure device was developed according to clinical status. The average diameter of the fenestration was 6 mm. All patients

showed clinical improvement without adverse events over one year of follow-up. The fenestration remained patent in 50 % of patients at 4 months of follow-up[7]. Schneider *et al.* used a homemade 4-mm fenestration in a conventional ASD closure device in 3 patients; indications for fenestration were two cases of restrictive left ventricular physiology and one case of PAH. These patients showed a gradual reduction in residual shunt at the 18-month follow-up[8]. Burch *et al.* closed ASD in 15 patients with PAH using a homemade fenestration and a conventional device. The average fenestration diameter was 5.2 mm. In follow-up, the fenestration remained patent in all patients[9].

Regarding our patient, we hypothesized that the residual shunt could be more stable long-term with the FASDD. Based on the literature, we considered a 6-mm fenestration. Hemodynamic and clinical status remained stable during follow-up. Stability was maintained even at 6 months.

Stumper *et al.* used the Diabolo stent technique in the atrial septum in 12 consecutive patients to relieve symptoms of inadequate Fontan circulation. All these patients showed clinical improvement regarding their PAH and protein-losing enteropathy[10].

After the intervention, our patient showed acceptable clinical conditions and the results of her 6-minute walk test were also good. We conducted a hemodynamic assessment of mPAP and PVR six months after the procedure while the patient was under sildenafil treatment. Pressures and PVR were normalized. We believe that hemodynamic changes in our patient were possibly due to the procedure being performed at the correct moment in the natural history of the ASD. To our knowledge, this is the first FASDD implanted in Argentina.

CONCLUSION

Closure with a FASDD to treat complicated ASD is a useful tool because it improves clinical and hemodynamic conditions through a low-complication procedure in high-risk patients. Further studies should be considered to prove consistency regarding complications and PAH improvement.

REFERENCES

1. *Wernovsky G, Anderson RH. (2020). Anderson's pediatric cardiology (Fourth edition.).*
2. *Tuder RM, Stacher E, Robinson J, et al. Pathology of pulmonary hypertension. Clin Chest Med 2013; 34: 639–650.*
3. *Miranda WR, Hagler DJ, Reeder GS, et al. Temporary balloon occlusion of atrial septal defects in suspected or documented left ventricular diastolic dysfunction: Hemodynamic and clinical findings. Catheter Cardiovasc Interv. 2019 May 1;93(6):1069-1075. doi: 10.1002/ccd.28150. Epub 2019 Feb 12. PMID: 30747481.*
4. *Akseer S, Horlick E, Vishwanath V, et al. Prevalence and outcomes of pulmonary hypertension after percutaneous closure of atrial septal defect: a systematic review and meta-analysis. Eur Respir Rev 2020; 29: 200099 [https://doi.org/10.1183/16000617.0099-2020].*
5. *Cho YH, Jun TG, Yang JH, et al. Surgical strategy in patients with atrial septal defect and severe pulmonary hypertension. Heart Surg Forum 2012;15:E111–E115.*
6. *Pettersen MD, Du W, Skeens ME, Humes RA. Regression equations for calculation of z scores of cardiac structures in a large cohort of healthy infants, children, and adolescents: an echocardiographic study. J Am Soc Echocardiogr. 2008 Aug;21(8):922-34.*
7. *Abdelkarim A, Levi DS, Tran B, Ghobrial J, Aboulhosn J. Fenestrated Transcatheter ASD Closure in Adults with Diastolic Dysfunction and/or Pulmonary Hypertension: Case Series and Review of the Literature. Congenit Heart Dis. 2016 Dec;11(6):663-671. doi: 10.1111/chd.12367. Epub 2016 Apr 29. PMID.*
8. *Schneider HE, Jux C, Kriebel T, Paul T. Fate of a modified fenestration of atrial septal occluder device after transcatheter closure of atrial septal defects in elderly patients. J IntervCardiol. 2011 Oct;24(5):485-90. doi: 10.1111/j.1540-8183.2011.00653.x.Epub 2011 Jun 1. PMID: 21627693.*
9. *Bruch L, Winkelmann A, Sonntag S, et al. Fenestrated occluders for treatment of ASD in elderly patients with pulmonary hypertension and/or right heart failure. J IntervCardiol. 2008 Feb;21(1):44-9. doi: 10.1111/j.1540-8183.2007.00324.x.Epub 2007 Dec 11. PMID: 18086135.*
10. *Stümper O, Gewillig M, Vettukattil J, et al. Modified technique of stent fenestration of the atrial septum. Heart. 2003 Oct;89(10):1227-30. doi: 10.1136/heart.89.10.1227. PMID: 12975427; PMCID: PMC1767900.*

Percutaneous mitral valve-in-valve implantation

Implante percutáneo de valve in valve mitral

Alejandro Kim[1], Federico Blanco[1], Sofía Pizarro[1], Carolina Gálvez Gil[1], Gerardo Esteban Gigena[1]

ABSTRACT

This female patient had a history of multiple pathologies and severe symptomatic mitral regurgitation with a mitral bioprosthesis secondary to infective endocarditis. After solving the infectious condition with antibiotic treatment, the patient experienced marked deterioration in her quality of life due to dyspnea caused by valve disease.

Due to the high risk of surgical reintervention, the chosen alternative was a valve-in-valve mitral procedure with a percutaneous balloon-expandable Myval Ø30.5-mm valve (Meril). The implantation, performed under general anesthesia and guided by transesophageal echocardiography, was successful, without complications. The patient progressed favorably and was discharged 48 hours after the procedure. At the 30-day follow-up, the patient showed significant clinical improvement, and the Doppler echocardiogram confirmed a well-inserted and functional prosthesis.

Keywords: mitral bioprosthetic insufficiency, transcatheter mitral valve in valve, balloon-expandable valve.

RESUMEN

Paciente de sexo femenino con múltiples antecedentes patológicos y portadora de insuficiencia mitral severa sintomática de prótesis biológica mitral secundaria a endocarditis infecciosa. Resuelto el cuadro infeccioso con tratamiento antibiótico, la paciente presentó un marcado deterioro en la calidad de vida consecuente a la disnea ocasionada por la enfermedad valvular.

Debido al elevado riesgo de la reintervención quirúrgica, se decidió realizar valve in valve mitral con prótesis valvular percutánea balón expandible Myval Ø30.5 mm (Meril). Bajo anestesia general y guiado por ecocardiograma transesofágico, el implante se realizó en forma exitosa, sin complicaciones. La paciente evolucionó favorablemente por lo que fue externada a las 48 horas desde el posoperatorio. A los 30 días de seguimiento se evidenció mejoría clínica significativa, y se constató prótesis normoinserta y normofuncionante en el ecocardiograma Doppler.

Palabras clave: insuficiencia mitral protésica, valve in valve mitral transcatéter, válvula percutánea balón expandible.

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):20-22. https://doi.org/10.30567/RACI/202401/0020-0022

INTRODUCTION

Patients who underwent mitral valve replacement with biological prostheses may possibly require reintervention within 10 years. Since the mortality rate for each surgical reintervention is high, the use of percutaneous valves has been explored. While there are percutaneous prostheses specific for the mitral valve under development, percutaneous balloon-expandable devices have been successfully and safely used for challenging cases like the one presented in this article.

The Edwards SAPIEN device is the percutaneous prosthesis most frequently used in the currently available evidence. Meanwhile, the similar Meril Myval prosthesis offers other features that could be favorable for implantation: a wider range of sizes, including extra-large options, and the possibility of using 14-French sheaths. Small studies have taken note of the feasibility and safety of its successful implantation. However, there is no available evidence of valve-in-valve procedures with the FOC Medical-HFS biological prosthesis used in our patient.

Meticulous planning is mandatory for the correct selection of prosthesis size to allow for anchoring on the valve structure, while also avoiding one of the most feared complications: left ventricular outflow tract obstruction.

CLINICAL CASE

Our patient was a 64-year-old woman with dyslipidemia, former smoker, with a history of Crohn's disease, breast cancer requiring surgical and radiotherapy treatment, chronic atrial fibrillation, infectious endocarditis due to *Staphylococcus aureus* at 21 years old, and at 23 years old due to *Streptococcus*, with an embolic stroke as a complication. Over the years, she developed moderate mitral regurgitation with prolapse and perforated pseudoaneurysm. She subsequently progressed to symptomatic severe mitral regurgitation, leading to a mitral valve replacement in 2022 using the FOC Medical-HFS bioprosthesis, with preservation of the subvalvular apparatus and tricuspid valve repair with placement of a size 32 hemi-ring. Echocardiograms performed after surgery and during the follow-up confirmed the presence of two perivalvular leaks; one was mild and the other, moderate. One year after surgery, she developed severe prosthetic mitral valve regurgitation due to infectious endocarditis, which required antibiotic treatment. Following treatment, a PET scan confirmed the infectious endocarditis had been successfully resolved. Due to high surgical risk (EuroSCORE II: 8.42) for a new mitral valve replacement through conventional surgery, the chosen alternative was a valve-in-valve procedure using a balloon-expandable percutaneous valve in mitral position with a Myval (Meril Lifescience) device. Up to two weeks prior to the procedure, the patient had a very severe clinical condition as per her assessment through the Kansas City Cardiomyopathy Questionnaire (global score: 8.33), experiencing dyspnea with mini-

TABLE 1. Cardiomyopathy Questionnaire Kansas City score.

	Up to 2 weeks prior	At the 1-month follow-up
Physical limitation	0	83.33
Symptom frequency	25	87.5
Quality of life	0	62.5
Social limitation	8.33	75
Overall score	8.33	77.08

1. Hemodynamics Unit, Hospital Argerich. CABA, Argentina.

✉ Corresponding author: *Alejandro Kim. alekim7@gmail.com*

Conflicts of interests: Federico Blanco is a consultant for the valve prosthesis manufacturer.

Received: 08/03/2024 | Accepted: 17/04/2024

Figure 1. *(Left) Measurement of the internal diameter of the ring. (Right) Measurement of the external diameter of the ring.*

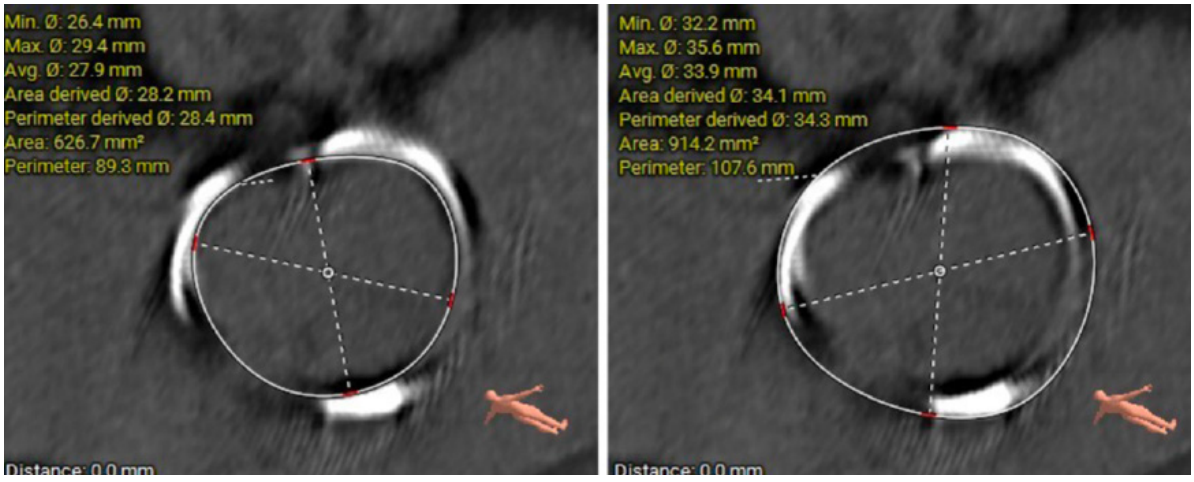


Figure 2. *(Left) Left ventricular outflow tract area. (Right) Neo left ventricular outflow tract area.*

mal exertion, rest dyspnea, and inability to walk 50 meters (55 yards) or sleep in supine position (**Table 1**).

The echocardiogram before the intervention showed preserved biventricular systolic function, sPAP 25 mmHg, severe left atrial dilation (63-mm diameter), 2 perivalvular leaks, and severe mitral regurgitation. The outflow tract area and the internal diameter of the mitral valve ring measured by CT angiography were 542.4 mm^2 and 626.7 mm^2, respectively (**Figures 1 and 2**). The procedure was performed under general anesthesia, using a right transfemoral venous access. A Transeptal intra-atrial puncture was performed with transesophageal echocardiographic guide. Due to the need for greater support, after losing position while attempting to advance the device over a Safari guidewire, progress was made using a hydrophilic-coated Cobra catheter through the transeptal puncture, left ventricle, and thoracic aorta. The distal end of the guidewire was captured with a snare from a left transfemoral arterial access and withdrawn through the introducer sheath. Subsequently, the Cobra catheter was replaced with a 7-Fr guidewire catheter. Progress was made through the catheter and, in parallel, with the hydrophilic-coated catheter, a Back Up Meier guidewire, which was also captured with the snare and withdrawn through the left transfemoral access. The hydrophilic-coated catheter and the guidewire catheter were both removed. Under pacing at 150 beats per minute, a Myval (Meril) Ø30.5-mm valve was successfully implanted (**Figure 3**). The echocardiographic control confirmed normal function of the prosthetic valve, without regurgitation, along the previously existing paravalvular leaks. During the procedure, the patient required vasopressors and experienced bradycardia requiring temporary pacing prior to valve implantation. The patient was extubated in the Hemodynamics OR, progressed favorably without complications, and was discharged 48 hours after the intervention.

At one month of follow-up, the patient showed significant clinical improvement as per assessment through the Cardiomyopathy Questionnaire Kansas City (global score: 77.08). An echocardiogram confirmed good systolic left ventricular function, a well-inserted and functional percutaneous bioprosthesis, and two periprosthetic mild-to-moderate leaks (which were already present before the procedure).

DISCUSSION

The mitral valve has a very complex anatomical and functional structure, which is reflected in its challenging treatment. The high surgical risk of reoperation for conventional valve replacement has led to the development of percutaneous techniques and devices in recent years.

Figure 3. *(Left) Balloon-expandable percutaneous valve implant. (Right) Left ventriculogram after implantation of percutaneous valve.*

The first key step is to identify the bioprosthesis implanted in the patient. Its type and size will determine the feasibility of a valve-in-valve mitral (ViVM) procedure and the correct size for the percutaneous prosthesis[1]. Our patient had received a FOC Medical HFS valve during her mitral replacement procedure. That specific valve is not included in the valve-in-valve program developed by the Minneapolis Heart Institute Foundation to help physicians choose a percutaneous prosthesis and its size, which consequently posed a challenge[2].

In a systematic review with 2684 patients who underwent ViVM using the Edwards SAPIEN balloon-expandable device, the successful implantation rate was 94-98%; the rate of mortality during the procedure ranged from 1-3%, the rate of stroke was 0-2%, and survival rates at one month and one year were 93-97% and 83-89%, respectively[3]. In principle, this would be an effective alternative with acceptable outcomes at one year. Other studies have shown similar results compared with redo surgical mitral valve replacement (redo SMVR), with one-year mortality at 11.9% for ViVM vs. 11.3% for redo SMVR[4].

Since the mitral valve diameter is typically larger aortic valve diameter, in many cases, the extra-large sizes of the Myval device (30.5 mm and 32 mm) are convenient for these types of implants. While the evidence regarding this new device in ViVM is limited compared with that for the Edwards SAPIEN valve, there is a small registry featuring the Myval balloon valve where successful implantation was reported in all cases, without residual mitral stenosis or left ventricular outflow tract obstruction[5]. Similar results have been obtained in a more recent study[6].

Left ventricular outflow tract (LVOT) obstruction, defined as an increase in the outflow tract gradient of at least 10 mmHg[6], is one of the most feared complications for ViVM. Since it is associated with higher surgical mortality, this measurement is important for procedural safety. The reported cutoff points for LVOT area are ≤1.7 cm^2 or ≤189 mm^2; they are instrumental in determining increased risk of obstruction[7, 8].

Percutaneous mitral valve implantation is a therapeutic alternative for this pathology. It can also be considered for patients with surgical mitral ring implantation (valve-in-ring) or severe native mitral valve insufficiency. However, it is still a therapeutic option that needs further exploration. Similarly to percutaneous aortic implants, in these cases durability remains uncertain. Comparative trials with conventional surgery are also pending.

CONCLUSION

The use of the Myval balloon-expandable percutaneous valve in this case of mitral valve-in-valve implantation has been successful and safe, with good clinical and echocardiographic outcomes at the 30-day follow-up. While more solid evidence with a larger number of cases is needed, this valve prosthesis could be a valid option for these patients.

REFERENCES

1. *Pirelli L, Hong E, Steffen R, et al. Mitral valve-in-valve and valve-in-ring: tips, tricks, and outcomes. Ann Cardiothorac Surg. 2021 Jan;10(1):96-112.*
2. *mplsheart.org/valve-in-valve-digital-application.*
3. *Eleid MF, Rihal CS, Guerrero ME. Transcatheter mitral valve replacement for degenerated mitral bioprostheses: a systematic review. Ann Cardiothorac Surg. 2021;10(5):558-63.*
4. *Sengupta A, Yazdchi F, Alexis SL, et al. Reoperative Mitral Surgery Versus Transcatheter Mitral Valve Replacement: A Systematic Review. J Am Heart Assoc. 2021;10(6):e019854.*
5. *Blasco-Turrión S, Serrador-Frutos A, Jose J, et al. Transcatheter Mitral Valve-in-Valve Implantation with the Balloon-Expandable Myval Device. J Clin Med. 2022;11(17):5210. Published 2022 Sep 2.*
6. *Sankardas MA, Subban V, Kothandam S, et al. Clinical Outcomes Following Transcatheter Mitral Valve-in-Valve Replacement Using a MerilMyval Transcatheter Heart Valve. Heart Lung Circ. Published online January 19, 2024.*
7. *Yoon SH, Bleiziffer S, Latib A, et al. Predictors of Left Ventricular Outflow Tract Obstruction After Transcatheter Mitral Valve Replacement. JACC Cardiovasc Interv. 2019;12(2):182-93.*
8. *Lisko J, Kamioka N, Gleason P, et al. Prevention and Treatment of Left Ventricular Outflow Tract Obstruction After Transcatheter Mitral Valve Replacement. IntervCardiol Clin. 2019;8(3):279-85.*

Stent collapse during hybrid revascularization of extensive iliofemoral occlusive disease

Colapso de stent durante revascularización híbrida de enfermedad oclusiva iliofemoral extensa

Marcel Voos Budal Arins (ORCID 0000-0002-5329-532X)[1], Ernesto Bravo[2], Antenor Alvarez[1], Marcelo Locascio[2], Rodolfo O. Gavícola[3]

ABSTRACT

Combined revascularization with endovascular and open surgery is widely used. This hybrid strategy (HS) treats complex anatomies in high-risk patients. Guidelines recommend open surgery (OS) or hybrid approaches to treat iliofemoral occlusion (IO). While OS is associated with excellent long-term patency outcomes, it is also linked to high morbidity. HS is an alternative with lower morbidity and shorter hospital stay.
We report a case of self-expandable stent collapse during HS for IO in a high-risk patient, followed by expansion and realignment using a balloon-expandable stent.

Keywords: hybrid, endovascular procedure, multilevel revascularization, occlusive iliac disease, stent collapse.

RESUMEN

La revascularización combinando cirugía endovascular y abierta se utiliza ampliamente. La estrategia híbrida (EH) trata anatomías complejas en pacientes de alto riesgo. Las guías recomiendan la cirugía abierta (CA) o híbrida para tratar la oclusión iliofemoral (OI). Si bien la CA se asocia con excelentes resultados de permeabilidad a largo plazo, se asocia con elevada morbilidad. La EH es una alternativa con menor morbilidad y estancia hospitalaria más corta.
Reportamos un caso de colapso de stent autoexpandible durante la EH para OI en un paciente de alto riesgo, que fue expandido y realineado con un stent expandible por balón.

Palabras clave: híbrido, procedimiento endovascular, revascularización multinivel, enfermedad ilíaca oclusiva, colapso de stent.

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):23-25. https://doi.org/10.30567/RACI/202401/0023-0025

INTRODUCTION

Patients with multilevel occlusive vascular disease, especially those at high surgical risk, may benefit from a hybrid strategy (HS)[1]. Current treatment guidelines recommend both open surgery (OS) and HS combining iliac angioplasty with femoral endarterectomy to treat extensive iliofemoral occlusions[2]. While traditional OS with aorto or iliofemoral bypass is associated with excellent long-term patency outcomes, it is also associated with significant perioperative morbidity. HS is an attractive and minimally invasive alternative to OS; its potential advantages are reduced perioperative morbidity and shorter hospital stay[3]. We report a case of self-expandable stent collapse during HS for iliofemoral occlusion (IO) in a high-risk patient, followed by expansion and realignment with a balloon-expandable stent.

CLINICAL CASE

The patient was a 75-year-old man with cardiovascular risk factors including hypertension, former smoking, dyslipidemia, and obesity. He had a history of ischemic heart disease and chronic obstructive pulmonary disease (COPD). He had severe intermittent claudication (Rutherford 3) in the left lower limb (LLL), which prevented him from walking more than 50 meters (55 yards). A Doppler ultrasound (DU) revealed monophasic waveforms, which are characteristic of multilevel occlusive disease (**Figure 1A**). The ankle-brachial index (ABI) in the LLL is 0.6. An angiography (**Figure 1B**) showed moderate stenosis in the right common iliac artery (RCIA), severe stenosis in the right external iliac artery (REIA), severely calcified stenosis in the left common iliac artery (LCIA), chronic total occlusion of the left external iliac artery (LEIA), chronic total occlusion of the left common femoral artery (LCFA), patent bilateral hypogastric arteries and deep femoral arteries (both of them), chronic total occlusion of both superficial femoral arteries (SFA), and patent infrapopliteal vessels (all three).
OS was ruled out due to the patient's age and comorbidities. A hybrid approach was chosen for the left iliofemoral axis and an endovascular approach for the right iliac axis.

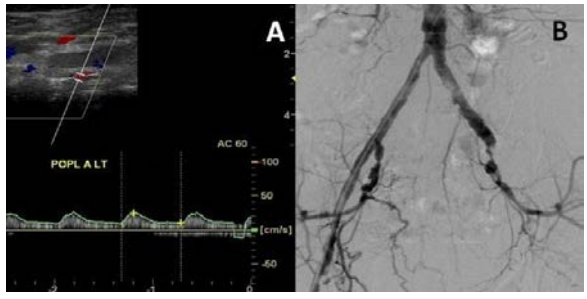


Figure 1. *Doppler ultrasound (DU) of the left popliteal artery and digital subtraction angiography (DSA) of the aortoiliac axis. A. DU of the left popliteal artery: monophasic waveform. B. DSA: extensive iliofemoral occlusion on the left side and severe stenosis in the right iliac axis.*

1. Department of Comprehensive Hemodynamics. Centro de Cardiología Intervencionista y Terapéutica Endovascular Periférica. Santiago del Estero, Argentina.
2. Department of Cardiovascular Surgery. Sanatorio 9 de Julio. Santiago del Estero, Argentina.
3. Department of Cardiology. Sanatorio 9 de Julio. Santiago del Estero, Argentina.

✉ Corresponding author: *Marcel Voos Budal Arins. Hemodinamia Integral. Centro de Cardiología Intervencionista y Terapéutica Endovascular Periférica. 9 de Julio 580. CP 4200. Santiago del Estero, Argentina. Tel.: +541144082595. marcelvoos@gmail.com*

No conflicts of interest whatsoever.

Received: 10/11/2023 | Accepted: 17/04/2024

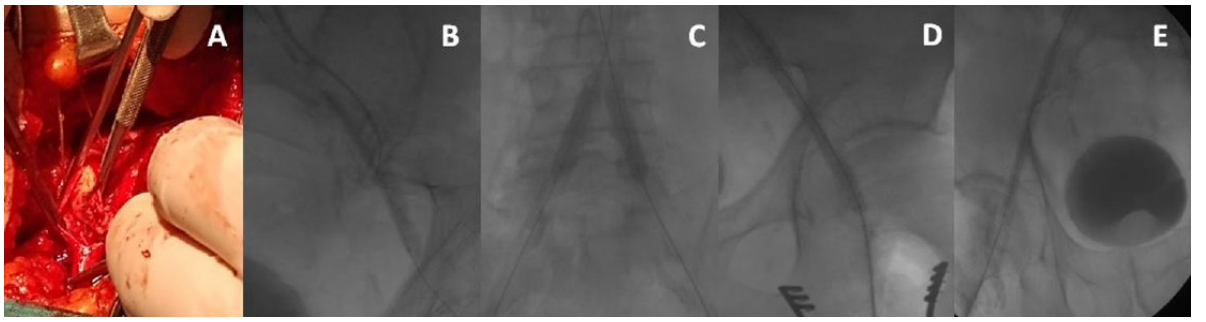


Figure 2. *Procedure. A. Femoral endarterectomy. B. Retrograde CART technique. C. Kissing stent technique. D and E. Post-dilation of self-expanding stents in both external iliac arteries.*

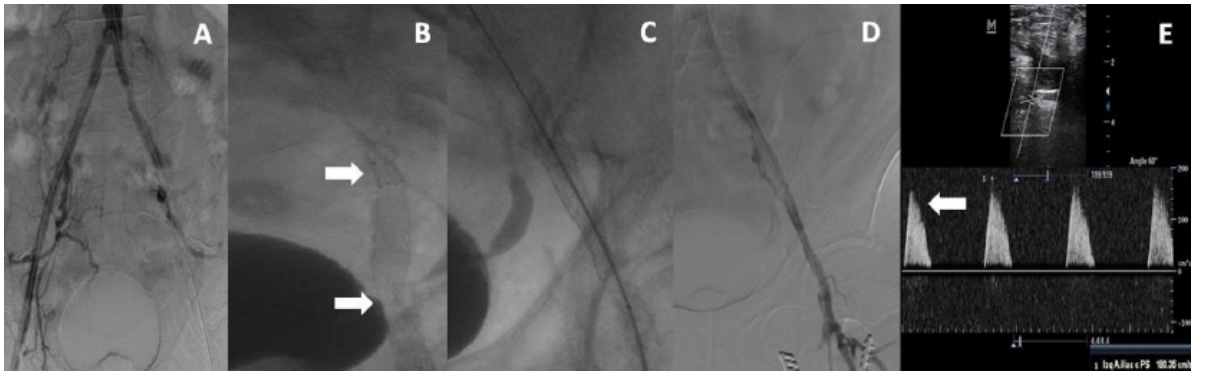


Figure 3. *Stent collapse, final outcome, and echocardiographic follow-up. A. Left external iliac artery occlusion. B. Stent collapse (arrows). C. Complete stent deployment after balloon-expandable stent implantation. D. Complete patency of the stented segment, the left common femoral artery, and the left deep femoral artery. E. DU of the distal left external iliac artery: PSV of 180 cm/s, low-volume high-resistance waveform, and a shoulder in the systolic downstroke curve, reflecting the pulse wave from distal disease.*

The patient underwent endarterectomy of the LCFA with a bovine pericardium patch and profundaplasty (**Figure 2A**).A 0.035" hydrophilic-coated guidewire was inserted through puncture in the distal portion of the patch, and a 7-Fr introducer sheath was placed. Retrograde crossing of the LEIA was attempted with support from a 4-Fr vertebral catheter and a 0.035" hydrophilic-coated guidewire, without success. The right common femoral artery was punctured retrogradely, and a 6-Fr, 45-cm introducer sheath was placed in the LCIA using the crossover technique. This maneuver was challenging due to severely calcified stenosis in the LCIA, requiring predilation with 4-mm and 6-mm balloons to facilitate introducer sheath advancement. The first attempt at LEIA antegrade rechanneling with 0.018" and 0.035" guidewires and support from various catheters failed Subsequently, operators attempted a retrograde CART technique (**Figure 2B**) with a 6-mm × 100-mm balloon at 4 atmospheres, achieving antegrade subintimal crossing and externalization of the 0.035" hydrophilic-coated guidewire through the left femoral introducer sheath.

Predilation with a 7-mm ×100-mm balloon at 16 atmospheres

The kissing stent technique was used to implant two 9-mm × 37-mm balloon-expandable coated stents (BeGraft, Bentley) in both common iliac arteries (**Figure 2C**). Two self-expanding (SE) stents (EPIC, Boston Scientific), 8 mm × 120 mm and 8 mm × 80 mm, were implanted in the distal LCIA and LEIA, respectively. An 8-mm × 100-mm SE stent (EPIC, Boston Scientific) was implanted in the REIA. On the left side, the stent was deployed at the upper edge of the endarterectomy patch (**Figures 2D and 2E**).

A control angiography revealed occlusion in the LEIA (**Figure 3A**) due to incomplete stent expansion in the most heavily calcified area (**Figure 3B, arrows**), despite post-dilation with a non-compliant 7-mm × 40-mm balloon at 20 atmospheres. To solve the stent collapse, a 7-mm × 57-mm balloon-expandable stent (BES) (Express LD Vascular, Boston Scientific) was implanted, resulting in complete stent expansion (**Figure 3C**) and complete patency of the stented segment, the LCFA, and left deep femoral artery (**Figure 3D**).

RESULTS

The patient progressed without complications and was discharged on the second day after the procedure. Dual antiplatelet therapy (aspirin 100 mg/day plus clopidogrel 75 mg/day) was prescribed for 1 year. Currently, 5 months after the procedure, the patient experiences Rutherford class 1 claudication, and his LLL ABI is 0.85. A Doppler ultrasound recorded a peak systolic velocity (PSV) of 180 cm/s, and a low-volume high-resistance waveform and a characteristic shoulder in the systolic downstroke curve, in the distal LEIA, reflecting the pulse wave of distal disease (**Figure 3E**).

DISCUSSION

Traditionally, OS is considered the most durable intervention for the treatment of IO, with excellent long-term patency. However, advanced age and patient comorbidities are associated with poor outcomes, which has spurred interest in the HS in recent decades[3]. The HS has been associated with shorter hospital stays and lower perioperative morbidity, while maintaining medium-term patency rates comparable to OS in patients with IO (TASC C/D)[4].

During the HS performed in our patient with extensive IO, an EPIC SE stent collapsed in the area of greatest calcification. Because the LEIA rechanneling was completely subintimal, no intravascular atherectomy or lithotripsy devices were used for plaque preparation.

The decision to use coated stents in both common iliac arteries (CIA) was due to their high radial force and precise implantation[5]. In the external iliac arteries (EIA), we implanted bare self-expandable (SE) stents to keep both hypogastric arteries patent, considering their greater flexibility, better adaptation to the vascular wall, and lower neointimal hyperplasia[6]. The EPIC stent has shown good results in studies on primary patency and efficacy, and it can be recommended for most iliac artery lesions[7, 8]. Cases of collapse of BES in the iliac artery have been very infrequent. Ichihashi *et al.*[9] described BES fracture and collapse in both CIA due to *shiatsu* massage, and Park *et al.*[10] reported a case of BES collapse in CIA due to minor external compression in a thin patient.

CONCLUSION

A HS for extensive IO treatment allows for multilevel revascularization in high-risk surgical patients, maintaining favorable patency and a low complication rate. Stent collapse in the iliac arteries is extremely rare. There are reports of BES collapse in the iliac arteries. We did not find any cases of SE collapse in the iliac arteries in the literature. However, this rare event should be considered before implanting an SE in a severely calcified chronic total iliac occlusion.

REFERENCES

1. *Jin Hyun Joh, Sun-Hyung Joo, Ho-Chul Park. Simultaneous hybrid revascularization for symptomatic lower extremity arterial occlusive disease. Experimental and Therapeutic Medicine 7: 804-810, 2014.*
2. *Aboyans V, Ricco J-B, Bartelink M-LEL, et al. Editor's Choice-2017 ESC guidelines on the diagnosis and treatment of peripheral arterial diseases, in collaboration with the European Society for Vascular Surgery (ESVS). Eur J VascEndovasc Surg 2018;55:305-68.*
3. *Starodubtsev V, Mitrofanov V, Ignatenko P, et al. Hybrid vs. Open Surgical Reconstruction for Iliofemoral Occlusive Disease: A Prospective Randomised Trial. Eur J VascEndovasc Surg (2022) 63, 557-565.*
4. *Starodubtsev V, Karpenko A, Ignatenko P. Hybrid and open surgery of Trans-Atlantic Inter-Society II type C and D iliac occlusive disease and concomitant lesion of common femoral artery. Int Angiol2016;35:484-91.*
5. *Su Hong Kim. Endovascular Therapy of Iliac Artery Disease: Stent Matters. Korean Circ J 2021 May;51(5):452-454.*
6. *Krankenberg H, Zeller T, Ingwersen M, et al. Self-expanding versus balloon-expandable stents for iliac artery occlusive disease: the randomized ICE trial. JACC Cardiovasc Interv2017;10:1694-704.*
7. *Kim DY, Ko YG, Lee SJ, et al. Korean multicenter registry study of EPIC stents for the treatment of iliac artery disease: K-EPIC registry. Korean Circ J 2021;51:441-51.*
8. *Tsujimura T, Iida O, Fujita M, et al. Two-year clinical outcomes post implantation of Epic™ self expanding nitinol stents for the aortoiliac occlusive disease in patients with peripheral arterial disease. J AtherosclerThromb2018;25:344.*
9. *Ichihashi S, Higashiura W, Itoh H, et al. Fracture and collapse of balloon-expandable stents in the bilateral common iliac arteries due to shiatsu massage. Cardiovasc InterventRadiol. 2012 Dec;35(6):1500-4.*
10. *Park SE, Choi HC, Cho SB, et al. Collapse of the Balloon-Expandable Stent in the Common Iliac Artery Due to Minor External Compression in a Lean Patient. J Korean Soc Radiol 2017;77(2):121-124.*

Management of bilateral type II endoleaks following endovascular repair of abdominal aortic aneurysm: a case report and literature review

Manejo de endoleaks tipo II bilaterales tras implante de endoprótesis aortobiilíaca: reporte de un caso y revisión bibliográfica

Leonardo Danduch[1,2], Marcos de la Vega[1,2], Claudio Gerbaudo[1,2], Juan Luciano[1,2], Lucas Gerbaudo[1,2]

ABSTRACT

A patient underwent endovascular repair of an abdominal aortic aneurysm with aortoiliac endoprosthesis implantation. During follow-up, bilateral type II endoleaks originating from lumbar branches led to aneurysm sac growth, prompting embolization of those branches with coils. Subsequent angiographic follow-up showed no further growth of the aneurysm sac.
We present this case due to the current controversy regarding the management of type II endoleaks, adding by a brief literature review on the topic.

Keywords (MESH)**:** aortic aneurysm, endovascular repair, endoleak.

RESUMEN

Se trata de un paciente que fue sometido a reparación endovascular de aneurisma de aorta abdominal con implante de endoprótesis aortobiilíaca. Durante el seguimiento presentó endoleak tipo II bilateral, originado a partir de ramos lumbares, con crecimiento de saco aneurismático, por lo que se procedió a embolizar estos ramos con coils. En el seguimiento angiográfico no se volvió a evidenciar crecimiento del saco aneurismático.
Compartimos este caso debido a la controversia que existe actualmente en relación al manejo de endoleaks tipo II, y agregamos una revisión bibliográfica concisa del tema.

Palabras clave: (MESH): aneurisma aórtico, reparación endovascular, endoleak.

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):26-29. https://doi.org/10.30567/RACI/202401/0026-0029

CLINICAL CASE

The patient was a 74-year-old man with hypertension and type-2 diabetes, under medical treatment for more than 10 years. An ultrasound showed that he had a 52 × 48 × 43-mm asymptomatic infrarenal abdominal aortic aneurysm, which was treated without complications by implanting an Endurant II® endoprosthesis (Medtronic, Santa Rosa, United States) in October 2015, with no immediate complications.
At the 6-month clinical follow-up, the patient remained asymptomatic. Follow-up CT angiography revealed a type II endoleak from lumbar branches of the hypogastric arteries, with aneurysm sac growth from 52 mm to 59 mm (**Figure 1**).

An angiography revealed well-developed lumbar branches originating from both hypogastric arteries (**Figure 2**) and emptying into the aneurysm sac.
Given the 7-cm sac growth over the previous 6 months, the chosen strategy was invasive treatment by means of embolization of both branches.

The *right lumbar branch* was the first to be embolized (**Figure 3A**). Using a 6-Fr right transfemoral arterial access and supported by a 6-Fr mammary guidewire catheter, operators advanced a 0.014" hydrophilic-coated guidewire (a 0.018" guidewire was unsuccessful due to severe vessel tortuosity). The guidewire was progressed distally, confirming the connection with the aneurysm sac, and an EchelonTM10 (Covidien/ev3, Medtronic, Irvine, USA) microcatheter was advanced over it. Angiography showed contrast passage into the aneurysm sac, leading to the release of four 5 × 10-mm and 5 × 20-mm AXIUM PRIME-3DTM (Covidien/ev3, Medtronic, Irvine, USA) detachable coils. The final angiography confirmed proper vessel occlusion with no contrast passage into the aneurysm sac. The patient had a good recovery.
Embolization of the *left lumbar branch* was scheduled (**Figure 3B**) to be conducted three weeks later. The strategy used was similar, using a 6-Fr left transfemoral arterial access. After selectively catheterizing the lumbar branch with a mammary catheter, a 0.014" hydrophilic-coated guidewire was advanced to confirm connection with the aneurysm sac. A microcatheter was then advanced, and upon confirming contrast solution going into the aneurysm sac, four 5 × 10-mm and 5 × 20-mm detachable coils of were released, demonstrating proper vessel occlusion with no contrast solution passage into the aneurysm sac.

On a follow-up CT angiography at 2 months, the coils were visualized in the lumbar branches (**Figure 4A**), with persistent type II endoleak that was smaller in size compared with the previous CT angiography (**Figure 4B**), and without aneurysm sac growth.

1. Department of Hemodynamics and Interventional Cardiology. Sanatorio del Salvador, Córdoba, Argentina.
2. Department of Hemodynamics and Interventional Cardiology. Sanatorio de la Cañada, Córdoba, Argentina.

✉ Corresponding author: *Leonardo Danduch. leodanduch@gmail.com. ORCID: 000-0002-7337-3399*

No conflicts of interest whatsoever.

Received: 30/12/2023 | Accepted: 17/04/2024

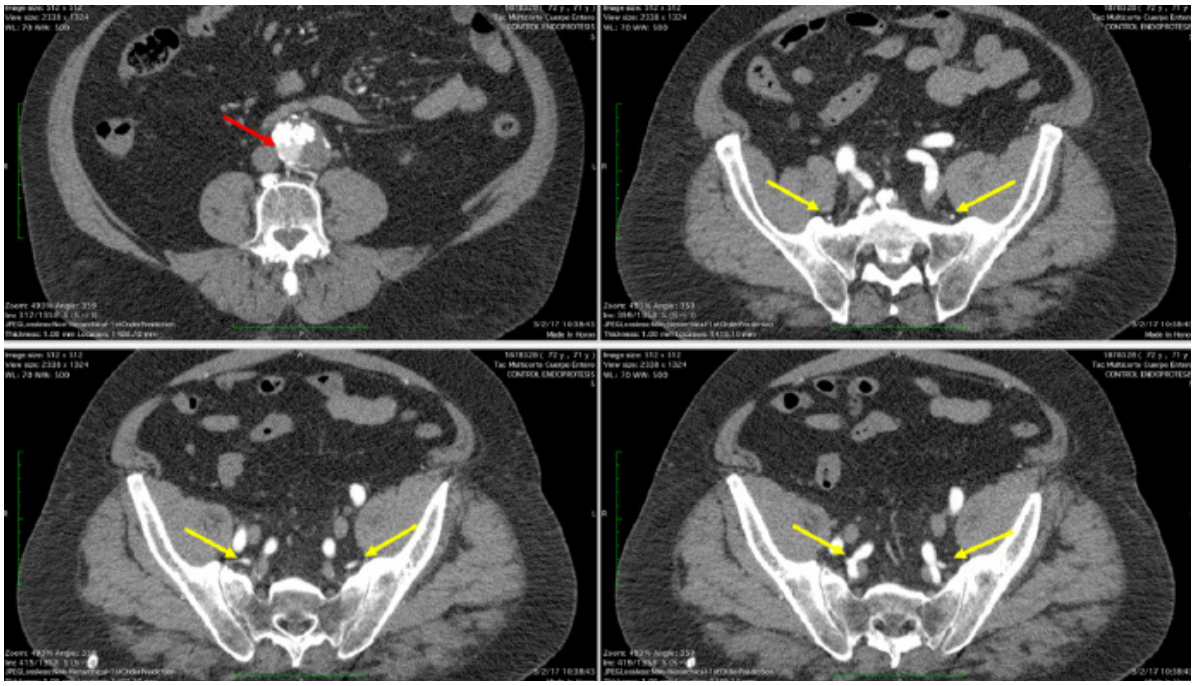


Figure 1. *The lumbar branches (yellow arrows), from the hypogastric arteries to the aneurysm sac (red arrow).*

REVIEW

Half of all patients who suffer from abdominal aortic aneurysm rupture die before reaching the hospital and, of those who do, up to 50% die during hospitalization[1, 2]. Given the minimal symptoms of a growing abdominal aortic aneurysm and the high mortality rate resulting from its rupture, we must be thorough during screening and follow-up of patients with this condition.

It is a well-known fact that the risk of aneurysm rupture significantly increases when it exceeds 5.5 cm in diameter (5.0 cm in women)[3], or when its growth rate is greater than 1 cm/year[4] (compared always using the same imaging method). Thus, either of these factors constitutes a formal indication for invasive treatment[3].

Invasive treatment can be surgical, although there is compelling evidence in favor of percutaneous treatment as the technique of choice because these patients have shorter hospital stays and lower short-term mortality (3-5% vs. 0.5-2%), even though long-term mortality remains similar[5-12]. The DREAM-Trial (Dutch Randomized Endovascular Aneurysm Management trial) randomized 351 patients to open or percutaneous treatment, demonstrating lower mortality perioperatively[7] (4.6% vs. 1.2%) and at two years[8] (5.7% vs. 2.1%). Additionally, there was a lower rate of major complications in favor of percutaneous treatment[7, 8] (26.4% vs. 11.7%). The EVAR1-Trial, after randomizing 1252 patients, showed lower 30-day mortality in favor of percutaneous treatment (1.8 % vs. 4.3 %)[9]; however, in the long-term follow-up, this benefit diminishes due to late rupture of the aneurysm sac (possibly related to endoleak), with similar mortality rates observed at 12.7 years (9.3% vs. 8.9%)[10]. Similarly, the OVER-Trial, which randomized 881 patients, also demonstrated initial benefits in mortality favoring percutaneous treatment (0.5% vs. 2% at 4 years)[11], but with similar figures in terms of survival at 14 years[12].

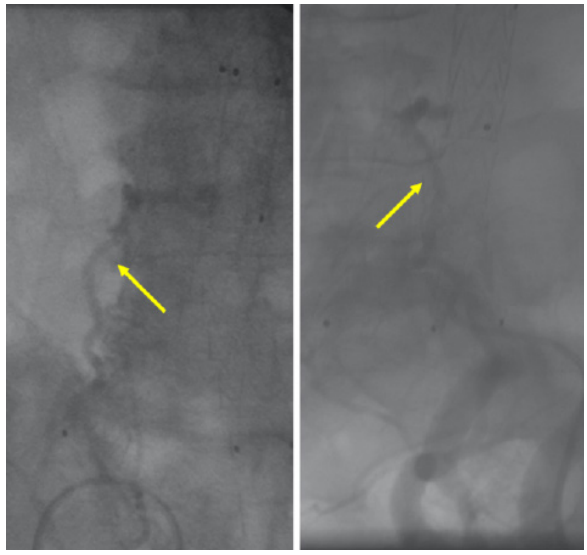


Figure 2. *Angiography of the lumbar branches connecting the hypogastric arteries to the aneurysm sac.*

Regarding follow-up of patients who have undergone percutaneous treatment, recommendations are CT angiography at one month and twelve months in search for displacement of prosthetic bodies, endoleak, and signs of aneurysm sac growth. If any anomaly is found, the imaging study should be repeated at the sixth month[15].

The presence (immediate or delayed) of periprosthetic flow continuing to feed the aneurysm sac is called an endoleak, one of the main medium- to long-term complications, reported in 20-50% of patients[13-15]. Depending on the source of the flow, endoleaks are classified into 5 variants[(14)]:

Type I, with the leak occurring at the level of the proximal (1A) or distal (1B) anchoring site.

Type II, which is due to retrograde flow from an artery branch excluded by the endoprosthesis (most commonly, the inferior mesenteric, lumbar, or accessory renal arteries).

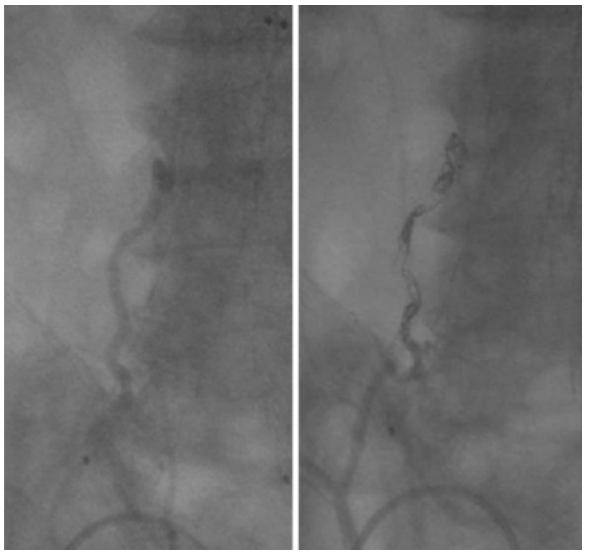


Figure 3. *Embolization of the right lumbar branch.*

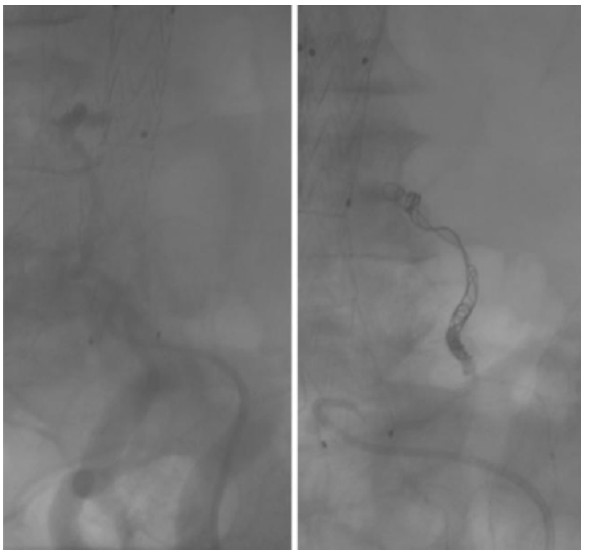


Figure 4. *Embolization of the left lumbar branch.*

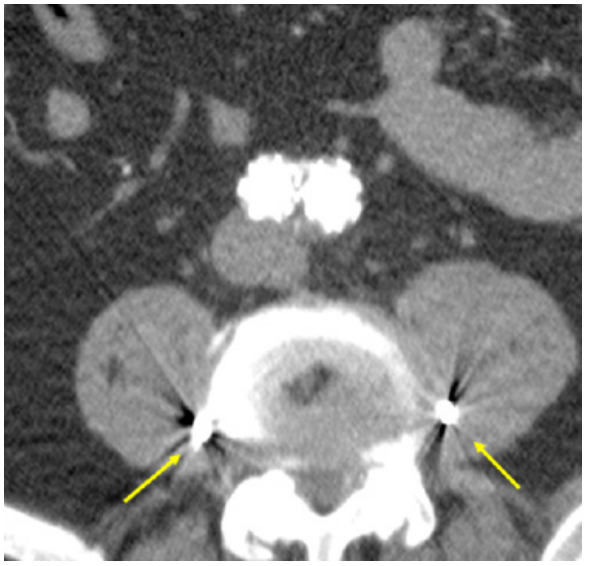


Figure 5. *Metallic coils (yellow arrows) implanted in the lumbar branches, without contrast solution passage.*

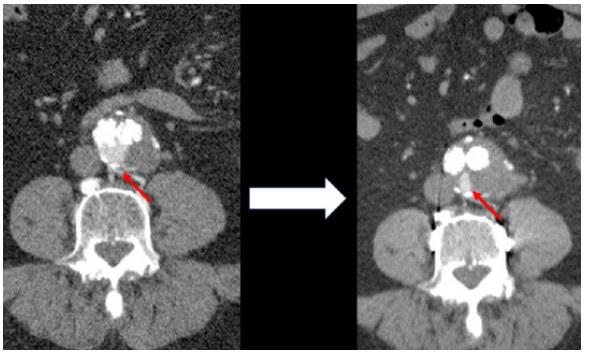


Figure 6. *Red arrows marking the decrease in contrast solution leaking into the aneurysm sac, before and after percutaneous closure of the leaks. Of note, no evidence of aneurysm sac growth.*

Type III, which entails direct leak through endoprosthesis rupture or defects.
Type IV, which is due to prosthesis porosity related to excessive anticoagulation.
Type V, with no apparent leak; it is considered to be due to blood pressure transmitted to the aneurysm sac through the prosthesis.
In the presence of type I or type III endoleaks, the usual consensus is that they should be treated percutaneously with a stent-graft or prosthetic extension[16, 17].
Type II endoleak is the most common, accounting for up to 76% of all endoleaks[14]; it affects up to 9% of patients undergoing percutaneous repair [18, 19]. This is the type of endoleak in the case we have discussed. It is commonly accepted that most type II endoleaks resolve spontaneously[20], so they should simply be monitored with a new CT angiography at 12 months, and intervention should only be considered in cases where sac growth exceeds 5 mm/12 months[21].

For percutaneous treatment, there are two techniques:
Translumbar embolization, which is reserved for cases where transarterial embolization is not possible (occlusion of iliac arteries) or when it has failed. It involves embolizing the aneurysm sac by direct puncture over the paraspinal lumbar region. This procedure is not widely practiced due to limited experience in most sites.
Transarterial embolization, which is the most used and widely known technique. Access to the branches causing the endoleak is achieved, usually through selective catheterization of internal iliac arteries, and they are embolized, typically with microcoils.

Regardless of the technique used, the recurrence rate is high, reaching 37.5% for transarterial approaches and 19% for translumbar approaches[22]. Ligating afferent branches through open surgery is associated with high rates of morbidity and mortality[23, 24].

CONCLUSIONS

This case highlights the importance of postoperative follow-up to detect late complications, thereby improving patient survival.

REFERENCES

1. *Bown MJ, Sutton AJ, Bell PR, Sayers RD. A meta-analysis of 50 years of ruptured abdominal aortic aneurysm repair. Br J Surg 2002; 89:714.*
2. *Hoornweg LL, Storm-Versloot MN, Ubbink DT, et al. Meta analysis on mortality of ruptured abdominal aortic aneurysms. Eur J Vasc Endovasc Surg 2008; 35:558.*
3. *Wanhainen A, Verzini F, Van Herzeele I, et al. Editor's Choice - European Society for Vascular Surgery (ESVS) 2019 Clinical Practice Guidelines on the Management of Abdominal Aorto-iliac Artery Aneurysms. Eur J Vasc Endovasc Surg 2019; 57:8.*
4. *Sharp MA, Collin J. A myth exposed: fast growth in diameter does not justify precocious abdominal aortic aneurysm repair. Eur J Vasc Endovasc Surg. 2003 May;25(5):408-11. doi: 10.1053/ejvs.2002.1850. PMID: 12713778.*
5. *Dillavou ED, Muluk SC, Makaroun MS. Improving aneurysm-related outcomes: nationwide benefits of endovascular repair. J Vasc Surg 2006; 43:446.*
6. *Lee WA, Carter JW, Upchurch G, et al. Perioperative outcomes after open and endovascular repair of intact abdominal aortic aneurysms in the United States during 2001. J Vasc Surg 2004; 39:491.*
7. *Prinssen M, Verhoeven EL, Buth J, et al.; Dutch Randomized Endovascular Aneurysm Management (DREAM)Trial Group. A randomized trial comparing conventional and endovascular repair of abdominal aortic aneurysms. N Engl J Med. 2004 Oct 14;351(16):1607-18. doi: 10.1056/NEJMoa042002. PMID: 15483279.*
8. *Blankensteijn JD, de Jong SE, Prinssen M, et al.; Dutch Randomized Endovascular Aneurysm Management (DREAM) Trial Group. Two-year outcomes after conventional or endovascular repair of abdominal aortic aneurysms. N Engl J Med. 2005 Jun 9;352(23):2398-405. doi: 10.1056/NEJMoa051255. PMID: 15944424.*
9. *EVAR trial participants. Endovascular aneurysm repair versus open repair in patients with abdominal aortic aneurysm (EVAR trial 1): randomised controlled trial. Lancet. 2005 Jun 25-Jul 1;365(9478):2179-86. doi: 10.1016/S0140-6736(05)666275. PMID: 15978925.*
10. *Patel R, Sweeting MJ, Powell JT, Greenhalgh RM; EVAR trial investigators. Endovascular versus open repair of abdominal aortic aneurysm in 15-years' follow-up of the UK endovascular aneurysm repair trial 1 (EVAR trial 1): a randomised controlled trial. Lancet. 2016 Nov 12;388(10058):2366-2374. doi: 10.1016/S0140-6736(16)31135-7. Epub 2016 Oct 12. PMID: 27743617.*
11. *Lederle FA, Freischlag JA, Kyriakides TC, et al.; Open Versus Endovascular Repair (OVER) Veterans Affairs Cooperative Study Group. Outcomes following endovascular vs open repair of abdominal aortic aneurysm: a randomized trial. JAMA. 2009 Oct 14;302(14):1535-42. doi: 10.1001/jama.2009.1426. PMID: 19826022.*
12. *Lederle FA, Freischlag JA, Kyriakides TC, et al.; OVER Veterans Affairs Cooperative Study Group. Long-term comparison of endovascular and open repair of abdominal aortic aneurysm. N Engl J Med. 2012 Nov 22;367(21):1988-97. doi: 10.1056/NEJMoa1207481. PMID: 23171095.*
13. *Zaiem F, Almasri J, Tello M, Prokop LJ, Chaikof EL, Murad MH. A systematic review of surveillance after endovascular aortic repair. J Vasc Surg. 2018 Jan;67(1):320-331.e37. doi: 10.1016/j.jvs.2017.04.058. Epub 2017 Jun 26. PMID: 28662928.*
14. *Buth J, Harris PL, van Marrewijk C, Fransen G. The significance and management of different types of endoleaks. Semin Vasc Surg. 2003 Jun;16(2):95-102. doi: 10.1016/s0895-7967(03)00007-3. PMID: 12920679.*
15. *Chaikof EL, Dalman RL, Eskandari MK, et al. The Society for Vascular Surgery practice guidelines on the care of patients with an abdominal aortic aneurysm. J Vasc Surg. 2018 Jan;67(1):2-77.e2. doi: 10.1016/j.jvs.2017.10.044. PMID: 29268916.*
16. *Veith FJ, Baum RA, Ohki T, et al. Nature and significance of endoleaks and endotension: summary of opinions expressed at an international conference. J Vasc Surg. 2002 May;35(5):1029-35. doi: 10.1067/mva.2002.123095. PMID: 12021724.*
17. *Eng ML, Brewer MB, Rowe VL, Weaver FA. Treatment options for late type III endoleaks after endovascular aneurysm repair. Ann Vasc Surg. 2015 Apr;29(3):594.e5-9. doi: 10.1016/j.avsg.2014.10.032. Epub 2015 Jan 15. PMID: 25597652.*
18. *Mohan IV, Laheij RJ, Harris PL; EUROSTAR COLLABORATORS. Risk factors for endoleak and the evidence for stent-graft oversizing in patients undergoing endovascular aneurysm repair. Eur J Vasc Endovasc Surg. 2001 Apr;21(4):344-9. doi: 10.1053/ejvs.2000.1341. PMID: 11359336.*
19. *van Marrewijk C, Buth J, Harris PL, Norgren L, Nevelsteen A, Wyatt MG. Significance of endoleaks after endovascular repair of abdominal aortic aneurysms: The EUROSTAR experience. J Vasc Surg. 2002 Mar;35(3):461-73. doi: 10.1067/mva.2002.118823. PMID: 11877693.*
20. *Silverberg D, Baril DT, Ellozy SH, et al. An 8-year experience with type II endoleaks: natural history suggests selective intervention is a safe approach. J Vasc Surg. 2006 Sep;44(3):453-9. doi: 10.1016/j.jvs.2006.04.058. PMID: 16950415.*
21. *Chaikof EL, Brewster DC, Dalman RL, et al.; Society for Vascular Surgery. The care of patients with an abdominal aortic aneurysm: the Society for Vascular Surgery practice guidelines. J Vasc Surg. 2009 Oct;50(4 Suppl):S2-49. doi: 10.1016/j.jvs.2009.07.002. PMID: 19786250.*
22. *Sidloff DA, Stather PW, Choke E, Bown MJ, Sayers RD. Type II endoleak after endovascular aneurysm repair. Br J Surg. 2013 Sep;100(10):1262-70. doi: 10.1002/bjs.9181. PMID: 23939840.*
23. *Ferrari M, Sardella SG, Berchiolli R, et al. Surgical treatment of persistent type 2 endoleaks, with increase of the aneurysm sac: indications and technical notes. Eur J Vasc Endovasc Surg. 2005 Jan;29(1):43-6. doi: 10.1016/j.ejvs.2004.10.008. PMID: 15570270.*
24. *Kolvenbach R, Pinter L, Raghunandan M, Cheshire N, Ramadan H, Dion YM. Laparoscopic remodeling of abdominal aortic aneurysms after endovascular exclusion: a technical description. J Vasc Surg. 2002 Dec;36(6):1267-70. doi: 10.1067/mva.2002.129493. PMID: 12469062.*

Endovascular treatment of aorto-atrial fistula. Complication and resolution

Tratamiento endovascular de fístula aortoatrial. Complicación y resolución

María J. Bernal Calle[1], Jorge Gómez[2], Alejandro Salvatierra[2], Andrés Cuenca del Rey[3], Miguel Villegas[4]

ABSTRACT

Aorto-atrial fistulae can potentially cause refractory heart failure.
A 47-year-old man presented a 6-month history of lower limb edema, ascites, and progressive dyspnea. Right-to-left heart catheterization revealed a right aorto-atrial fistula. The fistula was successfully closed, but, ten days later, the patient showed signs of heart failure due to device embolization. He was readmitted to the Department of Hemodynamics for fistula closure and removal of the embolized device.
Endovascular closure of aorto-atrial fistulae is an effective procedure that is less invasive than surgery.

Keywords: aorto-atrial fistula, percutaneous closure, device embolization.

RESUMEN

Las fístulas aortoatriales son una patología capaz de provocar insuficiencia cardíaca refractaria.
Se presenta paciente masculino de 47 años con cuadro de 6 meses de evolución de edemas de miembros inferiores, ascitis y disnea progresiva. Se realiza cateterismo derecho-izquierdo que evidencia fístula aortoatrial derecha. Se cierra exitosamente la fístula y diez días después intercurre con signos de insuficiencia cardíaca debido a embolización de dispositivo. Ingresa nuevamente al Servicio de Hemodinamia para cierre de fístula y extracción del dispositivo embolizado.
El cierre endovascular de fístulas aortoatriales es un procedimiento efectivo y menos invasivo que la cirugía.

Palabras clave: fístula aortoatrial, cierre percutáneo, embolización dispositivo.

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):30-32. https://doi.org/10.30567/RACI/202401/0030-0032

INTRODUCTION

Aorto-atrial fistulae are a rare condition characterized by an abnormal connection between the aorta and the atria[1]. Their prevalence and incidence in the population are unknown. They typically occur secondary to infective endocarditis, non-coronary sinus of Valsava rupture due to aneurysmal defect, periprosthetic abscesses, cardiac surgeries such as aortic valve replacement, or congenital heart disease plus other anomalies like bicuspid aortic valve. There are few documented cases where it has been reported as a complication of aortic dissection[2]. The diagnostic method of choice is echocardiography, and treatment can be surgical or endovascular depending on fistula location and association with other structural heart defects[3].

CASE DESCRIPTION

The patient is a 47-year-old man with cardiovascular risk factors: morbid obesity, hypertension, former smoker,sedentary lifestyle, and a history of congenital solitary kidney, under follow-up by the Department of Cardiology due to a 6-month history of lower limb edema, ascites, and progressive dyspnea up to functional class III. Echocardiography + Doppler revealed a 65% ejection fraction, left ventricular hypertrophy, grade III diastolic dysfunction, dilated right ventricle, biatrial enlargement, right coronary sinus aneurysm with shunt to the right atrium, thoracic aorta dilation (63 mm), diastolic reverse flow 44 cm/s, moderate tricuspid valve regurgitation, pulmonary hypertension (systolic pulmonary artery pressure 73 mmHg), and pulmonary trunk diameter 39 mm. A transesophageal echocardiography (TEE) confirmed fistula over the right coronary sinus towards the right atrium with a proximal mouth of 7 mm and a distal mouth of 8 mm, with continuous flow and QP/QS of 1.8, gradient 24 mmHg, and intact interatrial and interventricular septum (**Figure 1**).

An aortocoronary angiography revealed a fistula at the coronary sinus level towards the right atrial cavity with QP/QS 3.0 and pulmonary hypertension by right catheterization with a mean pulmonary artery pressure of 40 mmHg.

The patient was scheduled to undergo a right aorto-atrial fistula closure with intraprocedural TEE control. The right femoral artery and vein were punctured with a JR catheter. The lesion was crossed over from the aorta to the right atrium with a 0.035" hydrophilic-coated Glidewire (Terumo Medical Corporation, Japan) exchange guidewire. The guidewire was threaded through the superior vena cava and exited through the femoral vein, thus establishing an arteriovenous loop. Through the vein, a 9-French sheath was advanced up to the ascending aorta. Then, the dilator and guidewire were removed. A MemoPart (Lepu Medical, China) device, designed for closure of 14-mm tubular ducts, was then inserted. On the aortic side, the 18-mm retention disc

1. Fellow del Servicio de Hemodinamia. Hospital Nacional "Prof. Alejandro Posadas", Argentina.
2. Attending Physician at the Department of Hemodynamics. Hospital Nacional "Prof. Alejandro Posadas"
3. Attending Physician at the Department of Echocardiography. Hospital Nacional "Prof. Alejandro Posadas
4. Chief of the Department of Hemodynamics. Hospital Nacional "Prof. Alejandro Posadas"

✉ Corresponding author: *María José Bernal Calle. Servicio de Hemodinamia, Hospital Nacional "Prof. Alejandro Posadas". Avenida Presidente Arturo U. Illia s/n, B1684 El Palomar. Provincia de Buenos Aires, Rep. Argentina. majo_bc14@hotmail.com | 1133083831*

No conflicts of interest whatsoever

Received: 10/2/2024 | Accepted: 17/04/2024

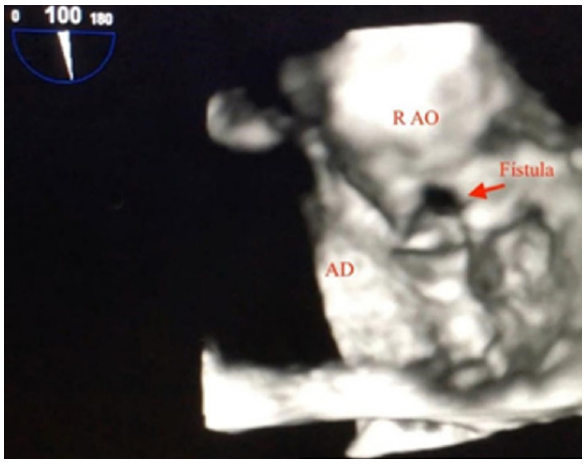


Figure 1. *3D color TEE. Right aorto-atrial fistula.*

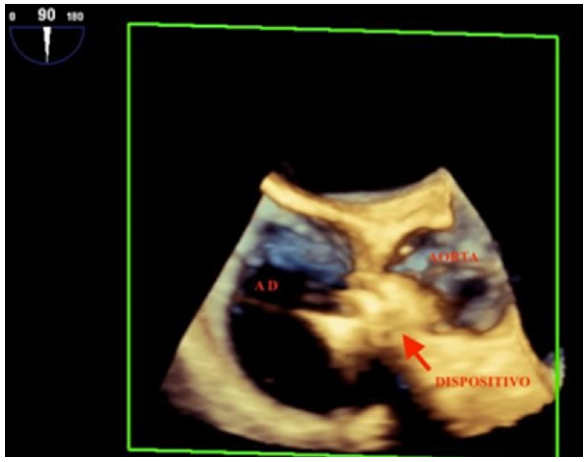


Figure 2. *3D color TEE. MemoPart device, designed for closure of 14-mm tubular ducts, closing the right aorto-atrial fistula.*

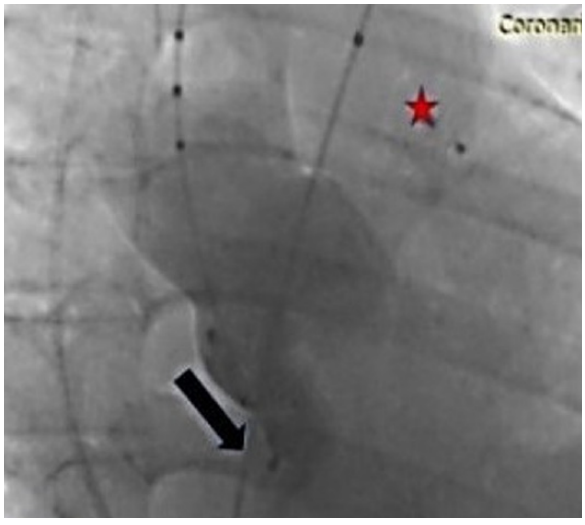


Figure 3. *Angiography of the aortic root. The arrow shows the deployed MemoPart ASD device closing the right aorto-atrial fistula. The star shows the embolized first device in the left pulmonary artery.*

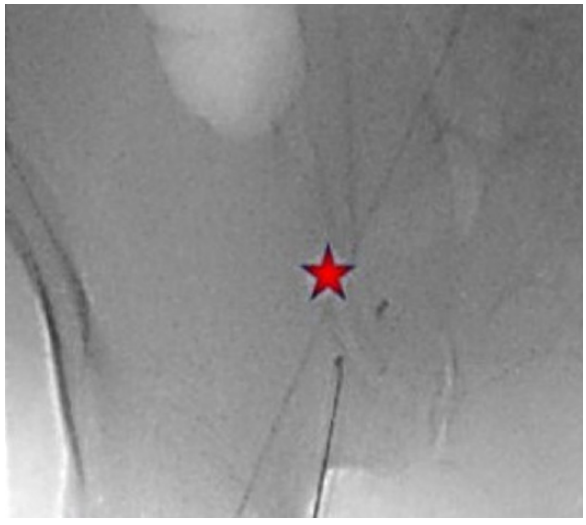


Figure 4. *Angiography. The star shows the extraction of the embolized first device through the femoral vein.*

opened, and the remainder of the device was deployed over the lesion in a good position under echocardiographic control (**Figure 2**). There was minimal residual intradevice flow, and the device was released without issues.

The patient was transferred to the Coronary Care Unit, where he stayed for 4 days for optimal heart failure treatment. His clinical condition improved, and the echocardiographic control showed the device in normal position.

Ten days after the procedure, the patient developed severe signs of right heart failure. A fluoroscopy revealed device embolization towards the left pulmonary artery. The patient was admitted to the Coronary Care Unit with signs, symptoms, and laboratory findings consistent with multiorgan failure, requiring intravenous inotropic and chronotropic therapy. In order to stabilize him and extract the embolized device, two days later the fistula was closed in the cath lab. The procedure consisted in the same maneuvers as in the previous procedure to establish an arteriovenous loop. The right aorto-atrial fistula was closed with a 9-mm MemoPart ASD (Lepu Medical, China) device specially designed for atrial septal defect closure. This device has a 23-mm left-side disc (which is larger than the 18-mm retention disc of the previously used device). Device deployment at the site of the fistula resulted in the 21-mm right disc going into the right atrium, as visualized on the control 3D transesophageal echocardiography (**Figure 3**). The device was in good position and deployed without issues, leaving a small 1-mm residual flow. After this procedure, the embolized device was extracted using the retention disc hub. Due to its position, it was partially sheathed and removed together with the sheath through the femoral vein without complications (**Figure 4**).

The patient continued inotropic support for 5 days with negative fluid balance, showing clinical improvement, and normalization of laboratory parameters. A Doppler echocardiogram showed no residual shunt. Discharge from the hospital was on the seventh day after the procedure.

DISCUSSION

Fistulae located between the aorta and the atria are rare; they are often the result of an underlying condition affecting cardiac structures. They can be congenital; secondary to conditions such as aortic dissection, infective endocarditis, or valve replacement; or iatrogenic. Secondary causes lead

to local deterioration of the cardiac wall, resulting in fistulous connections, while iatrogenic causes are more traumatic in nature. Signs and symptoms include volume overload and heart failure, and patients often present with fever, continuous murmurs, dilated cardiomyopathy, and lower limb edema[1].

Early detection and diagnosis of this serious pathology depend on its echocardiographic identification. Combining 3D imaging techniques, such as transesophageal echocardiography or computed tomography, is highly recommended whenever possible, as it provides spatial orientation and high anatomical definition for procedure planning purposes. The assessment may also include cardiac magnetic resonance imaging or cardiac catheterization to further quantify the shunt[4].

Due to the low incidence of fistulae between the aorta and the atria, treatment strategies depend on the underlying disease, and interventions are based on expert opinions and consensus among treating physicians. However, fistula closure is recommended in symptomatic patients[5].

Available evidence on this matter is scarce and based solely on clinical cases or case series. More information is needed to better define optimal therapeutic strategies in this scenario[6].

CONCLUSION

Aorto-atrial fistulae are rare and uncommon, but they can lead to serious complications such as refractory heart failure, sometimes requiring their closure for clinical improvement. Given the limited evidence available on the treatment of these pathologies, managing these patients is a challenge for medical personnel.

Interventional procedures are effective and much less invasive than surgery, allowing for rapid recovery of clinically compromised patients. The possibility of complications such as device embolization highlights the importance of operator expertise and appropriate materials for treatment.

Due to the patient's progression, choosing a double-disc device seems like a better alternative for fistula resolution, even though the initial goal with the first chosen alternative was to leave a smaller disc on the aortic side.

REFERENCES

1. *Fierro EA, Sikachi RR, Agrawal A, Verma I, Orjrzanowski M, Sahni S. Aorto-Atrial fistulas: A contemporary Review. Cardol Rev. 2018; 26(3): p. 137-144.*
2. *Hsu RB, Chien CY, Wang SS, Chu SH. Aorto-right atrial fistula a rare complication od aortic dissection. Tex Heart Inst J. 2000; 27(1): p. 64-66.*
3. *Castano O, Bastidas O, Ocampo Chaparro JM, Urrea Zapata JK, Bucheli V. Fístula Aorto-atrial derecha: unapresentacióninusual. RevistaColombiana de Cardiología. 2018; 25(4): p. 280.*
4. *Tamargo M, Elizaga J, Fernandez Aviles F. Cierre percutáneo de unafístula entre la aorta y la aurículaizquierda. REC Interv. Cardiol. 2023; 5(3): p. 222 -224.*
5. *Jainandunsing JS, Linnemann R, Maessen J, et al. Aorto-atrial fistula formation and therapy. J Thorac Dis. 2019; 11(3): p. 1016 - 1021.*
6. *Foster TJ, Amin AH, Busu T, et al. Aorto-cardiac fistula etiology, presentation, and management: A systematic review. Heart Lung. 2020; 49(3): p. 317 - 323.*

Letter from the President of CACI

Carta del Presidente del CACI

Revista Argentina de Cardioangiología Intervencionista 2024;15(1):33. https://doi.org/10.30567/RACI/202401/0033-0033

Dear colleagues, In this brief overview, I want to convey my regards and welcome the new Board of Directors for 2023-2025 along with Vice-President-elect Dr. Alfredo Bravo, who will occupy my current position by the end of 2025.
I also want to express my gratitude to Dr. Alfredo Rodríguez for his commitment and dedication during his tenure as Editor of the CACI Journal. He will be succeeded by Dr. Carlos Fernández Pereira (who is part of the same group, thus providing continuity).
Since I took office on December 16, several events have unfolded. I will try to summarize them:
Unfortunately, we witnessed the passing of two founding fathers of interventional cardiology worldwide: Dr. David Antonucci and Dr. Alain Cribier.
In late October, when the supply crisis intensified (with a shortage of contrast solutions, stents, devices), we were summoned by the Secretary of Commerce, alongside representatives from various cardiology societies (SAC, FAC, CCV, FCA, CAC), in an attempt to address these issues. Little progress was made in that meeting, and little did the authorities leaving office do to solve the problem.
However, that meeting paved the way for the aforementioned societies to come together and establish " Cardiología Unida" (Cardiology United), a working group under a Framework Agreement recently signed by all parties. This enabled us to secure a meeting with the Minister of Health, Dr. Mario Antonio Russo, where we could present our issues and discuss potential solutions on equal footing.
Regarding our guild activities, much has been accomplished in recent months, encouraging the creation of associations nationwide to pursue the long-awaited direct payment of our fees through provincial associations.
While many events have transpired, it is our intention to remain deeply engaged in further initiatives.
Colleagues, it is imperative that we all make the deepest commitment; opportunities do not simply present themselves: we must create them.
I wish to convey that holding this position is an honor for me, and I pledge to face all challenges head on to achieve the best outcomes for our association.

Juan Fernández
President of CACI

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

Publications rules Argentine Journal of Interventional Cardioangiology

La *Revista Argentina de Cardioangiología Intervencionista* (RACI) es una publicación trimestral editada por el Colegio Argentino de Cardioangiólogos Intervencionistas (CACI) con objetivos asentados en la divulgación de material científico y educativo para la especialidad. La distribución nacional es gratuita y está dirigida a cardioangiólogos intervencionistas, cardiólogos clínicos y pediátricos, radiólogos, neurólogos, técnicos en hemodinamia y especialidades afines. La publicación es de tipo impresa y electrónica (www.caci.org.ar).
Los principios editoriales de la revista se basan en las recomendaciones para manuscritos enviados a revistas Biomédicas *(Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly Work in Medical Journals)* redactados por el Comité Internacional de Editores de Revistas Médicas *(International Committee of Medical Journal Editors - ICMJE)* en su más reciente actualización, disponible en www.icmje.org.

A partir del número 2 volumen 9 año 2018, por razones editoriales, los elementos gráficos (figuras, tablas, fotos) se editan a lo sumo en dos colores (azul y negro). Aquellos que los deseen a todo color deberán pagar un costo adicional por el trabajo de 200 US$.

Los artículos enviados deben ser originales. El Comité Editorial evaluará los trabajos y luego de un primer análisis sobre si el artículo sigue las normas Editoriales de la Revista, el Director y/o Directores Asociados serán los encargados de enviarlos a un arbitraje externo, que será simple ciego, que significa que los autores no conocen el nombre de los revisores y los revisores a su vez no conocen el nombre de otros revisores. Esta política del RACI se hace siguiendo los mismos criterios empleados por el Comité de Revisión y Editorial del *J Am Coll Cardiol* (JACC), que es la revista de cardiología de mayor factor impacto. La decisión final quedará en manos del Comité Editorial de acuerdo con las conclusiones del arbitraje. Asimismo, el Comité Editorial tendrá la facultad de introducir, con el consentimiento de los autores, todos los cambios editoriales exigidos por las normas gramaticales y las necesidades de edición de la revista. Los artículos de Revisión y Editoriales también serán objeto de la misma revisión. Los artículos Editoriales son usualmente pedidos por el Comité Editorial.

Luego de la primera revisión, los trabajos pueden ser aceptados en la forma en que fue incialmente enviado; Revisiones Menores es cuando si bien el trabajo tiene aportes importantes existen limitaciones menores que deben ser corregidas antes de su eventual publicación; Revisiones Mayores es cuando el trabajo es inaceptable para publicar de acuerdo a como fue presentado. Sin embargo, el Comite Editorial consideraría un posible nuevo envío, tambien llamado *de novo submission*, si el trabajo es modificado sustancialmente; Rechazo, es cuando los revisores y el Comité Editorial consideran que el trabajo es inapropiado para publicar en la Revista RACI
En casos especiales de consensos de diagnóstico y/o tratamiento realizados en conjunto entre el CACI y sociedades científicas afines, tal consenso, de común acuerdo entre las mismas y con conocimiento del Comité Editorial, podrá ser publicado en forma excepcional por las revistas oficiales de ambas sociedades en forma simultánea.

PRESENTACIÓN GENERAL DEL MANUSCRITO

Todos los autores así como los miembros del Comité Editorial deben declarar conflictos de intereses, en caso de que existan, con las publicaciones.

Cada artículo debe ser presentado con una primera página que debe contener: (a) el título, informativo y conciso; (b) los nombres completos de los autores y de las instituciones en que se desempeñan; (c) un título abreviado para cabeza de página; (d) el número total de palabras del artículo, sin las referencias bibliográficas; (e) el nombre y dirección completa, con fax y dirección electrónica, del autor con quien se deba mantener correspondencia. La segunda página debe incluir el resumen (abstract) en español y en inglés, con 3-6 palabras clave al final de éstos con términos incluidos en la lista del Index Medicus *(Medical Subject Headings - MeSH)*. Luego, en la tercera página, se debe desarrollar el contenido del manuscrito (véase Preparación del manuscrito), iniciando una nueva página para cada sección. Todas las páginas deben ir numeradas desde la portada.

El envío del artículo (texto, tablas y figuras) debe realizarse por correo electrónico a revista@caci.org.ar, con una nota firmada por todos los autores (véase modelo página web), con la indicación de la sección a que correspondería el manuscrito y la aseveración de que los contenidos no han sido anteriormente publicados. Una vez recibido el material, el Comité Editorial iniciará el proceso de incorporación que tiene una duración media de cinco semanas.
Quienes figuren como autores deben haber participado en la investigación o en la elaboración del manuscrito y hacerse públicamente responsables de su contenido.
Para cada artículo se permite un máximo de 8 autores, que deben adaptarse a las normas sobre autoría expuestas por la IMCJE. Cada manuscrito recibido es examinado por el Comité Editor y por uno o dos revisores externos. Posteriormente se notificará al autor responsable sobre la aceptación (con o sin correcciones y cambios) o el rechazo del manuscrito. Aprobada la publicación del trabajo, la RACI retiene los derechos de autor para su reproducción total o parcial.

Los autores deberan proveer su código de ORCID a los efectos de consignar sus datos filiatorios.

SECCIONES

Artículos originales
(véase Preparación del manuscrito)
Son trabajos científicos o educativos de investigación básica o clínica original. Condiciones: a) texto general, hasta 5.000 palabras, incluidas las referencias; b) resumen, hasta 250 palabras; c) tablas + figuras, hasta 8; e) autores, hasta 10.

Comunicaciones breves
Los trabajos de esta sección cumplen con los lineamientos de Artículos originales, pero no tienen la suficiente cantidad de pacientes como para ser considerados como tales.

Artículos de revisión
Son artículos sobre temas relevantes de la especialidad solicitados por el Comité Editor a autores de reconocida trayectoria (nacionales o extranjeros). Puede ser escrito por diferentes tipos de médicos (no más de 3 autores). Condiciones: ídem Artículo Original.

Educación básica
Son artículos sobre el manejo racional y protocolizado de diferentes circunstancias que se presentan en la práctica diaria. Son revisados y consensuados previamente con especialistas en el tema, y se culminan con un diagrama de flujo sobre el manejo diagnóstico y terapéutico de la patología. Es solicitado por el Comité Editor. Condiciones: a) texto general, hasta 2.500 palabras excluyendo referencias; b) resumen, hasta 150 palabras; c) tablas + figuras, hasta 6; d) referencias, hasta 20; e) autores, hasta 4.

Caso clínico
Es la descripción de un caso clínico de características inusuales, con su abordaje diagnóstico y terapéutico y su resolución final. Debe acompañarse de una breve discusión bibliográfica. Condiciones: a) texto general, hasta 1.200 palabras; b) resumen, hasta 100 palabras; c) tablas + figuras, hasta 4; d) referencias, hasta 10; e) autores, hasta 5.

¿Cómo traté?
Bajo el título "¿Cómo traté?" los autores presentarán un caso desafiante y la descripción del tratamiento realizado. El título deberá estar incluido al comienzo del texto, por ejemplo "¿Cómo traté un aneurisma en la descendente anterior?". Luego se incluirán los nombres, apellidos, títulos y lugar de trabajo de los autores. Deberá indicarse el autor que recibirá la correspondencia, incluyendo su dirección postal y e-mail. Todos los autores deberán declarar sus conflictos de interés y, en el caso de no tenerlos, indicarlo. Texto, figuras y referencias seguirán los criterios del Caso Clínico

Imágenes en intervencionismo
Se aceptarán para publicar imágenes de casos excepcionales, ilustrativas, y que el Comité Editorial y los revisores externos consideren de sumo interés para su publicacion en la revista. Deben ir acompañadas de una leyenda explicativa y un breve resumen de historia clínica. Condiciones: a) texto general, hasta 300 palabras; b) solo 2 figuras originales; c) referencias, hasta 3; d) autores, hasta 5.

Protocolos de investigación
Como artículos especiales la Revista aceptará la publicacion de Protocolos de Investigacion Clinica, preferentemente multicéntricos y siempre que los mismos no hubiesen reportado antes los resultados parciales o totales del estudio.

Editoriales
Son análisis y/o comentarios de temas relevantes de la especialidad o de la Cardiología General que tuviesen relación con nuestra especialidad. Siempre serán solicitados por el Comité Editor a un experto en el tema. Asimismo, pueden solicitarse comentarios sobre temas no relacionados a un artículo en particular. Condiciones: a) texto general, hasta 2.000 palabras; b) referencias, hasta 40.

Cartas del lector
Es una opinión sobre un artículo publicado en el último número de la revista, el cual requiere un arbitraje realizado por miembros del Comité Editor. Condiciones: a) texto, hasta 250 palabras; b) se podrá publicar una tabla y/o figura; c) referencias, hasta 5. Se aceptarán solo aquellas cartas enviadas dentro del mes de haber salido la versión impresa del número de la revista donde se publicó el artículo original.

PREPARACIÓN DEL MANUSCRITO

El artículo debe estar escrito en castellano, en un procesador de texto Word (Microsoft®) y guardado con extensión *.doc. El tamaño de la página debe ser A4 o carta, con doble espacio interlineado, márgenes de 25 mm con texto justificado y con tamaño de letra de 12 puntos tipo Times New Roman o Arial. Las páginas se numerarán en forma consecutiva comenzando con la portada. El manuscrito (artículo original) debe seguir la estructura «IMR D», es decir, Introducción, Material y métodos, Resultados y Discusión (véanse las normas de publicación ICMJE). Además, debe incluir Título, Resumen, Conclusiones, Conflicto de Intereses y Bibliografía. Al final de cada artículo original, antes de las referencias, deberá hacerse como una tabla destacada de los puntos relevantes del trabajo que se llamará Resumen de Puntos Salientes.

En estos 4 o 5 renglones se deberán señalar los problemas y el conocimiento que hay en el tema tratado hasta el momento y además cuáles serían los interrogantes.

En los dos últimos renglones se destaca el aporte y/o los aportes del trabajo más relevantes sobre este tema. Al final de las referencias se escribirán los Agradecimientos y un Apéndice Suplementario cuando correspondiese en estudios aleatorizados o registros multicéntricos que necesiten reportar todos los investigadores incluidos en el estudio.

Como unidad de medida se utilizará el sistema métrico decimal, usando comas para los decimales. Todas las mediciones clínicas, hematológicas y químicas deben expresarse en unidades del sistema métrico y/o UI. Solo se utilizarán las abreviaturas comunes, evitándose su uso en el título y en el resumen. La primera vez que se empleen irán precedidas por el término completo excepto que se trate de unidades de medida estándar.

Las tablas deben presentarse en hojas individuales, numerándose de forma consecutiva utilizando números arábigos (0, 1, 2, etc.) según el orden en que fueron citadas en el texto, con un

título breve para cada una de ellas. Todas las abreviaturas de la tabla no estandarizadas deben explicarse. Las notas aclaratorias deben ir al pie de la misma utilizando los siguientes símbolos en esta secuencia: *, †, ‡, §, ¶, **, ††, ‡‡, etc.

Las figuras deben tener formato TIFF, PSD o JPEG e ir, cada una, en un archivo aparte a 300 dpi en formato final. Cada una de ellas tiene que estar numerada de forma correlativa junto a la leyenda explicativa en archivo aparte. El tamaño usual de las fotografías debe ser de 127 x 173 mm. Los títulos y las explicaciones detalladas se colocan en el texto de las leyendas y no en la ilustración misma.

Las referencia s bibliográficas se enumerarán de manera consecutiva con números arábigos entre paréntesis. Se incluirán todos los autores cuando sean seis o menos; si fueran más, el tercero será seguido de la expresión «, et al.». Los títulos de las revistas serán abreviados según el estilo empleado en el Index Medicus. Ejemplos:

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).*