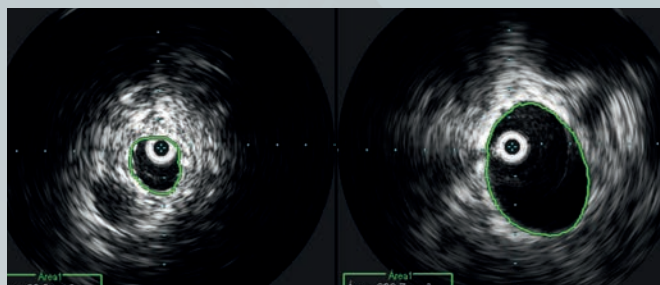




# REVISTA ARGENTINA DE CARDIOANGIOLOGÍA INTERVENCIONISTA

January - March 2020 | Year 11 | Number 1



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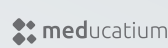
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### ORIGINAL ARTICLE / ARTÍCULO ORIGINAL

#### NEUTROPHIL-LYMPHOCYTE RATIO TO PREDICT EARLY STENT THROMBOSIS

Suilbert Rodríguez Blanco, Abel Y. Leyva Quert, José M. Aguilar Medina

**Introduction.** Inflammation is the main mechanism proposed in the physiological genesis of stent thrombosis. An expression of the inflammatory state is the lymphocytic neutrophil index. Objective. Evaluate the prognostic value of the lymphococcal neutrophil index in the prediction of early thrombosis of the stent. Method. Prospective research at the Hermanos Ameijeiras Hospital, Havana, Cuba, between December 2018 and June 2019. Results. 196 patients were studied; the variables high levels of neutrophil ( $p=0.009$ ) and lymphocytic neutrophil index ( $p=0.007$ ) after the proceeding are significantly related to the presence of stent thrombosis and the ROC curve found a sensitivity of 70% and a specificity of 62% for an index level greater than 6 (0.712; IC95%: 0.610-0.988; 0.012). Conclusion. The increase in the neutrophil-lymphocytic index at 6 hours of percutaneous coronary interventionism has high sensitivity and high specificity as predictive value in early stent thrombosis.

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### BRIEF COMMUNICATIONS / COMUNICACIONES BREVES

#### BALLOON SIZING TECHNIQUE WITH TAVR IN PATIENTS WITH SEVERE AORTIC STENOSIS WITH DEGENERATIVE BICUSPID AORTA

Marco G. Massano, Sebastián Lerga, Fabricio Torrent, Lucas Gerbaudo, Marcos De La Vega, Leonardo Danduch, Juan Moreno

**Introduction and objectives:** The indication on transcatheter aortic valve replacement (TAVR) has been increasing during the last years thanks to new prosthesis and technics on the implantation. The objective of this study is to show how the balloon sizing technic is effective in the election on the size of the prosthesis in patients with bicuspid aorta.

**Methods.** Balloon sizing technic was realized in 8 high risk patients with aortic stenosis and bicuspid aorta previous TAVR

**Results.** The implantation of the valve was 100% successfully. The 63% of the patients had indication N° 34 size Evolut R valve and 25% had indication N° 26 Evolut R. As regards the implanted valves, 38% had Evolut R 29, 38% Evolut R 26 and 25% Evolut R 23. The average on the implantation high was  $2.5 \text{ mm} \pm 0.93$ , with a range between 1 and 4 mm. The access was 86% right femoral and 14% left femoral. Only one patient had a vascular complication. No death was register during the study. It's important to remark that 5 N° 34 valve were suggested because of the CT scan and none N° 23 and thanks balloon sizing technic 2 N° 23 valve and none N° 34 were implanted. After the procedure mild or no aortic regurgitation was registered.

**Conclusions.** Balloon sizing is a complementary technic with CT scan and echocardiogram. It can be useful when there are doubts in the ring dimension, when the measure are in a "grey zone" between two valve sizes and when the anatomic situation are not helpful such as bicuspid aortic and septal lump.

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### CASO CLÍNICO Y REVISIÓN / CASE REPORTS AND REVIEW

#### REVASCLARIZATION OF INFERIOR VENA CAVA DUE TO THROMBOSIS AFTER FILTER IMPLANT

André Câmara Matoso Chacon, Igor R. Sincos, Vinicius Bertoldi, Paulo Nasser Borges, Walter Campos Júnior

**Objectives.** Report a case of revascularization of inferior vena cava due to thrombosis following the use of a filter and investigate the number of cases available in the medical literature and compare diagnosis and treatments.

**Results.** Medical literature describes the implantation of a single stent covering the filter and kissing stents with good patency rates with the use of isolated anticoagulation, which is safe and effective at the mid-term follow-up with minimal morbidity and low reintervention rates, but with few cases per study.

**Conclusion.** The recanalization of the inferior vena cava due to filter thrombosis can be performed by implanting kissing stents even with patients with thrombophilia with good patency rates in the mid-term.

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### CASOS CLÍNICOS / CASE REPORTS

#### PERIPHERAL TRANSLUMINAL ANGIOPLASTY TO THROMBOEMBOLIC OCCLUSION OF THE SUPERIOR MESENTERIC ARTERY

Germán Stupaczuk, Carlos Álvarez Iorio, Alejandro Álvarez Iorio, Fernando Ordóñez, Martín Ordóñez

Thromboembolic occlusion of the superior mesenteric artery is a rare condition (8.6/100 000 people/year). In many cases it is consistent with a misdiagnosed entity, since it is only possible to recognize it

when it has a catastrophic onset as an intestinal infarction. This is the case of a 68-year-old male with a past medical history of hypertension, smoking, and non-anticoagulated paroxysmal atrial fibrillation admitted to the intensive care unit with a diagnosis of acute abdominal pain. An urgent exploratory laparotomy performed revealed signs of intestinal distress but no signs of necrosis. The arteriography of mesenteric vessels performed confirmed the thrombotic occlusion of the superior mesenteric artery.

### **CORONARY ANEURYSM, FINDING IN STEMI**

*Esteban M. Quarchioni, María C. Licheri, Luis Gerardo, Alberto Licheri*

The aneurysms of coronary arteries were described for the first time by Morgagni back in 1761 in a patient with syphilis. It is a rare condition with an approximate incidence rate from 1% and 2% in our specialty. Its main significance, from the clinical point of view, is the possibility of causing infarctions due to thrombosis or spasm, and rupture. Very little is known about its evolution, prognosis, and treatment.<sup>1</sup>

This is the case of a patient with ST-segment elevation acute coronary syndrome (STEMI). Revascularization reveals the presence of a giant aneurysm in the left anterior descending coronary artery. The medical literature is reviewed to update the information on this condition.

### **COMPRESSIVE CHRONIC GIANT PSEUDOANEURYSM OF THE LEFT EXTERNAL ILIAC ARTERY DUE TO GUNSHOT WOUND**

*Federico M. Riolo, Patricio Rattagan, Jorge O. Cortez Yáñez, Miguel O. Villegas*

Post-traumatic iliac pseudoaneurysms are rare. This is the case of a 44-year-old male patient with a past medical history of a gunshot wound who required a colostomy with bowel transit reconstruction. The patient sought medical attention 13 years later due to the presence of a painful pulsatile mass in his abdomen associated with rest pain of the patient's lower left extremity (Fontaine III - Rutherford IV) of 2-year duration. The CCTA revealed the presence of a pseudoaneurysm of the left external iliac artery of sacular morphology and a maximum diameter of 213 mm. The endovascular approach using 3 graft stents was successful. The CCTA had good results. This is the diagnostic, therapeutic and 1-year-follow-up approach.

### **TRANSCOLLATERAL RETROGRADE APPROACH: A COMPLETELY ENDOVASCULAR TECHNIQUE TO PRESERVE VASCULAR ACCESS FOR HEMODIALYSIS**

*Marcel Voos Budal Arins, Raúl Llano, Pablo Vega, Esteban Mendaro*

**Objective.** Vascular access (VA) dysfunction in patients with end-stage renal disease is associated with an increased morbidity and mortality. Consequently, maintaining the existing VA sites is of utmost importance regarding hemodialysis. We describe the feasibility of the transcollateral retrograde approach (TCRA), an entirely endovascular technique to avoid the hemodialysis of the VA.

**Methods.** This is the case of a male patient with left upper limb edema and high venous pressure during the hemodialysis of an AV graft due to the occlusion of the post-anastomotic vein and central veins with developed collateral vessels. Since the antegrade access failed and no puncture site for retrograde recanalization was anatomically available, we adopted the TCRA strategy and completed the procedure successfully by implanting venous self-expandable nitinol stents. The angiography performed confirmed the AV patency and proper flow.

**Results.** In the outpatient follow-up, hemodialysis was performed uneventfully, and the patient showed the complete resolution of the left upper limb edema.

**Conclusion.** This fully endovascular technique turned out to be a feasible alternative to solve a dysfunctional VA.

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#### **LETTER FROM THE PRESIDENT / CARTA DEL PRESIDENTE**

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*Diego Grinfeld*

# Annual decrease in the number of percutaneous coronary interventions performed in the United States: a cause for concern

Declinación en el uso de los métodos de revascularización y de angioplastia coronaria en Estados Unidos: previsible pero muy preocupante

*Revista Argentina de Cardioangiología Intervencionista* 2020;11(1). <https://doi.org/10.30567/RACI/202001/>

Back in February the scientific journal *JAMA Cardiology*<sup>1</sup> published a large database on the temporary changes that affected revascularization in the United States from 2003 through 2016. As expected, these changes affected the 2 techniques widely used by everyone these days: coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI).

Authors divide this period into 3 stages: from 2003 through 2007, from 2008 through 2012, and from 2013 through 2016.

Excluding the ethnic and racial variations that do not affect our country, a lower use of both revascularization procedures (CABG and PCI) is obvious, yet the most evident changes affect the PCI.

Ever since PCI was massively introduced in the routine clinical practice in the United States, there has been a constant and gradual reduction in the use of CABG as the revascularization procedure.

However, the opposite thing happened in the case of PCI that experienced an ongoing growth over 3 decades: the 1980s, the 1990s, and the 2000s.

The arrival of drug-eluting stents (DES) reduced significantly the rate of new revascularizations within the first year. An even higher growth in the number of PCIs performed was just a matter of time.

Yet this does not seem to be the case. The use of CABG decreased between 2003 and 2016. However, the curve is less steep compared to the drop of PCI as the main figure of this paper<sup>1</sup> shows.

During this period, there was an increasing use of PCI for the management of patients with STEMI, NSTEMI, use of FFR, circulatory support, and chronic total coronary occlusions. However, the PCI was less common for the management of stable patients, those with bare-metal stents (BMS), and for management of multiple vessels.

CABG was more widely used for the management of myocardial infarction, one- or two-vessel lesions, use of arterial ducts, and management of cardiogenic shock. Both revascularization strategies were associated with significant comorbidities.

The in-hospital mortality rate seen reduced significantly with CABG and increased significantly with PCI, which is hard to explain with the data reported by the manuscript; however, the higher 30-day mortality rate associated with the PCI was seen in patients with AMI and patients with unstable or stable angina.

This reduction in the use of myocardial revascularization procedures was expected given the results seen in the clinical management of coronary artery disease. However, no one doubts that this affected the PCI much more than it affected the CABG given the much more invasive nature of the latter.

We should also mention here that this observation was made at a time when the results from several randomized clinical trials had not been published yet. Editorials are always the expression of one's opinions and I firmly believe that these results were absolutely negative for the PCI whether compared to CABG or medical treatment: SYNTAX, BEST, NOBLE, EXCEL, ORBITA, and ISCHEMIA trials.<sup>2-8</sup>

That's why in the years to come I think we can expect to see a reduction in the use of percutaneous coronary interventions.

I think time has come for all of us who love this profession—interventionists and the pharmaceutical industry basically—to rethink what we have been doing over the last 15 years with the PCI to come to this point. Time has come to rewrite history and think what legacy we'll be leaving to the new medical students in the years to come. For the time being and until we find out what really happened over the last 15 years with the PCI and what is the safest and most efficient device (DES and/or BMS) for the PCI, we should not conduct any more comparative, randomized trials in our specialty between CABG and medical treatment.

**Alfredo E. Rodríguez, MD, PhD, FACC, FSCAI**

Editor-in-chief of *Revista Argentina de Cardioangiología Intervencionista (RACI)*

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# ICI CACI: Innovation meeting looking for ideas and technological solutions in favor of cardiovascular medicine

ICI CACI: Encuentro de innovación en busca de ideas y soluciones tecnológicas a favor de la medicina cardiovascular

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The ICI CACI in its first edition in South America faces the task of bringing disruptive technologies from a great variety of domains and the use of institutional resources and trained staff in order to promote medical technological solutions. In addition we will emphasize the cooperation between industry and physicians and the importance of ideas and connections.

The technological progress highlights the importance of the physician at the first line in the interface of the medical treatment and the patient, and the implementation and creation of these ideas.

The physician's environment makes possible a unique perspective of the critical points at the medical array, identifying the unmet clinical needs, the thinking process and the possibility of a wide overview of the multiple ways of a complex net as is the comprehensive medical treatment. Also poses the physician at a special position, in order to create new solutions regarding chance and improvement in the sequence of the medical services.

Dr. Rene Laennec was physician and musician and operated a successful clinic at the very beginning of the 19th century, was quoted as saying that "his career's summit took place during a period in which medicine was not his main occupation but the right one for invent the stethoscope".

In light of the existing great variation of treatment strategies the motivation to develop better alternatives and promotion of knowledge is driven from the real need of doctors and entrepreneurs.

## THE ECHOSYSTEM

The aim of ICI CACI is to put Argentina as an active and throbbing center of the entrepreneurs' ecosystem in Latin America.

This powerful entrepreneurship, the human capital and fruitful activity, all together are translated in successful commercial transactions and new markets.

It is remarkable that very relevant companies dealing with medical technology and products with important clinical value, refer to doctors in order to invent, develop and update their products' portfolio.

The radiologist Julio Palmaz and the cardiologist Richard Schatz developed the stents technology. At the beginning they were financially supported by an American restaurant owner, who toll after years that his investment of 250 K dollars yielded about 600 million dollars at the time that Johnson and Johnson acquired all the rights of the invention.

This is an example of cooperation between inventors who are closed to the clinical activity the initial funding factor and the industry. With the FDA certification stents are implanted in more than 90% of vessels interventions.

In order to establish the priority of ICI CACI as a design partner of choice for the medical technological industry and entrepreneurs, we are going to launch the first event in Latin America at Buenos Aires, Argentina. ICI CACI pretends to be the principal pipeline for share developments in healthcare and the promotion of the benefits coming from the innovative products, to bring up disrupting technologies and the intelligent use of institutional or private resources.

ICI CACI will use the global well known methodology AGILE, i.e. agility and easy movement.

The ICI CACI strategy is to connect with the innovation world, real partnership with entrepreneurs, startups, global companies, investors and other nations. In addition databases and acquaintance with the regulatory rules, allow ICI CACI to promote technological development in an accelerated rate providing a significant value. A varied of activity fields like pharma, medical devices, digital health, based on the creation of many domains: cyber, artificial intelligence, finance, cell therapy, biotechnology, biomaterials' engineering, etc.

ICI CACI is defined as an independent initiative and then lets this framework to move quickly and to harness us to ventures, investors funding, work spaces and entrepreneurship centers.

With this operational concept, from the point of view of the industry the way to go is done and familiar, and ICI CACI would be the mediator and accelerator between the institutional resources like university medical centers, universities and startups and the leading medical staff, research laboratories and management board.

In our view, the most important tier is the personal relationship of the medical staff with industry's representatives composing a true "team". Doctors will be associated founders, side by side with leader entrepreneurs of the industry.

Others, may be the majority, will take the role of consultants in their specialties. The case of medical centers that are operating an innovation department, will combine forces in order to promote projects coming for the different wards or form startups.

Commercial models for cooperation with the industry would lean on transparency, agility and fairness, and most important to allow every single project to progress in the right way in order to ensure its success being the ICI CACI full partners of the success.

For the industry the closeness with ICI CACI will lead to the creation of a pilot working at the beta website. The beta website versions, is a prerelease of software that is given out to a large group of users to try under real conditions to give the possibility to create solutions that will touch the life of people all around the world, aspiring to solve complex problems in the medical contemporary field.

The biomed industry looks for the well being of patients and in parallel to be profitable: "doing well by doing good", and to build up commercial entrepreneurship to finally create a sustainable echosystem.

**Alberto Hendler MD FESC PhD**

Beilinson Medical Center, Cath Lab. Assuta Medical Center, Cath Lab  
Tel-Aviv University

# Neutrophil-lymphocyte ratio to predict early stent thrombosis

## Índice neutrófilo-linfocitario en la predicción de trombosis temprana del stent

Suilbert Rodríguez Blanco, Abel Y. Leyva Quert, and José M. Aguilar Medina

### ABSTRACT

**Introduction.** Inflammation is the main mechanism proposed in the physiological genesis of stent thrombosis. An expression of the inflammatory state is the lymphocytic neutrophil index. **Objective.** Evaluate the prognostic value of the lymphocytic neutrophil index in the prediction of early thrombosis of the stent. **Method.** Prospective research at the Hermanos Ameijeiras Hospital, Havana, Cuba, between December 2018 and June 2019. **Results.** 196 patients were studied; the variables high levels of neutrophil ( $p=0.009$ ) and lymphocytic neutrophil index ( $p=0.007$ ) after the proceeding are significantly related to the presence of stent thrombosis and the ROC curve found a sensitivity of 70% and a specificity of 62% for an index level greater than 6 (0.712; IC95%: 0.610-0.988; 0.012). **Conclusion.** The increase in the neutrophil-lymphocytic index at 6 hours of percutaneous coronary interventionism has high sensitivity and high specificity as predictive value in early stent thrombosis

**Keywords:** lymphocytic neutrophil ratio, early stent thrombosis.

### RESUMEN

**Introducción.** La inflamación es el principal mecanismo propuesto en la génesis fisiopatológica de la trombosis del stent. Una expresión del estado inflamatorio es el índice neutrófilo linfocitario. **Objetivo.** Evaluar el valor pronóstico del índice neutrófilo linfocitario en la predicción de trombosis temprana del stent. **Método.** Investigación prospectiva en el Hospital Hermanos Ameijeiras, La Habana, Cuba, entre diciembre de 2018 y junio 2019. **Resultados.** Se estudiaron 196 pacientes; las variables niveles elevados de neutrófilo ( $p=0,009$ ) e índice neutrófilo linfocitario ( $p=0,007$ ) después del proceder se relacionan significativamente con la presencia de trombosis del stent y la curva ROC encontró una sensibilidad de 70% y una especificidad de 62% para un nivel del índice mayor de 6 (0,712; IC95%: 0,610-0,988;  $p=0,012$ ). **Conclusión.** El aumento del índice neutrófilo-linfocitario a las 6 horas del intervencionismo coronario percutáneo, tiene alta sensibilidad y alta especificidad en la predicción de trombosis temprana del stent.

**Palabras clave:** índice neutrófilo linfocitario, trombosis temprana del stent.

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## INTRODUCTION

Stent thrombosis (ST) is one of the main complications of percutaneous coronary intervention (PCI) and is associated with high morbidity and mortality rates<sup>1-3</sup>. It is a complex and multifactor process involving several patient-related factors such as early withdrawal of dual antiplatelet therapy, diabetes mellitus, unstable patient, previous ST, and other; anatomical factors such as the spread of coronary artery disease, thin vessels, ostial lesions, coronary bifurcations, and other; and finally procedure-related factors such as complex bifurcation technique, length of the segment treated, and other.<sup>2</sup>

Back in 2008 the Academic Research Consortium published the clinical practice guidelines on how to classify ST.<sup>4</sup> Depending on when the ST occurs, it is classified as acute, subacute, late, and very late ST. Acute (<24 hours) and subacute ST (from 24 hours to 30 days) are called early stent thrombosis. Probable ST is defined as any inexplicable death within the first 30 days after stent implantation or the presence of ST-segment elevation acute coronary syndrome with topography consistent with the territory of the artery treated. On the other hand, definitive ST requires confirmation through angiography or anatomopathological examination of the presence of a thrombus inside the stent or 5 mm anterior or posterior to it.

The advances made in antiplatelet therapy, the ongoing improvements of stents, and the implantation technique used have reduced the rate of ST to 0.7%. This complication is minor in elective (from 0.3% to 0.5%) compared to urgent procedures (3.4%).<sup>5,6</sup> Stents are endovascular devices that are potentially thrombogenic, a property that basically depends on the electro-positive charge of the metal surface that seems to be affected by the composition, configuration, and size of the stent and, consequently, by the vessel protective response. Beyond the stent thrombogenic properties as a metal structure there are different clinical, technical, and procedural factors that play a significant role in the occurrence of acute and/or subacute ST (early ST) after its implantation; however, this is not the case when thrombotic events are considered late, which seems to be directly associated with a complex immediate and delayed vessel response with respect to the presence of the stent (usually pharmacological), the platform, the drug, and the polymer. This response is triggered by incomplete endothelialization and neointimal formation, hypersensitivity, endothelial dysfunction (late inflammatory response), and late acquired incomplete stent apposition.<sup>7-9</sup> The rate of early ST seems a little higher with bare-metal stents compared to drug-eluting stents. It has been suggested that the polymer matrix of drug-eluting stents can reduce acute thrombogenicity. The factors associated with the procedure are the most important ones (stent malapposition and underexpansion, edge dissection), but there are other clinical factors involved such as diabetes mellitus, reduced LVEF, genetic traits, among other, that can trigger the inflammatory state.<sup>10,11</sup>

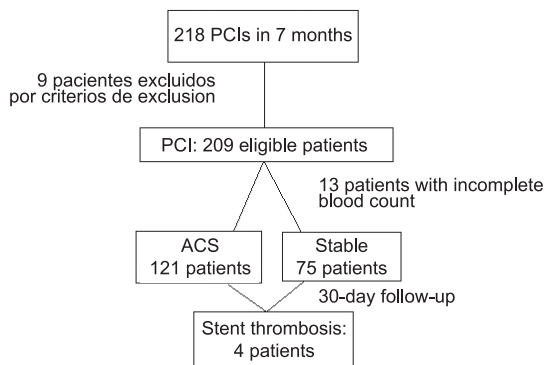
This inflammatory factor that has been described in late and very late ST is associated with stent implantation and there is evidence that it is associated with inflammatory markers and ST.<sup>12</sup>

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**Figure 1.** Fluid balance chart of the study sample.

The neutrophil-lymphocyte ratio (NLR) is an inflammatory marker associated with the presence, severity, and spread of coronary artery disease,<sup>13</sup> adverse cardiovascular events in patients with acute myocardial infarction previously treated with PCI<sup>14</sup>, and with the presence of periprocedural type 4a acute myocardial infarction.<sup>15</sup> This easy-to-determine, reproducible, and cost-effective NLR biomarker is the marker of choice of the inflammatory state. In this sense, there are studies that associate the NLR with ST and the high mortality rate of patients with acute coronary syndrome.<sup>16</sup>

## OBJECTIVE

To assess the prognostic value of neutrophil-lymphocyte ratio to predict early stent thrombosis.

## METHODOLOGICAL DESIGN

Type of research: applied, descriptive-correlational, and prospective study.

Period and place: Hospital Hermanos Ameijeiras, Havana, Cuba, from December 2018 through June 2019.

## PARTICIPANTS

### Inclusion criteria

- Patients >18 years undergoing percutaneous coronary intervention.

### Exclusion criteria

- Severe left ventricular systolic dysfunction (ejection fraction <30%).
- PCI of chronic total occlusion.
- Myocardial revascularization surgery 3 months before.
- Severe lung disease. Neoplasm. Chronic hematologic disease.
- Corticosteroid therapy within the last year. Chronic inflammatory disease. Active infection when the procedure was performed.

### Sample

One hundred and ninety-six consecutive patients who met the inclusion and exclusion criteria during the timeframe mentioned above.

## Main variable

- Neutrophil-lymphocyte ratio: it is defined as the absolute number of neutrophils divided by the absolute number of lymphocytes. It was estimated prior to the procedure performed and 6 hours later.
- Stent thrombosis: early ST (probable or definitive) was defined as the ST occurring within the first 30 days after stent implantation.

## Techniques and procedures

- Automatic analysis of leukogram: the Pentra-DX NE-XUS automated hematology analyzer was used. A fully automated hematology analyzer for the in-vitro diagnosis of anticoagulated whole blood samples with EDTA at 10%.
- Lymphocytes (LYN): expressed as absolute value (#).
- Neutrophils (NEU): expressed as absolute value (#)

## Statistics

The comparison of non-parametric values between both groups was conducted using the Mann-Whitney *U* test. Categorical variables were compared using the chi-square test. Regression analysis was used to assess the predictors of stent thrombosis. Variables with *P* values <0.05 according to the univariate analysis were included in a multivariate regression model and their odds ratio (OR) was estimated using the 95% confidence interval (95%CI). The ROC curve was established to determine the prediction of the value of NLR in stent thrombosis.

## RESULTS

The fluid balance chart of **Figure 1** shows that 218 procedures were performed during the study period. Thirteen out of the 209 eligible patients had incomplete data and 196 patients were studied. Of these, 4 showed early stent thrombosis (2.04%).

Procedural clinical and angiographic variables and laboratory parameters are shown on **Table 1**. The distribution of these variables based on the presence of early stent thrombosis shows that variables such as old age ( $P=0.047$ ), presence of diabetes mellitus ( $P=0.04$ ), bifurcation lesion ( $P=0.036$ ), and acute coronary syndrome ( $P=0.04$ ) are associated with this complication. Similarly, high neutrophil ( $P=0.009$ ) and NLR levels ( $P=0.007$ ) after the procedure are significantly associated with the presence of ST.

The distribution of patients with ST based on the time of appearance, definitive diagnosis, and location is not statistically significant (**Table 2**), which is associated with the poor frequency of stent thrombosis.

The level of NLR based on the presence of ST is shown on **Figure 2** and **Figure 3**. In patients with early stent thrombosis, the NLR was high after the procedure ( $P<0.05$ ), the sensitivity of the ROC curve was 70% and its specificity was 62% for NLR levels > 6 (0.712; 95%CI: 0.610-0.988;  $P=0.012$ ).

In the multivariate analysis only these variables were independently associated with the presence of this complication (**Table 3**): bifurcation lesion (0.905; IC95%: 0.744-0.991;  $P=0.003$ ), postprocedural high neutrophil (0.833; 95%CI: 0.645-0.911;  $P=0.012$ ) and NLR levels (0.809; 95%CI: 0.689-0.873;  $P=0.009$ ).

**TABLE 1.** Procedural, clinical, angiographic variables and laboratory parameters in the study patient.

Variable	Patients	Presence of early stent thrombosis		P
		Yes (4)	Not (192)	
Age	65.3±9.1	69.6±8.2	63.1±6.1	.047
Male (%)	122 (62.2%)	3 (75%)	119 (61.9%)	.23
DM (%)	83 (42.3%)	4 (100%)	79 (41.1%)	.04
Smoking	92 (46.9%)	2 (50%)	90 (46.9%)	.6
CKD > 1 (%)	31 (15.8%)	1 (25%)	30 (15.6%)	.78
Previous AMI	52 (26.5%)	2 (50%)	50 (26.0%)	.09
LVEF	55.4±3	46±8.9	57±4.2	.056
UA/NSTEMI	121(38.2%)	3 (75%)	118 (61.5%)	.04
ASA + clopidogrel	196 (100%)	4 (100%)	192 (100%)	1
Statins	133 (67.9%)	4 (100%)	129 (67.2%)	.12
SYNTAX score	24.1±4.2	28.2±4.1	23.0±3.3	.23
Bifurcation lesion (%)	71 (36.2%)	4 (100%)	67 (34.9%)	.036
Total length of the stented segment (mm)	21±9.2	28±10.1	20±8.3	.38
Presence of thrombus	12 (6.12%)	1 (25%)	11 (5.7%)	.09
Stent thrombosis related artery				
- LMCA	18 (9.2%)	1 (25%)	17 (8.9%)	.9
- LAD	88 (44.9%)	2 (50%)	86 (44.8%)	.45
- Diagonal	6 (3.1%)	1 (25%)	5 (2.6%)	.2
- Cx	29 (14.8%)	0	29 (15.1%)	
- RCA	79 (40.3%)	0	79 (41.1%)	
Complex bifurcation technique	4 (2%)	0	4 (2.1%)	
Conventional stent	109 (55.6%)	1 (25%)	108 (56.3%)	.6
Drug-eluting stent	87 (44.4%)	3 (75%)	84 (43.8%)	.5
Neutrophils (×10 <sup>3</sup> /mm <sup>3</sup> )				
- Preprocedural	3.0±1.2	3.4±0.5	3.0±1.1	.08
- Postprocedural	3.8±1.8	5.8±0.4	3.7±1.2	.009
Lymphocytes (×10 <sup>3</sup> /m <sup>3</sup> )				
- Preprocedural	1.9±1.3	1.9±1.4	2.0±1.0	.08
- Postprocedural	1.4±1.2	0.9±0.4	1.9±1.2	.14
NLR				
- Preprocedural	2.1±1.5	3.5±1.3	2.8±1.9	.09
- Postprocedural	2.7±1.8	6.5±0.3	3.0±1.0	.007

AMI, acute myocardial infarction; ASA, acetylsalicylic; CKD, chronic kidney disease; DM, diabetes mellitus; LVEF, left ventricular ejection fraction; NLR, neutrophil-lymphocyte ratio; NSTEMI, non-ST-elevation acute myocardial infarction; UA, unstable angina.

**TABLE 2.** Distribution of patients with early stent thrombosis according to time and location.

	Acute ST	Subacute ST	Definitive ST	Probable ST	LMCA	LAD	Diag
Case#1	X		X			X	
Case#2		X	X			X	
Case#3		X	X				X
Case#4		X		X	X		

ST, stent thrombosis.

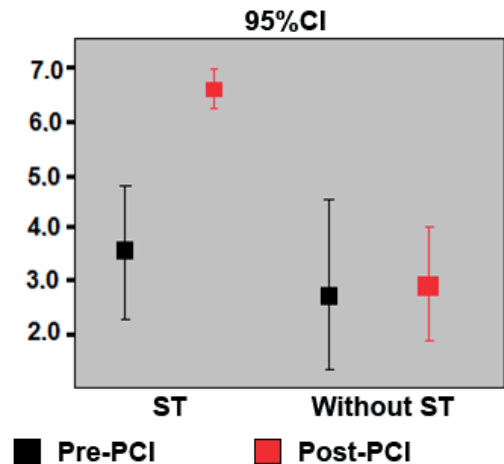
## DISCUSSION

Inflammation is the main mechanism proposed in the pathophysiological process of stent thrombosis.<sup>12</sup> The neutrophil-lymphocyte ratio expresses the inflammatory state of coronary arteries. High neutrophil levels increase the secretion of inflammatory markers like the proteolytic enzyme elastase that deteriorates the vascular basement membrane causing endothelial damage.<sup>17</sup> In contrast, the lymphocyte levels associated with the secretion of cortisol go down worsening the inflammatory response.<sup>18</sup>

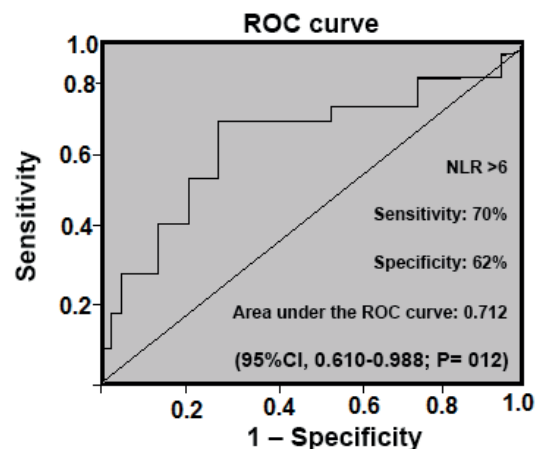
**TABLE 3.** Multivariate analysis of variables associated with the presence of stent thrombosis.

Variables	OR (95%CI)	P
Age	1.023 (0.874-2.064)	.147
Diabetes mellitus	0.994 (0.836-1.582)	.245
UA/NSTEMI	1.693 (0.726-2.059)	.133
Bifurcation lesion	0.905 (0.744-0.991)	.003
Postprocedural neutrophil levels (6 hours)	0.833 (0.645-0.911)	.012
Preprocedural NLR levels	1.19 (0.428-1.977)	.544
Postprocedural NLR levels (6 hours)	0.809 (0.689-0.873)	.009

95%CI, 95% confidence interval; NSTEMI, non-ST-elevation acute myocardial infarction; OR, odds ratio; ST, stent thrombosis; UA, unstable angina.



**Figure 2.** Association between the NLR and the presence (or not) of ST.



**Figure 3.** ROC curve. Neutrophil-lymphocyte ratio to predict ST.

Our data suggest that there is a significant correlation between higher postprocedural NLR levels > 6 and the presence of early stent thrombosis with high sensitivity and specificity. Burak A et al.<sup>16</sup> found similar results. They showed that NLRs > 4.9 have high sensitivity and specificity to predict in-hospital mortality while keeping a close correlation with the presence of ST.

The neutrophil count 6 hours after the procedure was independently associated with the presence of stent thrombosis in this series. Former studies correlate this parameter with the higher cardiovascular mortality due to coronary artery disease,<sup>19</sup> which explains the inflammatory state found in the coronary tree of patients with ST.

## STUDY LIMITATIONS

The size of this study was not big enough. Although the percentage of patients with early stent thrombosis is similar to that reported by the medical literature, these patients were misrepresented in this study.

## CONCLUSION

High neutrophil-lymphocyte ratio levels 6 hours after a percutaneous coronary intervention show high sensitivity and specificity to predict early stent thrombosis.

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# Balloon sizing technique with TAVR in patients with severe aortic stenosis with degenerative bicuspid aorta

Implante valvular aórtico percutáneo con técnica de balloon sizing en anillo aórtico en pacientes mayores de 55 años con estenosis aórtica severa sintomática con válvula bicúspide degenerativa

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## ABSTRACT

**Introduction and objectives:** The indication on transcatheter aortic valve replacement (TAVR) has been increasing during the last years thanks to new prosthesis and techniques on the implantation. The objective of this study is to show how the balloon sizing technique is effective in the election on the size of the prosthesis in patients with bicuspid aorta.

**Methods.** Balloon sizing technique was realized in 8 high risk patients with aortic stenosis and bicuspid aorta previous TAVR

**Results.** The implantation of the valve was 100% successfully. The 63% of the patients had indication N° 34 size Evolut R valve and 25% had indication N° 26 Evolut R. As regards the implanted valves, 38% had Evolut R 29, 38% Evolut R 26 and 25% Evolut R 23. The average on the implantation high was 2.5 mm  $\pm$  0.93, with a range between 1 and 4 mm. The access was 86% right femoral and 14% left femoral. Only one patient had a vascular complication. No death was registered during the study. It's important to remark that 5 N° 34 valve were suggested because of the CT scan and none N° 23 and thanks balloon sizing technique 2 N° 23 valve and none N° 34 were implanted. After the procedure mild or no aortic regurgitation was registered.

**Conclusions.** Balloon sizing is a complementary technique with CT scan and echocardiogram. It can be useful when there are doubts in the ring dimension, when the measure are in a "grey zone" between two valve sizes and when the anatomic situation are not helpful such as bicuspid aortic and septal lump.

**Keywords:** balloon sizing, TAVR, bicuspid aorta.

## RESUMEN

**Introducción y objetivos.** El implante valvular aórtico percutáneo (TAVI) es un procedimiento que ha crecido exponencialmente en los últimos años y cuya indicación va aumentando a medida que se desarrollan nuevas prótesis y mejora su técnica de implantación. El objetivo de este pequeño estudio es demostrar que la técnica de *balloon sizing* es efectiva para colaborar con la elección del tamaño de la prótesis en pacientes con aorta bicúspide.

**Métodos.** Se le realizó *balloon sizing* a 8 pacientes de alto riesgo con estenosis aórtica y aorta bicúspide previo a la colocación de TAVI.

**Resultados.** El éxito técnico, definido como el implante de la válvula se logró en el 100%. El 63% tenía indicación de implante de válvula Evolut R 34 y el 25% Evolut R 26. Con respecto a las válvulas implantadas, el 38% tuvo válvula Evolut R 29, el 38% Evolut R 26 y el 25% Evolut R 23. Las válvulas fueron implantadas en una altura promedio de 2,5 mm  $\pm$  0,93, con un rango comprendido entre 1 y 4 mm. La vía de acceso en el 86% de los casos fue FD (femoral derecha); y solo en el 14% fue FI (femoral izquierda). Un solo paciente tuvo complicaciones vasculares, quien además registraba marcapasos definitivo previo al tratamiento. Tampoco se registraron casos de pacientes que fallecieron. Es importante remarcar que según el perímetro valvular por tomografía se sugirieron 5 válvulas N° 34 y ninguna N° 23, y gracias al *balloon sizing* se terminaron implantando 2 N° 23 y ninguna N° 34. La insuficiencia aórtica residual leve o ausente al final del procedimiento se observó en el 100% de los procedimientos.

**Conclusiones.** *Balloon sizing* es una técnica complementaria a MSCT y al tamaño de ETE convencional. Es especialmente útil cuando existe incertidumbre en cuanto a las dimensiones del anillo, cuando las mediciones caen en la "zona gris" entre dos tamaños de válvula y en las siguientes situaciones anatómicas poco claras: válvula aórtica bicúspide, bulto septal.

**Palabras clave:** balloon sizing, TAVI, aorta bicúspide.

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## INTRODUCTION

Transcatheter aortic valve implantation (TAVI) has become the treatment of choice for patients with severe aortic stenosis considered inoperable and gives better results compared to conservative management including the aortic valvuloplasty. In another group of patients—those of high surgical risk—TAVI proved to be non-inferior to surgical aortic valve replacement (SAVR). In this registry we will be describing a series of successful procedures with the balloon sizing technique in patients with symptomatic severe aortic stenosis with de-

generative bicuspid aortic valve and percutaneous valve implantations. We will also be reviewing the experience reported so far.

## Theoretical framework

Currently, aortic stenosis (AS) is the most common valve disease in developed countries given the increased life expectancy. Mostly, it is associated with calcified AS in older patients (between 2% and 7% of the population over 65).<sup>1</sup> Surgical valve replacement is still the treatment of choice in patients with symptomatic severe AS (class I recommendation with level of evidence B, ACC/AHA clinical practice guidelines, *Circ.* 2008;118:e523-e661).<sup>o</sup>

Without surgery prognosis is extremely ominous with rates < 30% at the 3-year follow-up; however, in 33% of all patients > 75 with severe AS surgery is not an option.<sup>2</sup> The mortality rate of high-risk patients with symptomatic severe AS is > 50% to 60% at 2 years. A significant percentage of those who finally end up undergoing aortic valve replacement surgery has a high morbimortality rate associated with the procedure.<sup>3</sup>

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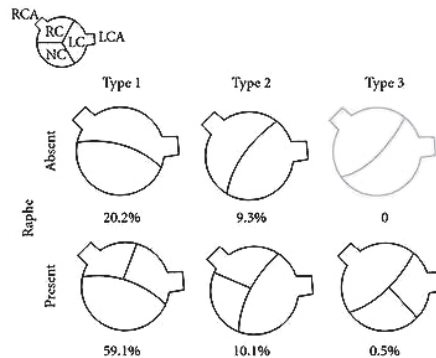
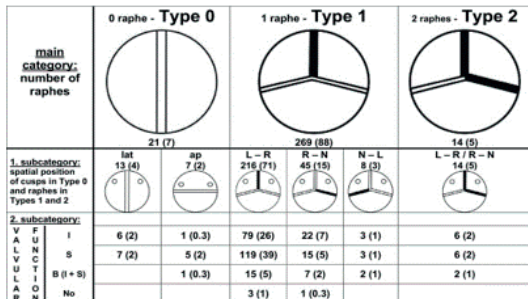
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**TABLE 1.** Valve characterization.

Valve selection Después del ICP	CoreValve Evolut R			
Size	23 mm	26 mm	29 mm	34 mm
Annulus diameter (mm)	18-20	20-23	23-27	26-29
Annulus perimeter (mm)	56.5-62.8	62.8-72.3	72.3-81.7	81.7-94.2
Annulus area (mm <sup>2</sup> )	254.5-314.2	314.2-415.5	415.5-572.6	530.9-660.5
Diameter of ascending aorta (mm)	< 34	< 40	< 43	< 43
Diameter of Valsalva sinus (mm)	> 25	> 27	> 29	> 31
Height of Valsalva sinus (mm)	> 15	> 15	> 15	> 16



**Figure 1.** A y B. Valve classification.

The percutaneous balloon valvuloplasty was the first catheter-based technique to ever solve this problem. After the initial promising results,<sup>4,5</sup> the long-term follow-up data showed a high rate of restenosis and lack of significant clinical improvement in time.<sup>6</sup> For that reason, balloon valvuloplasty is considered an emergency option today as a bridging therapy to surgery or transcatheter aortic valve implantation (TAVI) and as compassionate treatment for some patients. TAVI, initially described by Andersen,<sup>7</sup> was first introduced in 2008 by Cribier for old patients of high surgical risk with symptomatic severe aortic stenosis.<sup>8</sup> The first single-center series showed the feasibility and efficacy of the balloon-expandable Sapien Edwards<sup>TM</sup> valve (Edwards Lifesciences LLC, Irvine, CA, United States)<sup>9</sup> and the self-expandable CoreValve<sup>TM</sup>, now the Medtronic CoreValve<sup>TM</sup> (Medtronic Core-Valve, Irvine, CA, United States).<sup>10-12</sup> This was confirmed in a large multicenter Medtronic CoreValve registry.<sup>13</sup> The promising results across the world led to the wider use of this technique in the routine clinical practice with a rapid increase in the implantation rate of both valves.<sup>14</sup> The right size of transcatheter heart valve (THV) is an important factor to minimize and prevent the complications associated with transcatheter aortic valve replacement (TAVR) such as valve embolization, aortic annulus rupture, paravalvular aortic regurgitation (PAR), and early or late valve thrombosis.

Transesophageal echocardiography (TEE) and multi-slice computed tomography scan (MSCT) are the imaging modalities used to measure the aortic annulus before the procedure, especially MSCT.<sup>28,29</sup> Most of the actual THV systems require annular oversize for optimal adjustment purposes.<sup>28</sup> Inadequate oversizing can cause heart blockage, aortic root hematoma, and valve dysfunction or rupture. The balloon sizing technique is a valuable additional tool that should be included in the therapeutic armamentarium of TAVR. It can help establish the

right size of THV in ambiguous cases of different valve sizes. The size of the balloon can also be used as an imaging modality regardless of the annular size/THV. Patsalis et al. confirmed that nearly 39% of their patients had borderline annular sizes as seen on the transesophageal Doppler echocardiography. They saw a significant reduction of PAR and 30-day and 1-year mortality rates with the use of the balloon sizing technique with aortography and conventional TEE.

**Objective**

The objective of this study is to show the early experience of a heart team with TAVI plus CoreValve Evolut R valve implantation using the balloon sizing technique in different centers of the inland regions of the country.

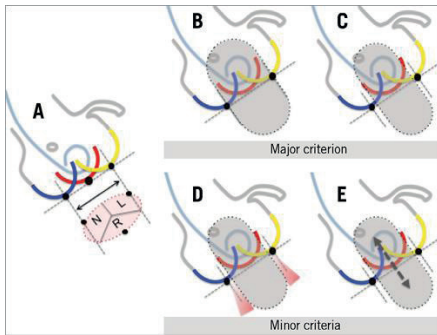
**MATERIALS AND METHODS**

**Design**

Descriptive, cross-sectional, observational study of 8 high surgical risk patients and an indication for TAVI due to degenerative bicuspid aortic valve.

The study population included a total of 8 patients > 55 years (5 males and 3 females) with symptomatic severe aortic stenosis, high surgical risk, and degenerative bicuspid valve treated with TAVI between May 2017 and March 2019 in different Argentinian hospitals of Córdoba (Sanatorio Del Salvador, Clínica Sucre, Clínica Fusavim), Villa María (Clínica Regional del Sud - Río Cuarto), San Juan (Clínica Santa Clara), and Neuquén (Clínica Pasteur). The decision to treat and perform TAVI was based on heart team consensus. All patients gave their informed consent prior to the procedure.

The study conducted prior to selecting the patients included general assessments and transthoracic echocardiography (TTE) performed by an operator to confirm the diagnosis. MSCT was performed too. Both imaging modalities—TTE



**Figure 2.** Schematic view of major and minor criteria for the aortic annulus balloon sizing. A) Obtain the coaxial implantation view. Place the flexible cable catheter in the right coronary sinus and with a fast stimulation infuse 10–15 mL of contrast at a maximum flow rate of 10 mL/s. B) and C) The main criterion for balloon sizing describes the anatomical correlation between the sinus articulation sites and the balloon. In panel B, the balloon is big enough and it can reach the articulation sites; in panel C the balloon is smaller compared to the annulus and cannot reach the articulation sites. D) and E). Minor criteria for balloon sizing describe the functional correlation between contrast contraflow and the balloon movement in relation to the size of the annulus. Panel D shows contrast contraflow with a fully expanded balloon indicative of the insufficient seal of the annulus by the balloon. Panel E shows upward and downward movement of a fully expanded balloon indicative that the balloon is not properly anchored to the annulus.

and MSCT—were used to assess the dimensions of the aorta and aortic valve, their morphology, and the degree and distribution of calcifications.

All patients underwent coronary angiography and aortography prior to the procedure in cases where revascularization with angioplasty and stent implantation was necessary. In 100% of the cases the valve was implanted without intraprocedural need for TEE, TTE or general anesthesia.

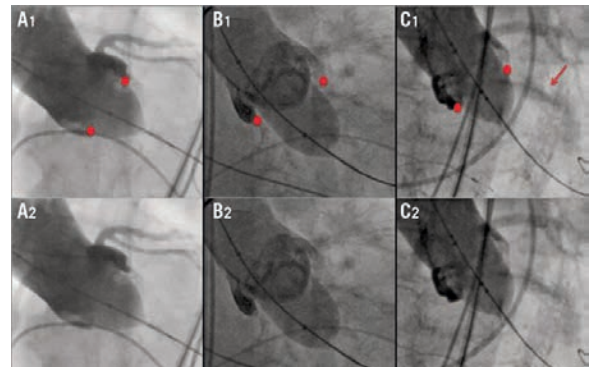
### Techniques and procedures

Valve implantation was basically an elective procedure. Preoperative measurements of the aortic annulus using MDCT were taken followed by valve characterization (bicuspid or tricuspid) (Table 1; Figure 1). Cases of bicuspid valve were suspicious of excessive valve oversize with the corresponding complications involved.

During valve implantation it was suggested to use a certain percutaneous valve that matched the perimeter of the valve (bigger valve) and a smaller valve based on the result obtained using the balloon sizing technique.

The balloon sizing technique consists of performing an aortic valvuloplasty prior to valve implantation using a balloon catheter to differentiate the valve annulus and determine the size of the corresponding valve (Figure 2A). After a fast enough stimulation between 10 mL and 15 mL of contrast are infused at a flow rate of 10 mL/s to guarantee the optimal visualization of the valve annulus, the degree of anchorage of the balloon catheter, and the presence of regurgitation towards the left ventricle (LV) at maximum balloon catheter inflation pressure (Figure 2A).

To choose the right size for the THV when it falls within the “gray zone” between 2 different valve sizes, use balloons with a valve outer diameter that is smaller compared to the size of the balloon. Regarding the Evolut R Medtronic valve, for example, use a 25 mm-balloon when having to decide between a 29 mm or a 34 mm THV. If the 25 mm-balloon has good anchorage and there is no regurgitation towards



**Figure 2.** Cine angiography imaging of major and minor criteria for the aortic annulus balloon sizing. A1/A2) Main criterion: the size of the balloon is able to reach the articulation sites; therefore, the balloon is big enough meaning that a same size THV can be picked. B1/B2) Main criterion: the size of the balloon is smaller compared to the annulus and cannot reach the articulation sites; therefore, the biggest THV of all should be picked here. C1/C2) Minor criterion: the balloon is borderline big, and it is uncertain whether it will be able to reach the articulation sites; however, there is contrast reflow around the balloon. Therefore, the biggest THV of all should be picked here.

the LV, a 29 mm-valve should be used. On the contrary a 34 mm-valve should be implanted.

In conclusion: contrast contraflow in the LV during valvuloplasty (Figure 2D) suggests that the balloon does not provide enough annular coverage. Therefore, it is advised to choose the biggest THV. Similarly, retrieving the balloon with movement during valvuloplasty (Figure 2E) is indicative of the inadequate anchorage of the balloon to the annulus. Therefore, choosing the biggest THV is recommended here.

Figure 3 shows angiographic examples of major and minor criteria for the aortic annulus size with balloon. Figures 3A1, 3A2, and motion-based image #1 show the main criterion where the size of the balloon is big enough to reach the articulation sites. In this scenario, a THV of the same size should be implanted. Figures 3B1, 3B2, and motion-based image #2 show the main criterion where the size of the balloon is smaller compared to the anatomy of the annulus and, therefore, not big enough to reach the articulation sites; here the biggest size of THV should be used. Figures 3C1, 3C2, and motion-based image #3 show the minor criterion where the size of the balloon is borderline big, and it is unclear whether it can reach the articulation sites. However, during the aortogram there is a contrast contraflow both around the balloon and in the LV; here the biggest THV should be used.

## RESULTS

Technical success, defined as the implantation of the valve, was achieved in 100% of the cases. Mean age of the population was  $70.3 \pm 9.2$  years and 63% were males. Mean peak transvalvular gradient was  $76.17 \pm 8.89$  mmHg and the mean gradient was  $50.83 \pm 4.64$ . Mean valve area was  $0.65 \pm 0.16$  mm (range: 0.5 mm to 0.95 mm). Mean angulation was  $50.5 \pm 15.77$  ranging from 27 to 75; mean sinus size was  $25.38 \pm 14.98$ . One patient was already the carrier of a permanent pacemaker before the procedure. The remain-

**TABLE 1.** General characteristics

Variable	Mean	SD	Min	Max
Peak grad.	76.17	8.89	65	91
Echo pre-TAVI mean grad.	50.83	4.54	45	51
Area	0.65	0.16	0.5	0.95
Perimeter	79.38	9.02	65	90
Angulation	50.5	15.77	27	75
Mean sinuses	25.38	14.98	2	37

**TABLE 4.** Degrees of aortic regurgitation.

Classification	N	%
Mild	1	0.14
Pre mild - No post	1	0.14
Pre moderate – Post mild	1	0.14
Pre moderate – No post	1	0.14
No AR	2	0.29
No pre – Post mild	1	0.14

ning patients did not require a pacemaker after the implant (**Table 1**).

Sixty-three per cent had an indication for the implantation of the Evolut R34 valve, and 25% for the implantation of the Evolut R26 valve. Of the total, 75% had a raphe and 63% a type I valve (R-L). Twenty-five per cent of the patients had a type 0 valve and 13% a type II valve (R-NC). Regarding the valves implanted, 38% of the patients received the Evolut R29 device, 38% the Evolut R26 valve, and 25% the Evolut R23 valve (**Table 2**). Valves were implanted at a mean height in relation to the annulus of  $2.5 \text{ mm} \pm 0.93 \text{ mm}$  ranging from 1 mm to 4 mm. In 86% of the cases the surgical access route was the RFA (right femoral artery) and only in 14% of the cases the LFA (left femoral artery) was used. We should mention here that 34-mm valves were not used. Instead 23-mm valves were used whose size was changed after using the balloon sizing technique.

Only one patient, who was also the carrier of a permanent pacemaker, had minor vascular complications (access site hematoma). No cases of death were reported.

We should mention here that based on the perimeter of the valve according to the MSCT 5 different 34-mm valves and 0 23-mm valve were proposed. Thanks to the balloon sizing technique 2 23-mm valves per 0 34-mm valves ended up being implanted.

Residual aortic regurgitation was mild or absent at the end of the procedure in 100% of the patients. No severe aortic regurgitation was reported. When the degrees of aortic regurgitation were analyzed it was evident that the particular situation of each patient was different. Table 3 shows all cases seen.

## DISCUSSION

The degenerative bicuspid aortic valve has been an absolute or relative contraindication for TAVI for quite some time now. This has been so because it took a long time it took to predict the behavior of the percutaneous valve in this type of complex valve annulus.

**TABLE 3.** Characteristics of the valve

Variable		N°	%
Perimeter-based valve	R26	2	25%
	R29	1	13%
	R34	5	63%
Raphe	With	6	75%
	Without	2	25%
Valve type	0	2	25%
	Type I (R-L)	5	63%
	Type II (R-NC)	1	13%
Valve implanted using the balloon sizing technique	R 23	2	25%
	R 26	3	38%
	R 29	3	38%

The TAVI technique has been perfected over time and to this day some still say that the size of the valve to be implanted should only be based on the size of the valve perimeter as seen on the MDCT; currently, a group of interventional cardiologists is developing the balloon sizing technique specifically for these patients anticipating a possible excessive oversizing of much bigger valves and knowing that 20% to 30% oversizing is usually accepted for proper anchoring. This suspicion makes them use prior valvuloplasty with the post-dilatation balloon catheter of the aortic valve right underneath the perimeter-estimated valve with an aortogram simultaneous to balloon inflation.

With this technique, the valve orifice total occlusion using the balloon at maximum expansion can be seen, which involves the use of a smaller size valve. If not possible, an MDCT perimeter-estimated valve is used.

These case registries clearly show less use of bigger valves (34 mm) and much more use of smaller valves with respect to the MDCT planning.

## CONCLUSION

The balloon sizing technique is complementary to the multi-slice computed tomography and the size of conventional TEE. This technique is especially useful when there is uncertainty around the annulus actual dimensions, when measures fall within the “gray zone” between 2 valve sizes, and in the following unclear anatomical situations: bicuspid aortic valve, septal bulge. The balloon size imitates valve implantation without having the valve in its actual place; it gives us additional anatomical information not available on the MSCT or TEE imaging. Balloon sizing allows us to assess visually how situations like severe and eccentric calcifications and the cusp volume will affect valve implantation, functional results, and associated complications. The patency of coronary ostia can also be seen during balloon sizing.

For the time being this has been a promising technique with good clinical results. However, since the studies conducted have used small size series, they have not produced a statistically significant impact to be able to recommend the use of this technique in the routine clinical practice.

For the time being the use of this technique that is still under study and research is left at the heart team's discretion.

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# Revascularization of inferior vena cava due to thrombosis after filter implant

## Recanalización de vena cava inferior por trombosis luego de implante de filtro

André Câmara Matoso Chacon, Igor Rafael Sincos, Vinícius Bertoldi, Paulo Nasser Borges, and Walter Campos Júnior

### ABSTRACT

**Objectives.** Report a case of revascularization of inferior vena cava due to thrombosis following the use of a filter and investigate the number of cases available in the medical literature and compare diagnosis and treatments.

**Results.** Medical literature describes the implantation of a single stent covering the filter and kissing stents with good patency rates with the use of isolated anticoagulation, which is safe and effective at the mid-term follow-up with minimal morbidity and low reintervention rates, but with few cases per study.

**Conclusion.** The recanalization of the inferior vena cava due to filter thrombosis can be performed by implanting kissing stents even with patients with thrombophilia with good patency rates in the mid-term.

**Keywords:** inferior vein cava filter, thrombosis, inferior vein cava.

### RESUMEN

**Objetivos.** Relatar un caso de revascularización de vena cava inferior debido a una trombosis como consecuencia del uso de filtro, investigar en la literatura el número de casos y comparar el diagnóstico y los tratamientos.

**Resultados.** Los trabajos de la literatura describen la colocación de un único stent cubriendo el filtro y kissing stents, con buenas tasas de permeabilidad con el uso de anticoagulación aislada, siendo seguros y eficaces en el seguimiento a mediano plazo, con una mínima morbilidad y tasas de reintervenciones bajas, pero con pocos casos en cada estudio.

**Conclusión.** La recanalización de la vena cava inferior debido a la trombosis de filtro se puede realizar con la colocación de kissing stents, incluso con pacientes trombofílicos, con buena tasa de permeabilidad a mediano plazo.

**Palabras clave:** filtro de vena cava, trombosis, vena cava inferior.

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### INTRODUCTION

The occlusion of the inferior vena cava (IVC) or iliac veins due to thrombosis or non-thrombotic conditions is an important cause for venous flow reduction. This can lead to serious health problems like post-thrombotic syndrome (PTS) with ulcerated lesions in lower extremities (LE) that affect the patients' quality of life.<sup>1</sup> Diagnosis requires high clinical suspicion and, currently, treatment is endovascular.

The vena cava filter can contribute to the occlusion of the IVC. However, its revascularization has not been contraindicated.<sup>2</sup> We hereby present the case of a patient referred from another unit with an implant below the filter and an IVC occlusion associated with Behçet's syndrome (BS) and PTS with CEAP-C6 in the patient's right lower extremity (RLE).

Behçet's syndrome is a multisystem vasculitis of unknown etiology. Vascular compromise has been reported in 40% of the cases. It is the only vasculitis capable of damaging vessels of all types and sizes.<sup>3</sup> Lower extremity (LE) deep venous thrombosis (DVT) is the most common of all followed by thrombosis of the vena cava.

### CASE STUDY DESCRIPTION

Back in 2002, this 48-year-old male patient experienced pain in his RLE associated with edema. After performing a

Doppler echocardiography of his LE in a different unit, he was diagnosed with DVT in RLE and common femoral, superficial, and popliteal veins. At that time the patient also showed oral and genital ulcers. After being examined, he was diagnosed with BS, his thrombosis was treated with marevan, and his BS with azathioprine, meticorten, and colchicine. The patient's comorbidities were left brain hemorrhagic stroke and smoking. Over the next few years he experienced periods of relapse and remission of his BS and 3 more episodes of DVT in his LE until 2006 when a non-retrievable inferior vena cava filter was indicated due to repeated episodes of DVT despite the use of marevan with an international normalized ratio (INR) of 2-3. He also had relapsing ulcers in his LE. From 2006 through 2018 when he came to our office, his PTS was being treated with marevan, elastic compression stockings, and topical dersani.

We suspected a more proximal occlusion because the patient showed bilateral clinical signs, presence of vasculitis and the IVC filter. The coronary computed tomography angiography (CCTA) of the patient's abdomen and pelvis (**Figure 1**) confirmed the presence of an almost total thrombosis of the infrarenal IVC and the implant below the filter whose distal portion was located almost at the confluence of the common iliac veins and several tributaries of the azygos and hemiazygos veins with drainage sites.

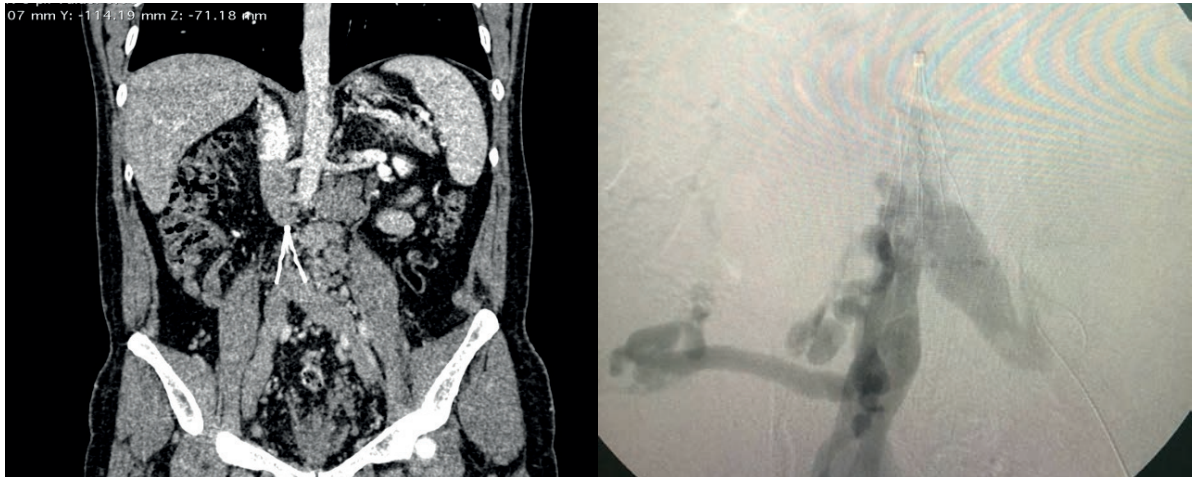
After performing endovascular surgery under general anesthesia, the 2 femoral veins were punctured using Doppler echocardiography guidance. The phlebography performed (**Figure 1**) confirmed an occlusion of IVC very close to the renal veins until the lower part of the filter. After passing 0.035 in x 260 bilateral guidewires up to the superior vena cava, an intravascular ultrasound (IVUS) was used to see the veins (**Figure 3**) and later confirm the presence of iliac artery trabeculae.

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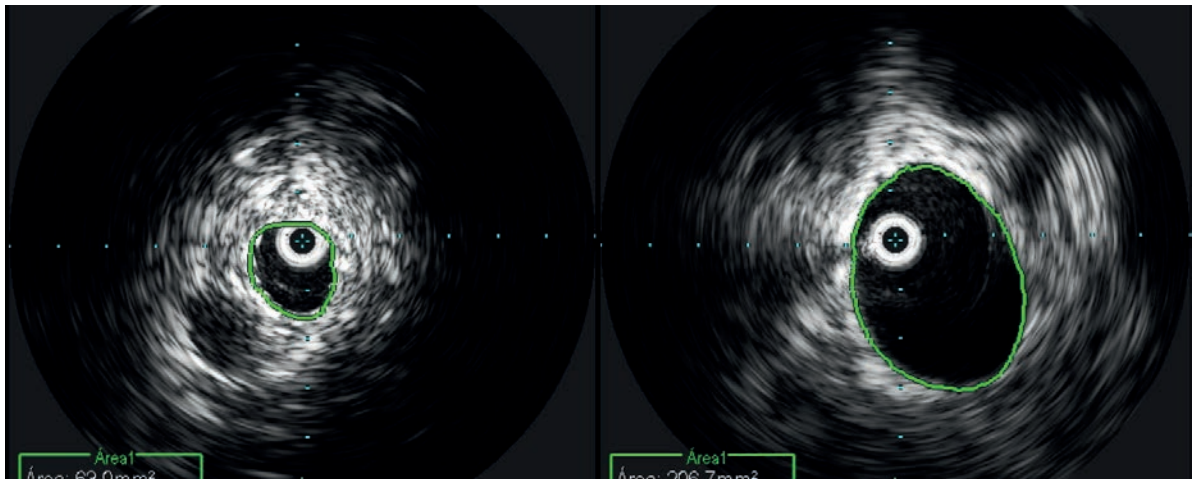
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**Figure 1.** Preoperative CTA (left) showing an IVC filter thrombosis with IVC occlusion and renal vein refill. The CTA was used for surgical planning purposes; early phlebography (right) confirming the IVC filter thrombosis associated with the large number of tributary veins.



**Figure 2.** On the right the IVUS shows the patent common iliac vein and on the left the inferior vena cava distal portion with a significant reduction of its area and fibrosis.

Guidewires were changed for the Lunderquist guidewire followed by ballooning with 2 Mustang 12 x 80 and 12 x 60 balloons using the kissing technique and implantation of 2 16 x 90 and 12 x 60 and 12 x 80 Wallstent endoprostheses, again using the kissing technique, in the inferior vena cava towards the common iliac veins with previous phlebographic control (**Figure 3**) and significant reduction of tributary veins as seen on the IVUS. Trabecular areas were covered with stents and maintenance therapy with mareavan was used the next day with clopidogrel 300 mg at 75 mg/day. The control Doppler echocardiography of the cavo-ilio-femoral segment conducted at the 1-week and 3-month follow-up and the CCTA conducted at the 1-month follow-up (**Figure 4**) confirmed the patency of the stents. The patient's anticoagulation was treated with mareavan and clopidogrel over the course of 3 months. The patient's venous claudication and swelling had improved significantly. His legs did not feel tired anymore and he had no pain. In any case, the elastic compression stockings were not removed.

## REFERENCE REVIEW

The studies reviewed analyzed a total of 809 patients with critical occlusions or stenosis of the cavo-ilio-femoral segment. The main etiology of 98 of these 809 patients was

thrombosis of the IVC filter implant (different types were used: Trapease, Optease, Gunt-Tulip, Celect, Denali) and the second most common etiology was neoplasm related acquired thrombophilia.

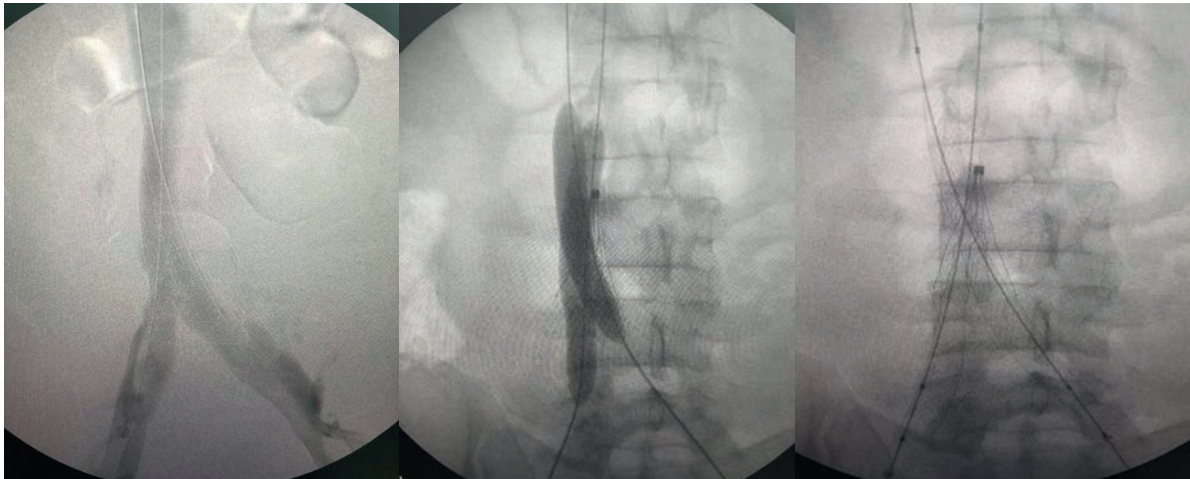
### Inclusion criteria

- Cavo-ilio-femoral segment stenosis or occlusions.
- Hereditary or acquired thrombophilia.
- Patients with failed clinical treatment.
- Stratification of CVD on the CEAP clinical classification (class C) prior to surgery ( $\leq 30$  days).

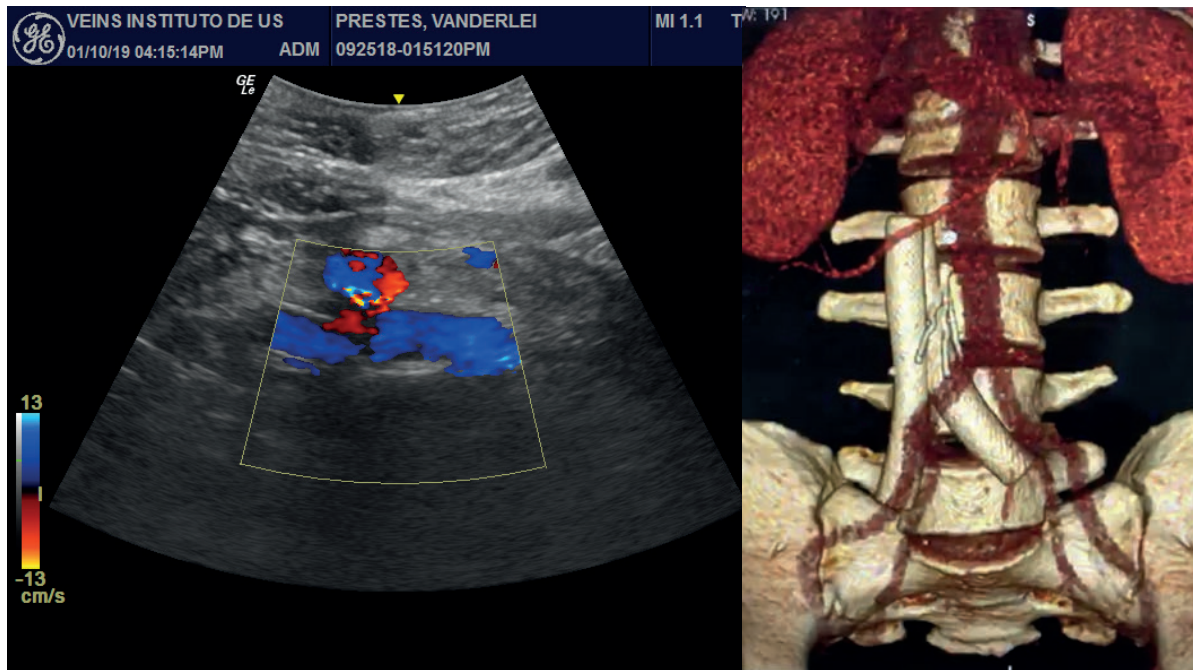
### Exclusion criteria

- No filter thrombosis.
- < 18 years old.
- Acute or chronic thrombosis of lower extremities requiring thrombolysis prior to stenting.
- Peripheral artery disease with clinical signs of weak or absent peripheral pulses.

Back in 2007, Neglén P et al.<sup>4</sup> studied a total of 708 patients. Fifty-three of them had an occluded IVC filter. The filter was removed laterally or remodeled and an IVC stent was implanted. Twelve per cent of the patients from this group suffered postoperative stent thrombo-



**Figure 3.** Kissing balloon and stent of the inferior vena cava towards the common iliac veins with phlebographic control.



**Figure 4.** Control CCTA at the 1-month follow-up. Right: reconstruction showing the crushing of the IVC filter. Left: patency as seen on the Doppler echocardiography performed at the heart center.

sis. At the 54-month follow-up, the rates of primary and secondary patency of this group were 32% and 42%, respectively.

In 2015, Fatima J et al.<sup>7</sup> studied 28 patients. Sixteen showed IVC filter occlusions, 13 had passed the IVC filter, 14 had thrombophilia (half due to neoplasms). Self-expandable stents (Wallstent; Boston Scientific, Natick, Mass, United States) were the most commonly used ones on the IVC (n = 22) with or without secondary use of balloon expandable stents (PalmaZ stent; Cordis, New Brunswick, NJ, United States). In this study, no reinterventions were reported in 84% of the patients over 2 years with patency and symptom-free survival rates of 90% and 80%, respectively at the 2-year follow-up.

Back in 2017, Sasan Partovi et al.<sup>5</sup> studied 7 patients (mean age 55 ± 16 years; all of them male patients). The indications for implanting the IVC filter were contraindications for anticoagulation (n = 3) and additional PE protection (n = 4). The patients received the following filters: TrapEase IVC

filter (n = 3; Cordis, Warren, NJ, United States), OptEase IVC filter (n = 1; Cordis, Warren, NJ, United States), Gunther-Tulip IVC filter (n = 1; Cook Inc.; Bloomington, IN, United States), and the Celect IVC filter (n = 1; Cook Inc., Bloomington, IN, United States). Two IVC filters were implanted in 1 patient: one IVN Simon Nitinol inferior vena cava filter (Bard Peripheral Vascular, Tempe, AZ, United States) and one IVC Celect filter. At the follow-up, the stent primary patency rate was 85.7% (6 out of the 7 patients), while the secondary patency rate was 100% (7 out of the 7 patients) at the 51-month follow-up.

In 2018, Erben Y et al.<sup>6</sup> studied 66 patients with thrombosis of the vena cava. In 25 of these patients the inferior vena cava filter was the etiology confirmed. A single stent was deployed to cover the entire filter area. Follow-up was 42 ± 36 months. Four patients were lost to follow-up. Primary patency, primary assisted patency, and secondary patency at the 36-month follow-up were 78%, 87%, and 91%, respectively. Symptoms resolved in 83% of the patients.

## DISCUSSION

Thrombosis of the vena cava is a known complication of ICV filters. A large number of patients had a 20% thrombosis rate in their ICV filters as confirmed by the follow-up CCTA. However, most of them were asymptomatic. In a different study that analyzed 121 patients after IVC filter permanent implantation, the ultrasound confirmed the presence of asymptomatic filter thrombosis in up to 6% of the patients.<sup>5</sup> The main reasons of filter thrombosis are associated with the capture of a large thrombus or even primary thrombosis of the filter.<sup>9</sup>

According to the series studied by Corriere et al.<sup>10</sup> thrombosis was more common in retrievable compared to permanent filters. Also, there was a greater incidence in bionic devices. According to this same author, the option of using retrievable filters is highly attractive; however, the risk of pulmonary embolism should always be taken into consideration and the device retrieved to avoid further complications. Data from the medical literature on endovascular recanalization therapy of the inferior vena and its patency rates are scarce, especially in patients with thrombophilia—in our case it was BS. The surgeries presented in the studies were the use of a single stent or the stent kissing technique to cover the vena cava filter. In certain situations where the fil-

ter was patent with mild cava vein occlusion below the filter, the cephalic portion of the stent was positioned right underneath the filter. According to Neglén et al.<sup>5</sup> the patency of thrombotic occlusions of the vena cava with or without the presence of a filter did not change the patency of the stent after treatment at the 54-month follow-up. In our case, positioning was well-beneath the vena cava filter, which prevented the use of a single stent.

The treatment option of using the kissing technique in the iliac veins towards the inferior vena cava is a feasible alternative for the management of thrombosis in this segment as it has been reported by Sasan Partovi et al.<sup>6</sup> A kissing stent was used in all of them and in most it was associated with phar-maco-mechanical thrombosis with a good patency rate.

## CONCLUSION

In patients with inferior vena cava occlusions or stenoses, the use of a non-retrievable filter, even with vasculitis, and the implantation of a single stent in the cava vein or a venous kissing stent from the iliac veins towards the inferior vena cava can be an alternative treatment. It is safe and effective in the mid-term follow-up with minimal morbidity and low reintervention rates according to the studies analyzed. It also improves the patients' quality of life.

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# Peripheral transluminal angioplasty to thromboembolic occlusion of the superior mesenteric artery

## Angioplastia transluminal periférica a oclusión tromboembólica de la arteria mesentérica superior

Germán Stupaczuk, Carlos Álvarez Iorio, Alejandro Álvarez Iorio, Fernando Ordóñez, and Martín Ordóñez

### ABSTRACT

Thromboembolic occlusion of the superior mesenteric artery is a rare condition (8.6/100 000 people/year). In many cases it is consistent with a misdiagnosed entity, since it is only possible to recognize it when it has a catastrophic onset as an intestinal infarction. This is the case of a 68-year-old male with a past medical history of hypertension, smoking, and non-anticoagulated paroxysmal atrial fibrillation admitted to the intensive care unit with a diagnosis of acute abdominal pain. An urgent exploratory laparotomy performed revealed signs of intestinal distress but no signs of necrosis. The arteriography of mesentery vessels performed confirmed the thrombotic occlusion of the superior mesenteric artery.

**Keywords:** superior mesenteric artery, atrial fibrillation, abdominal pain.

### RESUMEN

La oclusión tromboembólica de la arteria mesentérica superior es una patología infrecuente (8,6/100.000 personas al año). Corresponde en muchas ocasiones a una entidad subdiagnosticada, y que solo es posible reconocerla cuando debuta catastróficamente como infarto intestinal. Se presenta el caso de un paciente masculino de 68 años extabaquista con antecedentes de hipertensión arterial y fibrilación auricular paroxística no anticoagulado, que ingresa a Unidad de Cuidados Intensivos con diagnóstico de abdomen agudo. Se realiza laparotomía exploradora de urgencia constatóndose signos de sufrimiento intestinal sin signos de necrosis; la arteriografía de vasos mesentéricos revela oclusión trombótica de la arteria mesentérica superior.

**Palabras clave:** mesentérica superior, fibrilación auricular, abdomen agudo.

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### INTRODUCTION

The thromboembolic occlusion of the superior mesenteric artery is a rare entity with a high mortality rate (59% to 93% of the cases) that can compromise the functionality of the gastrointestinal (GI) tract, which is why it requires an early diagnosis and treatment.

Surgery has been the treatment of choice of this entity for years. However, over the last few decades endovascular treatment has been widely used with good pharmacological and/or mechanical treatments to the point of being a good treatment option for revascularization.

### CLINICAL CASE

This is the case of a 68-year-old male with cardiovascular risk factors (high blood pressure, dyslipidemia) and a past medical history of non-anticoagulated paroxysmal atrial fibrillation (multiple episodes). The patient was admitted to our center with abdominal pain, vomits, and asthenia of 24-hour duration. He was admitted to the Intensive Care Unit with a diagnosis of acute abdomen. The emergent exploratory laparotomy performed confirmed the presence of GI distress without necrosis. The mesenteric angiography performed revealed the presence of a proximal thrombotic occlusion of the superior mesenteric artery (**Figure 1**). The superior mesenteric artery proximal occlusion was recanalized.

The superior mesenteric artery was catheterized via right femoral access using a 7-Fr JR guiding catheter (Convey 7 French, JR 3.5 Boston Scientific, United States). Afterwards, the occlusion was crossed using a 0.014 in PT2 guidewire (PT2 Moderate Support Guide Wire – Boston Scientific, United States) that was advanced until the artery distal segment.

Then, manual thromboaspiration was performed (Export Advance, Medtronic, United States) but not macroscopic thrombotic material was obtained. The guiding catheter could not restore the antegrade flow either. Predilatation with 1.5, 4.0, and 5.0 mm diameter balloons was attempted (**Figure 2**) that restored parts of the superior mesenteric artery branches (**Figure 3**). Given the presence of a residual thrombus in the artery proximal segment, a self-expandable nitinol stent was implanted (Epic Vascular, 6.0 x 40 mm, Boston Scientific, United States) with very good final angiographic results (**Figure 4**).

The patient progression was good, and he was released from the hospital 7 days later with antiplatelet and anticoagulant therapy.

### DISCUSSION

Acute mesenteric ischemia predominantly affects male patients > 60 years old. Its prevalence is of 1 patient for every 1000 hospital admissions. It is a potentially lethal vascular emergency with mortality rates > 60%. For this reason, early diagnosis is essential to proceed rapidly, restore mesenteric blood flow, and prevent bowel necrosis.

The endovascular management of this entity appears to be a valid alternative, especially in high-surgical risk patients with good short and long-term results. In most of the patients, technical success is high and periprocedural mortality is low.

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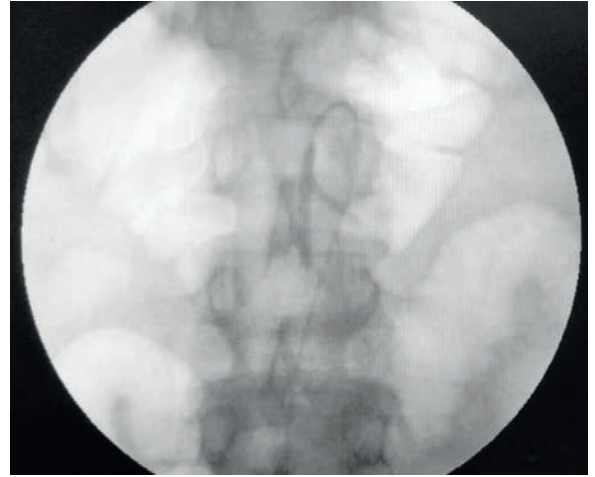
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**Figure 1.** Mesenteric arteriography: proximal thrombotic occlusion of superior mesenteric artery.



**Figure 2.** Predilatation using a 4.0-mm diameter coronary balloon.



**Figure 3.** Postdilatation angiographic result.



**Figure 4.** Final result after self-expandable stent implantation.

lity rate is between 0% and 13%. The rate of complications is between 0% and 25%. These results are even better combining stenting and angioplasty.

## CONCLUSION

Acute mesenteric ischemia is a vascular emergency whose mortality rate is > 60% and requires adequate treatment. Therefore, it is crucial to determine the risk that pa-

tients with acute abdominal pain syndrome have of suffering acute mesenteric ischemia. Open surgery has been the treatment of choice over the last few decades. However, the current endovascular techniques are an essential part of the therapeutic armamentarium for interventional cardiologists. Endovascular treatment is a good and valid therapeutic alternative with good short and long-term results, and a low rate of complications.

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# Coronary aneurysm, finding in STEMI

## Aneurisma coronario, hallazgo en SCACEST

Esteban Martín Quarchioni,<sup>1</sup> María Cecilia Licheri,<sup>1</sup> Luis Gerardo,<sup>1</sup> and Alberto Licheri<sup>2</sup>

### ABSTRACT

The aneurysms of coronary arteries were described for the first time by Morgagni back in 1761 in a patient with syphilis. It is a rare condition with an approximate incidence rate from 1% and 2% in our specialty. Its main significance, from the clinical point of view, is the possibility of causing infarctions due to thrombosis or spasm, and rupture. Very little is known about its evolution, prognosis, and treatment<sup>1</sup>

This is the case of a patient with ST-segment elevation acute coronary syndrome (STEMI). Revascularization reveals the presence of a giant aneurysm in the left anterior descending coronary artery. The medical literature is reviewed to update the information on this condition

**Keywords:** aneurysm, STEMI, infarction, ectasia.

### RESUMEN

Los aneurismas de las arterias coronarias fueron descritos por primera vez por Morgagni en 1761 en un enfermo de sífilis. Se trata de una patología infrecuente, con una incidencia aproximada de entre el 1 y 2% en nuestro medio. Su principal importancia, desde el punto de vista clínico, es la posibilidad de producir infartos por trombosis o espasmo y ruptura. Se conoce muy poco sobre su evolución, pronóstico y tratamiento<sup>1</sup>.

Se comunica el caso de un paciente que presenta síndrome coronario agudo con elevación del segmento ST (SCACEST) y al revascularizar se observa la presencia de aneurisma gigante en la arteria descendente anterior. Se revisa la literatura con el objetivo de actualizar la información al respecto.

**Palabras clave:** aneurisma, SCACEST, infarto, ectasia.

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### CLINICAL CASE

A 67 year-old male patient with hypertension, type II diabetes, dyslipidemia, medicated (vidagliptin, metformin, atorvastatin, valsartan) was admitted to our hospital with oppressive precordial pain at rest of intensity 8/10 of 4-hour duration. The pain was radiating to the epigastrium and upper limbs and was accompanied by nausea. The cardiac physical examination performed showed no abnormalities. The electrocardiogram (ECG) revealed sinus rhythm, heart rate of 100 bpm, pathological Q-wave in V1-4, and ST-segment supra-elevation in V1-5. The baseline CPK MB levels were high. The patient received nitroglycerin (10 g/min IV infusion), heparin (5000 U through an IV infusion), salicylic acid (250 mg/chewed tablets), clopidogrel (600 mg/orally), and the interventional cardiology unit was tipped off. The cine coronary arteriography performed revealed: patent mid-caliber left main coronary artery (LMCA) without lesions; left anterior descending coronary artery (LAD) occluded in its proximal segment; large caliber, ectatic, dominant, patent left circumflex artery (LCx) without lesions, and hypoplastic and patent right coronary artery (RCA) without lesions (**Figure 1**). An urgent angioplasty was decided. A 3.5 guiding catheter was used (BX<sup>®</sup>) through the left coronary ostium. A 0.014 floppy guidewire (Choice<sup>®</sup>) was crossed and placed distal to the LAD. A 2.5 x 20 mm balloon

(Maverick<sup>®</sup>) was used for predilatation and the vessel was opened. A giant aneurysm was found at the proximal and middle third junction (**Figure 2**). Considering the materials available at the emergency unit it was decided to use a 3.5 x 38 stent (Waltz<sup>®</sup>) (**Figure 3**) that was deployed at 20 atm. The control angiography confirmed the resolution of the lesion with revascularization of the vessel treated, no signs of complications, and final TIMI grade 3 flow (**Figure 4**).

Upon readmission at the coronary unit, the Q-wave in V1-4 was still present, the ST-segment supra-elevation in V1-5 was gone, there were no physical signs of pump failure and precordial pain was gone. The medication prescribed was valsartan 80 mg/day, bisoprolol 10 mg/day, atorvastatin 40 mg/day, aspirin 100 mg/day, and clopidogrel 75 mg/day. It was decided to keep on infusing IV heparin at 18 000 u/kg/day. Also, insulin was administered based on the glycemic levels reported.

The Doppler echocardiography performed 48 hours later revealed normal LV dimensions, a 43 mm left atrium, a 36 mm aortic root, preserved LVEF, and apical segment hypokinesia and thinning consistent with the presence of a basilar-tip aneurysm and grade I diastolic dysfunction. The 17 x 17 mm steady-state hypoechoic imaging were consistent with the presence of an apical thrombus.

The clinical progression of the patient was good, and he was released from the hospital 4 days after admission with the treatment mentioned before. The patient remained on oral anticoagulants with rivaroxaban 20 mg/day.

In the serial clinical controls conducted 3, 6, and 9 months after hospital discharge the patient said he was stable without any symptoms associated with his coronary artery disease (no angina, palpitations, dyspnea or syncope). He had not been hospitalized or gone to the ER either with any associated symptoms. He works out daily without any limitations.

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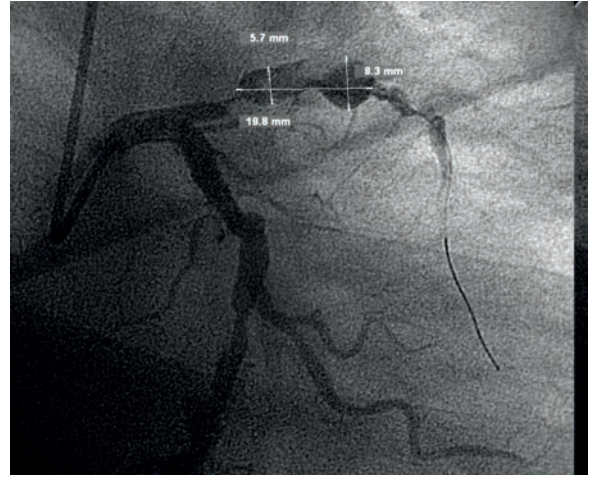
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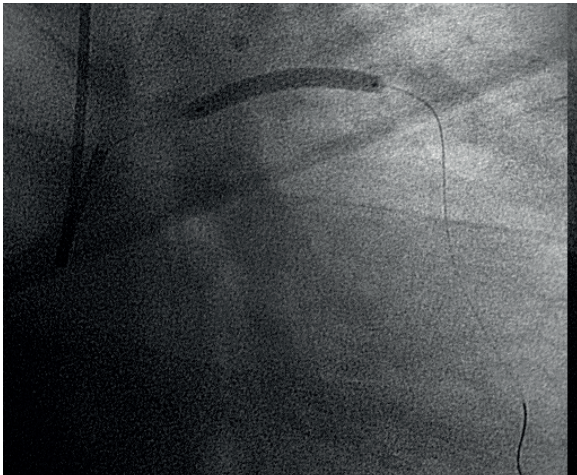
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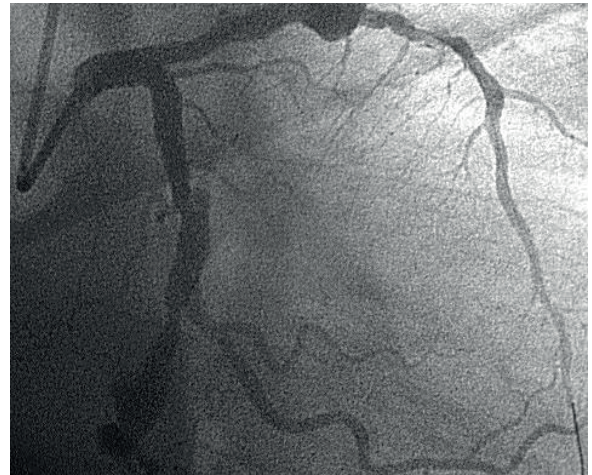
**Figure 1.** The cine coronary arteriography performed revealed: patent, mid-caliber left main coronary artery (LMCA) without any lesions; left anterior descending coronary artery (LAD) occluded in its proximal segment; large caliber, ectatic, dominant, patent left circumflex artery (LCx) without lesions, and hypoplastic and patent right coronary artery (RCA) without lesions.



**Figure 2.** An urgent angioplasty was decided. A 3.5 guiding catheter was used (BX<sup>®</sup>) through the left coronary ostium. A 0.014 in floppy guidewire (Choice<sup>®</sup>) was crossed and placed distal to the LAD. A 2.5 x 20 mm balloon (Maverick<sup>®</sup>) was used for predilatation and the vessel was opened. A giant aneurysm was found at the proximal and middle third junction.



**Figure 3.** 3.5 x 38 stent (Waltz<sup>®</sup>) deployed at the lesion site at 20 atm.



**Figure 4.** Control angiography. Resolution of the lesion with revascularization of the vessel treated, no complications and final TIMI grade 3 flow.

## DISCUSSION

Coronary aneurysms are defined as dilatations located inside a blood vessel that exceed surrounding segments by 1.5 times. Atherosclerosis is the disease most commonly associated with it, although congenital aneurysms have been reported too. Aneurysms associated with the Kawasaki disease, connective tissue, infectious diseases or due to endovascular procedures have been described as well. It is more prevalent in males in a 4:1 ratio and it occurs more often, in descending order, in the RCA, LCx, and LAD.<sup>2</sup> In our patient the lesion was located at the left anterior descending coronary artery, which is somehow uncommon.

It has been diagnosed more often thanks to the coronary angiography, the use of non-invasive diagnostic imaging modalities like the ultrasound scan, CT scan, magnetic resonance imaging, and lung scans.<sup>3</sup>

Atherosclerotic damage may be the underlying reason to end up developing coronary aneurysms through the activation of several mechanisms: initially the formation of atheromatous plaque with damage to the intima and internal elastic lamina with lipid, collagen and cell (macrophages,

lymphocytes T, etc.) deposits and smooth muscle cell proliferation. Apparently, this early lesion ends up damaging the media and adventitial layers with the corresponding remodeling and neof ormation of vasa vasorum in the atheromatous plaque.<sup>4</sup>

We believe that this could be the etiology of the case presented here. It would also explain the diffuse ectasia seen in other main epicardial coronary arteries. Several other major complications have been reported over the course of the disease including thrombosis and distal embolization, ischemia or myocardial infarction, dissection, vasospasm, calcification, fistulization and rarely rupture.

The therapeutic options are surgical, percutaneous or medical treatment.

Treatment should be individualized and based on the size, location, presence of aneurysmal complications and the patient's clinical course. The limited number of cases reported in the medical literature makes the therapeutic decision-making process more difficult.<sup>5</sup>

In symptomatic patients with significant coronary stenoses associated with the aneurysm, surgery could be the best option through aneurysm ligation and bypass. However, some

cases reported in the medical literature show the feasibility, safety, and efficacy of PTFE-covered stents in the management of aneurysms.

In asymptomatic patients some groups recommend conservative treatment by accurately controlling risk factors and antiplatelet therapy by combining oral anticoagulation.

For the management of coronary aneurysm with infarction due to thrombosis—as in the case presented here—endovascular revascularization therapy with conventional

stents or PTFE-covered stent grafts is recommended. They can effectively seal the aneurysm. However, there is a higher rate of subacute thrombosis between the first and the second month, which may be due to very late PTFE-covered stent endothelialization.<sup>6</sup> In the case presented here a conventional stent was used to successfully revascularize the vessel which added to the usual anti-ischemic/antiplatelet therapy plus oral anticoagulation course led to an excellent clinical progression.

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# Compressive chronic giant pseudoaneurysm of the left external iliac artery due to gunshot wound

## Pseudoaneurisma gigante crónico compresivo de arteria ilíaca externa izquierda secundario a herida de arma de fuego

Federico Martín Riolo, Patricio Rattagan, Jorge Orlando Cortez Yáñez, and Miguel Osvaldo Villegas

### ABSTRACT

Post-traumatic iliac pseudoaneurysms are rare. This is the case of a 44-year-old male patient with a past medical history of a gunshot wound who required a colostomy with bowel transit reconstruction. The patient sought medical attention 13 years later due to the presence of a painful pulsatile mass in his abdomen associated with rest pain of the patient's lower left extremity (Fontaine III - Rutherford IV) of 2-year duration. The CCTA revealed the presence of a pseudoaneurysm of the left external iliac artery of saccular morphology and a maximum diameter of 213 mm. The endovascular approach using 3 graft stents was successful. The CCTA had good results. This is the diagnostic, therapeutic and 1-year-follow-up approach.

**Keywords:** pseudoaneurysm, post-traumatic pseudoaneurysm, false aneurysm, gunshot wound, iliac angioplasty.

### RESUMEN

Los pseudoaneurismas ilíacos postraumáticos son poco frecuentes. Presentamos un paciente masculino de 44 años con antecedentes herida de arma de fuego y requerimiento de colostomía con reconstrucción del tránsito. Consulta 13 años después por masa pulsátil dolorosa en abdomen asociada a dolor en reposo del miembro inferior izquierdo (Fontaine III – Rutherford IV) de dos años de evolución. La angio-TC evidenció pseudoaneurisma de arteria ilíaca externa izquierda de morfología sacular y diámetro máximo de 213 mm. El abordaje endovascular con tres stents graft fue exitoso. La angio-TC demostró buen resultado. Presentamos el enfoque diagnóstico, terapéutico y seguimiento al año.

**Palabras clave:** pseudoaneurisma, pseudoaneurisma postraumático, falso aneurisma, herida de arma de fuego, angioplastia ilíaca.

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## INTRODUCTION

Post-traumatic iliac pseudoaneurysms are rare as very few cases of gunshot wound (GSW) related post-traumatic iliac pseudoaneurysms have been reported in the medical literature.

Pseudoaneurysms are due the interruption of the continuity of the arterial wall as the result of inflammation, trauma or iatrogenic causes. Under the influence of sustained blood pressure, blood dissects the tissues surrounding the artery yielding a perfused sac that communicates with the arterial lumen. The sac perfused is contained by the tunica media or tunica adventitia or simply by soft tissue structures surrounding the injured vessel.

This is the case of a 44-year-old male with a past medical history of GSW related colostomy and bowel transit reconstruction. The patient's clinical course progressed to a pseudoaneurysm located in the left external iliac artery (LEIA) that compressed the adjacent structures. The patient seeks medical attention 13 years after the fact. The patient was treated with endovascular therapy. This is the diagnostic, therapeutic, and follow-up approach at the 1-year follow-up.

## OBJECTIVE

To show the case of a giant, chronic, post-traumatic pseudoaneurysm with LEIA occlusion treated with covered stents (CS) using the retrograde approach from an unconventional access site and present the outpatient follow-up.

## CLINICAL CASE

This is the case of a 44-year-old male patient with a past medical history of GSW that required colostomy and bowel transit reconstruction. The patient seeks medical attention 13 years later due to painful pulsatile mass upon abdominal palpation and rest pain in his left lower extremity (Fontaine III - Rutherford IV) of 2-year duration. The CCTA (**Figure 1**) confirmed the presence of a saccular pseudoaneurysm located in the LEIA (171 mm x 165 mm x 213 mm) with displacement of adjacent structures at both pelvic and abdominal level, and external iliac artery lumen thinning and occlusion due to extrinsic compression and revealed the pseudoaneurysm entry site.

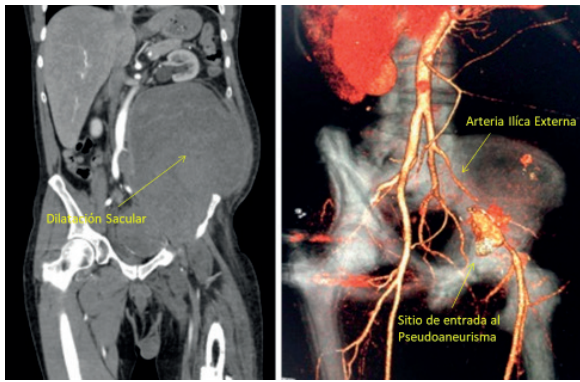
Using the Seldinger technique a 5-Fr sheath was inserted into the right common femoral artery. An S1 catheter was advanced and placed at left common iliac artery level. The control angiography confirmed the LEIA occlusion and thinning. Retrograde access was decided with angiographic guidance through antegrade access. A 7-Fr sheath was inserted into the left deep femoral artery and 60 IU/kg of heparin were administered. A 0.035 in hydrophilic guidewire (Radifocus Terumo, Tokyo, Japan) was advanced over a Cobra-type catheter towards the abdominal aorta. Once the lesion was crossed it was uneventfully dilated using a 5 mm x 120 mm balloon catheter (Mustang, Boston, Massachusetts, United States) at LEIA level. Afterwards, three 8 mm x 59 mm balloon-expandable CSs (Advanta V12, Maquet, Rastatt, Germany) were implanted in a telescopic fashion.

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**Figure 1.** CCTA. A. Sacular dilatation (171 mm x 165 mm x 213 mm) in pelvis displacing adjacent structures at abdominal-pelvic level. B. Vascular reconstruction: iliac artery lumen thinning due to the compression exerted by the pseudoaneurysm and contrast-enhanced large area consistent with the pseudoaneurysm entry site.

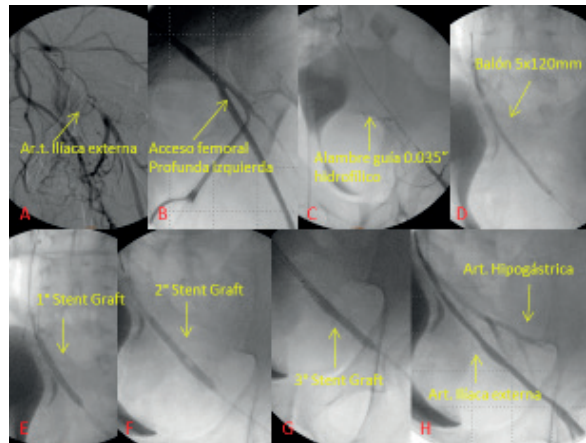


**Figure 3.** CCTA at the 6-month follow-up. It shows the patency of the left iliofemoral axis and the exclusion of the pseudoaneurysm.

Finally, the angiography confirmed the patency of the LEIA with sealing and complete exclusion of the pseudoaneurysm (Figure 2). The patient had no complications and was released from the hospital 24 hours later with an indication for dual antiplatelet therapy. Disease progression at the 6-month and 1-year follow-up was asymptomatic and with lack of pulsatile mass. In the CCTA performed at the 6-month follow-up the LEIA looked patent and a 6 cm reduction of the sac was confirmed (Figure 3).

## DISCUSSION

Pseudoaneurysms of the EIA are due to trauma, tumors, infections, vasculitis, atherosclerosis or iatrogenic complications.<sup>1</sup>



**Figure 2.** A. Right common femoral artery access with a 5-Fr sheath. Angiography performed using the Simmons 1 catheter. Collapsed small caliber left external iliac artery. B. Left deep femoral artery access (origin at the head of the femur). C. Hydrophilic guidewire advanced over a Cobra-type catheter towards the abdominal aorta. D. Predilatation with balloon catheter (5 mm x 120 mm). E, F, and G. Three 8 mm x 59 mm stent grafts implanted in a telescopic fashion. H. Final arteriography. Patent external iliac artery and exclusion of the pseudoaneurysm.

Most pseudoaneurysms are found when the trauma occurs, but there are cases of arterial lacerations that grow progressively and end up causing a pseudoaneurysm years later.<sup>2</sup>

Pseudoaneurysms can have complications such as thromboembolism, rupture, neurovascular compression, infection, anemia, and death.

Thromboembolism and anemia are the most common complications of all. Ruptures can occur spontaneously or during an occlusion attempt by compression maneuver mainly in non-compressible pseudoaneurysms or those only compressible with increased strength. Similarly, serious and major complications like the ones described above can and should be avoided. The best way to do so is by making treatment decisions early in time.

The most common presentation at iliac level is an incidental finding without associated clinical signs. However, signs and symptoms associated with local compression can occur in up to 43% of the cases.<sup>3</sup> Neuropathic pain affected 9.5% of the patients in Krupski's series,<sup>3</sup> and up to 20% of the patients in Gardiner's series.<sup>4</sup> Other associated signs are nonspecific abdominal pain (19%), urinary tract infection and hematuria (10%), vein compression related swelling (5%), and intermittent claudication (10%).<sup>3</sup> Claudication and the pulsatile mass were the symptoms and signs described by our patient. These pseudoaneurysms often remain silent; however, if they rupture the consequences can be deadly.

The diagnosis of isolated iliac aneurysms and pseudoaneurysms can be confirmed using the following imaging modalities: ultrasound, computed tomography scan, magnetic resonance imaging, and arteriography. The ultrasound is less expensive compared to other imaging modalities, is operator-based, and often imprecise due to the depth of the arteries located in the pelvis or the presence of underlying intestinal gas.

In relation to treatment we can describe 6 different approaches: wait-and-see, surgical, blind or ultrasound-guided compression, ultrasound or angiography-guided saline infusion followed by endovascular compression using CSs or coils, and angiography or ultrasound-guided thrombin injection. Several studies published to this day claim that small

diameters < 2 cm often close through spontaneous thrombosis. Surgery is spared for cases of rupture, compression of adjacent neurovascular structures, skin ischemia, intense pain, and fast growth. Compression therapy is contraindicated in non-compressible or compressible pseudoaneurysms with arterial occlusions or increased distal flow reduction, superior location of the inguinal ligament, presence of infection, venous thrombosis, limb or skin ischemia, neurovascular compression or compartmental syndrome.<sup>5</sup>

The morbimortality rate of endovascular therapy is lower compared to conventional surgery with good mid-term results, which makes it a valid alternative for patients of high-surgical risk or previous abdominal surgery.<sup>6</sup> CSs for the exclusion of pseudoaneurysm are currently used as an alternative to open surgical repair.<sup>7</sup>

If pseudoaneurysm has a wide neck the use of a CS or surgery are the preferred options given the high risk of coil embolization or embolization of the material used. However, CSs should not be used in terminal or small caliber vessels due to their high rate of thrombosis and restenosis.<sup>8</sup>

In our case we based our decision to choose endovascular therapy on the previous history of abdominal-pelvic surgery

in the gunshot wound setting, which would have made a second access associated with the need for revascularization of the LEIA more difficult due to its compression by the large volume of the pseudoaneurysm. The use of thrombin and coils would not be recommended here given the pseudoaneurysm large volume and wide neck. Compression would not be useful either because it would be placed above the inguinal canal.

CSs or endoprotheses have been successful used in the exclusion of pseudoaneurysms since the 1990s.

## CONCLUSION

Trauma related complications are mostly the result of diagnostic, treatment or follow-up delays or errors and they can be occur in the short, mid, and long-term. Endovascular therapy stands as an alternative for high-surgical risk patients or those treated with previous abdominal surgery. The main goal of surgery for the management of vascular lesions is to control the hemorrhage.

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# Transcollateral retrograde approach: A completely endovascular technique to preserve vascular access for hemodialysis

## Abordaje retrógrado transcolateral: Una técnica completamente endovascular para preservar el acceso vascular para hemodiálisis

Marcel Voos Budal Arins<sup>1</sup>, Raúl Llano<sup>1</sup>, Pablo Vega<sup>1</sup>, and Esteban Mendaro<sup>1</sup>

### ABSTRACT

**Objective.** Vascular access (VA) dysfunction in patients with end-stage renal disease is associated with an increased morbidity and mortality. Consequently, maintaining the existing VA sites is of utmost importance regarding hemodialysis. We describe the feasibility of the transcollateral retrograde approach (TCRA), an entirely endovascular technique to avoid the hemodialysis of the VA.

**Methods.** This is the case of a male patient with left upper limb edema and high venous pressure during the hemodialysis of an AV graft due to the occlusion of the post-anastomotic vein and central veins with developed collateral vessels. Since the antegrade access failed and no puncture site for retrograde recanalization was anatomically available, we adopted the TCRA strategy and completed the procedure successfully by implanting venous self-expandable nitinol stents. The angiography performed confirmed the AV patency and proper flow.

**Results.** In the outpatient follow-up, hemodialysis was performed uneventfully, and the patient showed the complete resolution of the left upper limb edema.

**Conclusion.** This fully endovascular technique turned out to be a feasible alternative to solve a dysfunctional VA.

**Keywords:** vascular access, hemodialysis, endovascular procedure, trans-collateral retrograde approach.

### RESUMEN

**Objetivo.** La disfunción del acceso vascular (AV) en pacientes con enfermedad renal en etapa terminal se asocia con una mayor morbilidad y mortalidad. En consecuencia, el mantenimiento de los AV existentes es de suma importancia para la hemodiálisis. Describimos la viabilidad del abordaje retrógrado transcolateral, una técnica completamente endovascular para salvar una AV de hemodiálisis.

**Métodos.** Reportamos un paciente con edema del miembro superior izquierdo y presión venosa alta durante la hemodiálisis en un AV protésico debido a la oclusión de la vena posanastomótica y las venas centrales con vasos colaterales desarrollados. Debido a que el abordaje anterógrado falló y no había un sitio de punción disponible para la recanalización retrógrada, adoptamos la estrategia de abordaje retrógrado por vía transcolateral y completamos con éxito el procedimiento con el implante de stents venosos de nitinol autoexpandibles. La angiografía mostró permeabilidad y buen flujo en el AV.

**Resultados.** En el seguimiento ambulatorio, el paciente evolucionó con resolución completa del edema en el miembro superior izquierdo y con buena dinámica de flujo durante la hemodiálisis.

**Conclusión.** Esta técnica totalmente endovascular permitió una alternativa factible para rescatar un AV disfuncional.

**Palabras claves:** acceso vascular, hemodiálisis, técnica endovascular, abordaje retrógrado transcolateral.

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### CLINICAL CASE

Sixty-three-year-old male patient with end-stage chronic kidney disease referred to our unit with left upper limb edema and higher blood pressure rates during hemodialysis through a prosthetic vascular access that was patent 13 months ago (**Figure 1A**). The direct puncture angiography of the prosthetic sector performed revealed the occlusion of the post-anastomotic vein and the central veins with the development of collateral circulation between the post-anastomotic vein and the axillary vein (**Figures 1B and 1C**). An 8-Fr introducer sheath was placed into the prosthetic sector. The antegrade approach was first tried to cross the occlusion of the post-anastomotic vein with support from a 4-Fr vertebral catheter plus a 6.8 gram 0.018 in hydrophilic guidewire and a 0.035 in stiff hydrophilic guidewire. None

of these guidewires was able to cross the occlusion and both guidewires were in the subintimal space (**Figure 1D**). Given the occlusion of the central veins, retrograde access through the patient's left internal jugular vein was not feasible. Afterwards, retrograde access was tried through transcollateral approach using a 4-Fr 0.018 in support catheter and a 6.8 gram 0.018 in hydrophilic guidewire, and the occlusion was successfully crossed. The guidewire was externalized through the introducer with a snare (**Figure 1E**).

Then, with the use of a 4-Fr vertebral catheter and a 0.035 in stiff hydrophilic guidewire the occlusion was crossed at central vein level. The antegrade access was used for high-pressure predilatation with non-compliant balloons, self-expandable nitinol venous stents, and postdilatation with non-compliant balloons (**figure 1F**).

The angiography confirmed the patency of vascular access with proper blood flow (**Figures 1G and 1H**).

### RESULTS

No complications associated with the procedure were reported. During the outpatient follow-up the patient's disease progression was good with total resolution of his left upper limb edema and good flow dynamics during hemodialysis.

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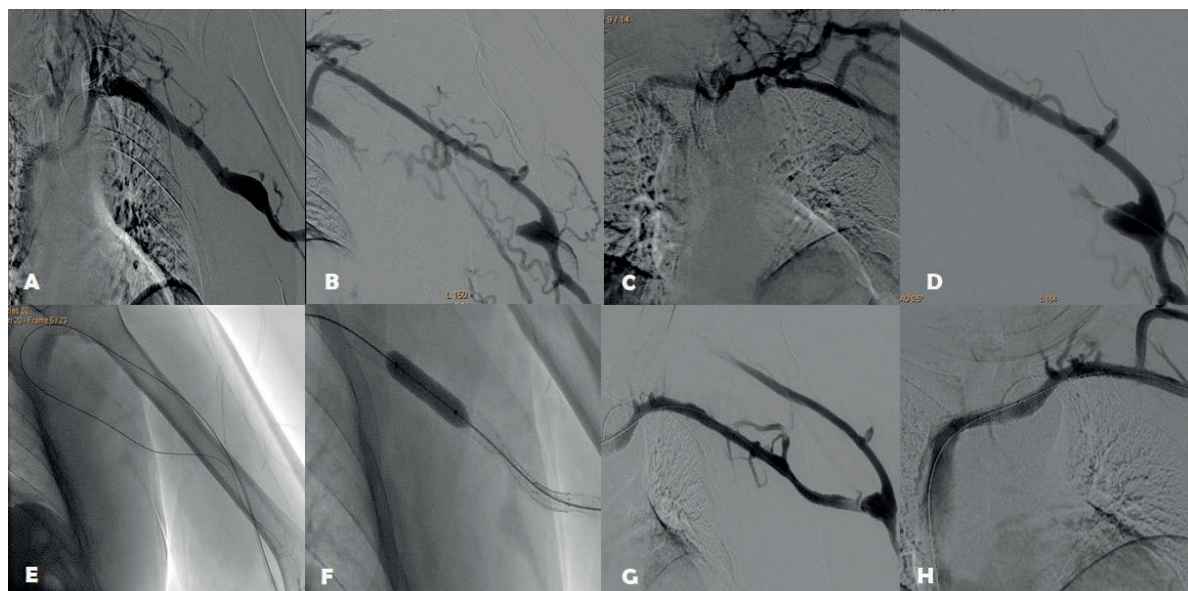


Figure 1.

## DISCUSSION

Vascular access (VA) dysfunction is associated with high morbimortality rates.<sup>1</sup> Consequently, a proper functioning VA is essential to perform hemodialysis efficiently.<sup>2</sup> According to the Kidney Disease Outcomes Quality Initiative clinical guidelines published in 2006 and updated in 2010, the main options for the management of a dysfunctional arteriovenous or prosthetic fistula are the endovascular and surgical approaches; both are considered a good and feasible option.<sup>3</sup> This was the case of a patient with left upper limb edema and high venous pressure during hemodialysis in a prosthetic VA due to the occlusion of the post-anastomotic vein and central veins with well-developed collateral vessels. The cause was attributed to volume overload in collateral vessels and the occlusion of central veins. Therefore, we decided to treat the vascular occlusion to alleviate its symptoms and improve the dynamics of hemodialysis.

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Since the antegrade recanalization failed and the left internal jugular access could not be used for retrograde recanalization, the retrograde access via transcollateral approach was crucial to be able to continue with the procedure.

Recently, new endovascular techniques for the management of vascular accesses for hemodialysis purposes are being used. One of these techniques is the transcollateral approach that is used for long chronic total coronary occlusions when no distal puncture site is available.<sup>4</sup>

In this manuscript we suggested a fully endovascular strategy to save VA for hemodialysis purposes.

## CONCLUSION

This manuscript described a very complex case of VA dysfunction for hemodialysis that was successfully treated using the retrograde access via transcollateral approach. This fully endovascular technique turned out to be a feasible alternative as the bail-out strategy of a dysfunctional VA.

## Words from the President of CACI 2020-2021

### Palabras del Presidente del CACI 2020-2021

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Dear friends and colleagues,

It is a great honor to have been appointed the representative of our College and work with the Board of Directors and all of you for the benefit and growth of our medical specialty. It is with great satisfaction that I reach you in this new issue from our journal and I would like to take this opportunity to share with you some of the goals that the Board of Directors and I have envisioned for 2020-2021.

Following in the footsteps already taken by CACI quite a few years ago we intend to keep growing as a scientific and educational society locally but also across Latin American, and the world thanks to the agreements signed with EuroPCR, GACI, SOLACI, C3, CIT, India Live, and TCT. We have been able to organize the very first congress on innovation in Latin America that will be held together with the prestigious Israeli ICI meeting in Buenos Aires, Argentina next August 4 at the Puerto Madero Hilton Hotel. We have also signed an agreement with HENDOLAT (Endovascular Horizons Latin America). HENDOLAT is a multidisciplinary, international organization of continuing medical education to promote and spread scientific knowledge across Latin American through a digital platform. Also, we intend to keep giving grants to our members so they can attend national and international congresses. The CACI Innovation Unit (*InnovaCACI in Spanish*) has been created. Its main objective will be to assist interventional cardiologists in the entrepreneurial efforts of developing innovation projects. It will also provide the necessary back up so these projects can be escalated with project-oriented tools.

This year will see the new iteration of our prestigious UBA-CACI course for specialists. Also, the educational area has implemented a new course for technicians, nurses, and interventionists that has received a warm welcome. Actually, it was sold out within a matter of days.

We'll keep strengthening our relations with the Argentinian Ministry of Sanitation, ANMAT, and other government and funding institutions by developing group activities in our headquarters and signing agreements for bilateral cooperation purposes.

Sick or accident leave subsidies will still be effective as agreed by the Board of Directors back in 2016-2017.

Answering the call from many members who have been asking to strengthen CACI collegiate nature, a professional commission has been created. It manages the collegiate secretary and the tariffs and social works commissions to improve quality, compensation, and funding for our clinical practice.

We wish to keep communication open with our members. We'll be meeting in the different Argentinian states, keeping close contact with our members, and discussing local issues; for this to work, we'll need to work closely with the state delegates.

Also, we wish to see our journal grow. For this reason, we wish to invite all of you to submit original scientific papers and clinical cases that are interesting for the cardiology community for their originality and complexity. This year we'll be working on the English edition of our journal too. There is no doubt that it will bring new readers from all over the world.

I also announce that we will ratify our commitment to the Stent Save a Life program and the RADAC Registry.

Chapter IV of the E-Book on Hemodynamics and Interventional Cardiology will be presented in SOLACI 2020 that will be held in Buenos Aires, Argentina. Work on chapter V has already begun by the way.

We will be giving more publicity to our simulation center to conduct training programs for members not only at local level but also across Latin American as well.

In order to meet these objectives and avoid the problems that we'll certainly have throughout the year we need to work together to do our job effectively.

**Diego Grinfeld**  
President of CACI 2020 - 2021

# Publication Guidelines of the *Revista Argentina de Cardioangiología Intervencionista*

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

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

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

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

The articles submitted to the journal shall be originals. The Editorial Committee will study the papers submitted and confirm whether they follow the Publication Guidelines established by the journal. The Director, and/or Associate Directors will be responsible for submitting these papers for the external blind peer review process. This means that the authors do not know the reviewers' name and the reviewers do not know the name of other reviewers. This policy established by RACI follows the same criteria implemented by the Review and Editorial Committee of the *Journal of the American College of Cardiology (JACC)*, the highest impact factor cardiology journal. The Editorial Committee will make the final publication decision in accordance with the conclusions drawn by blind peer reviewers. Similarly, the Editorial Committee can introduce grammar related editorial changes according to the publication needs of the journal always after obtaining prior consent from the authors. Review articles and editorials will be subject to the same review process. Editorials are often required by the Editorial Committee as well.

After the first review, the articles can be accepted in the same form they were initially submitted; minor reviews are those pertaining to articles with significant contributions that still have some minor limitations that need to be corrected or proof read before its eventual publication; major reviews are those pertaining to articles that are unfit for publication as originally submitted to the journal. In any case, the Editorial Committee can consider new submissions called de novo submissions as long as the ar-

ticle is modified substantially; the rejection of the article occurs when both the reviewers and the Editorial Committee deem the article unfit for publication in the RACI journal.

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

### INSTRUCTIONS TO AUTHORS AND GUIDELINES FOR MANUSCRIPT SUBMISSION

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

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

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

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

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

## SECTIONS (See Preparation of the manuscript)

### Original articles

These are scientific or educational papers of original basic or clinical studies. Requisites: a) general text, up to 5000 words including references; b) abstract, up to 250 words; c) tables + figures, up to 8; d) authors, up to 10.

### Brief communications

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

### Review articles

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

### Continuing medical education

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

### Clinical case

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

### How did I approach it?

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

### Interventional cardiology images

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

### Research protocols

The publication of research protocols—preferably multicenter—will be accepted and published by the journal as special articles as long as these protocols do not include the study partial or total results.

### Editorials

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

### Letters to the editor

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

## PREPARATION OF THE MANUSCRIPT

The article will be written in Spanish language using a Microsoft® Word text processor and saved under the \*.doc file extension. The size of the page will be A4 or letter with double-spacing, 25 mm margins, fully justified text, and 12-point Times New Roman or Arial font. Pages will be numbered consecutively starting with the cover. The manuscript (original article) needs to follow the so-called IMRAD structure: Introduction, Material and method, Results, and Discussion (see the ICMJE Publication Guidelines). Also, it will include Title, Abstract, Conflicts of Interest, and References. In some cases, it will be necessary to add a Conclusion, Acknowledgements, and an Appendix. The metric system will be the standard system of measurement used with comas to write the decimals. All clinical, hematologic, and chemical parameters will be expressed in units of measure from the metric system and/or IU. Only common abbreviations will be used except for the title and the abstract. The first time these abbreviations are used they will be preceded by the whole term except for the use of standard units of measure.

Tables must be presented in individual sheets and they need to be numbered consecutively with Arabic numbers (0, 1, 2, etc.) according to the order in which they were quoted in the text with a short title for each and every one of them. All of the non-standardized abbreviations of the table need to be explained and developed. Explanatory notes will be placed at the foot of the table using the following symbols in this sequence: \*, †, ‡, §, ¶, \*\*, ††, ‡‡, etc. Figures need to be submitted in TIFF, PSD or JPEG format and each figure will be submitted in a separate file with a resolution of 300 dpi in its final format. Each of them will be numbered consecutively together with the explanatory legend in a separate file. The normal size of the photographs will be 127 mm x 173 mm. Titles and detailed explanations will be included in the text of the legend, not the illustration.

References will be numbered consecutively with Arabic numbers between brackets. All of the authors will be in-

cluded if they are six of them or fewer; if there are more authors involved, the third one will be followed by the expression «, et al.». The titles of the journals will be shortened based on the style used in Index Medicus. These are a few examples:

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