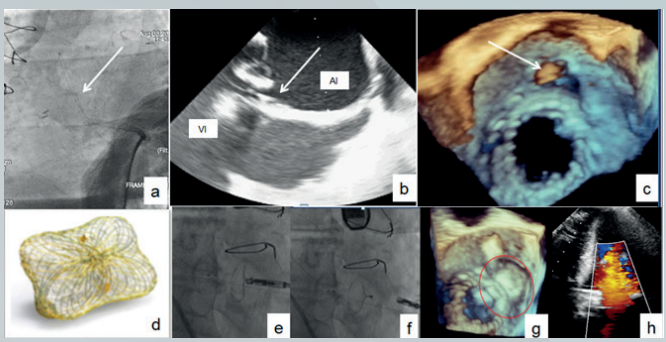
ISSN 2250-7531 ISSN 2313-9307 (online)

CACI

Argentinian College of Interventional Cardiologists

Argentinian Journal of Interventional Cardiology

April - June 2020 | Year 11 | Issue 2



Editorial

Eduardo Gabe MD, PhD, FACC (1953-2020). *In memoriam*
Rodríguez AE

Review articles

Multiorgan failure during COVID-19 pandemic in cardiovascular patients. Role of advanced cardiac and pulmonary support
Barbagelata A, et al.

CACI recommendations on interventional treatment during the COVID-19 pandemic
Kevorkian R, et al.

Brief communications

ST-T segment elevation myocardial infarction in a center from Buenos Aires city during the COVID-19 pandemic
Rodríguez-Granillo AM, et al.

Case reports

Severe hemolysis after transapical closure of mitral perivalvular leak requiring transeptal reintervention
Agüero MA, et al.

Endovascular management in a patient with kidney vascular malformation: review of the literature and the experience of 2 cases
LLahyah E, Ortiz G

Endovascular treatment of May-Thurner syndrome
Stupaczuk G, et al.

Indexed in latindex doi Google Scholar meducatium REDIB

Argentinian Journal of Interventional Cardiology

April - June 2020 | Year 11 | Issue 2

CACI BOARD OF DIRECTORS 2020-2021

CACI
Argentinian College of Interventional Cardiologists

Publicaciones Latinoamericanas s.r.l.

Argentinian Journal of Interventional Cardiology

Quarterly publication. © **CACI |** ISSN: **2250-7531**

Owner: Argentinian College of Interventional Cardiologists (CACI) | Viamonte 2146 6th floor | C1056ABH CABA - Argentine

Tel/fax: 54 11 4952-2117 | E-mail address: revista@caci.org.ar | www.revistacaci.org.ar

Publisher and editorial design

Publicaciones Latinoamericanas s.r.l.
Piedras 1333 | (C1240ABC) Ciudad Autónoma de Buenos Aires | Argentine
Tel/fax (5411) 5217-0292
E-mail address: info@publat.com.ar | http://www.publat.com.ar

Summary

Sumario

EDITORIAL / EDITORIAL

057

Eduardo Gabe MD, PhD, FACC (1953-2020). *In memoriam*
Eduardo Gabe MD, PhD, FACC (1953-2020). In memoriam
Rodríguez AE

REVIEW ARTICLES / ARTÍCULOS DE REVISIÓN

058

Multiorgan failure during COVID-19 pandemic in cardiovascular patients. Role of advanced cardiac and pulmonary support
Fallo multiorgánico durante la pandemia de COVID-19 en pacientes cardiovasculares. Rol de la asistencia circulatoria y pulmonart
Barbagelata A, et al.

065

CACI recommendations on interventional treatment during the COVID-19 pandemic
Recomendaciones del CACI sobre el tratamiento intervencionista durante la pandemia COVID-19
Kevorkian R, et al.

BRIEF COMMUNICATIONS / COMUNICACIONES BREVES

070

ST-T Segment Elevation Myocardial Infarction in a Center from Buenos Aires city During the COVID-19 Pandemic
Presentación del infarto agudo de miocardio con elevación del segmento ST-T en un centro de Ciudad de Buenos Aires durante la pandemia COVID-19
Rodríguez-Granillo AM, et al.

CASE REPORTS / CASOS CLÍNICOS

073

Severe hemolysis after transapical closure of mitral perivalvular leak requiring transeptal reintervention
Hemólisis severa postcierre de leak perivalvular mitral por vía transapical que requirió reintervención por vía transeptal
Agüero MA, et al.

077

Endovascular management in a patient with kidney vascular malformation: review of the literature and the experience of 2 cases
Manejo endovascular en pacientes con malformación vascular renal: revisión de la literatura y la experiencia de 2 casos
LLahyah E, Ortiz G

083

Endovascular treatment of May-Thurner syndrome
Tratamiento endovascular del síndrome de May-Thurner
Stupaczuk G, et al.

086

Coronary angioplasty in coronay left circunflex anomaly. Case report and discussion of literature
Angioplastia coronaria de arteria circunfleja con arteria coronaria izquierda anómala y nacimiento desde el seno de Valsalva derecho. Reporte de un caso
Martín RA, et al.

LETTER FROM THE PRESIDENT / CARTA DEL PRESIDENTE

088

Editorial letter
Carta editorial
Grinfeld D

RULES OF PUBLICATIONS
REGLAMENTO DE PUBLICACIONES

089

Analytic Summary

Sumario analítico

EDITORIAL/ EDITORIAL

EDUARDO GABE MD, PHD, FACC (1953-2020). IN MEMORIAM

Rodríguez AE

Back in March 28th when we were barely wrapping up the first issue of our journal for publication we found out about the sudded death of one of our members at the Editorial Committee, Dr. Eduardo Gabe, MD. I met Eduardo at Sanatorio Güemes at the end of 1979 and it would be the beginning of a relation of mutual respect and friendship. After my departure from Sanatorio Guemes in 1986 our lives went different directions until he joined the clinical cardiology working group at Sanatorio Otamendi. Death found him while he was preparing to take over the entire cardiology unit unit at Otamendi.

REVIEW ARTICLES / ARTÍCULOS DE REVISIÓN

MULTIORGAN FAILURE DURING COVID-19 PANDEMIC IN CARDIOVASCULAR PATIENTS. ROLE OF ADVANCED CARDIAC AND PULMONARY SUPPORT

Barbagelata A, et al.

COVID-19 has now claimed several thousands of lives and overwhelmed the healthcare systems of several countries. Patients with cardiovascular disease are at particular risk not just of the infection itself but of its cardiac complications. Compared to other hospitalized patients with COVID-19, those needing intensive care, are more likely to have preexisting cardiovascular diseases or risk factors. Cytokine storm with hyperinflammation correlates with the severity of the disease. It is associated with mortality and is a key factor in determining the clinical course of extrapulmonary multiple-organ failure, suggesting that the inflammatory storm is associated with damage in extrapulmonary tissues and organs. Advanced Cardiac and Pulmonary Support has been reported in selected a COVID population.

CACI RECOMMENDATIONS ON INTERVENTIONAL TREATMENT DURING THE COVID-19 PANDEMIC

Kevorkian R, et al.

Back in December 2019, China identified the very first cases of SARS-CoV–2. Shortly after that, the WHO declared an international emergency and in February 2020 over 800 000 cases had already been confirmed. This is a highly contagious viral infection with a high mortality rate in populations at risk. This disease is characterized by a severe acute respiratory distress syndrome that can cause myocardial damage through different mechanisms. It has been reported that high ultra-sensitive troponin levels associated with comorbidities lead to high in-hospital mortality rates..

BRIEF COMMUNICATIONS / COMUNICACIONES BREVES

ST-T SEGMENT ELEVATION MYOCARDIAL INFARCTION IN A CENTER FROM BUENOS AIRES CITY DURING THE COVID-19 PANDEMIC

Rodríguez-Granillo AM, et al.

La pandemia COVID-19 presentó un aumento exponencial en el número de internaciones en las unidades de cuidados intensivos alrededor del mundo debido al requerimiento de asistencia ventilatoria y una disminución en la consulta de patologías graves y prevalentes en años previos, en especial de casos graves como el síndrome coronario agudo con elevación del segmento ST-T. En nuestra institución se manifestó el fenómeno con un aumento en los tiempos dolor-primer contacto médico, con presentaciones tardías, y un aumento de las complicaciones intrahospitalarias, incluyendo shock cardiogénico e insuficiencia cardíaca aguda.

CASE REPORTS / CASOS CLÍNICOS

SEVERE HEMOLYSIS AFTER TRANSAPICAL CLOSURE OF MITRAL PERIVALVULAR LEAK REQUIRING TRANSEPTAL REINTERVENTION

Agüero MA, et al.

Congestive Heart Failure and hemolysis are the most common presentation of perivalvular leaks. We report a case of transapical closure of a Mitral perivalvular leak in a patient with Heart Failure who lately developed severe hemolysis due to a small residual defect and high-velocity jet, and its reintervention using transeptal approach.

ENDOVASCULAR MANAGEMENT IN A PATIENT WITH KIDNEY VASCULAR MALFORMATION: REVIEW OF THE LITERATURE AND THE EXPERIENCE OF 2 CASES

LLahyah E, Ortiz G

Arteriovenous malformations (AVM) remain relatively rare clinical lesions consisting in abnormal shunts between the arterial and venous vascular systems. In its clinical presentation, hematuria and hypertension predominate, with cardiac or pulmonary deterioration observed in 5% of cases. Hematuria is a reason for frequent consultation in the Emergency Department. Sometimes it is seen as a minor condition, and physicians might overlook some important diseases. The potential possibility of offering a curative treatment makes its diagnosis very important, allowing the natural course of the pathology to be modified. The heterogeneous vascular architecture of each AVM determines the endovascular treatment techniques employed. Sudden and anemic macroscopic hematuria should be studied in detail since it can be life-threatening. Performing minimally invasive procedures allows patients to preserve their kidney function with minimal complications and avoids more aggressive procedures such as heminephrectomy. We report our experience with

the endovascular treatment of 2 cases. The first is the case of a 43-year-old male athlete, and another case of a 28-year-old woman, both with no previous significant clinical history and with macroscopic hematuria.

ENDOVASCULAR TREATMENT OF MAY-THURNER SYNDROME

Stupaczuk G, et al.

May-Thurner syndrome is an anatomic disorder in which the left common iliac vein is compressed by the right common iliac artery and the spine at the level of the fifth lumbar vertebra with the consequent appearance of deep vein thrombosis in the lower limb left. We present the case of a 62-year-old woman with a history of ex-smoking who consults for pain and swelling of the left lower extremity of a one-year evolution that, after performing the abdominal-pelvic angiotomography, compression of the left iliac vein by the right common iliac artery was confirmed, undergoing endovascular treatment with self-expanding stent.

CORONARY ANGIOPLASTY IN CORONAY LEFT CIRCUNFLEX ANOMALY. CASE REPORT AND DISCUSSION OF LITERATURE

Martín RA, et al.

We present a clinical case of infrequent finding in which the patient presents association of abnormal left coronary artery and obstructive atherosclerotic injury on the circumflex artery. Based on this condition we carry out a search on the existing bibliography.

LETTER FROM THE PRESIDENT / CARTA DEL PRESIDENTE /

EDITORIAL LETTER

Grinfeld D

In February 2020, we found out about the existence of a new virus at the Chinese city of Wuhan that would probably cause a pandemic. Still, we could never imagine the world repercussion of this virus and the way we'd have to cope with it in our county. When back in March 20, 2020 mandatory social confinement was declared in our country, our lives changed overnight, and the only topics of conversation were coronavirus and the COVID-19 pandemic. This seriously impacted our jobs and our scientific and intellectual development. Our workload dropped and local and international events and congresses were suspended. We had to learn how to work remotely from a computer while being confined inside our own homes. CACI took over this challenge seriously and started working online from that day one. However, our activities scheduled for his year are still on including new activities and events under the new methodology imposed by the current situation.

Eduardo Gabe MD, PhD, FACC (1953-2020). In memoriam

Eduardo Gabe MD, PhD, FACC (1953-2020). In memoriam

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):57. https://doi.org/10.30567/RACI/202002/0057 -0057

Eduardo Gabe *MD, PhD, FACC (1953-2020).*

Back in March 28th when we were barely wrapping up the first issue of our journal for publication we found out about the sudded death of one of our members at the Editorial Committee, Dr. Eduardo Gabe, MD.

I met Eduardo at *Sanatorio Güemes* at the end of 1979 and it would be the beginning of a relation of mutual respect and friendship.

After my departure from *Sanatorio Guemes* in 1986 our lives went different directions until he joined the clinical cardiology working group at *Sanatorio Otamendi*. Death found him while he was preparing to take over the entire cardiology unit unit at *Otamendi.*

During his stay at *Otamendi* the young resident cardiologists and clinical staff were lucky enough to benefit from Dr. Gabe's vast knowledge of clinical cardiology and cardiovascular surgery.

If I had to summarize his medical skills in a few words I would borrow this sentence from another clinical cardiologist who studied with him at Favaloro Foundation, Dr. Pablo Stuzbach, MD: "***among other things, he was an excellent semiologist"***. A definition I totally agree with.

His extensive curriculum vitae reveals a successful career in *Sanatorio Güemes* and Favaloro Foundation alike. He had a PhD in Medicine (UBA) and was the recipient of several awards such as the Buenos Aires National Academy of Medicineaward and the Buenos Aires Medical School (UBA) award. Also, he had collaborated in several books and original papers and reviews published in Argentina and abroad.

While at the clinical cardiology unit at *Sanatorio Otamendi* he was the leading author of a study onTakotsubo cardiomyopathy, a condition for which heeven found one classification.

As a member of RACI Editorial Committee he was very active and reviewed and proofread some of the articles that would later be published.

One of his closest friends, Dr. Jorge Wisner, MD, sent us a few words that I wish to share with all our readers:

"To me it is not easy to write these lines after learning about your sudden and unexpected passing. I am just overwhelmed. Still, I wish to give you my final goodbye thanking you for the wonderful friendship we have had for over 40 years. We met while doing our residency in hemodynamics in the old Sanatorio Güemes at the beginning of 1979 and our friendship lifted up right from the start. A friendship that has withstood the test of time even when life took us through different paths and regardless of the occasional distancing that never damaged our relation. Your professional career has been long and successful in the field of clinical cardiology. My calling was a different one. Death is unavoidable. But, it is especially difficult to accept when a close friend like you has to embark on this journey. I know you are in a good place now. You were an excellent person and we are all going to miss you."

Dear Eduardo, you leave an indelible memory for those of us who knew you. Wherever your are, you will be missed very much.

Rest in peace.

Alfredo E. Rodríguez MD, PhD, FACC, FSCAI
Editor-in-chief
Revista Argentina de Cardioangiología Intervencionista (RACI)

Review article

Multiorgan failure during COVID-19 pandemic in cardiovascular patients. Role of advanced cardiac and pulmonary support

Fallo multiorgánico durante la pandemia de COVID-19 en pacientes cardiovasculares. Rol de la asistencia circulatoria y pulmonar

Alejandro Barbagelata[1], Juliana Giorgi[2], Michael M. Koerner[3], David A. Baran[4]

ABSTRACT

COVID-19 has now claimed several thousands of lives and overwhelmed the healthcare systems of several countries. Patients with cardiovascular disease are at particular risk not just of the infection itself but of its cardiac complications. Compared to other hospitalized patients with COVID-19, those needing intensive care, are more likely to have preexisting cardiovascular diseases or risk factors. Cytokine storm with hyperinflammation correlates with the severity of the disease. It is associated with mortality and is a key factor in determining the clinical course of extrapulmonary multiple-organ failure, suggesting that the inflammatory storm is associated with damage in extrapulmonary tissues and organs. Advanced Cardiac and Pulmonary Support has been reported in selected a COVID population.

Keywords: *COVID-19 pandemia, multiorgan failure, cardiovascular patients, advanced cardiac and pulmonary support.*

RESUMEN

La actual pandemia mundial con COVID-19 generó miles de contagios, colapsó los sistemas de salud y generó una elevada mortalidad y consecuencias en la salud pública y la economía de numerosos países. Los pacientes con enfermedad cardiovascular tienen un riesgo particular, no solo mayor propensión a la infección en sí sino también a las complicaciones cardiovasculares. En comparación con otros pacientes hospitalizados con COVID-19, los pacientes cardiovasculares tienen más probabilidades de requerir cuidados intensivos, intubación endotraqueal y entre 5 y 10 veces mayor probabilidad de morir. La respuesta del organismo hacia el virus se hace en algunos casos como hiperinflamación y tormenta de citoquinas para contrarrestar el virus, pero termina atacando a las células de su propio organismo. Este fenómeno se relaciona con la gravedad de la enfermedad y está asociada con compromiso de múltiples órganos, lo que sugiere que la tormenta inflamatoria se asocia con daños en los tejidos y órganos extrapulmonares. La necesidad de asistencia circulatoria y pulmonar es requerida en casos de gravedad y existen reportes que durante la pandemia se utilizó con resultados variables. Debido a que son terapias complejas y de alto costo, es necesario estandarizar su utilización.

Palabras claves: *COVID-19 pandemia, multiorgan failure, cardiovascular patients, advanced cardiac and pulmonary support.*

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):58-64. https://doi.org/10.30567/RACI/202002/0058-0064

INTRODUCTION

Patients with cardiovascular disease are at particular risk not just of the infection itself but of its cardiac complications. Cytokine storm is associated with mortality and is a key factor in determining the clinical course of extrapulmonary multiple-organ failure. Advanced cardiac and pulmonary support has been applied in selected COVID population

ILLUSTRATIVE CASE REPORT

A 68-year-old man was hospitalized in Sirio Libanês Hospital (São Paulo, Brazil) after neurosurgical treatment (temporal meningioma removal). At the 5th post-surgical day he started having fever, hypoxia and respiratory failure requiring mechanical ventilation. Chest CT showed a lesion of right lower lung and diffuse consolidation on both lower lungs. Nasopharyngeal swabs were positive for SARS-CoV-2 (COVID-19) nucleic acid by the fluorescence quantitative RT-PCR. His relevant comorbidities were obesity, hypertension, rheumatoid arthritis, coronary artery disease and prostatic cancer without metastatic lesion. Blood tests revealed WBC 4,8x10^9/L, LYM 0.10x10^9/L and elevated inflammatory markers as D-dimer, ferritin, troponin, lactate dehydrogenase (LDH) 1052 U/L, procalcitonin (PCT) 0.71 ng/ml, C-reactive protein (CRP) 24 mg/L. Blood gas analysis revealed: pH 7.17, PO2 71 mmHg, pCO2 58 mmHg with fraction of inspired oxygen (FiO2) 100% and the need of high doses of dobutamine (20 mcg/kg/min) and noradrenaline (0,8 mcg/kg/min) due to low mean arterial blood pressure of 55 mmHg. Echocardiogram showed an acutely reduced ejection fraction of 35% and estimated pulmonary pressures of 50 mmHg. Medical treatment with hydroxychloroquine 400 mg, azithromycin 500 mg and methylprednisolone 40 mg was started together with vancomycin, meropenem, fluconazole as coverage in case of a superimposed infection. All these means did not improve his clinical situation. Due to refractory cardiogenic shock with renal and pulmonary failure, percutaneous peripheral Veno-Arterial extracorporeal membrane oxygenation (V-A-ECMO) support (Maquet) was inserted at bedside. A heparin coated cannula (Maquet) was placed into the left femoral artery with a leg reperfusion cannula, and a heparin coated cannu-

1. Universidad Católica Argentina / Duke University School of Medicine
2. Sirio Libanês Hospital São Paulo, Brazil
3. Integris Baptist Medical Center, Oklahoma City, OK, USA
4. Eastern Virginia Medical School (Cardiology) Sentara Heart Hospital, Norfolk VA, USA

✉ Correspondencia: *Alejandro Barbagelata. n.barbagelata@duke.edu / barba001@me.com*

Los autores declaran no tener conflictos de intereses.

Recibido: 02/06/2020 | Aceptado: 08/06/2020

la (Maquet) was placed in the left femoral vein. The hemodynamic and metabolic situation stabilized together with renal replacement therapy and vasoactive drugs could be reduced. The patient also was treated with lopinavir/ritonavir (Kaletra®, Abbvie®). The ejection fraction improved to 50% after 4 days of V-A ECMO support with 2,77 lpm flow. Unfortunately, on the 3rd day after ECMO decannulation septic shock installed as a typical skin COVID-19 necrotizing fasciitis at the previous V-A-ECMO cannulation site. At this time the patient deteriorated due to multiple organ dysfunction and end of life therapy was implemented.

DISCUSSION

Around 15% of COVID-19 infected patients could develop severe disease warranting hospital admission, and 5% are designated as critically ill[1]. Whereas COVID-19 is primarily a respiratory infection, it has important systemic effects including the cardiovascular, coagulation and immune systems[2,3]. Those with preexisting cardiovascular conditions represent a large proportion with symptomatic infection, and experience disproportionately worse outcomes between a five- to tenfold increase in mortality[2,4]. Compared to other hospitalized patients with COVID-19, those needing intensive care, are more likely to have preexisting cardiovascular diseases or risk factors[5-14]. In a group of 191 patients, 62% of those who died were male and of these 30% had hypertension, 19% diabetes and 8% coronary artery disease[15]. In a similar population of 138 hospitalized COVID-19 patients, those requiring intensive care, were older and more likely to have hypertension, diabetes, and cardiovascular or cerebrovascular disease[6]. Italian data likewise show the same trend in older patients having co-morbidities. In a subsample of 355 Italian patients who died with COVID-19, the mean age was 79.5 years: 70% were men, 30% had ischemic heart disease, 36% diabetes, 20% cancer and 25% atrial fibrillation[13,14,16]. In the US, Washington state reported that in 21 intensive care patients with COVID-19, the mean age was 70 and 86% had comorbid conditions including congestive heart failure, chronic kidney disease, and diabetes[10]. A more recent report from New York, showed that of 1,150 adults hospitalized with COVID-19, 257 (22%) were critically ill with respiratory failure, 79% of patients received mechanical ventilation during hospitalization for median durations of 27 days among survivors and 10 days among non-survivors. One quarter of intubated patients received early neuromuscular blockade, 17% received prone positioning ventilation, and 3% received extracorporeal membrane oxygenation (ECMO)[17].

Immune System out of control in COVID-19 heralds multiorgan failure

When SARS-CoV-2 enters a cell to replicate, it can disable or destroy it, leading to the release of potential danger signals to activate the host's immune response. A rapid and well-coordinated innate immune response is the first line of defense against viral infection. The production of Interferon IFN-I or α/β is the key natural immune response. It is hypothesized that a delayed release of interferons (IFNs) in the early stages of COVID-19 infection that hinders the body's antiviral response and generate high levels of proinflammatory cytokines [interleukin (IL)-1β, IL-6, tumor necrosis factor (TNF) and chemokines][18] through elevated serum cytokine and chemokine levels related to the high number of neutrophils and monocytes in the patients lung tissues and peripheral blood. Dysregulated and excessive immune responses may cause immune damage to the human body. The virus eliminates key lymphocytes, particularly CD4+ as coordinator of T cell function. The lower the lymphocyte count, the worse the outcome[2]. With the immune system partially disabled, the macrophages and then neutrophils come in as a second line with IL-1 and IL-6 arriving on the scene particularly in the sickest COVID-19 patients where their blood has high levels of these immune system proteins developing the "cytokine storm" picture where the body starts to attack its own cells and tissues rather than just fighting off the virus[2,18].

Impending storm ahead

When biomarkers start rising particularly when CRP, troponin, IL-6, ferritin, D-dimer, creatinine start rising means that there is an impending storm. It means that some of these processes are at play and is particularly important given that many patients with CVD have heightened angiotensin-converting enzyme 2 (ACE2) receptor activity to begin with, making them vulnerable to COVID-19. Those who have higher levels of markers should be followed closely, monitored for arrhythmias, ischemia and organ failure particularly in CV patients, with efforts made to restore immune balance. Intervention will likely need to be instituted early, before the immune amplification process is fully underway. This cytokine storm is associated with disease progression in patients with high levels of IL-1B, IL-2R, IL-6 IFN-γ, IP-10 and monocyte chemoattractant protein 1 (MCP-1)[2] and the larger the number of immune cells that results in hyperinflammation correlate with the severity of the disease. In patients with acute respiratory distress syndrome (ARDS) cytokine level increase is positively correlated with mortality rate and is also a key factor in determining the clinical course of extrapulmonary multiple-organ failure, suggesting that the inflammatory storm is associated with damage in extrapulmonary tissues and organs. It also might explain why some people have a severe reaction to coronaviruses while others only experience mild symptoms particularly younger people as their immune systems are less developed and so produce lower levels of inflammation-driving cytokines[18]. Systemic inflammation has long been posited as a trigger for cardiovascular events and the body's potent immune response to COVID-19 poses unique risks to the heart and may result in part from a predilection of COVID-19 for the cardiovascular system, combined with the already widespread prevalence of cardiovascular disease that places patients at high risk of COVID-19 complications[19]. Positive feedback between cardiovascular disease and abnormal immune function might explain the increased risk of death in COVID-19 patients with cardiovascular risk factors[7,20]. Age (especially), diabetes, hypertension and obesity promote immune system dysregulation, while this dysregulation affects cholesterol metabolism and systemic inflammation[21]. Thus elderly patients with cardiovascular disease are especially vulnerable and the presence of cardiovascular risk factors may be a marker of accelerated immunologic aging or dysregulation that increases the likelihood of cardiovascular complications during the infection. The virus uses ACE-2 receptors to get into the cell that are highly expressed in the myocardium in addition to the lung and other organs[2,22].

Reports describing fulminant myocarditis confirmed at autopsy by the presence of inflammatory, mononuclear infiltrates, and even the virus itself as shown in an Italian patient with cardiogenic shock[23] remind us that the heart, and not just the lung, is a target[23-26]. ACE-2 receptors are also present in other organs and systems, including kidneys, eyes, gut, liver, vasculature and central nervous system that might attract inflammatory cytokines and multiorgan failure[27]. Severe COVID-19 infection can damage the heart through direct viral infection but also due to poor oxygenation, hemodynamic stress, hypercoagulability, exacerbation of diabetes and hypertension[2,9]. Elevated troponin or CK-MB levels may result from myocardial ischemia or non-ischemic processes such as myocarditis, and it frequently accompanies severe[28] COVID-19 infections. Compared to surviving patients, those who die have significantly higher troponin levels, especially when acute respiratory distress syndrome (ARDS) has complicated the picture[20]. Cohort studies from hospitalized patients estimate that myocardial injury occurs in 7-28%[6,7,29-31] and is significantly more common in patients admitted to intensive care and in those who died[4]. Even patients without known CV disease can die with elevated troponin levels and cardiac arrest[29,32]. It is clear that several mechanisms can injure the heart which singly or together can present in different ways (**Figure 1**), depending upon the pre-existing conditions, viral processes, degree of hypoxia, and inflammatory response of the patient[32,33].

Heart failure and cardiogenic shock can develop in COVID-19 patients. The complexity of these cases and their frequent progression to multiorgan dysfunction can often cloud the "exact" cause of death[9]. Zhou et al. observed heart failure in 23.0% of COVID-19 patients, and in 52% of the non-survivors[20]. The report from Washington state noted that 33% of intensive care patients developed cardiomyopathy[10]. The occurrence of pulmonary edema in COVID-19 infections is another source of clinical confusion, that is, whether it is non-cardiogenic (ARDS), cardiogenic, or both. It is important to distinguish these entities when managing the respiratory manifestations of COVID-19. Right heart catherization has been discouraged, as ICU physician trend to use the Berlin criteria for ARDS[34] and volume status can be assessed with serum brain natriuretic peptide levels and cardiac echocardiography[35]. Still, pulmonary artery catheterization may be considered as different management strategy for ARDS and left heart failure.

Arrhythmia, venous thromboembolism, strokes and skin lesions are also frequent complication in multiorgan failure[36-38]. The appearance of a new or marked worsening of an existing arrhythmia can result from the metabolic, neurohormonal, and inflammatory stress of COVID-19 infection in patients with or without cardiovascular disease[39] in particular malignant tachyarrhythmia appear in the setting of elevated troponin or myocarditis[40]. Most COVID patient may be at risk of arrhythmias caused by medication, electrolyte disorders, or both. Therapy combining hydroxychloroquine plus azithromycin can prolong QT-interval and generate fatal arrhytmias[41]. A 2000 patients NIH trial is underway to test safety and efficacy of this combination[42]. Recently a large multinational cohort study showed no benefit mainly due to arrhythmias[41]. This combination is no longer used in most countries.

The pro-coagulant effects of an overactive inflammatory response[3] can increase the likelihood of thrombosis and embolism[44]. Abnormal coagulation parameters may be present in severely ill patients with COVID-19 and are associated with increased mortality[3,44,45]. D-dimer levels are strongly associated with in-hospital death[14] along with fibrin degradation product levels with a frequent finding of disseminated intravascular coagulation[3,46].

Anticoagulation appears to have a critical role according to recent data[28].

Sequential organ failure assessment score

The Sequential Organ Failure Assessment (SOFA) score is a mortality prediction score that is based on the degree of dysfunction of six organ systems[47,48].

- The score is calculated on admission and every 24 hours until discharge using the worst parameters measured during the prior 24 hours.
- The scores is used in a number of ways.
- As individual scores for each organ to determine progression of organ dysfunction.
- As the sum of scores on one single ICU day.
- As the sum of the worst scores during the ICU stay.
- Cr, Bili, MAP, GCS, platelets, PaO2, FiO2, on mechanical ventilation.

The early detection of multiorgan failure can be an early marker of cytokine storm and mortality prediction or resources use[49].

Targeting therapy during the storm

On top of the most frequent used medications in COVID-19 patients[19,50,51] dozens of studies have been launched to see whether drugs and devices that block cytokines, or prevent their release in the first place, may keep COVID-19 patients from deteriorating and dying. Many anti-inflammatory agents have already been tested in the prevention of cardiovascular events[52]. Anti-COVID-19 anti-cytokine storm candidates include tocilizumab (Actemra®; Roche) and sarilumab (Kevzara®; Sanofi/Regeneron), both currently being studied and, could be affective reducing the risk of fatal ventricular tachycardia/fibrillation. Others are anakinra (Kineret®; Sobi), siltuximab (Sylvant®; EUSA Pharma) and ruxolitinib (Jafaki®; Incyte). Numerous studies are examining their effects on IL-6 and/or IL-1, key actors in the body's response to COVID-19 that can alter heart rhythm and drug absorption. Recently, a preliminary report randomized trial with dexamethasone in severe COVID-19 patients RECOVERY Trial showed a significant reduction in mortality in those receiving oxygen or on invasive mechanical ventilation. (Horby P, Lim WS, Emberson J, et al. Effect of Dexamethasone in Hospitalized Patients with COVID-19: Preliminary Report. medRxiv BMJ Yale. The preprint server for health sciences.doi: https://doi.org/10.1101/2020.06.22.20137273).

The medical community has so far proposed over 100 clinical trials in severe inflammatory storm including application of mesenchymal stem cells or haemadsorption.

https://clinicaltrials.gov/ct2/results?cond=Covid+&term=inflammation&cntry=&state=&city=&dist=

Mechanical assist devices and extracorporeal devices in multiorgan failure and shock

As described earlier, cardiovascular patients are more often affected and compromized by the virus or by the cytokine

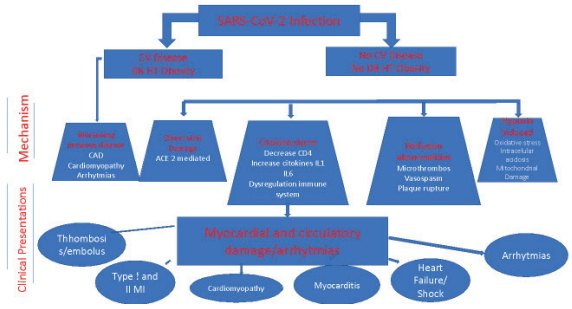


Figure 1. *Cardiovascular complications in COVID.*

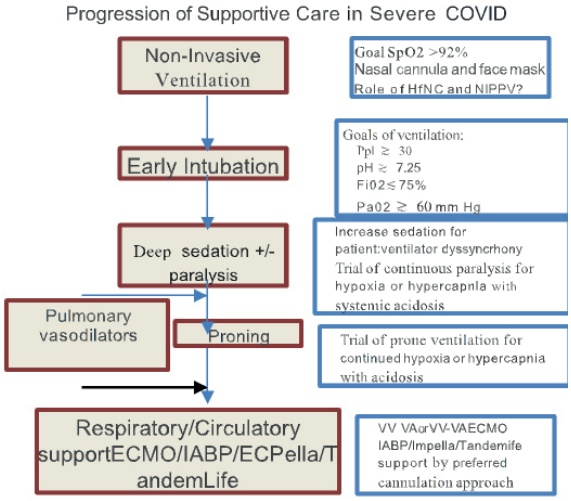


Figure 2.

storm, meaning that any ARDS needs to be assessed for cardiovascular involvement as heart failure or mixed shock can be confirmed and measured by physiologic parameters and echocardiography. Shock might be an uncommon but life-threatening complication of a COVID-19 infection. Giving the high number of infections however, an incidence of shock in 6.0% of all of COVID-19 patients translates in a significant number of patients[53]

A significant number of hospitalized patients with COVID-19 will develop acute respiratory distress syndrome (ARDS)[54-56]. According to one study, 12% of admitted patients progress to requiring mechanical ventilation with 3% needing extracorporeal membrane oxygenation (ECMO) support[57].

Guidelines should stress the importance of performing all other evidence-based interventions, such as lung-protective ventilation and prone positioning, prior to the consideration of ECMO[58] **(Figure 2)**. ECMO is a tool of cardiopulmonary support for refractory respiratory and cardiac failure.

There are 2 main types: veno-venous (V-V) and veno-arterial (V-A). V-V ECMO is used to correct hypoxemia and hypercapnia in isolated lung failure. In one form, a single dual-lumen catheter draws blood from a large vein and reinfuses oxygenated blood back into the right atrium[59]. Another uses 2 cannulas, usually drawing blood from a femoral vein and reinfusing it via the internal jugular vein into the right atrium. Dual-site cannulation is preferred for COVID-19 patients for pulmonary support, as it can be performed safely at the bedside without the need for fluoroscopy or transesophageal echocardiography, so that fewer personnel need to come into the room. V-A-ECMO provides cardiac and circulatory support in addition to oxygenation[60].

Nonrandomized studies, case series, and reports of using ECMO as a bridge to recovery in ARDS during the 2009 influenza A (H1N1) epidemic suggest that the mortality rate is lower with ECMO[61]. However, in the ECMO to Rescue Lung Injury in Severe ARDS (EOLIA) trial, the largest trial to date of early use of ECMO in severe ARDS, Coombes et al reported a statistically insignificant 11% absolute reduction in mortality at 60 days[62].

Reports from China with ECMO didn't show benefit although no control studies were undertaken[1,8,20,63].

In cardiovascular patients it is important to determine first whether left-sided cardiac dysfunction is present. Timely echocardiographic assessment in the presence of any clinical suspicion of cardiac dysfunction or sign of circulatory compromise should be undertaken[53,58,64]. Pulmonary arterial catheters (PA cath) are helpful for measurements of blood flow, filling pressures as well as for blood gas values from different circulatory compartments.

In high cardiac output states V-A access alone may not be sufficient and eventually a modifications to a hybrid constellation may be indicated (Hybrid ECMO like V-V-A) Shekar K.

Few cases with cardiopulmonary failure were reported using cardiopulmonary support during COVID[65,66]. A myocarditis case in a cardiogenic shock patient that required V-A-ECMO, was reported where a endomyocardial biopsy was undertaken and the virus located in the myocardium for the first time[23].

A recent case reported in a patient with combined cardiogenic and vasoplegic shock using V-A-ECMO and intravascular microaxial blood pump (CP Impella, Abiomed) with the rational to decrease afterload and to increase organ perfusion by increasing pump power and left ventricular unloading with the Impella and V-A-ECMO devices also by reducing the V-A-ECMO related increase in afterload[66].

Regardless of whether the systemic arterial hypotension is thought to be cardiogenic with LV failure, distributive, or mixed shock, the LVEF generally is a useful index to determine whether mechanical circulatory support (MCS) is reasonable. If LVEF is high or even normal in the setting of systemic arterial hypotension, the LVEDV and heart rate are normal, then the cardiac output is normal or elevated, and MCS would have to be able (with native output) to exceed that in order to have a hemodynamic benefit. In contrast, if the LVEF is low, then for a normal LVEDV and heart rate, the cardiac output is reduced despite optimal LV preload, and MCS may be reasonable. If the LVEF is reduced, and high doses of inotropes are required to treat systemic arterial hypotension, MCS for the LV may be appropriate in highly selected patients with COVID19.

If a PA cath can be placed expeditiously in patients with shock, they are recommended for the purposes of definitive diagnostics; from PA catheters, the cardiac output and index, LV power/cardiac power output, as well as the PA pulsatility index.

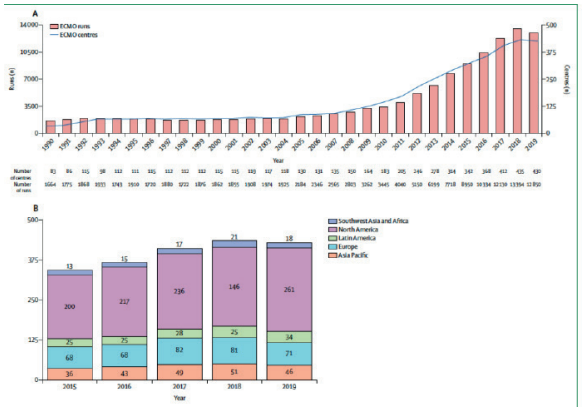


Figure 3. *Global ECMO capacity according to ELSO(A) Number of ECMO centres registered with ELSO and number of ECMO runs per year. (B) Geographical distribution of ELSO-registered ECMO centers as of January, 2020. Adapted from the ECMO*

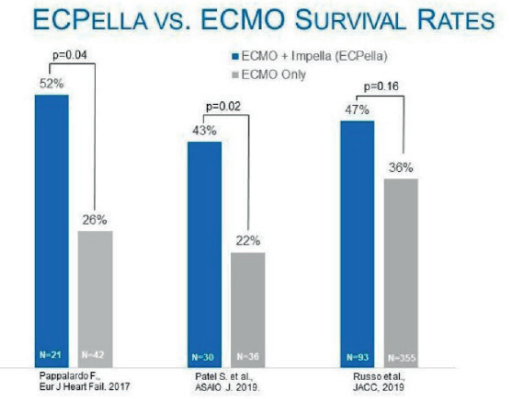


Figure 4. *Approximately 10,000 ECMO plus Impella (ECPella) patients with cardiogenic shock over the past 10 years.*

Hybrid V-V/V-A ECMO approaches may be reasonable to ensure oxygenation in the upper body. However, hybrid configurations are more complex and resource-intensive, typically requiring continuous bedside attendance.

Short-term left ventricular assist devices with either central or peripheral cannulation; short-term catheter-mounted left ventricular assist devices (Impella®, Abiomed)

The principal advantages of left ventricular assist devices over V-A-ECMO in shock are direct LV unloading, and more homogeneous distribution of blood flow through the systemic arterial circulation. Direct (inflow cannula within the left side of the heart, and particularly the LV) LV unloading is more effective in reduction of LVEDV, and consequently, LV diastolic and systolic pressures; this may be advantageous relative to indirect (inflow cannula proximal to/ upstream of the left side of the heart) unloading (eg, via V-A-ECMO) vis-à-vis greater reduction of pathological load-induced signals and resultant mechanotransduction[67].

The effectiveness of V-A-ECMO in unloading the left side of the heart is an area of some controversy with consistently result in augmentation of the LVEDV and LVEDP. What is less controversial regarding LV distension in V-A-ECMO, is that MCS approaches which employ leftsided circuit inflow (direct unloading) generally are more effective in achieving LV unloading than those which employ right-sided circuit inflow. [67] Consequently, in some patients, left ventricular assist device-based approaches may be superior to V-A-ECMO.

Percutaneous transfemoral placement may be performed at the bedside under echocardiographic guidance, rather than in a cardiac catheterization laboratory. In pandemic conditions, this may be useful. Second, placement via an axillary artery approach, using the newest iteration of introducer sheaths and securing devices may facilitate safer prone positioning. The original Impella 2.5 device generally may not provide adequate flow for the severely compromised shock patient for which robust LV MCS is required. The Impella CP device is better with a peak flow of 4.3 L/m. The Impella 5.0 and 5.5 devices, each of which may be introduced via side-grafts on the axillary artery, are capable of providing flows of 5.0 and 5.5 L/m. respectively, that is, levels of flow close to those achievable with surgically implanted left ventricular assist devices. Experience with Impella in combination with ECMO, that is, "ECPELLA", to enhance unloading and boost support is just beginning to emerge in severly compromised patients with COVID-19.[59]

RV support respiratory failure commonly causes anincrease in the pulmonary vascular impedance, increasing RV afterload

In some cases, this can occur to such an extent (afterload mismatch) that even in the setting of normal intrinsic RV contractility, the RVEF and output may decrease substantially (cor pulmonale). In such patients in the acute setting, attempting to treat the underlying etiology of impaired gas exchange using V-V-ECMO alone, may not be sufficient. This is because V-V ECMO recirculation is exacerbated by reduced RVEF and tricuspid regurgitation. In cases of cor pulmonale with COVID-19-related respiratory failure, we suggest that strategies to support the RV are appropriate. For patients who may require proning, percutaneous RVADs using femoro-femoral approaches, can be used with an oxygenator. The single cannula device (eg, Protek Duo®, Livanova) approach to this offers the advantages of peripheral cannulation via one site, and with minimal recirculation. Central approaches may be reasonable in patients in whom high flow rates cannot be achieved. If high flow rates are thought not to be achievable with a single cannula approach, then V-V-ECMO plus a device such as the Impella RP may be reasonable.

Because outcomes are clearly poorer when more organ systems are dysfunctional, we suggest that MCS ought to be highly selectively implemented in patients infected with COVID-19. ECMO is warranted when metrics indicate a high (80%) risk of mortality with conventional management. These notably include Pa O_2/FI O_2 ratio below 100, despite available optimal care and need to be avoided in inexperienced centers. Is not a therapy to be rushed to the front lines when all resources are stretched during a pandemic[53,68].

Patients without comorbid conditions under age 50 are the highest priority although resources are limited. Standard contraindications apply terminal disease or otherwise highly limited life expectancy at baseline, active biochemical or clini-

cal coagulopathy (particularly that which is unable to be treated or has failed treatment), major CNS damage, do not resuscitate (DNR status), and the absence of consent. Exclusions for COVID-19 during limited resources are hospital-specific. Because prognosis is worse, patients with major comorbid conditions (of note is immunosuppression—either due to disease or iatrogenically), age >70, and mechanical ventilation >7 days, could be reasonably excluded. Anecdotally, renal failure is not an exclusion; however, general outcomes with patients with COVID-19 with renal failure is exceedingly poor in the published Chinese experience[69].

CONCLUSION

Compared to other hospitalized patients with COVID-19, those needing intensive care, are more likely to have preexisting cardiovascular diseases or risk factors. Cytokine storm with hyperinflammation correlates with the severity of the disease. It is associated with mortality and is a key factor in determining the clinical course of extrapulmonary multiple-organ failure particularly the cardiovascular system. Advanced Cardiac and Pulmonary Support has been reported in selected a COVID population.

REFERENCES

1. *Guan WJ, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. N Engl J Med 2020.*
2. *Liu PP, et al. The Science Underlying COVID-19: Implications for the Cardiovascular System. Circulation 2020.*
3. *Tang N, et al. Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. J Thromb Haemost 2020.*
4. *Bonow RO, et al. Association of Coronavirus Disease 2019 (COVID-19) With Myocardial Injury and Mortality. JAMA Cardiol 2020.*
5. *Achenbach J. Medical databases show 1 in 10 hospitalized middle-aged coronavirus patients in U.S. do not survive. The Washington Post 2020.*
6. *Wang D, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. Jama 2020.*
7. *Huang C, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395(10223):497-506.*
8. *Chen N, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395(10223):507-13.*
9. *Ruan Q, et al. Clinical predictors of mortality due to COVID-19 based on an analysis of data of 150 patients from Wuhan, China. Intensive Care Med 2020.*
10. *Arentz M, et al. Characteristics and Outcomes of 21 Critically Ill Patients With COVID-19 in Washington State. Jama 2020.*
11. *Madjid M, et al. Potential Effects of Coronaviruses on the Cardiovascular System: A Review. JAMA Cardiol 2020.*
12. *Matthew J. Cummings, Matthew R. Baldwin, Darryl Abrams, et al. Epidemiology, clinical course, and outcomes of critically ill adults with COVID-19 in New York City: a prospective cohort study. medRXiv BMJ Yale, 2020.*
13. *Onder G, Rezza G, Brusaferro S. Case-Fatality Rate and Characteristics of Patients Dying in Relation to COVID-19 in Italy. JAMA Online 2020.*
14. *Grasselli G, Pesenti A, Cecconi M. Critical Care Utilization for the COVID-19 Outbreak in Lombardy, Italy: Early Experience and Forecast During an Emergency Response. Jama 2020.*
15. *Xu Z, et al. Pathological findings of COVID-19 associated with acute respiratory distress syndrome. Lancet Respir Med 2020.*
16. *Porcheddu, R., et al., Similarity in Case Fatality Rates (CFR) of COVID-19/SARS-COV-2 in Italy and China. J Infect Dev Ctries, 2020. 14(2): p. 125-128.*
17. *Matthew J Cummings, M.M.R.B., MD Darryl Abrams, MD, 1, Epidemiology, clinical course, and outcomes of critically ill adults with COVID-19 in New York City: A prospectivecohort study. The Lancet, 2020. 0(0).*
18. *Ye, Q., B. Wang, and J. Mao, The pathogenesis and treatment of the `Cytokine Storm' in COVID-19. J Infect, 2020.*
19. *Mehra, M.R., et al., Cardiovascular Disease, Drug Therapy, and Mortality in Covid-19. N Engl J Med, 2020.*
20. *Zhou, F., et al., Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet, 2020.*
21. *Zheng, Y.Y., et al., COVID-19 and the cardiovascular system. Nat Rev Cardiol, 2020.*
22. *Xiong, T.Y., et al., Coronaviruses and the cardiovascular system: acute and long-term implications. Eur Heart J, 2020.*
23. *Tavazzi, G., et al., Myocardial localization of coronavirus in COVID-19 cardiogenic shock. Eur J Heart Fail, 2020.*
24. *Alhogbani, T., Acute myocarditis associated with novel Middle east respiratory syndrome coronavirus. Ann Saudi Med, 2016. 36(1): p. 78-80.*
25. *Hu, H., et al., Coronavirus fulminant myocarditis saved with glucocorticoid and human immunoglobulin. Eur Heart J, 2020.*
26. *Lippi, G., C.J. Lavie, and F. Sanchis-Gomar, Cardiac troponin I in patients with coronavirus disease 2019 (COVID-19): Evidence from a meta-analysis. Prog Cardiovasc Dis, 2020.*
27. *Gheblawi, M., et al., Angiotensin Converting Enzyme 2: SARS-CoV-2 Receptor and Regulator of the Renin-Angiotensin System. Circ Res, 2020.*
28. *Paranjpe, I., et al., Association of Treatment Dose Anticoagulation with In-Hospital Survival Among Hospitalized Patients with COVID-19. Journal of the American College of Cardiology, 2020: p. 27327.*
29. *Shi, S., et al., Association of Cardiac Injury With Mortality in Hospitalized Patients With COVID-19 in Wuhan, China. JAMA Cardiol, 2020.*
30. *Lala, A., et al., Prevalence and Impact of Myocardial Injury in Patients Hospitalized with COVID-19 Infection. medRxiv, 2020: p. 2020.04.20.20072702.*
31. *Du, R.-H., et al., Predictors of Mortality for Patients with COVID-19 Pneumonia Caused by SARS-CoV-2: A Prospective Cohort Study. European Respiratory Journal, 2020: p. 2000524.*
32. *Chapman, A.R., A. Bularga, and N.L. Mills, High-Sensitivity Cardiac Troponin Can Be An Ally in the Fight Against COVID-19. Circulation. 0(0).*
33. *Hendren, N.S., et al., Description and Proposed Management of the Acute COVID-19 Cardiovascular Syndrome. Circulation, 2020.*
34. *Ferguson, N.D., et al., The Berlin definition of ARDS: an expanded rationale, justification, and supplementary material. Intensive Care Med, 2012. 38(10): p. 1573-82.*
35. *Karmpaliotis, D., et al., Diagnostic and prognostic utility of brain natriuretic Peptide in subjects admitted to the ICU with hypoxic respiratory failure due to noncardiogenic and cardiogenic pulmonary edema. Chest, 2007. 131(4): p. 964-71.*
36. *Green, S.J., Covid-19 accelerates endothelial dysfunction and nitric oxide deficiency. Microbes Infect, 2020.*
37. *Young, S. and A.P. Fernandez, Skin manifestations of COVID-19. Cleveland Clinic Journal of Medicine, 2020.*
38. *Oxley, T.J., et al., Large-Vessel Stroke as a Presenting Feature of Covid-19 in the Young. New England Journal of Medicine, 2020. 382(20): p. e60.*
39. *Guo, T., et al., Cardiovascular Implications of Fatal Outcomes of Patients With Coronavirus Disease 2019 (COVID-19). JAMA Cardiol, 2020.*
40. *Chen, C., Y. Zhou, and D.W. Wang, SARS-CoV-2: a potential novel etiology of fulminant myocarditis. Herz, 2020.*
41. *Roden, D.M., et al., Considerations for Drug Interactions on QTc in Exploratory COVID-19 (Coronavirus Disease 2019) Treatment. Circulation, 2020.*
42. *Health, N.I.o., Evaluating the Efficacy of Hydroxychloroquine and Azithromycin to Prevent Hospitalization or Death in Persons With COVID-19. 2020: https://clinicaltrials.gov.*
43. *Mandeep R Mehra, S.S.D., Frank Ruschitzka, Amit N Patel, Hydroxychloroquine or chloroquine with or without a macrolide for treatment of COVID-19: a multinational registry analysis. The Lancet, 2020.*
44. *Fan, B.E., et al., Hematologic parameters in patients with COVID-19 infection. Am J Hematol, 2020.*
45. *Zhang, Y., et al., Coagulopathy and Antiphospholipid Antibodies in Patients with Covid-19. N Engl J Med, 2020.*
46. *Cui, S., et al., Prevalence of venous thromboembolism in patients with severe novel coronavirus pneumonia. J Thromb Haemost, 2020.*

47. *Vacheron, C.-H., et al., A new simplified and accurate sa-SOFA score. Journal of Critical Care, 2020. 57: p. 240-245.*
48. *Lambden, S., et al., The SOFA score—development, utility and challenges of accurate assessment in clinical trials. Critical Care, 2019. 23.*
49. *Truog, R.D., C. Mitchell, and G.Q. Daley, The Toughest Triage — Allocating Ventilators in a Pandemic. New England Journal of Medicine, 2020. 382(21): p. 1973-1975.*
50. *Beigel, J.H., et al., Remdesivir for the Treatment of Covid-19 — Preliminary Report. New England Journal of Medicine, 2020.*
51. *Cao, B., et al., A Trial of Lopinavir-Ritonavir in Adults Hospitalized with Severe Covid-19. N Engl J Med, 2020. 382(19): p. 1787-1799.*
52. *Klingenberg, R. and S. Nitschmann, [Colchicine treatment after myocardial infarction: Colchicine Cardiovascular Outcomes Trial (COLCOT)]. Internist (Berl), 2020.*
53. *Bartlett, R.H., et al., Initial ELSO Guidance Document: ECMO for COVID-19 Patients with Severe Cardiopulmonary Failure. Asaio j, 2020. 66(5): p. 472-474.*
54. *Marini, J.J. and L. Gattinoni, Management of COVID-19 Respiratory Distress. JAMA, 2020.*
55. *Luciano Gattinoni, D.C.S.R., COVID-19 pneumonia: ARDS or not? Critical Care, 2020. 24: p. 154.*
56. *Mariusz Kowalewski, D.F., Artur Słomka, Giuseppe Maria Raffa,, COVID-19 and ECMO: the interplay between coagulation and inflammation—a narrative review. Critical Care, 2020. 24.*
57. *Ronco, C., T. Reis, and S. De Rosa, Coronavirus Epidemic and Extracorporeal Therapies in Intensive Care: si vis pacem para bellum. Blood Purif, 2020. 49(3): p. 255-258.*
58. *Ramanathan, K., et al., Planning and provision of ECMO services for severe ARDS during the COVID-19 pandemic and other outbreaks of emerging infectious diseases. Lancet Respir Med, 2020. 8(5): p. 518-526.*
59. *Rajagopal, K., et al., Advanced Pulmonary and Cardiac Support of COVID-19 Patients: Emerging Recommendations From ASAIO-a Living Working Document. Circ Heart Fail, 2020. 13(5): p. e007175.*
60. *Khan, R., et al., Utility of extracorporeal membrane oxygenation in COVID-19. Cleveland Clinic Journal of Medicine, 2020.*
61. *Lim, J.K.B., et al., Extracorporeal Membrane Oxygenation for Severe Respiratory Failure during Respiratory Epidemics and Pandemics: A Narrative Review. Ann Acad Med Singapore, 2020. 49(4): p. 1-34.*
62. *Combes, A., A.S. Slutsky, and D. Brodie, ECMO for Severe Acute Respiratory Distress Syndrome. N Engl J Med, 2018. 379(11): p. 1091-2.*
63. *Yang, X., et al., Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. Lancet Respir Med, 2020.*
64. *Chow, J., et al., Cardiovascular Collapse in COVID-19 Infection: The Role of Veno-Arterial Extracorporeal Membrane Oxygenation (VA-ECMO). CJC Open, 2020.*
65. *Fried, J.A., et al., The Variety of Cardiovascular Presentations of COVID-19. Circulation, 2020.*
66. *Bemtgen, X., et al., First successful treatment of COVID-19 induced refractory cardiogenic plus vasoplegic shock by combination of pVAD and ECMO - a case report. Asaio j, 2020.*
67. *Rajagopal, K., Left Ventricular Distension in Veno-arterial Extracorporeal Membrane Oxygenation: From Mechanics to Therapies. Asaio j, 2019. 65(1): p. 1-10.*
68. *MacLaren, G., D. Fisher, and D. Brodie, Preparing for the Most Critically Ill Patients With COVID-19: The Potential Role of Extracorporeal Membrane Oxygenation. Jama, 2020.*
69. *Schmidt, M., et al., Predicting survival after ECMO for refractory cardiogenic shock: the survival after veno-arterial-ECMO (SAVE)-score. Eur Heart J, 2015. 36(33): p. 2246-56.*

CACI recommendations on interventional treatment during the COVID-19 pandemic

Recomendaciones del CACI sobre el tratamiento intervencionista durante la pandemia COVID-19

Ruben Kevorkian, Gaspar Caponi, Gabriel Dionisio, José Luis Lazarte, Arturo Fernández Murga, Matías Sztejfman, Carla Agatiello, Juan Manuel Ponce, Oscar Carlevaro, Alejandro Cherro, Raúl Solerno, Fernando Cura, Carlos Fernández Pereira, Humberto Bassani Molinas, Diego Grinfeld

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):65-69. https://doi.org/10.30567/RACI/202002/0065-0069

Back in December 2019, China identified the very first cases of SARS-CoV–2. Shortly after that, the WHO declared an international emergency and in February 2020 over 800 000 cases had already been confirmed[1]. This is a highly contagious viral infection with a high mortality rate in populations at risk[2,3]. This disease is characterized by a severe acute respiratory distress syndrome that can cause myocardial damage through different mechanisms. It has been reported that high ultra-sensitive troponin levels associated with comorbidities lead to high in-hospital mortality rates[4].

This pandemic has put tremendous pressure on the healthcare systems across the world. Hospitals from China, Italy, Spain, and the United States, among other, experienced a sudden increase of critically ill patients with COVID-19 that has resulted in insufficient hospital resources and higher lethality and contagion rates for healthcare workers due to lack of personal protective equipment (PPE).

Although, in our country, cardiovascular disease is the first cause of death (33.3% back in 2018 [5]) in order to prepare for a potential exponential growth of contagions, the Argentinian Ministry of Health ordered that all scheduled procedures should be postponed following the line of action of other countries[6]. International studies show that consultations due to AMI have gone down or even been delayed[7]. In Spain the use of percutaneous coronary interventions (PCI) and the occurrence of structural heart disease dropped by 40%[8]. The use of PCIs also dropped in New York City with the corresponding increase of home sudden deaths[9,10].

The objective of this study was to design recommendations to perform procedures effectively by protecting patients and healthcare workers from contagion.

THE INTERVENTIONAL CARDIOLOGY EXPERIENCE ACROSS THE WORLD

The Chinese experience: This country adopted a very restrictive policy by suspending all scheduled procedures and surgeries and urgent care with invasive methods in very selected cases. For the management of the ST-segment elevation myocardial infarction (STEMI) fibrinolytic therapy was prioritized without the proper scientific back up[11,12].

The European experience: The recently published clinical practice guidelines[13] include in-hospital strategies for the protection of health professionals through triage, the proper use of PPE, and telemedicine. In patients with STEMI and high viral loads, level III PPE (the highest) while performing PCIs is advisable.In patients with non-ST-segment elevation acute coronary syndrome (NSTEACS), COVID-19 infection should be ruled out before performing any procedures. When performing PCIs on COVID-19-positive patients, the same cath lab should be spared for them using high-efficiency filters and total air exchange at a ratio of 15 times every hour.

The U.S. experience: Here consensus for the management of AMI[14] suggests adopting cautious measures due to the scarce scientific medical evidence available. PCI is recommended for the management of STEMI within a 3-group classification: defined, possible, and futile. Within the "possible" group, in suspected cases, it is advisable to perform bedside echocardiograms to rule out non-coronary presentations like myocarditis.Within the "possible" group, a coronary computed tomography angiography and ultra-rapid testing should be performed to detect coronavirus. Within the "futile" group with COVID-19 related severe systemic compromise, compassionate medical treatment should be considered. Patients with multiple-vessel lesions should be treated in one single session to shorten the hospital stay. In PCI-capable hospitals, fibrinolytic therapy should be considered based on the patient, possible delays, etc.

The New Zealandand Australian experience: The scientific societies of these two countries recommend considering fibrinolysis even in PCI-capable centers. They suggest performing PCIs only in patients with low chances of infection or high-risk AMI. They arrange and organize healthcare through referral networks. Also, they suggest dividing experienced health professionals into working groups with "clean" staff outside the cath lab[15].

1. Colegio Argentino de Cardioangiologos Intervencionistas

✉ Correspondencia: *Ruben Kevorkian. rubenkevorkian@gmail.com*

Los autores declaran no tener conflictos de intereses.

Recibido: 18/05/2020 | Aceptado: 20/05/2020

CASE DEFINITION

The definition of a confirmed or suspected COVID-19 case is dynamic and depends on the definitions established in our country by the Argentinian Ministry of Health[16]. https://www.argentina.gob.ar/noticias/ministerio-de-salud-actualizo-la-definicion-de-caso-sospechoso-de-covid-19

GENERALITIES ON THERAPEUTIC INTERVENTIONS

In this context every indication should include benefits, resource availability, and the risk of contagion. Indications may vary in time from one region of our country to the next. This means that there are no "one-size-fits-all" circumstances so to speak. For example, several procedures may be delayed until performing PCR tests; this will depend on the urgency, availability of the test, and the effective regulations.
Centers with several cath labs are compelled to use clean areas and COVID-specific areas. If possible, they will need to implement areas for healthcare and waiting, yellow or green depending on the international denomination; they will also have to define routes and protocols for the transfer of he patients. All rooms and areas will need to follow the disinfection protocols implemented. Portable machines like injection pumps, defibrillators, and others are possible sources of infection.
Patients with COVID-19-like symptoms will be told to avoid going to the hospitals. Also, they will be questioned upon admission according to the hospital rules and regulations. Triage will always be done prior to admission to the cath lab. The patient will need to wear a surgical mask even before entering the cath lab that should already be conditioned to host the patient with the staff also wearing their PPE. The cath lab personnel will need to work behind closed doors. The level of protection will always be high and include N95 masks. This recommendation is aimed at protecting health professionals who are difficult to replace; given the asymptomatic nature of patients and the low sensitivity of the tests it is difficult to establish the risks of contagion with lower protection measures. Lastly, the procedures and surgeries that have been brought to a minimum are meant to avoid overloading the resources of the healthcare system. Also, it is advisable to stabilize acute patients. Also, if invasive management of the airway is required, it is advisable to proceed this way rather than transferring the patient to the cath lab.

MANAGEMENT OF PATIENTS WITH ISCHEMIC HEART DISEASE

Scheduled care: The risk of infarction or death with the proper medical therapy in chronic coronary patients is low, which is why interventional cardiology procedures could be postponed; however, if angina symptoms were incapacitating, of high-risk or if stress tests confirmed it, we recommend performing a cine coronary arteriography and eventual treatment[17]. Similarly, coronary patients with significant ventricular dysfunction benefit from a revascularization strategy[18].
In areas with lower viral circulation, it is advisable to hold the indication to the effective guidelines. In outpatients with confirmed COVID-19 and moderate cardiovascular risk, it is advisable to wait until the patient is cleared of his infection[19,20].

Urgent care: Infection due to COVID-19 triggers mediators that predispose to the occurrence of acute coronary syndrome.The increase of cardiovascular eventshas already been confirmed in the context of other pandemics like H1N1 influenza A and MERS[21].

Patients with STEMI: When a patient with symptoms suggestive of AMI is admitted to the ER, the first thing to do is triage. These brief delays are necessary to establish a safe working routine. The current clinical practice guidelines recommend reperfusion for all patients with symptoms of myocardial ischemia of less than 12-hour duration and persistent ST-segment elevation[22-24]. The percutaneous coronary intervention (PCI) has proven to be the treatment of choice in multiple studies[25-28], yet the quality standards previously described should be observed at all time. In referred patients the timing of the care provided stays the same.In its consensus document for the management of STEMI, the Argentinian Society of Cardiology[29] recommends that, in non-PCI centers, low or medium-risk infarctions not reperfused < 90 minutes can be treated with rtPA or TNK with a low risk of bleeding (IB). The PCI related mortality benefit is lost with longer delays than adviced. This means that early reperfusion is more important than treatment *per se*[30]. If times during the transfer of the patient cannot be met, thrombolysis should be performed[30-33]. COVID-19-positive patients with severe myocardial ischemiashould be assessed to avoid therapeutic futility[34]. Once the PCI has successfully been performed in the culprit vessel, other accessible lesions can be treated[35,36]. Because of the multiple factors involved, we recommend leaving this decision to the discretion of the medical team.

Patients with NSTEACS: In patients who have tested COVID-19-negative, the corresponding clinical practice guidelines should be followed[37-39].
Although the cine coronary arteriography is an imaging modality indicated for the management of NSTEACS, in patients with COVID-19, the cardiovascular signs can be mistaken for a myocardial infarction[40]. Additional imaging modalities like echocardiography and coronary computed tomography angiography may contribute to the patient's diagnosis and prognosis.
In patients with confirmed or suspected COVID-19, the early invasive strategy is advisable in very high-risk clinical scenarios only:

- Refractory paincompromising a significant myocardial territory.
- Ischemia related heart failure or hemodynamic instability.
- Ischemia related severe arrhythmias.
- Significant ST-segment elevation.
- Patients of high ischemic risk (Grace score > 140)

Patients with severe pneumonia and on mechanical ventilation have a poor prognosis, which is why conservative treatment should be used. In patients without COVID-19 case criteria, the indication for a cine coronary arteriogra-

phy should follow the current indications for treatment[41-43]. Transfers are ill-advised during the management of COVID-19 related low-risk unstable anginas or severe anginas. Here, the ultimate decision should always be based on the patient's clinical status, the treating medical team, and the complexity of each particular center.

MANAGEMENT OF STRUCTURAL HEART DISEASE

Transcatheter aortic valve implantation (TAVI)
Because of their old age and comorbidities, several patients with severe symptomatic aortic stenosis (AS) have a high-risk of complications and death due to COVID-19. However, a higher mortality rate has also been confirmed in patients in whom treatment is delayed[44-45]. These are often challenging patients who need general anesthesia, transesophageal echocardiogram, pacemaker implantation, and whose indications should be reviewed.

In patients admitted due to severe, symptomatic AS, reduced LVEF, presence of congestive heart failure or syncope, TAVI is recommended during admission to minimize the progression of the disease.In symptomatic outpatients with severe-to-critical stenosis and NYHA functional class class III-IV dyspnea or syncope, TAVI is recommended without further delay. In patients with NYHA FC I-II symptoms and quantitative measures of the severity of the valve indicative of a critically stenosed valve, it may be reasonable to consider TAVI or close monitoring. In patients with asymptomatic severe-to-critical aortic stenosis it is reasonable to postpone TAVI based on the patient's clinical progression and capabilities of the treating center.
Close outpatient monitoring through telemedicine should be kept in all patients since symptoms are expected to become complicated in some of them; no algorithm can identify the patients whose procedures can be postponed safely.
All patients should undergo a COVID-19 diagnostic test to rule out positivity until the COVID-19 disease has been cleared.
Most TAVIs can be performed using a minimalistic approach with conscious sedation[46]. If necessary, the PCI should be performed the same day before the TAVI. The procedure should be limited to critical lesions for TAVI to be successful. Otherwise, the procedure can be postponed[47,48]. Aortic valvuloplasty as a bridging therapy to TAVI should be spared for hospitalized patients who do not respond to medical therapy[49]
Preprocedural imaging studies should be simplified to reduce the risk of contagion. Echocardiograms of the last 6 months should be enough. The diagnostic cine coronary arteriography can be performed prior to TAVI. The only mandatory imaging modality is coronary computed tomography angiography because of the information it provides.

MANAGEMENT OF VASCULOPATHIES

Here we will be giving recommendations for the management of aneurysms, aortic dissections, and other urgent vasculopathies. In all cases the current recommendations will be always followed while taking into considerations aspects already described for healthcare provision under the current pandemic. COVID-19 disease will be ruled out whenever possible. In suspicious or emergent cases, the risk of contagion and the expected benefits will be analyzed carefully.
During the pandemic: in the management of aneurysms of the abdominal aortathe urgent management of symptomatic aneurysms is always advised. Compared to surgery, this procedure can avoid the death of the patient and shorten the hospital stay. The remaining aneurysms of the abdominal aorta should always be postponed if asymptomatic.Treatment is recommended for the management of symptomatic peripheral aneurysms. In patients with peripheral pseudoaneurysms, the percutaneous treatment is recommended during the current pandemic when other less invasive treatments have failed. Percutaneous treatment should be used for the management of complicated type B aortic dissections. Percutaneous treatment is recommended for the management of splanchnic symptomatic aneurysms. It is advisable to treat symptomatic carotid stenosis too. Percutaneous treatment is recommended for the management of patients on dialysis with dysfunctional fistulae. Percutaneous treatment is recommended for the management of lower extremity vasculopathies. Percutaneous treatment is also recommended for the management of life-threatening treatment-refractory low GI bleeding during the current pandemic. Also, during the current pandemic, percutaneous treatment is recommended for the management of other non-medical bleedings in unstable, uncontrollable patients with general measures and on medical therapy[1,2].
Patients with COVID-19 will be assessed to see whether they can be treated or not.The risk that, in these cases, a procedure can be futile is very high and compromises personnel and resources that may be necessary for other patients who may be recoverable.Each case should be defined by the treating physician. However, it seems logical to consider conservative treatment until the infection of a patient with COVID-19 is gone.

CONCLUSION

The current COVID-19 pandemic is a challenge from the healthcare perspective. In disease-free patients, the indications to be followed should be those established by the clinical practice guidelines. Also, procedures should be postponed in patients with COVID-19 when possible.ST-Segment elevation myocardial infarction in a Buenos Aires center during the current COVID-19 pandemic

REFERENCES

1. *W. Guan, Z. Ni, Yu Hu, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. The China Medical Treatment Expert Group for Covid-19. N Engl J Med 2020 Apr 30;382(18):1708-1720.DOI: 10.1056/NEJMoa2002032.*
2. *www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-at-higher-risk.*
3. *Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19 port of 72 314 Cases From the Chi-*

nese Center for Disease Control and Prevention. JAMA. 2020;323(13):1239-1242. doi:10.1001/jama.2020.2648.

4. *Tao Guo, Yongzhen Fan, Ming Chen, et al. Cardiovascular Implications of Fatal Out-comes of Patients With Coronavirus Disease 2019 (COVID-19). JAMA Cardiol 2020 Mar 27. Epub ahead of print. doi:10.1001/jamacardio.2020.1017.*
5. *https://www.who.int/health-topics/cardiovascular-diseases.*
6. *www.cms.gov/files/document/31820-cms-adult-elective-surgery-and-procedures-reco mmendations.pdf*
7. *Katz JN, Sinha SS, Alviar CL. Disruptive Modifications to Cardiac Critical Care Delivery During the Covid-19 Pandemic: An International Perspective. J Am Coll Cardiol 2020 Apr 14. pii: S0735-1097(20)35002-6. DOI: 10.1016/j.jacc.2020.04.029.*
8. *Rodríguez-Leora O, Cid-Álvarezd B, Ojeda S. Impacto de la pandemia de COVID-19 sobre la actividad asistencial en cardiología intervencionista en España. REC Interv Cardiol 2020. Epub ahead of print.*
9. *De Filippo O, D'Ascenzo F, Angelini F. Reduced Rate of Hospital Ad-missions for ACS during Covid-19 Outbreak in Northern Italy. N Engl J Med 2020 Apr 28. Epub ahead of print. DOI: 10.1056/NEJMc2009166.*
10. *Garcia S, Albaghdadi MS, Meraj PM, et al. Reduction in ST-Segment Eleva-tion Cardiac Catheterization Laboratory Activations in the United States during COVID-19 Pandemic. J Am Coll Cardiol. 2020 Apr 9. Epub ahead of print. doi: 10.1016/j.jacc.2020.04.011.*
11. *Jing ZC, Zhu HD, Yan XW, et al. Recommendations from the Peking Union Medical College Hospital for the Management of acute myocardial infarction during the COVID-19 outbreak. Eur Heart J 2020 May 14;41(19):1791-1794. doi: 10.1093/eurheartj/ehaa258.*
12. *Chen Jiyan, Cheng Xiang, Han Yaling, et al. Consensus on Managing CVD during CO-VID-19 Epidemic. Chinese Journal of Cardiovascular Diseases 2020,48 (03): 189-94. DOI: 10.3760 / cma.j.cn112148-20200210-00066.*
13. *Andreini D, Arbelo E, Barbato E, et al. ESC Guidance for the Diagnosis and Management of CV Disease during the COVID-19 Pandemic Last updated on 21 April 2020. https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance.*
14. *Szerlip M, Anwaruddin S, G. Cohen M. Considerations for Cardiac Ca-theterization Laboratory Procedures During the COVID-19 Pandemic. Perspectives from the Society for Cardiovascular Angiography and Interventions Emerging Leader Mentorship (SCAI ELM) Members and Graduates. https://doi.org/10.1002/ccd.28887.*
15. *Lo STH, Yong AS, Sinhal A, et al. Consensus Guidelines for Interventional Cardiology Services delivery during COVID-19 Pandemic in Australia and New Zealand. Heart Lung Circ 2020 May 6. Epub ahead of print. doi: 10.1016/j.hlc.2020.04.002.*
16. *https://www.argentina.gob.ar/noticias/ministerio-de-salud-actualizo-la-definicion-de-caso-sospechoso-de-covid-19.*
17. *Antman EM, Braunwald E. Managing Stable Ischemic Heart Disease. Engl J Med 2020 Apr 9;382(15):1468-1470. doi: 10.1056/NEJMe2000239.*
18. *Knuuti J, Wijns W, Saraste A, et al. 2019 ESC Guidelines for the diagnosis and man-agement of chronic coronary syndromes: The Task Force for the diagnosis and man-agement of chronic coronary syndromes of the European Society of Cardiology (ESC). Eur Heart J, Volume 41, Issue 3, 14 January 2020, Pages 407–477. https://doi.org/10.1093/eurheartj/ehz425.*
19. *Borrás Pérez FX. Diagnóstico y estratificación de la angina estable. Rev Esp Cardiol Supl 2012;12(D):9-14.*
20. *Macin SM, Bono J, Ramos H, et al. Guías de manejo de cardiopatía isquémica crónica: angina crónica estable. Rev Fed Arg Cardiol 2009;38 (Suppl 1): S1-S23.*
21. *Ying-Ying Zheng, Yi-Tong Ma, Jin-Ying Zhang, et al. COVID-19 and the cardiovascular system. Nat Rev Cardiol 2020 May;17(5):259-260. doi: 10.1038/s41569-020-0360-5.*
22. *Levine GN, O'Gara PT, Bates ER, et al. 2015 ACC/AHA/SCAI Focused Update on primary percutaneous coronary intervention for patients with ST-elevation myocardial Infarction: an update of the 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention and the 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. Circulation. 2016 Mar 15;133(11):1135-47. doi: 10.1161/CIR.0000000000000336.*
23. *Ibanez B, James S, Agewall S, et al. Group ESCSD. 2017 ESC Guidelines for the man-agement of acute myocardial infarction in patients presenting with ST- segment eleva-tion: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2018;39(2):119-177. https://doi.org/10.1093/eurheartj/ehx393.*
24. *Tajer C, Charask A, de Abreu M, et al. Actualización del Consenso de Síndromes Co-ronarios Agudos con Elevación del Segmento ST – 2019. https://www.sac.org.ar/wp-content/uploads/2019/11/consenso-scacest-2019.*
25. *Grines CL, Browne KF, Marco J, et al. A comparison of immediate angioplasty with thrombolytic therapy for acute myocardial infarction. The Primary Angioplasty in Myo-cardial Infarction Study Group. N Engl J Med 1993;328:673-9.*
26. *Zijlstra F, de Boer MJ, Hoorntje JC, et al. A comparison of immediate coronary an-gioplasty with intravenous streptokinase in acute myocardial infarction. N Engl J Med 1993;328:680-4.*
27. *Keeley EC, Boura JA, Grines CL, et al. Primary angioplasty versus intravenous throm-bolytic therapy for acute myocardial infarction: a quantitative review of 23 randomised trials. Lancet 2003;361:13-20.*
28. *Thrane PG, Kristensen SD, Olesen KKW, et al. 16-year follow-up of the Danish Acute Myocardial Infarction 2 (DANAMI-2) trial: primary percutaneous coronary intervention vs. fibrinolysis in ST-segment elevation myocardial infarction. Eur Heart J 2020 Feb 14;41(7):847-854. doi: 10.1093/eurheartj/ehz595.*
29. *Tajer C, Charask A, de Abreu M, et al. Actualización del Consenso de Síndromes Co-ronarios Agudos con Elevación del Segmento ST – 2019. https://www.sac.org.ar/wp-content/uploads/2019/11/consenso-scacest-2019.*
30. *Daniels MJ; Mauricio G. Cohen; Anthony A. Bavry et al. Reperfusion of STEMI in the COVID-19 Era. Business as Usual? Circulation. 2020 Apr 13. Epub ahead of print. doi: 10.1161/CIRCULATIONAHA.120.047122.*
31. *Levine GN, O'Gara PT, Bates ER, et al. 2015 ACC/AHA/SCAI Focused Update on pri-mary percutaneous coronary intervention for patients with ST-elevation myocardial Infarction: an update of the 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention and the 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Society for Cardiovascu-lar Angiography and Interventions. Circulation. 2016 Mar 15;133(11):1135-47. doi: 10.1161/CIR.0000000000000336.*
32. *Ibanez B, James S, Agewall S, et al. Group ESCSD. 2017 ESC Guidelines for the man-agement of acute myocardial infarction in patients presenting with ST- segment eleva-tion: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2018;39(2):119-77. https://doi.org/10.1093/eurheartj/ehx393.*
33. *Tajer C, Charask A, de Abreu M. Actualización del Consenso de Síndromes Corona-rios Agudos con Elevación del Segmento ST – 2019. https://www.sac.org.ar/wp-content/uploads/2019/11/consenso-scacest-2019.*
34. *Szerlip M, Anwaruddin S, Aronow HD, Cohen MG. Considerations for Cardiac Catheterization Laboratory Procedures During the COVID-19 Pandemic. Perspectives from the Society for Cardiovascular Angiography and Interventions Emerging Leader Mentorship (SCAI ELM) Members and Graduates. https://doi.org/10.1002/ccd.28887.*
35. *Szerlip M, Anwaruddin S, Cohen MG, et al. Considerations for Cardiac Catheterization Laboratory Procedures During the COVID-19 Pandemic. Perspectives from the Society for Cardiovascular Angiography and Interventions Emerging Leader Mentorship (SCAI ELM) Members and Graduates. https://doi.org/10.1002/ccd.28887.*
36. *Andreini D, Arbelo E, Barbato E, et al. ESC Guidance for the Diagnosis and Management of CV Disease during the COVID-19 Pandemic Last updated on 21 April 2020. https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance.*
37. *Levine GN, O'Gara PT, Bates ER, et al. 2015 ACC/AHA/SCAI Focused Update on primary percutaneous coronary intervention for patients with ST-elevation myocardial Infarction: an update of the 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention and the 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Society for Cardiovascular Angiography and Interventions. Circulation 2016 Mar 15;133(11):1135-47. doi: 10.1161/CIR.0000000000000336.*

38. *Ibanez B, James S, Agewall S, et al. Group ESCSD. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST- segment elevation: The Task Force for the management of acute myocardial infarction in pa-tients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2018;39(2):119-77. https://doi.org/10.1093/eurheartj/ehx393.*
39. *Tajer C, Charask A, de Abreu M. Actualización del Consenso de Síndromes Coronarios Agudos con Elevación del Segmento ST – 2019. https://www.sac.org.ar/wp-content/uploads/2019/11/consenso-scacest-2019.*
40. *Guan W, Ni Z, Hu Y, et al. Clinical Characteristics of Coronavirus Disease 2019 in China. The China Medical Treatment Expert Group for Covid-19. N Engl J Med 2020 Apr 30;382(18):1708-20. DOI: 10.1056/NEJMoa2002032.*
41. *Levine GN, O'Gara PT, Bates ER, et al. 2015 ACC/AHA/SCAI Focused Update on primary percutaneous coronary intervention for patients with ST-elevation myocardial Infarction: an update of the 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention and the 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Society for Cardiovascu-lar Angiography and Interventions. Circulation 2016 Mar 15;133(11):1135-47. doi: 10.1161/CIR.0000 6.*
42. *Ibanez B, James S, Agewall S, et al. Group ESCSD. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST- segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 2018;39(2):119-77. https://doi.org/10.1093/eurheartj/ehx393.*
43. *Tajer C, Charask A, de Abreu M, et al. Actualización del Consenso de Síndromes Co-ronarios Agudos con Elevación del Segmento ST – 2019. https://www.sac.org.ar/wp-content/uploads/2019/11/consenso-scacest-2019.*
44. *Elbaz-Greener G, Maish S, Fang J, et al. Temporal trends and clinical consequences of wait times for transcatheter aortic valve replacement: a population study. Circulation 2018 Jul 31;138(5):483-493. doi: 10.1161/CIRCULATIONAHA.117.033432.*
45. *Elbaz-Greener G, Yarranton B, Qiu F, et al. Association between wait time for tran-scatheter aortic valve replacement and early postprocedural outcomes. J Am Heart Assoc 2019 Jan 8;8(1):e010407. doi: 10.1161/JAHA.118.010407.*
46. *Hyman MC, Vemulapalli S, Szeto WY, et al. Conscious sedation versus general anesthesia for transcatheter aortic valve replacement: insights from the national ACC/STS TVT registry. Circulation 2017 Nov 28;136(22):2132-40. doi: 10.1161/CIRCULATIONAHA.116.026656.*
47. *Van Mieghem NM, van der Boon RM, Faqiri E, et al. Complete revascularization is not a prerequisite for success in current transcatheter aortic valve implantation practice. JACC Cardiovasc Interv 2013 Aug;6(8):867-75. doi: 10.1016/j.jcin.2013.04.015.*
48. *Kotronias RA, Kwok CS, George S, et al. Transcatheter aortic valve implantation with or without percutaneous coronary artery revascularization strategy: a systematic review and metaanalysis. J Am Heart Assoc 2017 Jun 27;6(6). pii: e005960. doi: 10.1161/JAHA.117.005960.*
49. *Andreini D, Arbelo E, Barbato E, et al. ESC Guidance for the Diagnosis and Management of CV Disease during the COVID-19 Pandemic Last updated on 21 April 2020.https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance.*
50. *Benson RA, The Vascular and Endovascular Research Network (VERN) Collaborators, The COvid-19 Vascular sERvice (COVER) Study: An International Vascular and Endovascular Research Network (VERN) Collaborative Study Assessing the Provision, Practice, and Outcomes of Vascular Surgery During the COVID-19 Pandemic, Eur J Vasc Endovasc Surg. https://doi.org/10.1016/j.ejvs.2020.04.039.*
51. *Björck M, Boyle JR, Dick F, et al. The Need of Research Initiatives Amidst and After the Covid-19 Pandemic: A Message from the Editors of the EJVES. Eur J Vasc Endovasc Surg Vol. 59, Issue 5, p695–696. DOI:https://doi.org/10.1016/j.ejvs.2020.04.002.*

ST-T Segment Elevation Myocardial Infarction in a Center from Buenos Aires city During the COVID-19 Pandemic

Presentación del infarto agudo de miocardio con elevación del segmento ST-T en un centro de Ciudad de Buenos Aires durante la pandemia COVID-19

A. Matías Rodríguez-Granillo[1,3], Hernán Pavlovsky[2], Camila Correa-Sadouet[1], Camila Gallardo[1], Axel Vitale[1], María V. Curotto[1], Carlos Fernández-Pereira[2,3], Juan Mieres[2,3], Ricardo Pérez de la Hoz[1], Alfredo E. Rodríguez[2,3]

ABSTRACT

The COVID-19 pandemic presents an exponential growth in the number of admissions in intensive care units due to the necessity for respiratory support in this patients and a diminish in the consultation for another severe illnesses that were prevalent in years before, such as acute coronary syndromes with ST-T elevation segment. In our institution this phenomena was present with a delayed symptoms-first medical contact, with later presentations and an elevation of complications during hospitalization, including cardiogenic shock and acute heart failure.

Keywords: *STEMI, STEACS, COVID-19, SARS-CoV-2*

RESUMEN

La pandemia COVID-19 presentó un aumento exponencial en el número de internaciones en las unidades de cuidados intensivos alrededor del mundo debido al requerimiento de asistencia ventilatoria y una disminución en la consulta de patologías graves y prevalentes en años previos, en especial de casos graves como el síndrome coronario agudo con elevación del segmento ST-T. En nuestra institución se manifestó el fenómeno con un aumento en los tiempos dolor-primer contacto médico, con presentaciones tardías, y un aumento de las complicaciones intrahospitalarias, incluyendo shock cardiogénico e insuficiencia cardíaca aguda.

Palabras claves: *IAMCEST, SCACEST, COVID-19, SARS-CoV-2*

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):70-72. https://doi.org/10.30567/RACI/202002/0070-0072

INTRODUCTION

The highly infectious coronavirus-2 (SARS-CoV-2) that has caused the current COVID-19 pandemic has also caused the collapse of public healthcare systems of numerous countries in Asia, Europe, and America due to the need for ventilatory support in complex patients with long intensive care unit (ICU) stays[1,2]. At the same time, consultations due to other prevalent conditions have gone down significantly[3,4]. However, at the start of May 2020 the COVID-19 related infection and morality rates were lower in Argentina compared to the ones reported by other countries. Still, the consultations for conditions with a high morbimortality burden like the ST-segment elevation myocardial infarction (STEMI) have dropped compared to previous years. Similar results have been reported in other countries[3,4]. The objective of this manuscript is to assess the immediate impact of this findings to anticipate behavioral patterns to alleviate the possible consequences.

1. Servicio de Unidad Coronaria, Sanatorio Otamendi, CABA, Rep. Argentina.
2. Servicio de Cardiología Intervencionista, Sanatorio Otamendi, CABA, Rep. Argentina.
3. Centro de Estudios en Cardiología Intervencionista, CABA, Rep. Argentina.

✉ Correspondencia: *Matias Rodriguez Granillo. mrodriguezgranillo@gmail.com*

Los autores declaran no tener conflictos de intereses.

Recibido: 18/05/2020 | Aceptado: 23/05/2020

MATERIAL AND RESULTS

Since the World Health Organization (WHO) declared the SARS-CoV-2 pandemic back in March 11, 2020, many countries decided to implement quarantines as a way to flatten the curve of contagion. Argentina declared a mandatory quarantine back in March 20, 2020 at 00:00 hours[5]. Since then, 7 patients with a diagnosis of STEMI have been admitted to our center and included consecutively in this registry. The baseline, clinical, and angiographic data of all consecutive patients were analyzed and compared to the data of patients admitted the year before with the same condition. The main characteristics of both groups are shown on table 1. In the COVID-19 group the mean age was 70.8±10.4 years, 85.7% of the patients were males and they reported pain (first medical contact, 552±300 minutes). All cases underwent a primary coronary intervention. The rate of angiographic success was 100% and 1.8 stents were implanted per patient. The rate of complications was 71.4%. One patient had cardiogenic shock, 2 more patients required IV diuretics with KK class B at admission, 1 of them had cardiac tamponade and the other bleeding at the puncture site. The mean stay in the coronary unit was 9±10 days. When these results were compared to patients with ST-segment elevation from 2019 (Pre-COVID-19) significant differences were seen regarding the pain onset-to-first medical contact time (P=.001), but no differences were reported regarding the door-to-balloon time (P=.76). Cardiogenic shock, the ejection fraction measured on the color Doppler echocardiography, and the rate of bleeding that required longer hospital stays were higher in the COVID-19 group compared

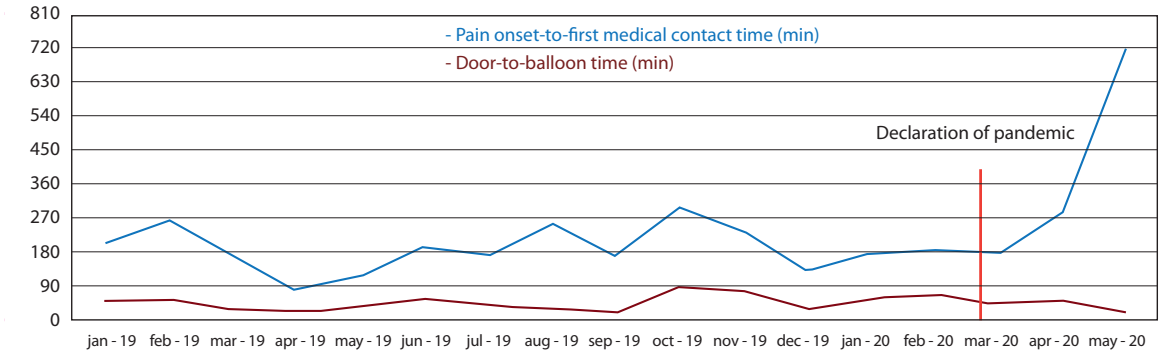


Figure 1. *Differences regarding complications between patients before and after COVID19*

TABLE 1. Baseline, clinical, and angiographic characteristics of patients with STEMI admitted to the coronary unit during the current COVID-19 pandemic.

N	Age	Sex	Pain onset-to-first medical contact time (min))	Door-to-balloon time (min)	Culprit vessel	Multiple vessels	Killip-Kimball	Cardiogenic shock	Post-PCI LVEF	Hospital stay (days)
1	57	Male	180	45	LAD	No	A	No	Mild	4
2	78	Female	120	60	LAD	Yes	B	No	Moderate	4
3	44	Male	360	90	LAD	Yes	A	No	Mild	5
4	55	Male	120	60	LAD	Yes	B	No	Moderate	5
5	63	Male	720	15	LAD	Yes	D	Yes	Severe	15
6	53	Male	840	30	LAD	Yes	A	No	Moderate	6
7	61	Male	600	15	LAD	Yes	A	No	Moderate	6

to patients previously admitted as shown on table 2. Figure 1 shows the pain onset-to-first medical contact time from January 2019 through May 2020. The start of the COVID-19 pandemic is shown with a red vertical line.

DISCUSSION

Yet despite its observational nature and unknown confounding factors, these findings are indicative that the impact the COVID-19 quarantine had had on our population has delayed consultation times especially in cases of ST-segment elevation myocardial infarction. This results in higher rates of complications and longer intervention times, which is especially detrimental to the patients' state of health, in particular, and the healthcare system in general since the occupation time of beds for high-complexity care is longer. These results are similar to those reported in other countries[7]. In a letter sent to the editor of Solomon et al. published in the *New England Journal of Medicine* back in May 19th, the authors reported fewer AMI related hospitalizations in a California hospital, United States compared to previous years; these results are similar to those reported in Northern Italy[7,8]. In our own experience, the beginning of the pandemic was associated with fewer consultations, which gave rise to a second stage where patients started seeking medical attention a little too late. This is somehow consistent to what has been published recently[7].This last stage is not over yet in our country.The consequences that these findings will have in the future are still unknown. However, based on previous data, the mortality rate could go up. The patients' rate of heart failure and their quality of life could go down as well. We suggest active policies to raise the awareness of the population on these indirect complications due to the current COVID-19 pandemic.

TABLE 2. Patients with STEMI admitted to our coronary unit before and after the current COVID-19 pandemic.

	2019 (Pre COVID-19)	2020 (COVID-19)
N	42	7
Age (Years)	63.5±13.8	50.6±10.5
Male sex	80.4%	85.7
Arterial hypertension	63.4%	85.7%
Dyslipidemia	31.7%	14.3%
Diabetes mellitus	29.3%	14.3%
Family history	9.8%	42.9%
Smokers	22%	14.3%
Previous coronary artery disease	17.1%	28.5%
Pain onset-to-first medical contact time (min)	193±37	552±300
Door-to-balloon time (min)	46±26	54±27
Percutaneous coronary intervention	98%	100%
UST peak levels (ng/L)	150000±26700	186000±8270
Post-revascularization LVEF	46.3±11.8%	40.2±8.5%
In-hospital mortality	4.7%	0.0%
Cardiogenic shock	4.7%	14.2%
Bleeding *	4.7%	14.2%

UST: ultrasensitive troponin. LVEF: left ventricular ejection fraction.
** Bleeding associated with longer hospital stays.*

REFERENCES

1. *Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 2020;395:497–506.*
2. *Grasselli G, Zangrillo A, Zanella A, et al. Baseline characteristics and outcomes of 1591 patients infected with SARS-CoV-2 admitted to ICUs of the Lombardy Region, Italy. JAMA 2020; doi: 10.1001/jama.2020.5394.*
3. *Garcia S, Albaghdadi MS, Meraj PM, et al. Reduction in STsegment elevation cardiac catheterization laboratory activations in the United States during COVID-19 pandemic. J Am Coll Cardiol 2020 April 9 (Epub ahead of print).*
4. *De Filippo O, D'Ascenzo F, Angelini F, et al. Reduced rate of hospital admissions for ACS during Covid-19 outbreak in northern Italy. N Engl J Med. DOI: 10.1056/NEJMc2009166.*
5. *World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19—11 March 2020. Available at https://www.who.int/dg/speeches/detail/whodirector-general-s-opening-remarks-at-the-media-briefing- on-covid-19—11-march-2020. Accessed March 12, 2020.*
6. *Cosentino N, Bartorelli NL, Marenzi G, Time to treatment still matters in ST-elevation myocardial infarction: a call to maintain treatment effectiveness during the COVID-19 pandemic, European Heart Journal - Cardiovascular Pharmacotherapy, pvaa054, https://doi.org/10.1093/ehjcvp/pvaa054*
7. *Solomon MD, McNulty EJ, Rana JS et al. The Covid-19 Pandemic and the Incidence of Acute Myocardial Infarction. N Enlg J Med. DOI: 10.1056/NEJMc2015630*
8. *De Filippo O, D'Ascenzo F, Angelini F, et al. Reduced rate ofhospital admissions for ACS during Covid-19 outbreak in northernItaly. N Engl J Med. DOI: 10.1056/NEJMc2009166.*

Severe hemolysis after transapical closure of mitral perivalvular leak requiring transeptal reintervention

Hemólisis severa postcierre de leak perivalvular mitral por vía transapical que requirió reintervención por vía transeptal

Marcelo A. Agüero[1], Jorge A. Baccaro[1], Pablo D. Liva[1], Gastón Pozzi[1], Walter J. García[2]

ABSTRACT

Congestive Heart Failure and hemolysis are the most common presentation of perivalvular leaks. We report a case of transapical closure of a Mitral perivalvular leak in a patient with Heart Failure who lately developed severe hemolysis due to a small residual defect and high-velocity jet, and its reintervention using transeptal approach.

Keywords: *mitral valve, hemolysis, mitral perivalve leak.*

RESUMEN

Las manifestaciones más frecuentes de las fugas perivalvulares son la insuficiencia cardíaca (IC) y la hemólisis. Reportamos un caso de cierre de leak perivalvular mitral por vía transapical, en paciente con síntomas de insuficiencia cardíaca que posteriormente desarrolló severa hemólisis secundaria a fuga residual pequeña con jet de alta velocidad y su reintervención posterior por vía transeptal.

Palabras claves: *válvula mitral, hemólisis, leak mitral perivalvular.*

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):73-76. https://doi.org/10.30567/RACI/202002/0073-0076

INTRODUCTION:

Paravalvular leaks (PVL) occur in between 6% and 15% of valve replacement surgeries. They are most common in the mitral compared to the aortic position and their occurrence is traditionally associated with conditions such as tissue friability, calcification or infections. (1,2) The presence of moderate or severe PVL after surgical or percutaneous valve replacement is associated with a higher mortality rate. (3)

In cases of moderate or severe regurgitations the usual clinical sign is heart failure. Small PVLs capable of producing high-velocity jets can cause hemolytic anemia as the main clinical sign. (4) Infectious endocarditis has also been reported as an unusual presentation sign.

The anatomical conditions that predispose to the development of PVL complicate its future surgical resolution. On the other hand, these patients have a high risk of reintervention since the presence of heart failure or severe hemolysis compromises their general state of health. In this context, interest on the transcatheter approach has been growing as a possible therapy for the management of PVL closure.

This is the case of a paraseptal mitral PVL closure via transapical access in a symptomatic patient with heart failure who developed severe hemolysis due to small residual leakage that required reintervention via transseptal approach.

CLINICAL CASE

Seventy-two-year-old male patient with HBP, type-2 diabetes, previous myocardial infarction with left main coronary artery disease and 3-vessel disease with moderate-to-severe heart failure of mixed etiology. The patient underwent coronary artery bypass graft surgery and mitral valve replacement with a 29-mm biologic prosthesis without complications. Three months later the patient presents with progressive dyspnea and signs of congestive heart failure. The echo-Doppler study performed confirmed the presence of a paravalvular leak related mitral regurgitation (grade 3

The patient progresses to heart failure of complicated pharmacological management and is hospitalized due to hemodynamic decompensation. The percutaneous closure of the defect is scheduled, and a transesophageal echocardiography (TEE) is performed followed by a volume CT scan (figure 1).

Given the paraseptal location of the leak the transapical access was used under general anesthesia with orotracheal intubation and transesophageal probe insertion. The left ventricular apex is accessed through an incision in the 5th left intercostal space, anterior axillary line, following the parameters seen on the CT scan assessment. The apex is then punctured using an 18-gauge guidewire followed by the insertion of a 6-Fr introducer sheath (Cordis). A 5-Fr JR catheter (Cordis) is advanced under radioscopic and ultrasound guidance towards the location of the defect, which is crossed until the left atrium is reached with a 0.032 in hydrophilic guidewire (Terumo). A 9-Fr Occlutech introducer sheath is advanced. Then, an HTFII coronary guidewire (Abbott) is left across the defect as a protective measure anticipating the eventual loss of the position already reached. The Occlutech PLD (14W) device is inserted into the sheath. The first disc is advanced towards the left atrium, the left ventricular sheath is removed, and a second disc in deployed in the left ventricle. The good results are confirmed when fewer regurgitation is seen on the TEE, which is why it is decided to release the device (figure 2). The procedure is completed with surgical hemostasis without further complications. The patient is released from the hospital 3 days after the surgery.

1. Servicio de Cardiología Intervencionista.
2. Servicio de Ecocardiografía. Instituto de Cardiología de Corrientes "Juana F. Cabral". Corrientes. Argentina.

✉ Correspondencia: *Marcelo A. Agüero. Bolívar 1334. W3400AMZ Corrientes. Rep. Argentina. Tel/Fax: 03794410000. marceloaguer@gmail.com*

Los autores declaran no tener conflictos de intereses.

Recibido: 08/04/2020 | Aceptado: 28/04/2020

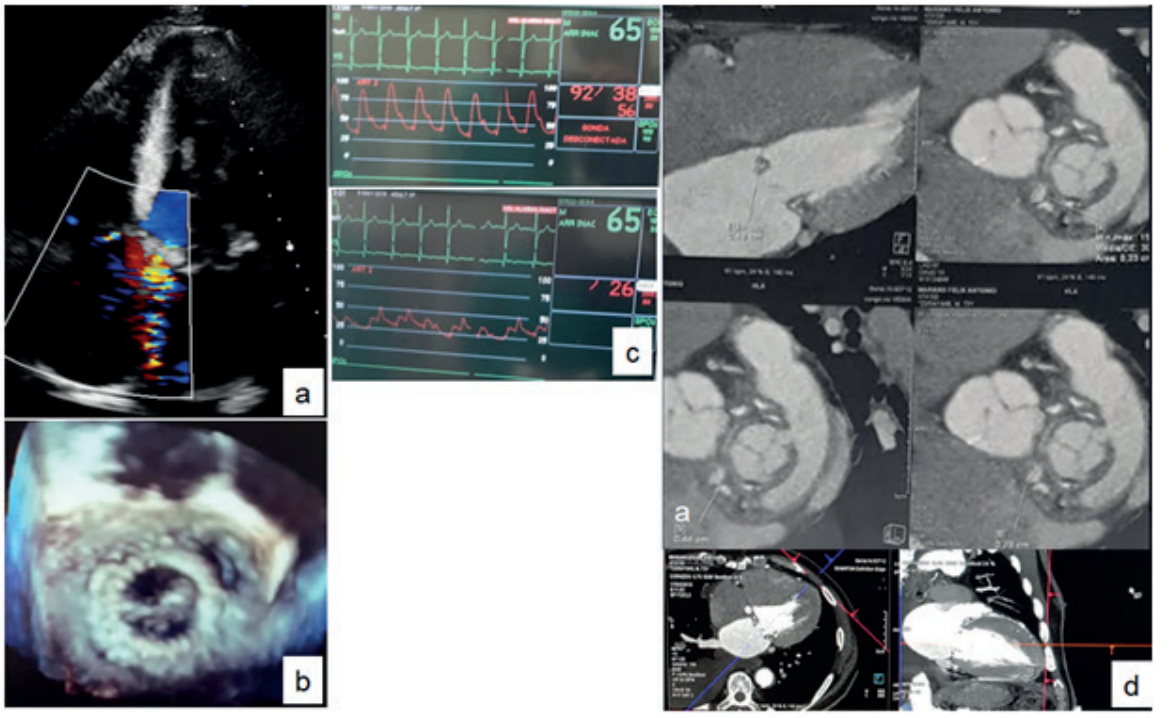


Figure 1. *Assessment prior to the closure of the leak via transapical access. a) Echo-Doppler study: Paraseptal mitral regurgitation jet. b) 3D TEE "en face": leak of 12 mm maximum diameter in hour 2. c) Hemodynamic repercussion: PAP, 92/38 (56) mmHg; PCWP, 26 mmHg; V wave, 54 mmHg. d) Volume CT scan: assessment of the leak and transapical access.*

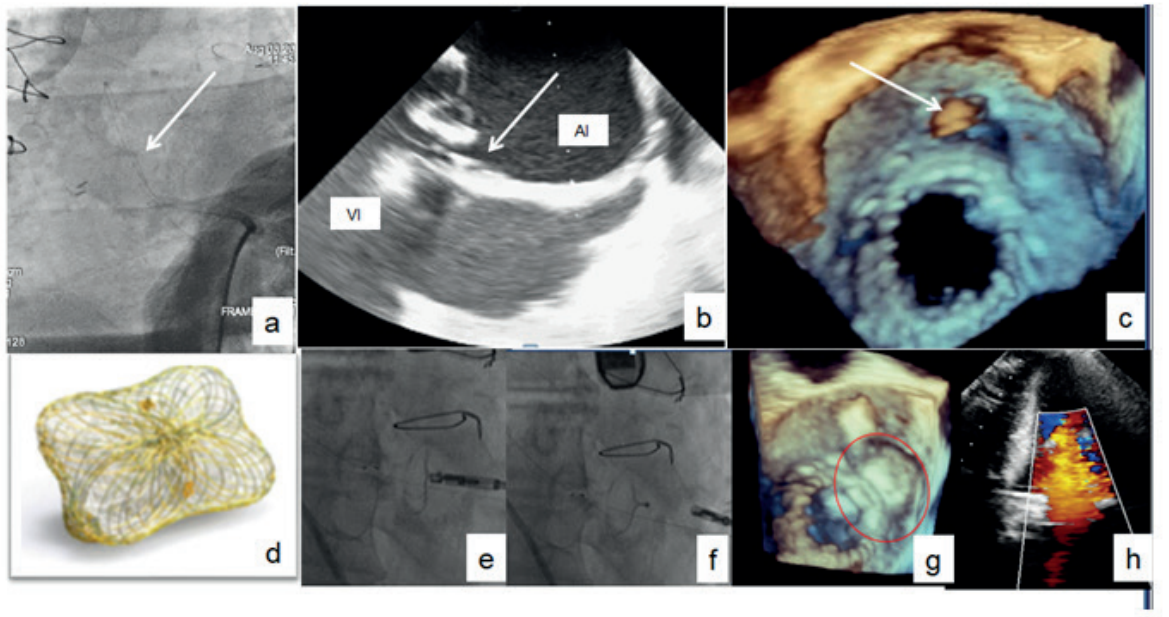


Figure 2. *Leak closure via transapical access. a and b) Radioscopy and TEE: HTF2 guidewire crossing the defect (arrow) from the LV towards the LA. c) c) 3D TEE "en face" confirming the guidewire passage (arrow) through the leak. d) Occlutech PLD (14 W) occluder device. e) Device connected to the delivery system. f) Device delivered. g) 3D TEE "en face": properly positioned device (circle). h) Echo-Doppler study: fewer leak. AI: left atrial. VI: left ventricle.*

The patient progression after discharge is good and the dose of diuretics is gradually lowered. Forty-five days after the procedure, the patient presents with dyspnea, asthenia, and weight loss. These are the levels obtained from the lab tests: hematocrit, 18%; hemoglobin, 6.4 grs/dL; total bilirubin, 4.27 mg/dL; direct bilirubin, 2.46 mg/dL; indirect bilirubin, 1.82 mg/dL; haptoglobin, 4 mg/dL. The clinical signs are interpreted as intravascular hemolytic anemia.

The echo-Doppler study performed confirms the presence of a small residual leak with high-velocity regurgitant jet. Within the next few weeks, the patient is polytransfused showing progressive impairment of her general state. Two TEE and volume CT scan assessments are performed to schedule the reintervention. The exact location of the defect is found between the ventricular disc of the device previously implanted and a calcified portion of the mitral annulus (figure 3).

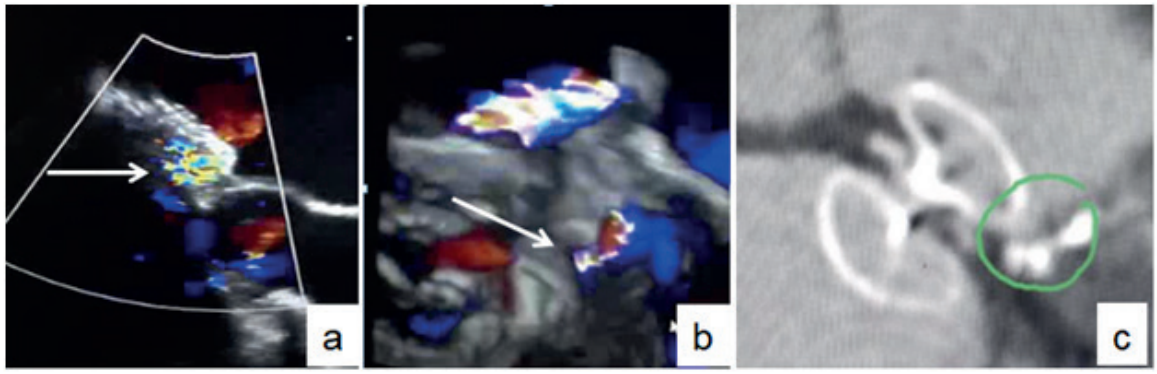


Figure 3. *Identification of high-velocity residual jet on the TEE and volume CT scan. a) TEE: high-velocity jet causing aliasing (arrow). b)3D color TEE: regurgitant jet peri-device previously implanted (arrow). c) Volume CT scan: precise identification of the leak site in relation to the calcified portion of the mitral annulus.*

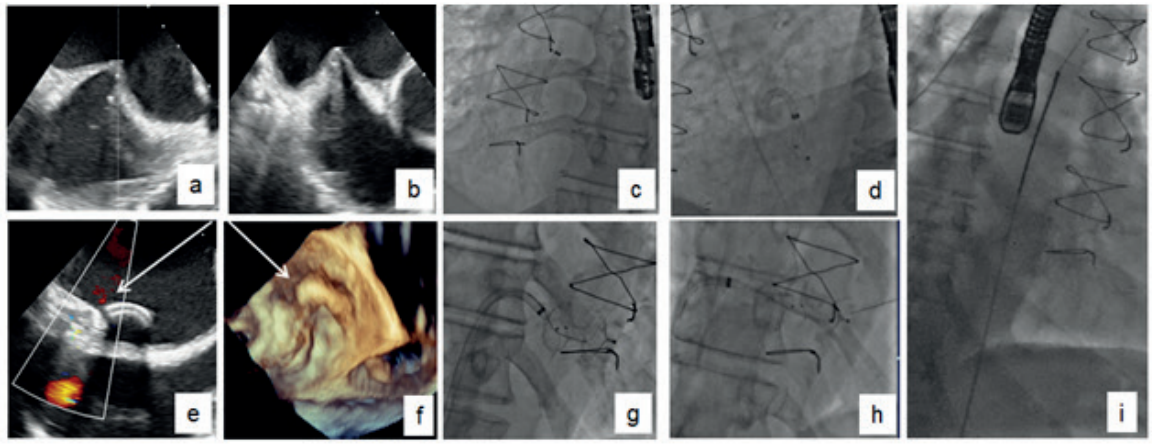


Figure 4. *Reintervention via transapical access. a) and b) TEE: bicaval and short axes, respectively. Tenting on the interatrial septum. c) and d) Fustar deflectable sheath in neutral position and maximum flexion, respectively. e) and f) Position of the Fustar sheath close to the defect seen on the 2D and 3D TEE, respectively (arrows). g) and h) Command 18-gauge guidewire crossing the defect. i) After capturing the Command guidewire with the snare in the LV, the wireis thenadvanced towards the aorta and retrieved through the femoral artery sheath.*

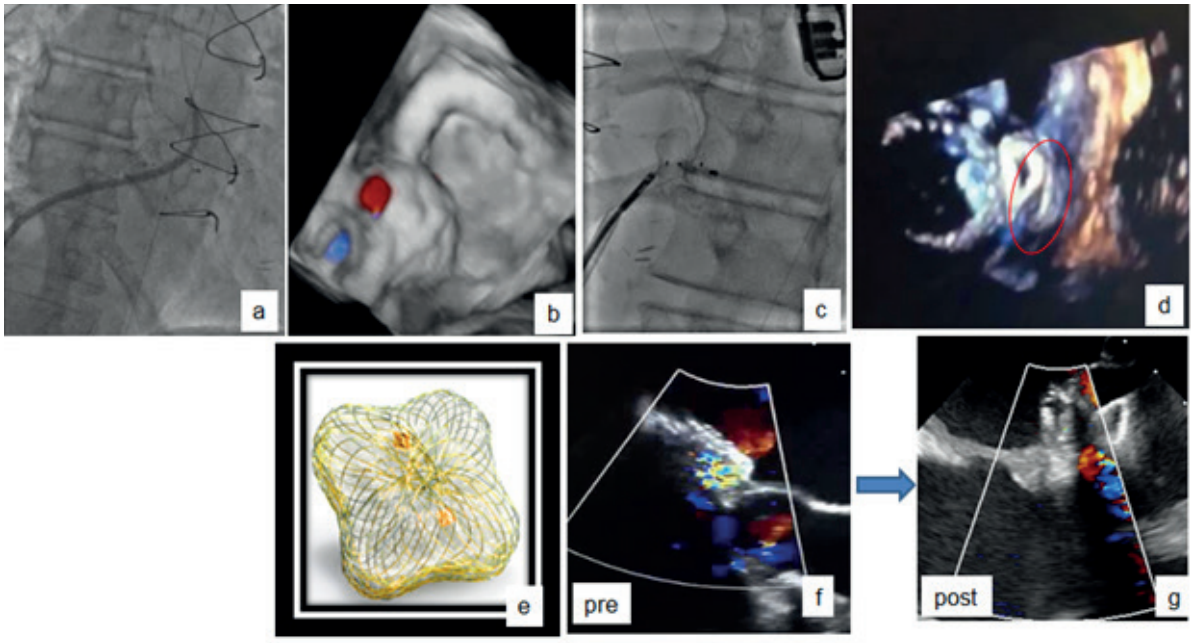


Figure 5. *Reintervention through transseptal access (cont). a) 9-Fr Occlutech introducer sheath crossing the defect. b) The 3D color TEE confirms the crossing of the sheath outside the device previously implanted. c) OcclutechPLD 5T occluderdevice in position prior to release. d) The 3D TEE confirms the right position of the occluderdevice. e) Occlutech PLD 5T occluder device. f)and g) Flow comparison through the defect before and after completing the procedure, respectively.*

Due to the deterioration of the patient general state and despite the unfavorable location of the defect, it is decided to avoid the transapical access again and change it for the transseptal approach.
The right femoral vein is punctured under general anesthesia. A transseptal puncture is performed under TEE guidance using a Brockenbrough needle and selecting the posterior-superior portion of the interatrial septum. An 8-Fr Fustar deflectable introducer sheath (Lifetech) is advanced towards the left atrium. Using anticlockwise rotation and a maximum deflection maneuver, the wire distal edge is positioned close to the defect based on the images obtained on the 3D TEE. After several attempts a Command 18-gauge, 300 cm guidewire (Abbott) is successfully advanced towards the left ventricle. Several devices (4-Fr JR and MP catheters and OTW balloons) are unsuccessfully mounted over the guidewire. Afterwards, the femoral artery is punctured and a 6-Fr introducer sheath (Cordis) is inserted and advanced towards the left ventricle. There, the Command-18 guidewire is captured and retrieved through the arterial introducer (figure 4). Thanks to the support obtained a delivery system with a 9-Fr sheath is advanced towards the left ventricle. The Occlutech PLD 5T device was advanced inside the sheath and parallel to the guidewire. Then, the sheath was retracted, and the ventricular and atrial discs were eventually deployed. The TEE confirms the total cessation of flow through the leak, and the device is eventually released (figure 5).
The procedure was completed without further complications. The in-hospital progression of the patient was uneventful, and he was discharged after 48 hours.
In the follow-up after hospital discharge and 30-day lab test results, the patient clinical improvement is confirmed with improved anemia and hemolysis parameters: hematocrit, 29%; total bilirubin, 0.55 mg/dL; direct bilirubin, 0.23 mg/dL, indirect bilirubin, 0.32 mg/dL.

DISCUSSION:

The case described leaves us a few reflections to make:
Assessment through multimodal imaging modalities (echo-Doppler, TEE, 3D, volume CT scan, and radioscopy) is an essential part in the diagnosis and treatment of PVL. Therefore, and as it occurs with the management of other structural heart diseases, interventional cardiologists trained in the aforementioned multimodal imaging are key for the management of this heart disease (5).
Paraseptal mitral PVLs are a tremendous technical challenge due to the difficulties involved when using transseptal access. In our patient, this meant that the early intervention was performed through transapical access. However, before the reintervention and due to the greater clinical impairment experienced by the patient, we decided to try the transseptal access first. Thus, given the satisfactory result obtained through this access route, we can conclude that the most challenging locations (such as paraseptal leaks) can be accessed via transseptal approach. The acquisition of the right kind of images in the cath lab (3D TEE), the availability of materials (deflectable sheaths, guidewires, snares, etc.), and the technical management of such materials facilitate the use of transseptal access first in virtually every location.
The percutaneous closure of PVLs is often described as successful when it brings regurgitation down to grade ≤ 1 in the absence of complications. This result is obtained in between 70% and 90% of the cases and the percentage is higher the more experienced the operator is. Currently, technical success rates close to 90% have been reported (6.7). Although a significant reduction of regurgitation was achieved during the first intervention bringing it down to degree ≤1, the case reported here conditioned the development of severe hemolytic anemia that deteriorated the patient quickly and led to a reintervention some time later. Therefore, although in patients PVL who develop heart failure the target is to bring regurgitation down to grade ≤1, it seems reasonable to think that we should not underestimate clinical significance that can be caused by high-velocity residual jets.

CONCLUSIONS:

As it occurs with the management of other structural heart diseases, the diagnosis and planning of the percutaneous management of PVLs requires training in multimodal imaging methods for the interventional cardiologist.
The closure of paraseptal mitral PVLs poses a technical challenge. Defects found in this location can be accessed using the transapical or transseptal approach. The latter is an attractive access route to reduce morbidity in critically ill patients, but it requires the use of specific materials and advanced technical skills.
Finally, the lowest possible degree of regurgitation should be aimed at to guarantee a favorable clinical progressi

ACKNOWLEDGEMENTS

Dr. León Valdivieso. Favaloro Foundation. Dr. Walter Bonfanti.

REFERENCES

1. *Ionescu A, Fraser AG, Butchart EG. Prevalence and clinical significance of incidental paraprostheticvalvar regurgitation: a prospective study using transoesophageal echocardiography. Heart 2003;89:1316-21.*
2. *O'Rourke DJ, Palac RT, Malenka DJ, Marrin CA, Arbuckle BE, Plehn JF. Outcome of mild periprosthetic regurgitation detected by intraoperative transesophageal echocardiography. J Am CollCardiol 2001;38:163-6.*
3. *Sponga S, Perron J, Dagenais F, et al. Impact of residual regurgitation after aortic valve replacement. Eur J CardiothoracSurg 2012;42:486-92.*
4. *Eleid MF, Cabalka AK, Malouf JF, Sanon S, Hagler DJ, Rihal CS. Techniques and Outcomes for the Treatment of Paravalvular Leak. CircCardiovasc Interv2015;8:e001945.*
5. *Sorajja P, Cabalka AK, Hagler DJ, Rihal CS. The learning curve in percutaneous repair of paravalvular prosthetic regurgitation: an analysis of 200 cases. JACC Cardiovasc Interv2014;7:521-9.*
6. *Ruiz CE, Jelnin V, Kronzon I, et al. Clinical outcomes in patients undergoing percutaneous closure of periprostheticparavalvular leaks. J Am Coll Cardiol2011;58:2210-7.*

Endovascular management in a patient with kidney vascular malformation: review of the literature and the experience of 2 cases

Manejo endovascular en pacientes con malformación vascular renal: revisión de la literatura y la experiencia de 2 casos

Eduardo LLahyah[1], Gonzalo Ortiz[1]

ABSTRACT

Arteriovenous malformations (AVM) remain relatively rare clinical lesions consisting in abnormal shunts between the arterial and venous vascular systems. In its clinical presentation, hematuria and hypertension predominate, with cardiac or pulmonary deterioration observed in 5% of cases. Hematuria is a reason for frequent consultation in the Emergency Department. Sometimes it is seen as a minor condition, and physicians might overlook some important diseases. The potential possibility of offering a curative treatment makes its diagnosis very important, allowing the natural course of the pathology to be modified. The heterogeneous vascular architecture of each AVM determines the endovascular treatment techniques employed.

Sudden and anemic macroscopic hematuria should be studied in detail since it can be life-threatening. Performing minimally invasive procedures allows patients to preserve their kidney function with minimal complications and avoids more aggressive procedures such as heminephrectomy.

We report our experience with the endovascular treatment of 2 cases. The first is the case of a 43-year-old male athlete, and another case of a 28-year-old woman, both with no previous significant clinical history and with macroscopic hematuria

Keywords: *renal arteriovenous malformations, hematuria, arterial hypertension, embolization.*

RESUMEN

Las malformaciones arteriovenosas (MAV) renales son alteraciones poco comunes que consisten en comunicaciones anómalas entre el sistema arterial y venoso intrarrenal. En su presentación clínica, predominan la hematuria y la hipertensión, observándose deterioro cardíaco o pulmonar en un 5% de los casos. La hematuria es un motivo de consulta frecuente en los servicios de urgencias; sin embargo, en algunas oportunidades esta no recibe la atención que merece y se corre el riesgo de pasar por alto algunas patologías de importancia. La potencial posibilidad de ofrecer un tratamiento curativo hace muy importante su diagnóstico, permitiendo modificar el curso natural de la patología. La arquitectura vascular heterogénea de cada MAV determina las técnicas de tratamiento endovascular a emplear.

La hematuria macroscópica súbita y anemizante debe ser estudiada con detalle puesto que puede comprometer la vida. La realización de procedimientos mínimamente invasivos permite a los pacientes preservar su función renal con mínimas complicaciones y les evita procedimientos más agresivos como la heminefrectomía.

Reportamos nuestra experiencia con el tratamiento endovascular de 2 casos .

El primero es el caso de un paciente varón de 43 años, deportista, y el otro es de un mujer de 28 años, ambos sin antecedentes clínicos de importancia previos y con hematuria macroscópica asociada a coágulos que requirieron embolización selectiva como tratamiento.

Palabras claves: *malformación arteriovenosa, hematuria, hipertensión arterial, embolización.*

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):77-82. https://doi.org/10.30567/RACI/202002/0077-0082

INTRODUCTION

Renal arteriovenous malformations (AVM) are abnormal communications between the intrarenal arterial and venous systems.[1]

AVMs are categorized as congenital, idiopathic, and acquired. The first amount to 25% of the total.[3,4,5,7] They occur more often during the third and fourth decades of life mostly in women and in the right kidney.[1,4,6] Acquired AVMs are also called AVF (arteriovenous fistulae), they are the most common of all (75%) and are due to iatrogenic trauma like that caused by renal biopsies, extracorporeal lithotripsies or surgeries. The estimated prevalence of renal AVMs is <0.04%.[5,6]

The clinical presentation is micro or macroscopic hematuria in 75% of the cases is due to the rupture of the dysplastic vessel inside the urine collection system. Hematuria is a common cause for consultation at the emergency room and urology offices.

Hematuria can be due to different causes. For study purposes it is useful to divide them into nephrological: primary (glomerulopathies, glomerulonephritis) and secondary causes (systemic erythematosus lupus, Schonlein-Henoch purpura, Goodpasture syndrome, vasculitis, Fabry disease, thrombotic microangiopathy, endocarditis, sepsis, and amyloidosis) and non-nephrological (renal tumors, renal lithiasis, urinary tract infections, cystic processes, urological traumas, radiation, metabolic disorders, blood dyscrasias, vasculorenal processes, and ex vacum hematuria).[9]

Other forms of presentation of renal AVMs can be flank, colic backpain due to the accumulation of clots in the urinary tract, nausea, vomits, arterial hypertension (AHT), congestive heart failure, continuous murmur or, less specific, palpable flank mass.[1,3,4,5,7,8]

The coronary computed tomography angiography (CCTA) is a sensitive imaging modality for the detection of renal AVMs while selective renal arteriographycan reveal the vascular architecture and hemodynamics in detail.[2,10,12] Therefore, treatment is etiology oriented.

Renal artery embolization (RAE) is the treatment of choice for the management of renal AVMswith different embolic materials and has given good results.

1. Servicio de Hemodinamia. Sanatorio Los Alerces . Rosario. Argentina

✉ Correspondencia: *Eduardo LLahyah. eduardo.llahyah@gmail.com*

Los autores declaran no tener conflictos de intereses.

Recibido: 27/04/2020 | Aceptado: 15/05/2020

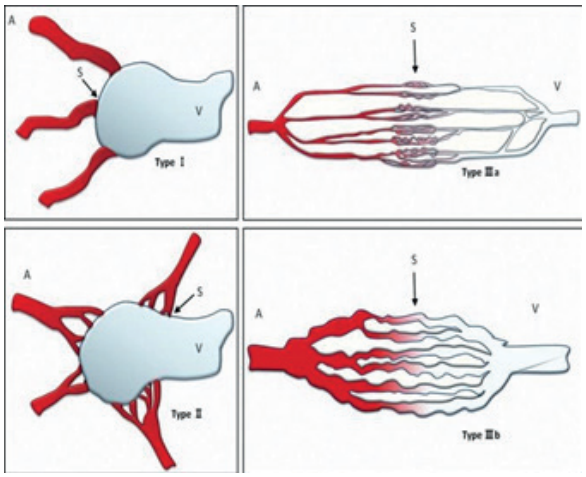


Figure 1. *Diagram of the angiographic classification of AV malformations by Cho et al.11: Type I shows less than 4 separate arteries shunting into one single draining vein. Type II shows multiple arterioles shunting into one single draining vein. Type IIIa shows multiple thin arteriovenous fistulae. Type IIIb shows multiple dilated AV fistulae that look like a complex vascular net. A: arterial compartment of the fistula. V: venous compartment of the fistula. S: shunt..*

We present the successful management of hematuria through selective artery embolization in 2 patients with hematuria and no significant past medical history.

REVIEW OF THE MEDICAL LITERATURE

Angiographic findings and embolization technique
Peripheral AVMs are classified according to the Cho et al. score[11] depending on the angioarchitecture formed among nutrient arteries, the nidus, and draining veins. This architecture seen on the angiographyis at the baseof the therapeutic and prognostic decisions made. Cho described 4 different architectures (figure 1) and proved thatAVMswith multiple arterial branches flowing towards a single vein, types #1 and #2, have a better response to therapy.AVMswith multiple entries and exits, types #3a and #3b, have a worse response to therapy.
Yakes[26] established a new classification (figure B) of the angioarchitecture of these lesions. This new AVM classification system is used to decide which endovascular approaches and embolic agents that will be able to eliminate these AVMs. Yakes classification included lesions that, according to the to theInternational Society for the Study of Vascular Anomalies (ISSVA) classification of 2018, are classified as arteriovenous fistulae (AVF) and notas AVMs.

Embolization technique

A 5-Fr introducer sheath is often inserted into the right common femoral artery. The selective catheterization of the renal artery was performed using a 5-Fr catheter (Cobra, Cook) for the renal arteriography. The contrast injection rate to perform the renal angiogram was established at 5 mL to 7 mL/s with a total volume ofbetween 10 mL to 15 mL. High-flow renal AVMs are defined as thedraining vein opacified before staining the renal parenchyma; on the contrary, they were defined as low-flow renal AVMs.
A 2.8-Fr microcatheter was inserted. Catheter insertion (Progreat catheter, Terumo, Japan) was performedinthe identifiable target vessels for the transarterial embolization.
Several embolic materials have been used for the embolization of renal AVMs including particles (gelatin sponge particles), polyvinyl alcohol (PVA) particles, metallic coils (detachable and pushable), vascular plugs, detachable balloons, and liquid materials (absolute ethanol, NBCA, and ethylene-vinyl alcohol copolymer) (Onyx). The right selection of the embolic material to use will be based on the type of renal AVM and the size and flow of the fistula.
A final renal angiography was performed after the procedure to assess the target vessel occlusion and the infarcted renal area of the damaged kidney.
Technical success was defined as the complete occlusion of the nutrient arteries and the nidus of the renal AVM with a greatest preservation possible of normal renal arterial branches. Clinical success was defined as the resolution of hematuria or the disappearance of relevant symptoms for renal AVMs.

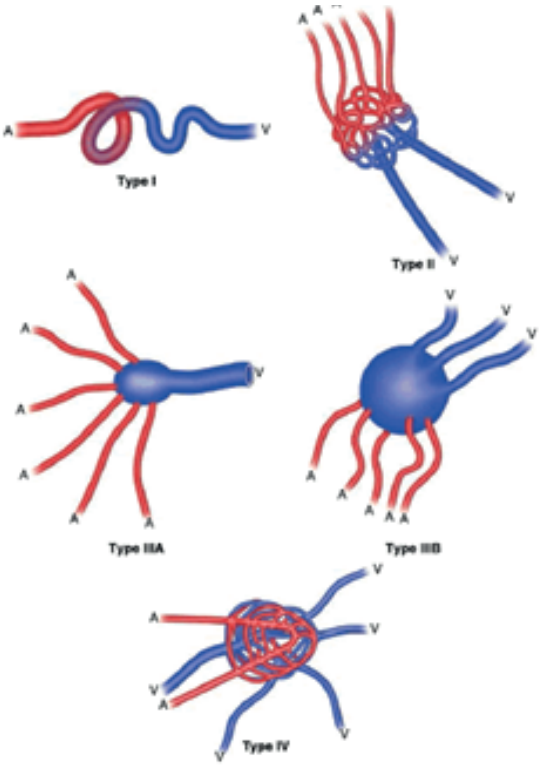


Figure 2. *Schematic drawing of Yakes classification. Source:Yakes et al.26: Type I. Direct arteriovenous fistula. It is a direct artery-vein connection. Type IIa.Multiple arteries/arterioles connected to a typical "nidus" interconnecting vascular tubular structures that then drain into out-flow veins. Type IIb. Same asType IIa, except for the nidus that drains into one single aneurysmal out-flow vein. Type IIIa. Multiple in-flow arterioles shunting into a aneurysmal vein that has a single vein outflow. The fistulae are in the vein wall. Type IIIb. Multiple in-flow arterioles shunting into an aneurysmal vein with multiple out-flow veins. The fistulae (nidus) are in the vein wall. Type IV. Multiple arteries/arterioles that branch in "en passage" fashion to form innumerable micro-fistulae that diffusely infiltrate the affected tissue. Because the tissue is viable and not devitalized, capillary beds must also be present admixed among the innumerable AVFs.*

CASE REPORT

Clinical case #1

Forty-three-year-old male patient, athlete (cyclist) from Paraná city (Entre Ríos) without a significant past medical history. Three months ago, macroscopic hematuria started suddenly after performing water ski. No hospitalization or

Figure 3.

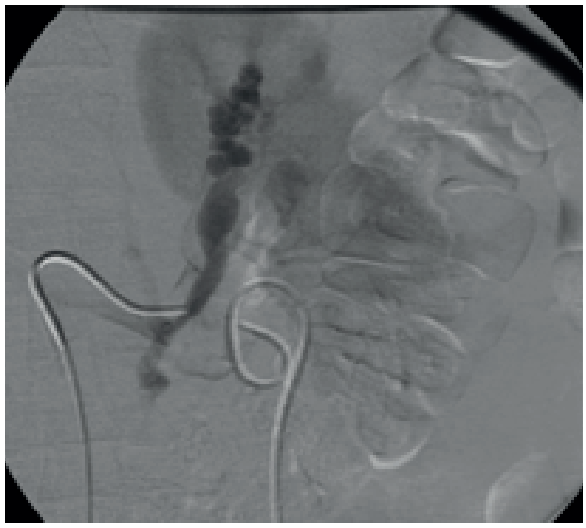


Figure 4.

transfusion was required at the time. Afterwards, the patient showed asthenia, lack of energy and repeated episodes of hematuria. The lab tests performed show these values: hematocrit, 31.2; hemoglobin, 11.9 with normal remaining parameters. The renal ultrasound, abdominal and pelvic CT scans, and abdominal NMRI (nuclear magnetic resonance imaging) performed show an image that is consistent with a renal AVM located in the upper portion of the left kidney. A selective renal arteriographyis performed that confirms the presence of a renal AVM with high-flow fistula (figure 1 and figure 2). The multidisciplinary team recommends selective renal arterial embolization.

Afterwards, the patient was referred by his company to our center. There he was treated with super-selective embolization of the renal AVM with a mixture of n-butyl-cyanocrylate (NBCA, Histoacryl) and iodized oil (Lipiodol; Guerbet) (figure 3). For the total occlusion of the nidus, the segmental artery was sacrificed, which induced a small renal infarction (figure 4). The only procedural complication reported by the patient was mild discomfort in the region of interest that would away within 3 days.The patient was released from the hospital 2 days after the procedure and after the control CT scan performed confirmed the embolization of the AVM and the renal infarction region in the upper portion of the kidney. The lab test confirmed the presence of a normal renal function.

Abdominal and pelvic Uro-CT scans were performed at the 3-and-6-month follow-up (figure5, axial view without IV contrast and figure 6, coronal view with IV contrast) followed by lab tests of the renal function. The patient's general state of health was good, and no hematuria relapses were reported.

Clinical case #2

Twenty-five-year-old woman who presents to the ER with clinical signs of hypogastric pain of 1-day duration and overt hematuria with sudden-onset clots. The patient has no significant past medical history; the physical examination conducted revealed a good general state of health, the patient remained hemodynamically stable with pale mucosa, soft, depressible and painless abdomen, and no masses or signs of peritoneal irritation. The results of the remainder of the physical examination were within normal limits.The patient was hospitalized, and the lab tests gave the following results: hemoglobin, 12.7; hematocrit, 37; leukocytes, 6800; platelets, 301000; normal coagulation times; cytochemical testing with urine pH 7; density, 1015; erythrocyte sedimentation rate >20; proteins, 500; creatinine, 0.7; negative PCR; normal electrolyte levels, renal and urinary tract ultrasound with intravesical clots. The CT urogram performed revealed the presence of intravesical clots and upper calyceal cluster images of heterogeneous densities that were consistent with a clot and late contrast clearance in the right kidney; the urology unit performed a diagnostic flexible uretero renoscopy that confirmed the presence of right lateralizing hematuria, multiple clots in the renal pelvis, and upper calyx; in the latter, erythematous, flat lesions of vascular appearance were seen. Also, another cribriform lesion was seen through which pulsatile blood was flowing out. A JJ catheter was inserted.

The patient remained with macroscopic hematuria and hemoglobin levels dropped to 7.8 with clinical signs of dizziness and adynamia. Therefore, 3 red blood cell units were transfused. Upon suspected arteriovenous malformation, an arteriography was performed without any significant findings. Then, a magnetic resonance angiography was performed that ruled out vascular malformations or other lesions in the renal parenchyma. Given the persistence of the clinical signs, a new arteriography was performed again without any significant findings. Therefore, it was decided to proceed with selective embolization with polyvinyl alcohol (PVA) particles (Contour 500–710 microns, Boston Scientific) and resorbable particles (Gelfoam, Pfizer) in the lobar and interlobal arteries of the upper pole of the right kidney. The hematuria was solved, and hemoglobin levels went back to normal. The patient was discharged after 5 days. Laboratory tests were conducted to assess the renal function at the 15-day follow-up. Renal function was looking good and the JJ catheter was removed.

DISCUSSION

RenalAVMs often present with hematuria, which poses a therapeutic challenge because of their deep location in the renal parenchyma.[14]

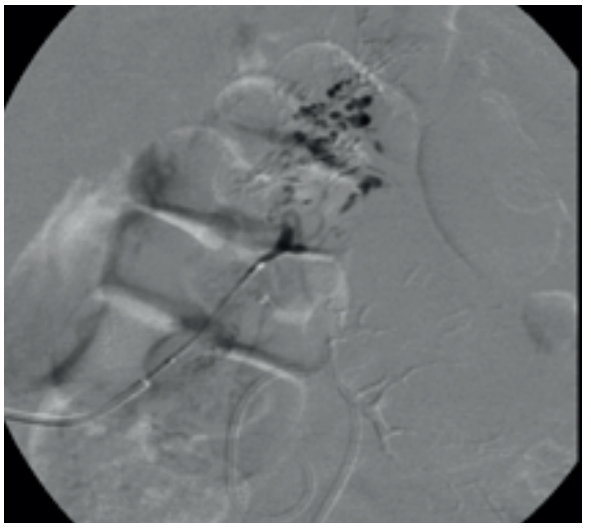


Figure 5. *Injection of n-butyl-cyanocrylate (Histoacryl) through the microcatheter into the segmental artery.*

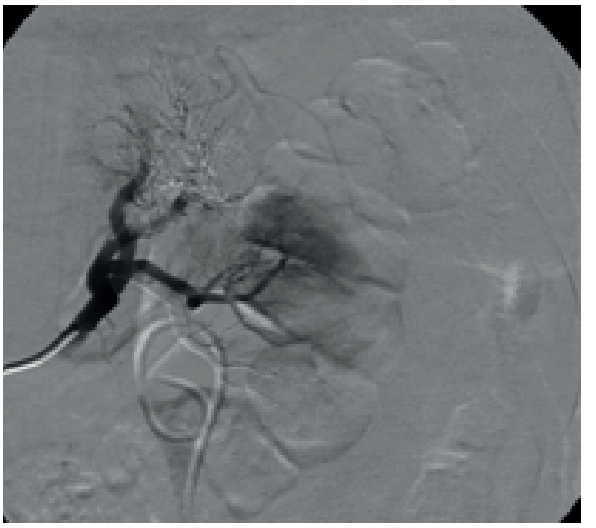


Figure 6. *Post-embolization follow-up*

Physicians have several diagnostic tools available for the study of hematuria: urine cytological-chemical test, urine culture, urine cytology, plain abdominal x-ray, renal and urinary tract ultrasound, computerized tomography urogram (Uro-CT scan), excretory urography, magnetic resonance imaging, and cytoscopy. The latter and urine cytology are probably the most important ones in elderly adults. It is in these patients that neoplastic disease should be ruled out as the first cause of the bleeding. Also, they have high-sensitivity and are cost-affordable.[1] However, we should remember the importance of the clinical history to be able to detect risk factors of neoplastic disease like smoking, occupational exposure to chemical materials, age > 40, recurrent urinary tract infections, abuse of analgesics, and pelvic irradiation.[5,6]
Lateralizing essential hematuria, also known as chronic unilateral hematuria or benign lateralizing hematuria, is defined by the cytoscopic finding of macroscopic hematuria in a single meatus even with all diagnostic imaging tools looking normal as it was the cases of the patient of clinical case #2. Some patients can have a colic as a consequence of the passage of the clots, and even anemia, but for the most part the patient will remain asymptomatic; it is more common in young patients and its prevalence is the same regardless of sex and side it occurs on. A complete study should include renal function tests, peripheral blood tests, hemograms, coagulation tests, urine cultures, urine cytologies, cultures for fungi and tuberculosis.[7]
There is still no consensus on whether to perform an arteriography in all patients with essential hematuria because spontaneous AV malformationsare a rare entity. Therefore, the arteriography should be limited to patients previously treated with renal biopsy, surgery or with renal trauma or tumors;it is also acceptable to perform an echo-Doppler ultrasound, contrast CT scan or CCTA; if an AV malformation is highly suspected a selective arteriography with embolization should be suggested;[8,13] congenital or idiopathic AV malformations are rare since they are often due to percutaneous renal procedures like renal biopsies or renal traumas, situations where the most common malformation are pseudoaneurysms.[10]
AV fistulae are an abnormal communication between the arterial and venous circulation without a capillary bed. They can be congenital, idiopathic or iatrogenic. In most cases, fistulae go misdiagnosed. However,they can cause anemizing macroscopic hematuria, abdominal pain, hypertension and, in extreme cases, heart failure and even death. Fistulae and aneurysms can present simultaneously, which is something that can happen when the periarterial hematoma of the aneurysm penetrates the vessel wall and establishes communication between these 2 types de circulation.[11] AV fistulae are often acquired due to traumas or percutaneous procedures. However, they can be idiopathic, often solitary, and due to renal artery congenital aneurysms that develop at the sides ofa venous vessel; their diagnosis is often an incidental finding in an imaging study or as part of the diagnostic algorithm of hematuria.[15,16]
Patients with hematuria due to vascular malformation should be managed according to their hemodynamic stability bearing in mind that this entity can lead patients to death; therefore, in unstable patients or patients with active bleeding, the proper resuscitation techniques should be used followed by an urgent procedure. However, in stable patients these procedures can be delayed, and if necessary other diagnostic tools can be used for clarification purposes.[17] Endovascular techniques and open-nephron sparing surgeries are elective in this second group of patients, that is, in stable or even asymptomatic patients; regarding unstable patients or patients with vascular anatomies non eligible for endovascular treatment, simple nephrectomy is the only therapeutic option here.[16] However, we should not forget that some AV malformations can resolve spontaneously without adding extra mortality to the patients. It is unknown as why this happens, but it has been suggested that the hematoma induced lesion compression, vasospasm, perilesional edema, and turbulent flow may contribute to solve this condition, something even more feasible in small single lesions.[18]
Although the digital subtraction angiography is the gold standard for the diagnosis of vascular disease,[19] there are some thin nutrient arteries of renal AVMs that cannot be identified clearly in the early arteriography. However, they become more evident after the occlusion of nutrition arteries. Therefore, an early renal arteriography should be performed carefully to reveal the details of the vascular structure. Also, the embolization protocol should be modified based on the arteriography performed during the procedure.
Arterial embolization has been used as a minimally invasive technique since 1973. Before this time, the only therapeutic

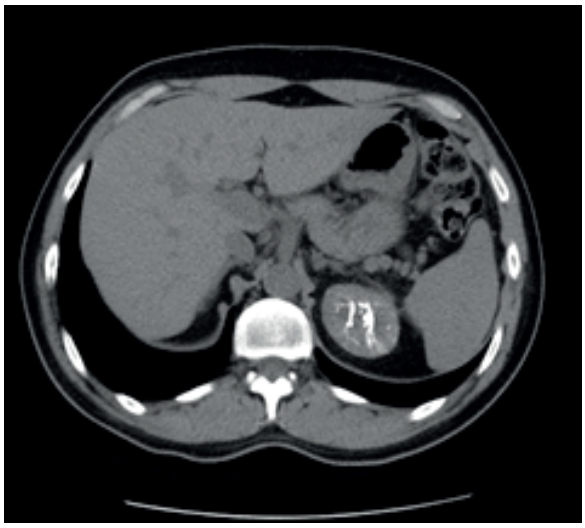


Figure 7. *Four-month-follow-up with abdominal CT scan without IV contrast. Axial view.*

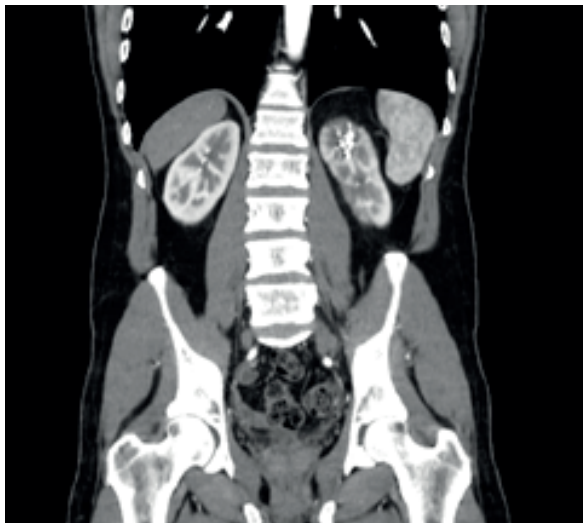


Figure 8. *. Follow-up with IV contrast. Coronal view.*

option was open surgery with its multiple morbidities and complications; currently, most patients are treated percutaneously with high rates of success and low morbidity rates. Complications are rare including post-embolization syndrome, renal artery dissection, and loss of renal function due to ischemia in the renal parenchyma, which is sometimes more extensive than expected.[20,21] The latter is the most significant complication of all because itimpacts the patients' quality of life and requires the use of iodinated contrast and post-embolization devascularization; however, super-selective embolization can reduced this as the loss of renal tissue is minimized to the fullest.[22]

During arterial embolization different materials can be used such as metallic coils, sclerosing agents, and particulate matter; choosing one material over the other depends on the anatomy, vascular hemodynamics, condition, and targets set by the operator.

In the patients of the afore mentioned 2 clinical cases, embolization was performed with polyvinyl alcohol (PVA), resorbable particles (gelfoam), and a mixture of butyl-cyanocrylate (NBCA, Histoacryl) and iodized oil (Lipiodol; Guerbet) since the goal here was to fully obliterate the blood flow.

Embolization should be performed selectively, as in the patients mentioned, because that is how the renal parenchyma sacrificed by ischemia after the catheterization of a specific lobar artery can be reduced. By doing this, the infarctions caused are segmental and limited; arteries can also be embolized supra-selectively by causing the specific occlusion of miniscule arterial branches, preserving the normal surrounding vasculature, and causing infarctions in <10% of the parenchyma, which is associated with a scarce reduction of renal function.[23]

Chatziioannou et al.[24] presented a series of 6 patients with renal vascular malformations who underwent a renal arteriography with selective embolization and a 23-month follow-up. The percentage of loss of renal parenchyma was estimated through an arteriography performed before and after the embolization and based on the creatinine levels measured before and after the procedure. All patients had good outcomes and required one session only; in all the patients urine cleared after 4 days. All of them had normal creatinine levels on day 5 when they were released from the hospital, except for one patient with underlying renal damage. None of the patients had complications, the resulting ischemic area in all the patients was between 0% and 30%, with an average 12%,[24] a percentage that can be reduced between 0% and 15% when supra-selective embolizations are performed.[25]

CONCLUSIONS

Patients with macroscopic hematuria should be studied in detail because, although it is evident that the first cause that should be ruled out is neoplasms, there are other significant causes like vascular malformations that, if not diagnosed in a timely manner or treated inadequately, can lead to the patient's death or loss of his kidneys. It is obvious that the best option for the management of these patients should be the one that benefits them the most with the fewest adverse events possible. Therefore, selective arterial embolization is a very good option because it solves hematuria and preserves a significant percentage of renal tissue.

REFERENCES

1. *Hatzidakis A, Rossi M, Mamoulakis C, y cols. Management of renal arteriovenous malformations: a pictorial review. Insights Imaging 2014 Aug;5(4):523-30.*
2. *Muller A, Rouvière O. Renal artery embolization indications, technical approaches and outcomes. Nat Rev Nephrol 2015 May;11(5):288-301.*
3. *Dames E, y cols. Congenital renal arteriovenous malformation presenting with gross hematuria after a routine jog: a case report. J Med Case Rep 2014 Feb 20;8:65.*
4. *Coppola D, Costa M, Palazzo C, y cols. Fístula renal arteriovenosa congénita. Tratamiento con embolización selectiva. A propósito de un caso. Rev Arg Urol 2001;67(1):55-8.*
5. *Zambrana AR, y cols. Arteriovenous renal congenital fistula. Actas Urol Esp 2009 Jun;33(6):696-9.*
6. *Miranda Utrera N, y cols. Congenital renal arteriovenous malformation: the value of magnetic resonance imaging for diagnosis and intravascular management. Actas Urol Esp 2010 Feb;34(2):215-17. Montoya G, Vega J, Moreno O, Huerta JC. Spontaneous renal arteriovenous fistula-caused hematuria: case report. Gac Med Mex 2004 Jan-Feb;140(1):85-7.*

7. *Moreno Alarcón C, et al. Hematuria secondary to congenital arteriovenous fistula treated with embolization. Arch Esp Urol 2011 Jul;64(6):550-3.*
8. *Sánchez-Carrera F, Leal Hernández F, Moncada Irribarren F, Rodríguez Fernández E, Díez Cordero JM. Hematuria. En: Urgencias urológicas. Tema monográfico LXI Congreso Nacional de Urología. Madrid: Ene; 1996. pp. 73-83.*
9. *Maruno, M, Kiyosue, H, Tanoue, S. Renal arteriovenous shunts: clinical features, imaging appearance, and transcatheter embolization based on angioarchitecture. Radiographics 2016;36(2):580-95.*
10. *Cho SK, Do YS, Shin SW. Arteriovenous malformations of the body and extremities: analysis of therapeutic outcomes and approaches according to a modified angiographic classification. J Endovasc Ther 2006;13(4):527-38.*
11. *Hwang JH, Do YS, Park KB, Chung HH, Park HS, Hyun D. Embolization of congenital renal arteriovenous malformations using ethanol and coil depending on angiographic types. J Vasc Interv Radiol 2017;28(1):64-70.*
12. *Campbell-Walsh. Urology, 10° ed. Evaluation of the Urologic Patient: History, Physical Examination and Urinalysis. Philadelphia: Elsevier; 2012.*
13. *Crotty KL, Orihuela E, Warren MM. Avances recientes en el diagnóstico y tratamiento de malformaciones arteriovenosas renales y fístulas. J Urol 1993;150(5 Pt 1).*
14. *Nakada S. Lateralizing Essential Hematuria. Advanced Endourology.The Complete Clinical Guide.Humana Press; 2006.*
15. *Smaldone MC, Stein RJ, Cho JS, Leng WW. Giant Idiopathic Renal Arteriovenous Fistula Requiring Urgent Nephrectomy. Urology. 2007 Mar;69(3):576. e1-3.*
16. *Singh D, Gill IS. Renal artery pseudoaneurysm following laparoscopic partial nephrectomy. J Urol 2005;174:2256.*
17. *Inoue T, Hashimura T. Spontaneous Regression of Renal Arteriovenous Malformation. J Urol 2000;163:232-3.*
18. *Bookstein JJ, Goldstein HM. Manejo exitoso de la fístula arteriovenosa posbiopsia con embolización arterial selectiva. Radiología 1973;109(3):535-6.*
19. *Schwartz MJ, Smith EB, Trost DW, et al. Renal artery embolization: clinical indications and experience from over 100 cases. BJU Int 2007;99:881.*
20. *Perini S, Gordon RL, LaBerge JM, et al. Transcatheter embolization of biopsy-related vascular injury in the transplant kidney: immediate and long-term outcome. J Vasc Interv Radiol 1998;9:1011-9.*
21. *Poulakis V, Ferakis N, Becht E, et al. Treatment of renal-vascular injury by transcatheter embolization: immediate and long-term effects on renal function. J Endourol 2006;20:405.*
22. *Ginat D, et al. Transcatheter Renal Artery Embolization: Clinical Applications and Techniques. Techniques in Vascular and Interventional Radiology 2009;12:224-39.*
23. *Chatziioannou A, Brountzos E, Primetis E, et al. Effects of Superselective Embolization for Renal Vascular Injuries on Renal Parenchyma and Function. Eur J Vasc Endovasc Surg 2004;28:201-206.*
24. *Dorffner R, Thurnher S, Prokesch R et al. Embolization of iatrogenic vascular injuries of renal transplants: immediate and follow-up results. Cardiovasc Intervent Radiol 1998;21:129-34.*
25. *Yakes WF, Vogelzang RL, Ivancev K, Yakes AM. New arteriographic classification of AVM based on the yakes classification system. In: Congenital Vascular Malformations 2017: 63-69.*

Endovascular treatment of May-Thurner syndrome

Tratamiento endovascular del síndrome de May-Thurner

Germán Stupaczuk[1], Carlos Álvarez Iorio[1], Alejandro Álvarez Iorio[1], Fernando Ordóñez[1], Martín Ordóñez[1]

ABSTRACT

May-Thurner syndrome is an anatomic disorder in which the left common iliac vein is compressed by the right common iliac artery and the spine at the level of the fifth lumbar vertebra with the consequent appearance of deep vein thrombosis in the lower limb left. We present the case of a 62-year-old woman with a history of ex-smoking who consults for pain and swelling of the left lower extremity of a one-year evolution that, after performing the abdominal-pelvic angiotomography, compression of the left iliac vein by the right common iliac artery was confirmed, undergoing endovascular treatment with self-expanding stent.

Keywords: *lower extremity ,stent, deep vein thrombosis.*

RESUMEN

El síndrome de May-Thurner es una alteración anatómica en la cual la vena ilíaca común izquierda está comprimida por la arteria iliaca común derecha y la columna a la altura de la quinta vértebra lumbar, con la consecuente aparición de trombosis venosa profunda en la extremidad inferior izquierda. Presentamos el caso de una mujer de 62 años, extabaquista, que consulta por dolor y tumefacción del miembro inferior izquierdo de un año de evolución, constatándose en la angiotomografía abdominopélvica compresión de la vena ilíaca izquierda por la arteria ilíaca común derecha. Se realizó tratamiento endovascular con stent autoexpandible.

Palabras claves: *miembro inferior, stent, trombosis venosa profunda.*

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):83-85. https://doi.org/10.30567/RACI/202002/0083-0085

INTRODUCTION

May-Thurner syndrome is a rare clinical entity in which the left common iliac vein is compressed by the right common iliac artery at L5 vertebra level.[1] This sustained compression and trauma caused by the pulsatile energy of the artery on the vein damages the intima occluding venous flow and prompting the development of venous thrombosis.[2,3]

CLINICAL CASE

This is the case of a 62 year-old-woman with a cardiovascular risk factor (former smoker). No other relevant past medical history was reported.

She presents with pain and swelling of left lower extremity of 12-month duration.

On the physical examination, the patient shows redness and increased temperature of her left lower extremity with hypersensitivity to compression associated with the presence of edema 3/6.

The venous echo-Doppler of the left lower extremity performed showed signs of deep venous thrombosis and varicose veins at pelvic level draining into both femoral saphenous veins with venous dilatation at such level.

The abdominal-pelvic coronary computed tomography angiography performed reveals a severe obstruction of the left iliac vein by the right common iliac artery at 5L vertebral level (May-Thurner syndrome) with pelvic varicose veins with hypogastric collateral circulation (figure 1).

Since the coronary computed tomography angiography suggests a diagnosis of May-Thurner syndrome and the patient shows signs of pain and edema in her left lower extremity, it was decided to perform endovascular treatment on the left common iliac vein.

Initially, the left femoral venous access was used to enter a 4-Fr introducer sheath and perform a diagnostic cavo-iliac phlebography that confirms the total occlusion of the left common iliac vein, unlike the left coronary computed tomography angiography that showed a severe obstruction of the left common iliac artery had due to the extrinsic compression of the right common iliac artery (figure 2).

It was decided to attempt the recanalization of the left iliac vein via endovascular access. First, the 4-Fr introducer sheath was changed for a 7-Fr sheath. After several attempts a 0.035 in hydrophilic guidewire (TERUMO) successfully crosses the total occlusion and advances towards the inferior vena cava. Afterwards, a 7- Fr JR guide catheter was used. Several thrombus aspirations were tried directly from it, but no macroscopic thrombotic material was retrieved. Since no thrombus was seen on the angiography, it was decided to continue with the procedure. Afterwards, the TERUMO guidewire was changed for a 0.035 in guidewire to provide extra support (SUPRACORE) and a Zilver Vena self-expandable stent was implanted (figure 3). An 8.0 mm-diameter balloon was used for postdilatation. The control angiography revealed the presence of another severe, radiolucent obstruction in the left external iliac vein and a Protégé GPS self-expandable stent was implanted. An 8.0 mm-diameter balloon was used for postdilatation with very good final angiographic results (figure 4).

The patient progression was good, and she was discharged 24 hours later on a 6-month course of oral anticoagulant therapy.

At the 3-month follow-up the examination performed by the patient's general physician confirmed that both the signs and symptoms of the disease had improved.

1. Hospital Privado del Sur, Bahía Blanca, Buenos Aires, Argentina

✉ Correspondencia: *Germán Stupaczuk. O'Higgins 29 piso 10 dpto B, Bahía Blanca, provincia de Buenos Aires, Rep. Argentina. Tel.: 0291-154124439. german.stupaczuk@gmail.com*

Los autores declaran no tener conflictos de intereses.

Recibido: 05/11/2019 | Aceptado: 14/05/2020

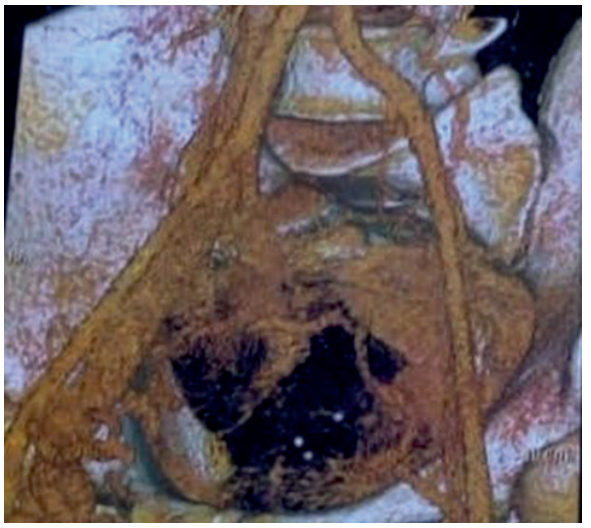


Figure 1. *Abdominal-pelvic coronary computed tomography angiography showing the obstruction of the left iliac vein by the right common iliac artery at 5L vertebra level (May-Thurner syndrome).*

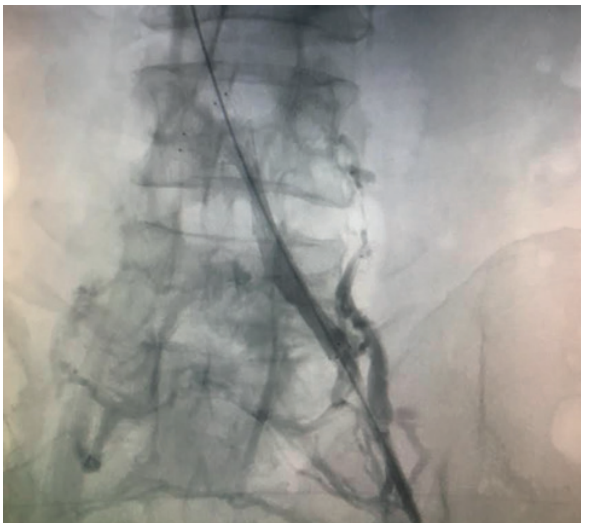


Figure 2. *Cavo-iliac phlebography showing the occlusion of the left common iliac vein.*

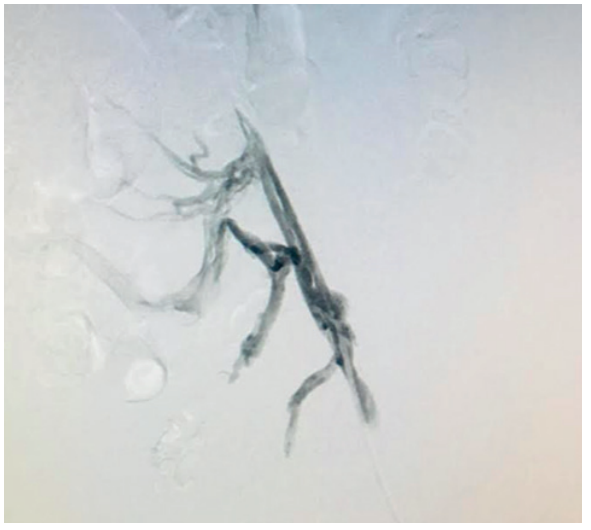


Figure 3. *Zilver Vena self-expandable stent implantation.*

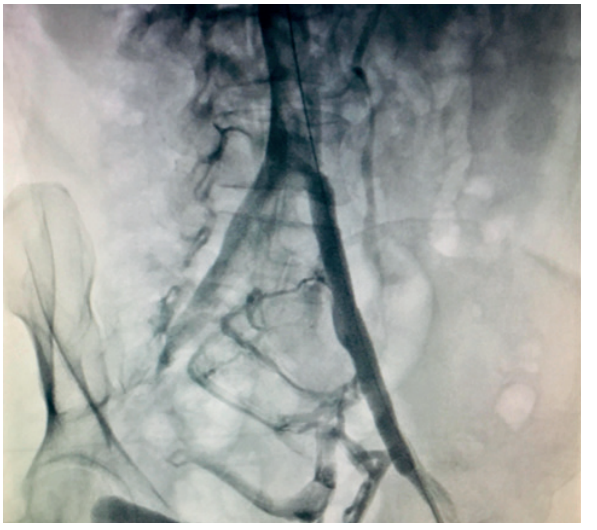


Figure 4. *Final angiographic result.*

DISCUSSION

The compression of the left common vein by the right common iliac artery—May-Thurner syndrome—is an entity that, on many occasions, is the underlying cause for deep venous thrombosis. Its actual prevalence is still unknown, but it is more common in women between the ages of 20 and 40. We should mention here that this condition often goes misdiagnosed.

The diagnosis of this entity is usually achieved by looking at the symptoms and clinical findings seen during the physical examination These findings are complemented by the results obtained from the ultrasonography,[4,5] coronary computed tomography angiography, and magnetic resonance imaging performed. These imaging modalities contribute to achieve diagnosis and plan treatment. However, the cavo-iliac phlebography is crucial for diagnostic confirmation purposes. It also looks for the presence of chronic lesions inside the vessel and congenital anomalies often associated with this syndrome like duplicated venous system or rudimentary venous system.[6]

Currently, both the endovascular treatment and medical therapy have proven effective with good long-term results. In our case, we saw progression of the disease after confirmation of the total occlusion of the left common iliac vein on the cavo-iliac phlebography 2 months after performing the abdominal-pelvic coronary computed tomography angiography. Therefore, it was decided to perform the endovascular recanalization of the vessel and implant 2 self-expandable stents with very good angiographic results. Afterwards, the patient was discharged on oral anticoagulation. We could argue if, after phlebographic confirmation of the left common iliac vein total occlusion, the procedure should have continued considering the eventual risk of thrombi embolization after crossing the guidewire during stent implantation. However, since no macroscopic thrombotic material was retrieved after multiple aspirations performed directly with the 7- Fr JR guide catheter and no thrombus was seen on the angiographic imaging, it was decided to continue the procedure achieving the successful recanalization of the vessel. The patient was discharged 24 hours later on a 6-month course of anticoagulation therapy.

Currently, endovascular treatment is the gold standard for the management of the May-Thurner syndrome and it gives good long-term results and a low rate of complications. The patient needs to be on sustained anticoagulation therapy for, at least, 6 months. According to medical literature, a 6-to-12-month course of anticoagulation therapy is advisable with only 1 episode of associated deep venous thrombosis reported. Also, it is advisable to anticoagulate indefinitely in the presence of multiple episodes of associated thrombosis.[7]

CONCLUSION

The May-Thurner syndrome is a progressive disease that can trigger serious complications in the long term such as deep venous thrombosis, post-thrombotic syndrome, and pulmonary thromboembolism. Therefore, an early diagnosis and treatment is crucial in the management of this entity.

REFERENCES

1. *Sakakibara Y, Kujiraoka Y. IliacCompressionSyndrome. Circulation. 1998;98:376.*
2. *Cockett F, Thomas L, Negus D. Iliac Vein Compression. Its relation to iliofemoral thrombosis and the post-thrombotic syndrome. BMJ. 1967;2:14-19.*
3. *May R, Thurner J. The cause of the predominately sinistral occurrence of thrombosis of the pelvic veins. Angiology. 1957;8:419-427.*
4. *Oğuzkurt L, Özkan U, Tercan F, KoçZ. Ultrasonographic diagnosis of iliac vein compression (May-Thurner) syndrome. Diagn IntervRadiol. 2007;13:152-155.*
5. *Mumoli N, Invernizzi C, Luschi R, Carmignani G, Camaiti A, Cei M. Phlegmasia cerulea dolens. Circulation 2012;125:1056-1057.*
6. *Early thrombus removal strategies for acute deep venous thrombosis: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum.Meissner MH, Gloviczki P, Comerota AJ, Dalsing MC, Eklof BG, Gillespie DL, Lohr JM, McLafferty RB, Murad MH, Padberg F, Pappas P, Raffetto JD, Wakefield TW, Society for Vascular Surgery,J Vasc Surg. 2012;55(5):1449.*
7. *Brazeau NF, Harvey HB, Pinto EG, Deipolyi A, Hesketh RL, Oklu R, May Thurner syndrome diagnosis and management, Vasa 2013,42:96-105.*

Coronary angioplasty in coronay left circunflex anomaly. Case report and discussion of literature

Angioplastia coronaria de arteria circunfleja con arteria coronaria izquierda anómala y nacimiento desde el seno de Valsalva derecho. Reporte de un caso

Rodrigo A. Martín[1], Ricardo M. Cetera[1], Amalia Descalzo[1], Sergio Zolorza[1]

ABSTRACT

We present a clinical case of infrequent finding in which the patient presents association of abnormal left coronary artery and obstructive atherosclerotic injury on the circumflex artery. Based on this condition we carry out a search on the existing bibliography.

Key words: *coronary anomaly, coronary angioplasty, stents.*

RESUMEN

Presentamos un caso clínico de hallazgo infrecuente en el cual el paciente presenta asociación de arteria coronaria izquierda anómala y lesión aterosclerótica obstructiva sobre la arteria circunfleja. En base a esta condición realizamos una búsqueda sobre la bibliografía existente.

Palabras claves: *coronaria anómala, angioplastia coronaria, stent.*

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):86-87. https://doi.org/10.30567/RACI/202002/0086-0087

INTRODUCTION

The origin of the left circumflex coronary artery from the right sinus of Valsalva a rare coronary anomaly with a rate between 0.2% and 1.2%. It usually does not have any clinical repercussions and its diagnosis is often an incidental finding. However,it can be associated with myocardial ischemia and even sudden death, especially in young people while doing physical activity. Atherosclerotic cardiovascular disease does not usually develop on an anomalous coronary trajectory. This is the case of a patient with obstructive coronary disease of circumflex artery andorigin of the left main coronary artery from right coronary sinus treated with a coronary angioplasty with stent.

Clinical case.

Sixty-six year-old-male patient with positive cardiovascular risk factors for arterial hypertension, smoking, and dyslipidemia. His past clinical history revealed the presence of an ST-segment elevation acute coronary syndrome 2 years ago treated with a percutaneous transluminal coronary angioplasty of the right coronary artery. The patient has remained asymptomatic until 6 months ago prior to his consultation when he started showing signs of angina pectoris NYHA FC II. The SPECT performed confirmed the presence of moderate ischemia in the apical lateral, apical anterolateral, and anterolateral medial territory. The patient was referred to the interventional cardiology unit to be treated with a percutaneous coronary intervention.A cine coronary angiography was performed via femoral access using the 6-Fr Super Sheath introducer sheath (Boston Scientific) and 6-FR Judkins Left 3.5 and Judkins Right 3 Impulse diagnostic catheters (Boston Scientific). No significant angiographic lesions were found on the right coronary artery and the left main coronary artery originated from the right coronary sinus. At this level the presence of a significant occlusion from the middle segment of the circumflex artery was confirmed (**figures 1 and 2**).Using the femoral access (**figures 3 and 4**), a 6-Fr Super Sheath introducer sheath and a 6-Fr Convey Left guide catheter (Boston Scientific) were inserted through a Choice Floppy 0.014 in x 180 cm guidewire (Boston Scientific). The wire was positioned with difficulties given the severe tortuosityof the vessel in the distal segment of the circumflex artery. Dilatation with a 2.5 mm x 15 mm Emerge balloon (Boston Scientific) was attempted followed by the implantation of a 3.0 mm x 16 mm Promus Premier everolimus-eluting stent(Boston Scientific).

Discussion.

The anomalies of coronary arteries found on the cine coronary angiography are a rare finding (**1**). Among these, the origin of the left main coronary artery from the right sinus of Valsalva is a very rare patternwhose rateis between 0.2%and 1.2% according depending on the series(**5**). Patients who are carriers of this anomaly are usually asymptomatic unless the anomalous trajectory of the vessel is located between the aorta and the pulmonary artery, which can lead to sudden death especially during physical activity(**2**). Here the rate of serious symptoms reported is around 20%.
The association between this anomaly and atherosclerotic cardiovascular disease is not a common finding. However, when it is present it rarely affects the anoma-

1. Hospital General de Agudos Presidente Perón. Avellaneda. Servicio de Cardiología Intervencionista y Hemodinamia.

✉ Correspondencia: *Rodrigo A. Martin. Juan B. Alberdi 4296. CABA. roanmartin@hotmail.com.*

Los autores declaran no tener conflictos de intereses.

Recibido: 21/07/2019 | Aceptado: 14/05/2020

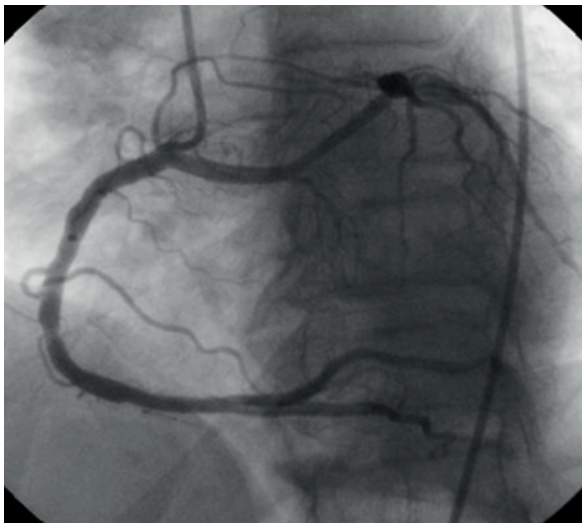


Figure 1. *During the catheterization of the right coronary artery, the origin of the left main coronary artery from the same sinus can be seen.*

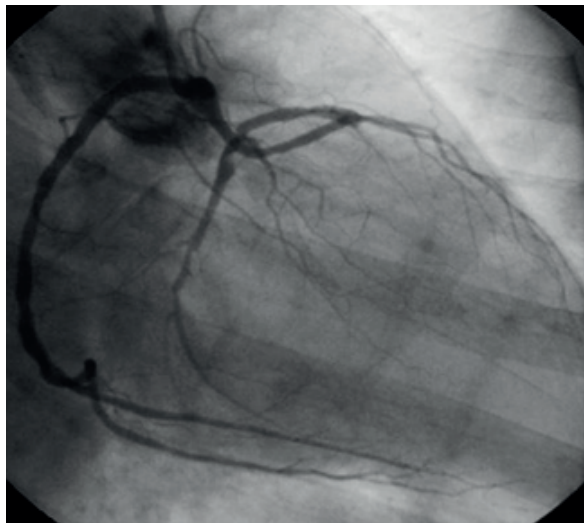


Figure 2. *Identification of a significant lesion in the distal segment of the anomalous circumflex artery.*

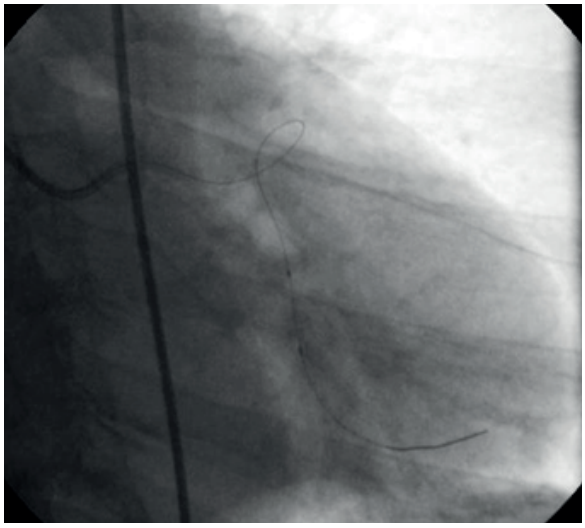


Figure 3. *Lesion crossed using a 0.014 in Floppy guidewire. Predilatation with a 2.5 mm x 15 mm balloon followed by the implantation of a 3.0 mm x 16 mm drug-eluting stent.*

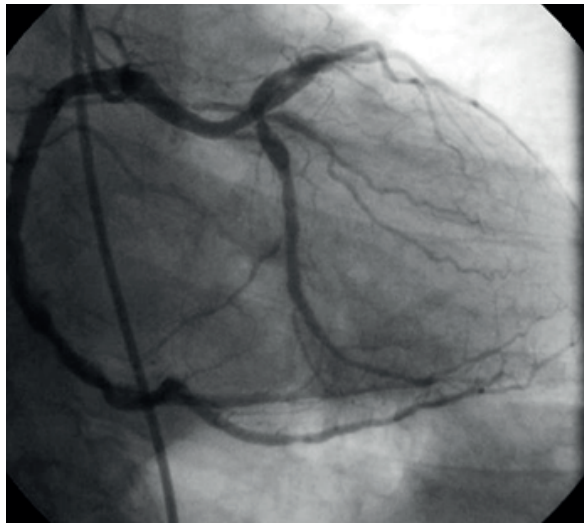


Figure 4. *Final result with resolution of the pre-existing lesion. No residual lesion is seen on the coronary angiography.*

lous segment. Obstructive atherosclerotic plaques located on the anomalous territory are often more aggressive and they occur in earlier stages from the pathophysiological point of view(**3**).

The coronary angiography is the imaging modality of choice to identify atherosclerotic lesions (**4**). However,it can cause some diagnostic problems during the 3D identification of the trajectory of the anomalous artery. In this sense, the multi-slice computed tomography (MSCT) can be useful because it provides a better view of the proximal portion, size, trajectory, and relation of the anomalous vessel to the surrounding structures.

In our case, the patient was in his sixth decade of life with a probably benign anomalous trajectory and a past medical history of atherosclerotic disease in the right coronary artery and additional studies that confirmed the presence of ischemia. For all these reasons, it was decided to perform a coronary angioplasty on the lesion found (**6**).

REFERENCES

1. *Angelini P, Velasco JA, Flamm S. Coronary anomalies: incidence, pathophysiology, and clinical relevance. Circulation 2002; 105: 2449-2454.*
2. *Chaitman BR, Lesperance J, Saltiel J, et al. Clinical, angiographic, and hemodynamic findings in patients with anomalous origin of the coronary arteries. Circulation 1976;53: 122-131.*
3. *Click RL, Holmes DR, Jr, Vlietstra RE, et al. Anomalous coronary arteries: location, degree of atherosclerosis and effect on survival: a report from the Coronary Artery Surgery Study. J Am Coll Cardiol 1989; 13: 531-37.*
4. *Gersony WM. Management of anomalous coronary artery from the contralateral coronary sinus. J Am Coll Cardiol 2007; 50: 2083-4.*
5. *Ugalde H, Ramírez A, Ugalde D, Farías E, Silva AM. Nacimiento anómalo de l arterias coronarias en 10.000 pacientes adultos sometidos a coronariografía. Rev Med Chil 2010; 138: 7-14.*
6. *Grasso AE, Pennell DJ. Myocardial infarction related to aberrant left circumflex artery, Int J Cardiol 2010; 138: 51-52.*

Editorial letter

Carta editorial

Revista Argentina de Cardioangiología Intervencionista 2020;11(2):88. https://doi.org/10.30567/RACI/202002/0088-0088

Dear colleagues,
In February 2020, we found out about the existence of a new virus at the Chinese city of Wuhan that would probably cause a pandemic. Still, we could never imagine the world repercussion of this virus and the way we'd have to cope with it in our county.
When back in March 20, 2020 mandatory social confinement was declared in our country, our lives changed overnight, and the only topics of conversation were coronavirus and the COVID-19 pandemic. This seriously impacted our jobs and our scientific and intellectual development. Our workload dropped and local and international events and congresses were suspended. We had to learn how to work remotely from a computer while being confined inside our own homes.
CACI took over this challenge seriously and started working online from that day one. However, our activities scheduled for his year are still on including new activities and events under the new methodology imposed by the current situation.
We have continued to work on the classes for specialists without any problems with capacity crowd results every time. We have started a course for technicians, nurses, and workers from the industry that join us every year with great repercussion and excellent results. We have been able to host the very first CACI-INDUSTRY workshop for one entire morning with a large number of attendees and great presentations from colleagues and industry workers with a very interesting and enriching final debate too.
We have funded and broadcast workshops, webinars, courses, and events organized by the industry, colleagues or partner societies. Also, we have organized and will keep organizing within the next few months workshops on coronary and structural heart disease, peripheral and aortic vascular disease, and management of venous disease to stay updated and in permanent contact with our members and colleagues from Argentina and Latin America.
Also, we organized the Discussion Response Forum on Infarction under the current COVID-19 Pandemic with acclaimed colleagues from the United States, Europe, and Argentina who participated with a very interesting final discussion in front of a large audience.
From the press office we have tried our best to talk about the problems faced by our medical specialty and the risk that our patients won't be coming to our offices in a timely manner and the serious consequences derived from this decision with important repercussions on the media, radio, and television.
Thus, recommendations or clinical practice guidelines with the format of consensus documents have been published to protect our patients, members, and colleague health workers paying special attention to the care provided inside the cath lab and unit of hemodynamics. Also, recommendations for the management of acute and chronic heart and valve disease have been published as well.
Our objective is to continue working withthe highest level of normalcy possible and fulfill the compromises already acquired and the new challenges we envisioned at the beginning of the year. Also, it is our desire to celebrate our annual congress at the end of this year. I really can't wait to see you all again and talk about this "new normal" ahead of us.
We are living very difficult times. However, I strongly believe that if we work together and share one common goal we will prevail and come out stronger and more united than ever.

Diego Grinfeld
President of the 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) and in print.

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

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

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

After the first review, the articles can be accepted in the same form they were initially submitted; minor reviews are those pertaining to articles with significant contributions that still have some minor limitations that need to be corrected or proof read before its eventual publication; major reviews are those pertaining to articles that are unfit for publication as originally submitted to the journal. In any case, the Editorial Committee can consider new submissions called de novo submissions as long as the article is modified substantially; the rejection of the article occurs when both the reviewers and the Editorial Committee deem the article unfit for publication in the RACI journal.

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

INSTRUCTIONS TO AUTHORS AND GUIDELINES FOR MANUSCRIPT SUBMISSION

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

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

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

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

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

SECTIONS (See Preparation of the manuscript)

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

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

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

Continuing medical education
These are articles on the rational and protocolized management of the different circumstances that can occur in the routine clinical practice. They are reviewed and agreed previously with subject matter experts and include a flow charton 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 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-mailwill 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: *, †, ǂ, §, ¶, **, ††, ǂǂ, 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 included 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 PRIAMHO II. Rev Esp Cardiol 2003;62:1165-1173. (Revistas en español).*