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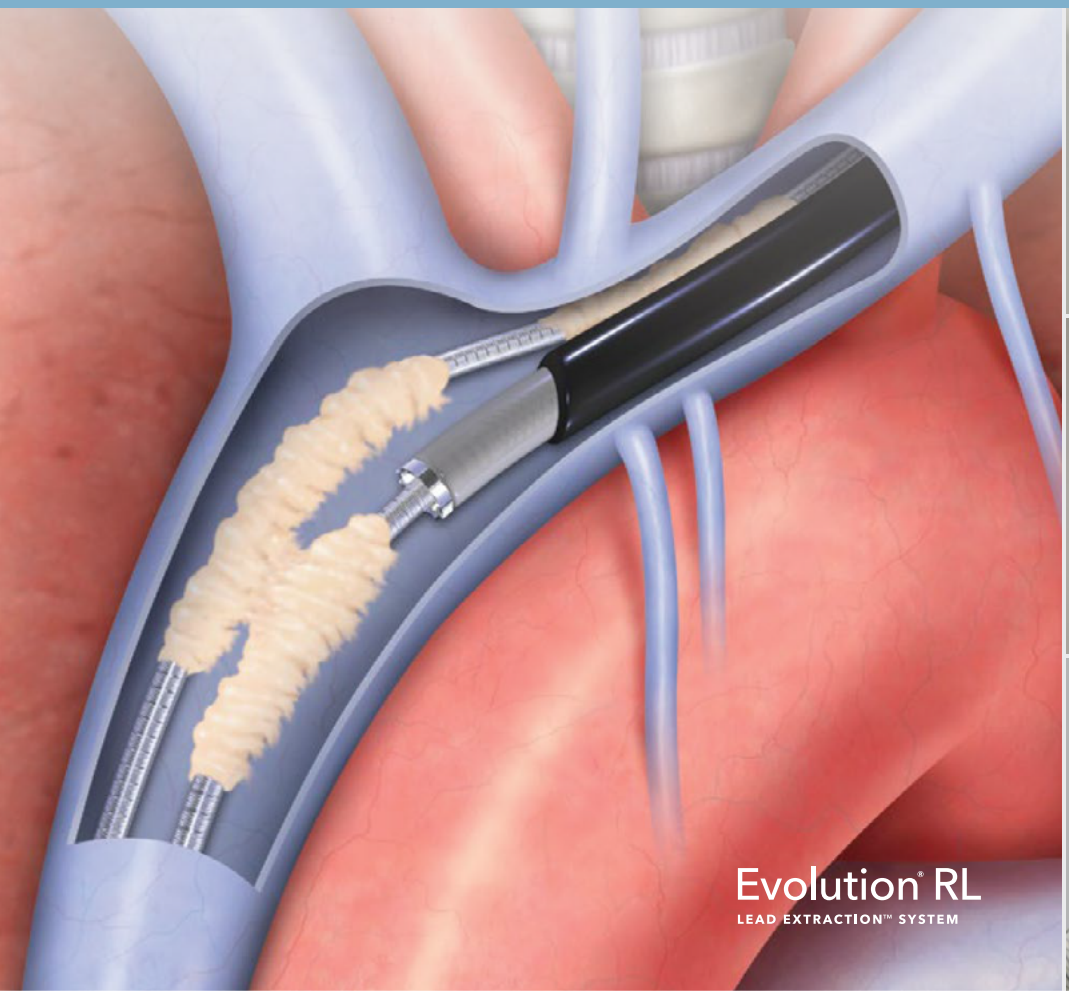

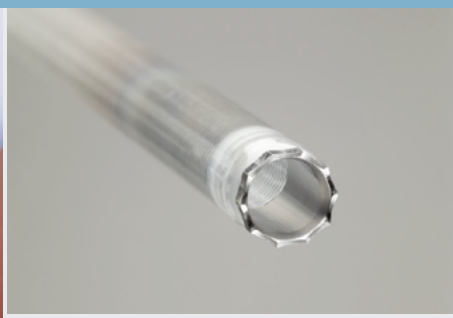

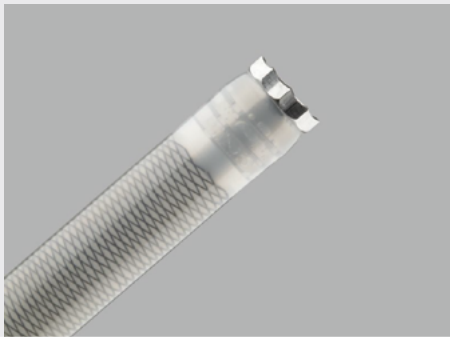

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SUMMARY

SCIENTIFIC LETTER

PORTAL CATHETER TRANSECTION DUE TO PINCH-OFF SYNDROME

ABSTRACT

We present a 59-year-old male patient with descending colon cancer undergoing chemotherapy via a portal catheter in the right subclavian vein. During the third chemotherapy session, he presented with erythema, edema, and mild pain in the chest region. A chest X-ray revealed complete transection of the catheter at the costoclavicular level, consistent with costoclavicular pinch-off syndrome. The device was removed, and the embolized fragment was retrieved endovascularly via the femoral route without complications. Subsequently, a new catheter was implanted via the right internal jugular vein. Pinch-off syndrome is a rare mechanical complication of subclavian access that can lead to catheter fracture and embolization, requiring timely diagnosis and treatment.

Keywords: *pinch-off syndrome; catheter transection; central venous access.*

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INTRODUCTION

Pinch-off syndrome (POS) is a rare mechanical complication of central venous catheters implanted via the subclavian route, caused by repetitive compression of the catheter between the clavicle and the first rib. This compression can lead to progressive deformation, structural deterioration, and, in advanced cases, complete catheter transection with intravascular embolization of the distal fragment. Its reported incidence is low, at 0.8-1%, yet it can cause serious complications, including cardiac arrhythmias, pulmonary embolism, infections, and loss of central venous access. Diagnosis is based on clinical suspicion in the setting of device dysfunction and is confirmed by radiologic studies; a chest X-ray is the initial imaging modality of choice. Once catheter transection is established, treatment consists of early removal of the reservoir and, when possible, endovascular retrieval of the embolized fragment. Given the low incidence of this complication and the importance of timely recognition, we present the following clinical case of pinch-off syndrome with complete transection of a portal catheter, resolved through surgical removal and endovascular retrieval of the distal fragment.

CLINICAL CASE

We present the case of a 59-year-old male patient with a history of descending colon cancer undergoing chemotherapy, who had a portal catheter placed in the right subclavian vein under ultrasound guidance and fluoroscopic control for this treatment (*Figure 1*).

After two chemotherapy sessions, at the start of the third session, he presented for an outpatient consultation due to erythema and edema, with mild discomfort upon moving the ipsilateral arm.

On physical examination, the symptoms were confirmed, and catheter dysfunction with leakage of chemotherapy into the right pectoral region was suspected. A chest X-ray was immediately ordered, which revealed complete sectioning of the catheter at the costoclavicular space (*Figure 2*).

The surgical approach was determined on an on-call basis. The device was removed, and the catheter rupture was confirmed (*Figure 3*). The remaining catheter was retrieved endovascularly via a femoral access using a snare, without complications (*Figures 4-6*).

One month later, following consultation with the Oncology Department regarding the continuation of his treatment, it was decided to implant a new portal catheter via the right jugular vein (*Figure 7*).

POS is described as the rupture of a catheter placed in the subclavian vein due to intermittent compression between the first rib and the clavicle. It is a rare mechanical complication, with an incidence rate of 0.86%. Peak incidence is observed 6 months after implantation.[1] The most common sites of catheter embolization are the pulmonary artery (35%), the right atrium (27.6%), the right ventricle (22%), and the superior vena cava (15.4%). Characteristic symptoms include chest pain, difficulty or pain during chemotherapy infusion, intermittent resistance to the passage of solutions, edema in the anterior chest region, and a history of difficult implantation.[2] Complications include arrhythmias, pulmonary embolism, and endocarditis. POS is classified into different grades based on its stage of progression:[3]

- Grade 0: no catheter deformation.
- Grade 1: no catheter deformation, but with catheter deviation.
- Grade 2: with deformation of the catheter lumen.
- Grade 3: catheter transection.

Treatment of POS consists of surgical removal of the catheter as soon as possible. Removal of the distal catheter fragment that has embolized into the right heart chambers or pulmonary arteries is recommended to avoid serious complications. The method of choice for its removal is endovascular, via the femoral vein using a snare catheter. When this option is unsuccessful, percutaneous access via the internal jugular vein may be attempted, and, as a last resort, a surgical approach with a median sternotomy.

To prevent POS, it is recommended to cannulate at the lateral aspect of the midclavicular line during subclavian venous access, perform the procedure with precision, avoid forced upper-limb positions, closely monitor patients after implantation, and remove the venous port immediately when it is no longer needed.[4]

Declaration
The authors declare no conflicts of interest.

FIGURE 1. Right subclavian portal catheter implantation on the day of the procedure; correct positioning is observed.

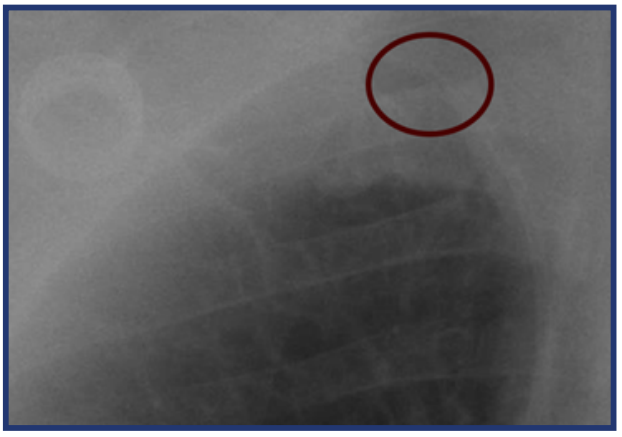

FIGURE 2. Chest X-ray. The section of the portal catheter is visible.

FIGURE 3. Removed catheter: the distal section is confirmed.

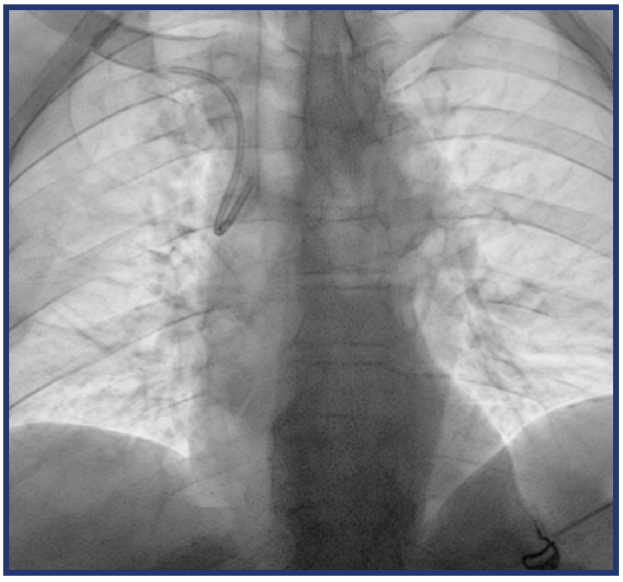

FIGURE 4. Distal remnant of the catheter lodged in the superior vena cava.

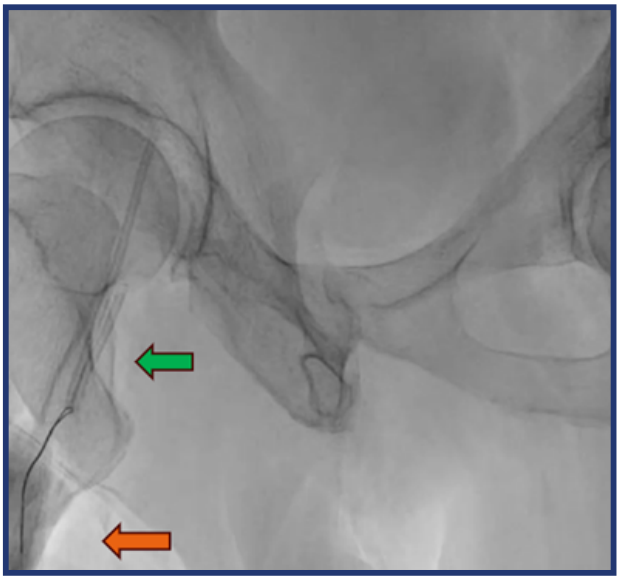

FIGURE 5. Removal of the remaining catheter. Green arrow: distal end of the catheter. Orange arrow: looped catheter.

FIGURE 6. Distal catheter remnant after removal.

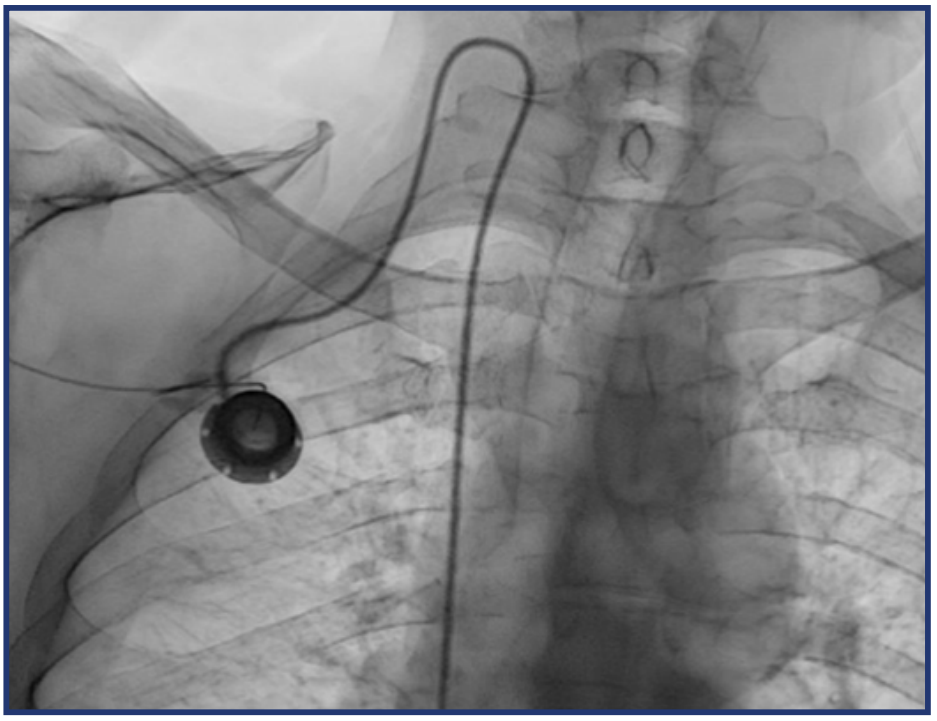

FIGURE 7. Portal catheter implanted via the right jugular vein.

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SCIENTIFIC LETTER

VIDEO-ASSISTED ENDOSCOPIC TRANSAXILLARY APPROACH FOR SUTURELESS AORTIC VALVE REPLACEMENT: REPORT ON THE FIRST NATIONAL SERIES

ABSTRACT

We present the first national experience with endoscopic video-assisted transaxillary aortic valve replacement using the Perceval™ sutureless aortic prosthesis. Three consecutive patients with severe aortic stenosis were included, all of whom underwent successful valve implantation.

Keywords: *aortic valve replacement; minimally invasive surgery; transaxillary approach; sutureless valve; Perceval™.*

Author

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INTRODUCTION

Aortic valve replacement (AVR) surgery has evolved toward minimally invasive techniques to reduce surgical trauma and optimize postoperative recovery. In this context, sutureless prostheses, such as the Perceval™ valve, have proven to be an effective alternative by simplifying valve implantation and significantly reducing cardiopulmonary bypass (CPB) and aortic clamping (Clp) times.[1] Furthermore, the video-assisted transaxillary (VAT) approach represents an emerging strategy that allows AVR to be performed without the need for sternotomy, while maintaining adequate surgical exposure and promoting faster recovery.[2] This study reports the first three cases of AVR using the VAT approach with the Perceval™ valve, along with a technical description of the transaxillary approach.

CLINICAL CASES

CASE 1

An 87-year-old male patient diagnosed with severe aortic stenosis (AS) and a history of non-insulin-dependent diabetes mellitus and Paget's disease. The Heart Team evaluated him; it was decided against endovascular treatment due to excessive calcification of the aortic annulus, which posed a high risk of paravalvular leak. Given his high surgical risk, it was decided to perform an AVR with a sutureless prosthesis. The preoperative echocardiogram showed a preserved left ventricular ejection fraction (LVEF), with maximum and mean gradients of 67 mmHg and 43 mmHg, respectively. Aortic valve replacement was performed via a VAT approach; a large-sized Perceval™ prosthesis was implanted. The final gradients were 15 mmHg (maximum) and 9 mmHg (mean), with no evidence of paravalvular leak. CPB and Clp times were 190 and 90 minutes, respectively.

The immediate postoperative course was favorable. As a complication, the patient developed nosocomial pneumonia requiring antibiotic therapy, followed by diarrhea with a positive culture for *Clostridioides difficile*, which prolonged the hospital stay. He was discharged on the tenth postoperative day.

CASE 2

A 71-year-old female patient diagnosed with severe AS and grade II obesity. The preoperative echocardiogram showed preserved ejection fraction, a bicuspid aortic valve with severe calcification of the aortic annulus and the mitral-aortic continuity, and a small aortic annulus (19 mm), with maximum and mean gradients of 140 mmHg and 58 mmHg, respectively.

A VAT approach to aortic valve replacement was performed, with implantation of a small-sized Perceval™ prosthesis. The final gradients were 24 mmHg (maximum) and 13 mmHg (mean), with no paravalvular leak. CPB and Clp times were 183 and 95 minutes, respectively. In this case, in addition to avoiding sternotomy in an obese patient, the use of a sutureless prosthesis enabled the avoidance of aortic ring enlargement or aortic root replacement (Bentall surgery) to prevent prosthesis-patient incompatibility. The patient was extubated 2 hours after the end of surgery without requiring a pacemaker or inotropic support and was discharged on the fourth postoperative day. As a technical detail, a temporary pacemaker was implanted before surgery to ensure electrical stimulation during the immediate postoperative period; it was removed on the second day.

CASE 3

A 69-year-old male patient, on anticoagulation, with a diagnosis of severe AS and a history of hypertension, diabetes mellitus, complete left bundle branch block, and atrial fibrillation. The preoperative echocardiogram showed preserved LVEF, with maximum and mean gradients of 140 mmHg and 58 mmHg, respectively. A VAT approach AVR was performed, with implantation of a large-sized Perceval™ prosthesis. Final gradients were 18 mmHg (maximum) and 11 mmHg (mean), with mild paravalvular regurgitation. CPB and Clp times were 185 and 86 minutes, respectively. The patient was extubated in the immediate postoperative period, without requiring vasopressors or a pacemaker. Discharge occurred on the seventh postoperative day due to the need to achieve the therapeutic range of anticoagulation indicated by his prior atrial fibrillation.

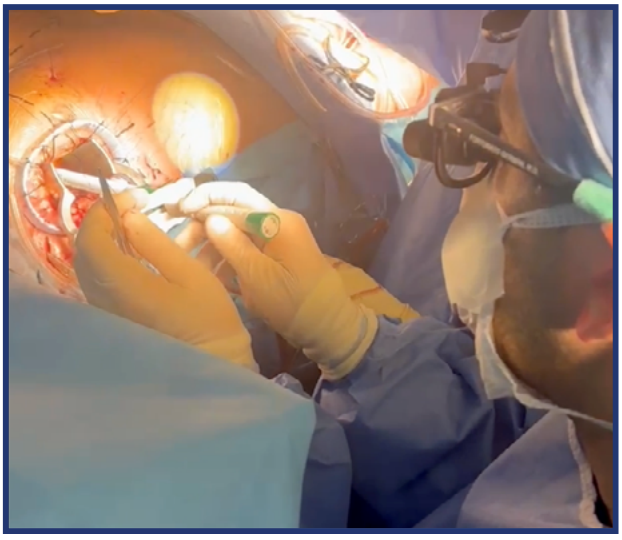

FIGURE 1. Initial set-up and surgeon's view.

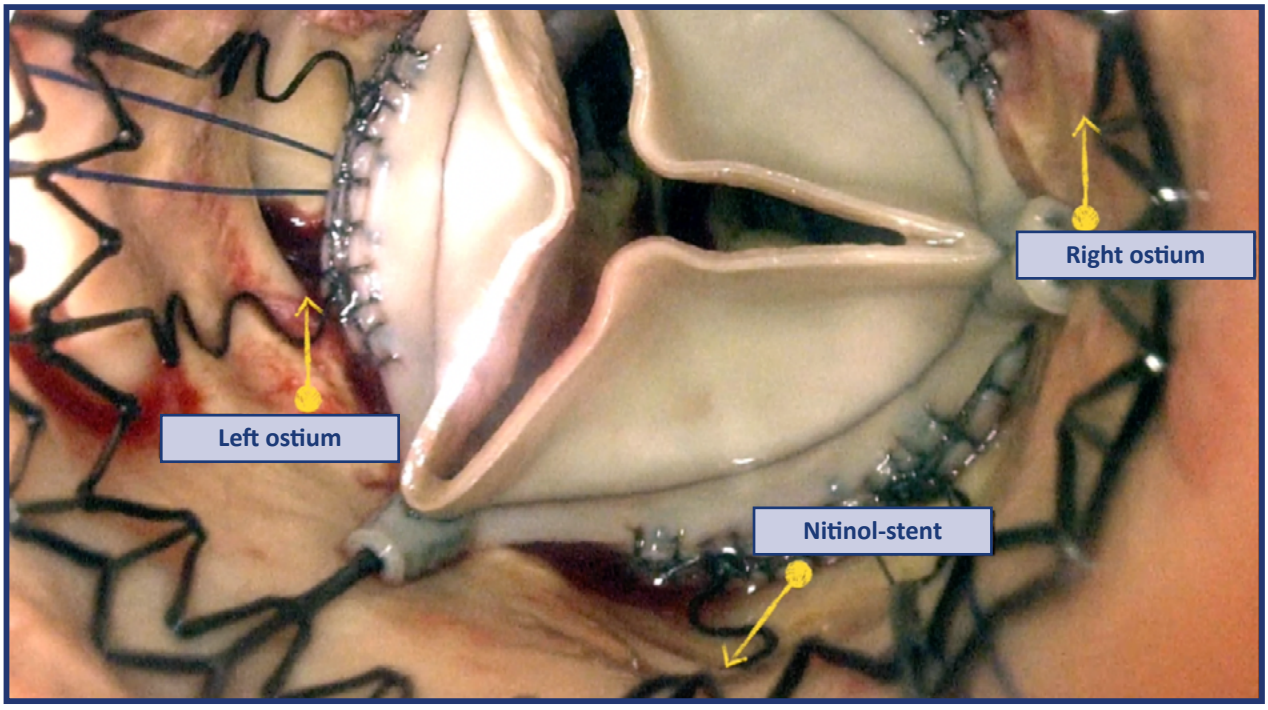

FIGURE 2. Final valve implantation under endoscopic visualization; the correct annular implant and the nitinol stent are visible. The coronary ostia are ensured to be free of obstruction.

DISCUSSION

The development of minimally invasive cardiac surgical techniques for mitral valve repair has expanded surgical options for selected patients, allowing for reduced surgical aggression without compromising hemodynamic outcomes. In this context, sutureless prostheses facilitate alternative approaches by simplifying valve implantation. The surgical technique and setup for the minimally invasive transaxillary approach (*Figure 1*) have been described.[3] For the implantation of the Perceval™ valve, certain technical aspects must be considered.[4] The aortotomy should be transverse and high (approximately 2 cm above the aortic pericardial fold) to avoid interference of the nitinol stent with the aortorrhaphy. Decalcification of the aortic annulus is necessary, though without excessive resection. Ring sizing with the sizers must be performed carefully: the transparent tip should pass easily into the left ventricle, while the white tip should do so with slight resistance. If there is uncertainty between two sizes, it is recommended to choose the smaller prosthesis. Three guide sutures are placed at the nadir of each coronary sinus to facilitate the descent of the prosthesis. After deployment, balloon dilation is performed at 4.5 atmospheres for 30 seconds, while the nitinol stent is irrigated with warm saline solution.

Upon completion of the implantation, a video camera was used to verify the correct position in the annular plane, the relationship with the coronary *ostia*, and the expansion of the stent (*Figure 2*). The VAT approach enabled successful AVR in all cases, without the need for conversion and with satisfactory hemodynamic outcomes. Although CPB and clamping times were longer than in conventional surgery, postoperative transvalvular gradients were low, and no significant paravalvular leaks were observed. However, the advantages of sutureless prostheses over traditional ones include faster implantation, improved transprosthetic gradients, and lower mortality, as we have demonstrated in a recent publication with statistically significant results.[5] The clinical outcome was favorable, with early extubation and no operative mortality.

CONCLUSION

The VAT approach, combined with sutureless valves, may be a safe, effective, and reproducible alternative for centers experienced in minimally invasive cardiac surgery. The main limitations of this study are its small sample size and descriptive nature.

Declaration

The authors have no conflicts of interest with Corcym or its product Perceval™.

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SCIENTIFIC LETTER

TRANSCAROTID TAVI WITH LEFT CAROTID-SUBCLAVIAN BYPASS FOR THE MANAGEMENT OF REFRACTORY ANGINA

ABSTRACT

New transcatheter and endovascular techniques have transformed cardiac surgery operating rooms into collaborative spaces where multidisciplinary teams address complex cases.

In the patient we present, surgical revascularization was performed; the patient then developed progressive angina with electrocardiographic changes in the anterior wall. Coronary angiography showed patent grafts and no progression of native coronary artery disease. Computed tomography revealed a calcified plaque at the origin of the left subclavian artery.

Endovascular treatment was performed using a covered stent proximal to the mammary artery. Despite this, refractory angina persisted, and further angioplasties were necessary, with no improvement in the vascular lumen. Additionally, echocardiography showed worsening of a preexisting aortic stenosis.

A multidisciplinary approach was chosen, involving a left transcarotid self-expanding transcatheter aortic valve implantation (TAVI) and concomitant carotid-subclavian bypass, using an alternative technique to achieve optimal annular alignment via a contralateral support balloon.

Keywords: *Heart Team, transcatheter aortic valve implantation, alternative access routes, subclavian stent restenosis, carotid-subclavian bypass, comprehensive approach.*

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CLINICAL CASE

A 69-year-old patient with coronary artery disease who underwent surgical revascularization in 1995 via a triple bypass: left internal mammary artery (LIMA) to the anterior descending artery (ADA) and sequential saphenous vein grafts to the first marginal artery (OM1) and the posterior descending artery (PDA).

Angina recurred despite patent bypass grafts; coronary angiography showed no progression of native disease. A chest CT scan revealed severe stenosis at the origin of the left subclavian artery (*Figure 1A*), which was treated with angioplasty and coated stent implantation in 2011. Moderate aortic stenosis was detected.

Symptoms recurred in 2014 and 2023, with stent restenosis (*Figure 1B*), which was treated with balloon angioplasties. Aortic valve disease progressed to a severe form. In 2024, the patient was admitted for non-ST-elevation myocardial infarction, severe aortic stenosis, and subclavian stent restenosis.

Echocardiography revealed moderate ventricular dysfunction (ejection fraction of 45%) with global hypokinesis and a severely calcified tricuspid valve. SPECT-MRI demonstrated anterior ischemia, despite the AMI-DA bypass being patent, with viability in all territories. CT scanning revealed a porcelain ascending aorta, stent restenosis, severe bilateral peripheral vascular disease with iliac arteries <4 mm, normal-caliber carotid arteries, and a patent circle of Willis.

A comprehensive treatment plan was decided upon, consisting of a left transcarotid transcatheter aortic valve implantation (TAVI) self-expanding, and a homolateral carotid-subclavian bypass.

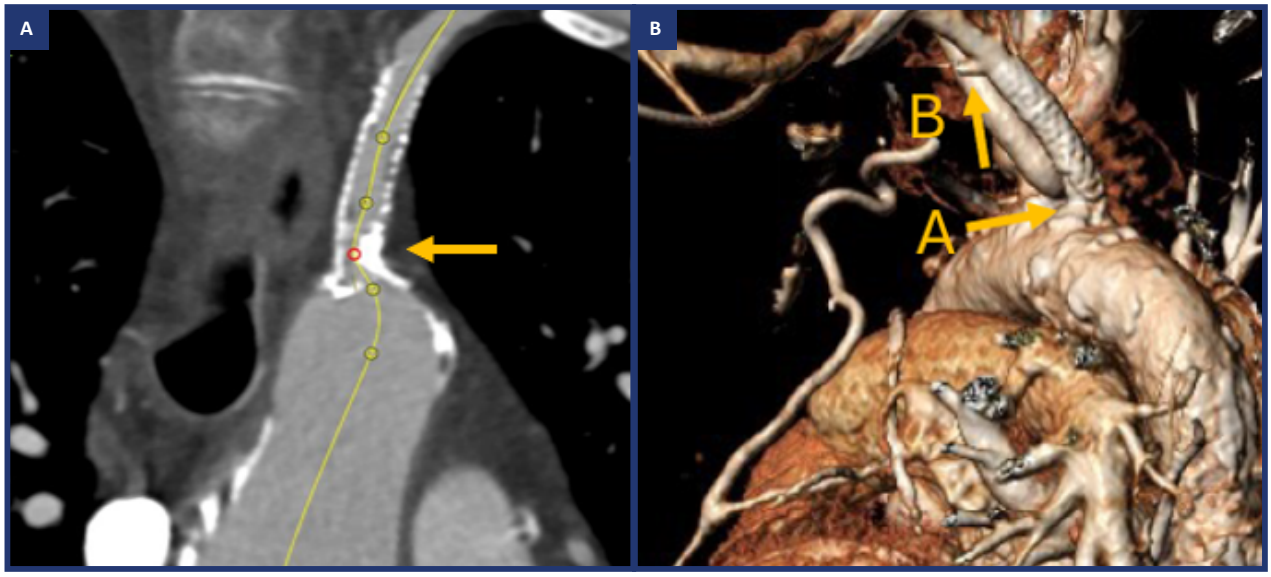

FIGURE 1. A: Calcified stenosis at the origin of the left subclavian artery involving the implanted stent. **B:** 3D view of the calcified stenosis (a). Origin of the left internal mammary artery (b).

Surgical procedure

The left carotid and subclavian arteries were dissected (*Figure 2A*), and the aortic annulus was predilated with a 22-mm balloon. An Acurate neo2™(Boston) self-expanding bioprosthesis was implanted via left transcarotid TAVI. Commissural alignment was correct, but coaxiality was poor; this was corrected by contralateral traction using a 20-mm balloon via the right radial artery (*Figure 2B*).

Finally, an extra-anatomical left carotid-subclavian bypass was performed using a 6-mm Gore-Tex™ graft (*Figure 2C*). The patient had an uneventful postoperative course and was discharged on the fourth day. A follow-up echocardiogram showed a normally functioning prosthesis and improved LVEF. On the CT angiography performed three months later, the bypass was patent (*Figure 2D*).

DISCUSSION

A multidisciplinary approach is key to managing complex cardiovascular disease, as it focuses on the patient and integrates diagnostic and therapeutic perspectives. Advances in TAVI have expanded treatment options and improved clinical outcomes.[1,2] Discussion within the Heart Team is essential for evaluating the clinical, anatomical, and technical characteristics of each patient to select the most appropriate strategy.[2]

Although the transfemoral approach remains the first choice, alternative access routes are required in patients with significant peripheral vascular disease. Individualized selection is crucial in patients with unfavorable anatomies.[3] Recent data suggest that alternative access routes, including the subclavian and carotid approaches, are safe and effective when

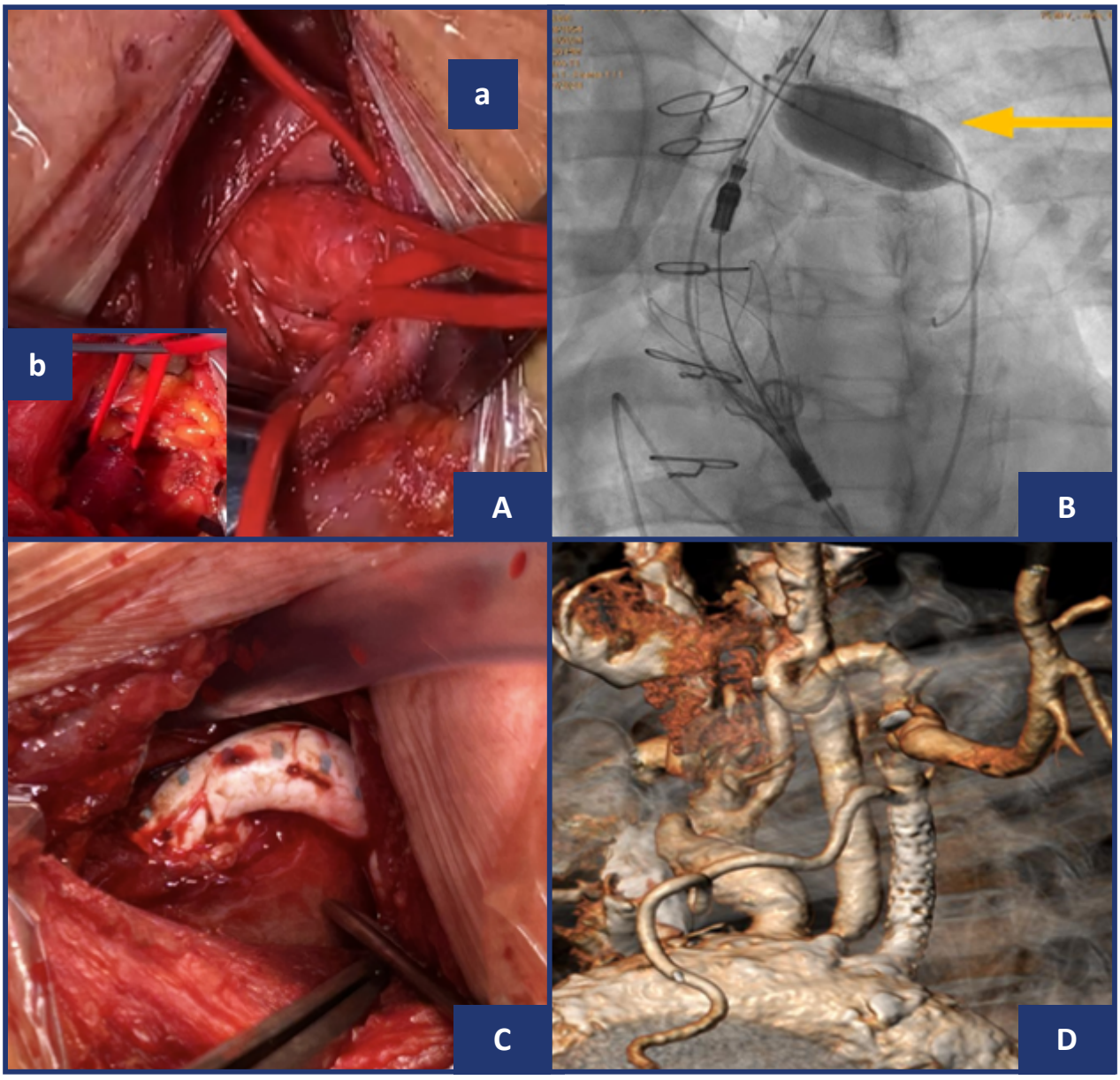

FIGURE 2. A: Dissection of the left common carotid artery (a) and the left middle subclavian artery, posterior to the left mammary artery (b). **B:** Contralateral balloon traction to position the prosthesis in the aortic ring. **C:** Proximal anastomosis of the left carotid-subclavian bypass. **D:** 3D reconstruction of the bypass based on a CT scan performed three months later.

performed at experienced centers.[4] Transcarotid access has shown favorable results in series and multicenter studies,[5] and constitutes a valid alternative when transfemoral access is not possible.[6]

The case we present demonstrates how a multidisciplinary approach integrates structural and vascular techniques to address multiple pathologies in a single procedure.

CONCLUSIONS

A multidisciplinary approach is essential for the effective management of complex cardiovascular conditions and improves care and outcomes.

This case illustrates the application of a comprehensive strategy in a complex scenario. Alternative TAVI pathways pose a technical challenge due to their annular alignment, necessitating innovative solutions to optimize implant placement.

Declaration

The authors declare no conflicts of interest.

Ethical considerations

This study complies with the standards of the center's Ethics Committee.

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SCIENTIFIC LETTER

QUADRICUSPID AORTIC VALVE: A CASE REPORT IN A REFERRAL HOSPITAL IN SOUTHERN COLOMBIA

ABSTRACT

A quadricuspid aortic valve is a rare congenital cardiac anomaly that is often diagnosed incidentally and may progress to significant valvular dysfunction during adulthood. We present the case of a 65-year-old woman admitted with retrosternal chest pain, fever, and hemoptysis, whose diagnostic evaluation revealed severe aortic regurgitation and significant coronary artery disease. The patient underwent surgical treatment with aortic valve replacement and coronary artery bypass grafting, during which a quadricuspid aortic valve was identified as an incidental intraoperative finding. The postoperative course was favorable, without major complications. This case highlights the importance of considering uncommon congenital valvular abnormalities in patients with severe aortic insufficiency and emphasizes the role of timely surgical management in achieving satisfactory clinical outcomes.

Keywords: *aortic valve, quadricuspid valve, congenital heart disease, echocardiography, cardiovascular surgery.*

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INTRODUCTION

A quadricuspid aortic valve (QAV) is a rare congenital cardiac anomaly characterized by the presence of four aortic cusps instead of the normal tricuspid configuration. Since its first description in the nineteenth century, QAV has been considered an uncommon entity frequently identified incidentally during imaging studies, cardiac surgery, or autopsy examinations.[1] Improvements in cardiovascular imaging techniques, particularly transthoracic and transesophageal echocardiography, have increased the recognition of this condition in recent decades.[2]

Although a patient with a QAV may remain asymptomatic for many years, progressive valvular dysfunction commonly develops with advancing age, especially aortic regurgitation resulting from abnormal cusp coaptation and structural degeneration.[3] In some patients, the anomaly may also coexist with other congenital or acquired cardiovascular disorders, including coronary artery abnormalities and structural heart disease, which may influence clinical presentation and surgical management.[4]

Because of its low prevalence and variable clinical manifestations, QAV continues to represent a diagnostic and therapeutic challenge. Early identification is important to prevent progressive cardiac remodeling and to determine the appropriate timing for surgical intervention in patients with significant valvular dysfunction.[5]

We present the case of a patient with severe aortic regurgitation and concomitant coronary artery disease in whom a quadricuspid aortic valve was identified incidentally during cardiac surgery at the Hospital Universitario Hernando Moncaleano Perdomo, a tertiary referral center in southern Colombia.

CASE REPORT

A 65-year-old patient from the municipality of Pitalito was admitted with a chronic clinical presentation characterized by retrosternal chest pain radiating to the dorsal region, rated 6/10 on the subjective pain scale, intermittent, self-limited, and unrelated to physical exertion or emotional stress. During the previous 10 days, the symptoms had become associated with unquantified febrile episodes and cough, initially dry and later accompanied by hemoptysis.

The patient initially sought medical attention at a secondary-level healthcare institution, where a diagnosis of acute bronchitis was established. Antibiotic therapy with ampicillin/sulbactam was initiated, and further diagnostic studies were requested, revealing severe aortic regurgitation. Consequently, the patient was referred to a higher-level institution for evaluation and management by the cardiovascular surgery service.

Medical history

The patient reported a medical history significant for type 2 diabetes mellitus, currently managed with insulin glargine and metformin; arterial hypertension treated with losartan and amlodipine; left inguinal herniorrhaphy; exploratory laparotomy secondary to a stab wound; hysterectomy; and a history of tobacco use.

Clinical findings

Upon admission, the patient was in fair general condition, alert, oriented to person, place, and time, and asymptomatic. Vital signs were as follows: blood pressure 120/53 mmHg, heart rate 67 beats per minute, respiratory rate 18 breaths per minute, oxygen saturation 97%, temperature 36.7 °C, and blood glucose level 152 mg/dL.

Physical examination revealed a normocephalic patient with moist mucous membranes. The neck was symmetric and mobile, without jugular venous distention or carotid pulsations. Cardiac auscultation revealed normal, regular heart sounds with a low-grade diastolic murmur at the aortic focus. Breath sounds were preserved bilaterally without adventitious sounds. The abdomen was soft and depressible, with no palpable masses or organomegaly and no signs of peritoneal irritation. The extremities were symmetric and eutrophic, with a capillary refill time of 2 seconds and palpable distal pulses, without motor or sensory deficits.

Diagnostic assessment

The patient was evaluated by the cardiovascular surgery service, which requested additional diagnostic studies to establish the appropriate management plan.

The patient's laboratory workup demonstrated preserved hematologic parameters without leukocytosis or thrombocytopenia. Renal function was consistent with stage II chronic kidney disease, while liver function tests showed hypoalbuminemia with otherwise unremarkable hepatic parameters. Hyperglycemia was also documented during admission. Serologic studies for hepatitis B virus, HIV, and syphilis were negative, and urinalysis was not suggestive of infection. The complete laboratory findings are summarized in *Table 1*.

Carotid Doppler ultrasound findings were within normal limits. Transesophageal echocardiography demonstrated mild left ventricular dilatation,

Parameter	Patient value	Reference range	Interpretation
Complete blood count			
Leukocytes	8,400/µL	4,000-11,000/µL	Normal
Neutrophils	5,500/µL	1,500-7,500/µL	Normal
Hemoglobin	14.5 g/dL	12-16 g/dL	Normal
Platelets	302,000/µL	150,000-450,000/µL	Normal
Electrolytes			
Sodium	142.4 mmol/L	135-145 mmol/L	Normal
Potassium	4.16 mmol/L	3.5-5.1 mmol/L	Normal
Chloride	104 mmol/L	98-107 mmol/L	Normal
Renal function			
Blood urea nitrogen	14.14 mg/dL	7-20 mg/dL	Normal
Creatinine	0.97 mg/dL	0.6-1.2 mg/dL	Normal
Estimated GFR	61.49 mL/min/1.73 m^2	>90 mL/min/1.73 m^2	Decreased
Liver function tests			
Total bilirubin	0.33 mg/dL	0.2-1.2 mg/dL	Normal
Direct bilirubin	0.12 mg/dL	0-0.3 mg/dL	Normal
Indirect bilirubin	0.21 mg/dL	0.2-0.8 mg/dL	Normal
AST	22.7 U/L	10-40 U/L	Normal
ALT	42 U/L	7-56 U/L	Normal
Total proteins	5.19 g/dL	6.0-8.3 g/dL	Decreased
Albumin	2.46 g/dL	3.5-5.0 g/dL	Decreased
Alkaline phosphatase	85 U/L	44-147 U/L	Normal
Prothrombin time	11.4 s	10-13 s	Normal
INR	1.04	0.8-1.2	Normal
Partial thromboplastin time	22.9 s	25-35 s	Slightly decreased
Metabolic and serologic tests			
Blood glucose	282.79 mg/dL	70-140 mg/dL	Increased
TSH	1.32 µIU/mL	0.4-–4.0 µIU/mL	Normal
HIV	Negative	Negative	Normal
Syphilis	Negative	Negative	Normal
Hepatitis B	Negative	Negative	Normal
Urinalysis			
Urinary sediment	No evidence of infection	Negative for infection	Normal

TABLE 1. Laboratory findings at admission.
ALT: alanine aminotransferase, AST: aspartate aminotransferase, GFR: glomerular filtration rate, HIV: human immunodeficiency virus, INR: international normalized ratio, TSH: thyroid-stimulating hormone.

normal-sized atrial chambers and right ventricle, with no intracardiac masses or thrombi. Adequate contractility of both ventricles was observed, with a left ventricular ejection fraction of 60%. Severe aortic regurgitation was identified, with an aortic annulus diameter of 3 cm. No sclerosis of the three valve cusps was reported, and the pericardium appeared normal without effusion.

Coronary angiography revealed severe single-vessel coronary artery disease involving the left anterior descending artery, with a 70% proximal stenotic lesion.

Therapeutic intervention

The patient was scheduled for mechanical aortic valve replacement combined with myocardial revascularization of the left anterior descending artery. During surgery, a quadricuspid aortic valve and proximal atherosclerotic disease of the left anterior descending artery were incidentally identified (*Figures 1* and *2*).

A median sternotomy was performed, followed by skeletonization of the left internal mammary artery. An inverted "T" pericardiotomy with suspension sutures was carried out. Double purse-string sutures with 3-0 Prolene were placed in the ascending aorta, and a single purse-string suture with 4-0 Prolene was placed in the right atrial appendage and right superior pulmonary vein.

After systemic heparinization at 3 mg/kg, arterial and bicaval cannulation were performed, and cardiopulmonary bypass was initiated. Following aortic cross-clamping, left heart decompression was achieved using a vent cannula. Aortotomy was performed, and Custodiol™ cardioplegic solution was administered through the coronary ostia until cardiac arrest was achieved.

The native aortic valve was resected, and a N.° 19 Sorin™ mechanical prosthetic valve was implanted. Exploration of the left anterior descending artery revealed an approximately 1.5 mm distal vessel bed. Arteriotomy and termino-lateral anastomosis with the left internal mammary artery were performed, confirming adequate distal flow.

Heparin reversal was achieved with protamine, followed by decannulation and hemostasis. Two mediastinal drainage tubes were placed. The pleurae were closed, and a temporary epicardial pacemaker lead was positioned in the right ventricle. Sternal closure was performed with steel wires, followed by routine layered closure using Vicryl and Monocryl sutures (*Figure 3*).

The postoperative course was uneventful, with no signs of cardiac tamponade and adequate urinary output.

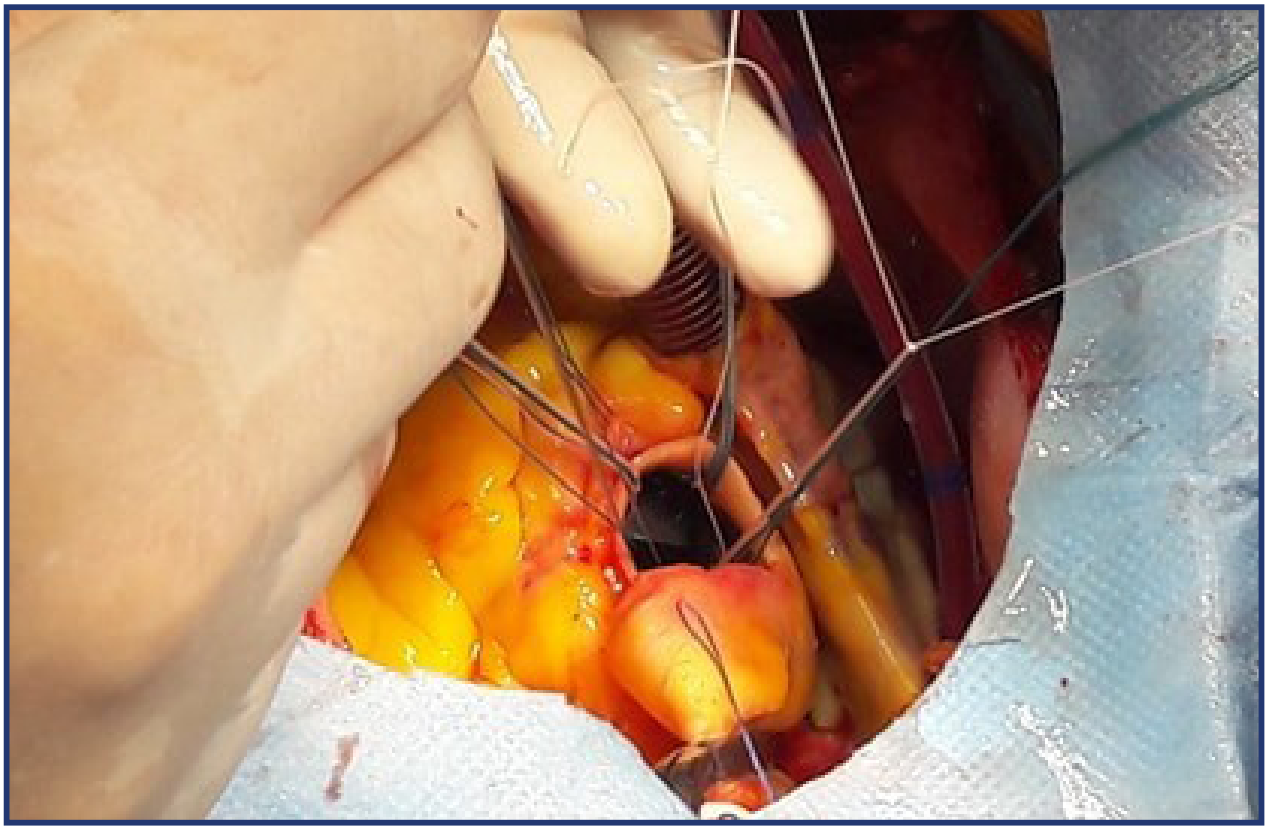

FIGURE 1. Surgical view of the quadricuspid aortic valve.

FIGURE 2. Quadricuspid aortic valve.

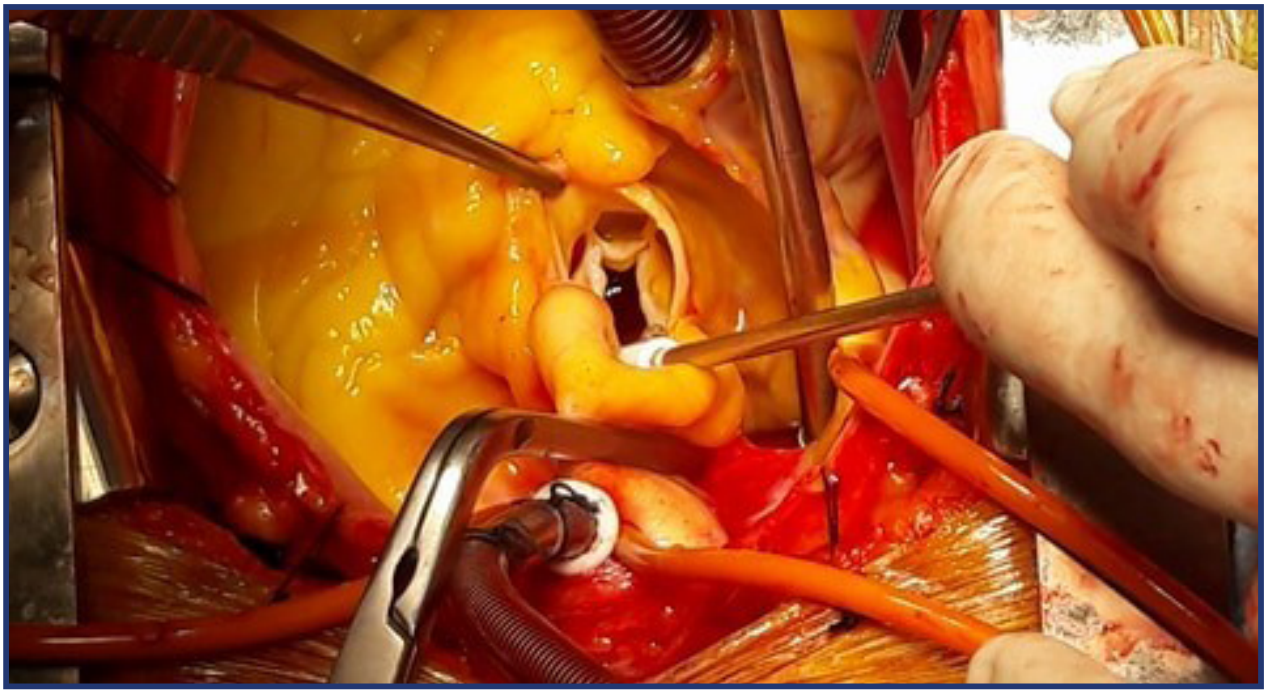

FIGURE 3. Aortic valve replacement.

DISCUSSION

The aortic valve has an average diameter of 23.3 mm in adult men and 21.6 mm in adult women. It is located at the outlet of the left ventricle, between the tricuspid/mitral valves and the pulmonary valve. It has a swallow's nest-like configuration and consists of three sinuses: the right coronary sinus, from which the right coronary artery arises; the left coronary sinus, from which the left coronary artery originates; and the non-coronary sinus.[3] The opening of the aortic valve marks the onset of ventricular systole. During this phase, the aortic cusps move in response to pressure changes, aligning parallel to the ascending aorta and allowing ventricular ejection. As systole progresses, the outflow decreases, promoting the formation of vortices between the aortic cusps and the sinus walls, thereby maintaining coronary perfusion and facilitating valve closure.[4]

Congenital anomalies of the aortic valve account for approximately 3-6% of congenital heart diseases

in adults. Among these, the bicuspid aortic valve is the most common, affecting nearly 2% of the population, followed by unicuspid and quadricuspid aortic valves.[5] This is the second documented case of a quadricuspid aortic valve at our hospital. The first case has already been published,[6] highlighting the importance of recognizing this rare congenital anomaly, its clinical manifestations, and the associated diagnostic and therapeutic implications.

The first case of quadricuspid aortic valve (QAV) was described by Balington in 1862 as an incidental autopsy finding. Later, in 1923, Simonds reported five cases of QAV among 25,666 autopsies. More recently, in 2004, Tutarel published studies based on autopsy findings and echocardiography-diagnosed cases.[7] Currently, QAV is recognized as an uncommon congenital cardiac anomaly, with a reported incidence of 0.008% in autopsy studies, 0.043% on two-dimensional transthoracic echocardiography, and approximately 1% among patients undergoing aortic valve surgery.[8]

QAV usually occurs as an isolated anomaly; however, it may also be associated with other congenital malformations, including ventricular septal defect, atrial septal defect, tetralogy of Fallot, mitral valve insufficiency, transposition of the great arteries, hypertrophic cardiomyopathy, subaortic fibromuscular stenosis, patent ductus arteriosus, and coronary ostial obstruction, the latter reported in nearly 10% of cases.[9]

The mechanism underlying this malformation remains poorly understood. Nevertheless, abnormalities during early truncal septation have been proposed, including aberrant fusion of the aorticopulmonary septum, abnormal mesenchymal proliferation, and asymmetric division of one of the three cusps, resulting in an unequal number of valvular primordia.[10]

Two morphological classification systems have been described for quadricuspid aortic valve (QAV): the Hurwitz and Roberts classification and the Nakamura classification (*Figures 4* and *5*). The Hurwitz and Roberts system, originally described in 1973, classifies QAV according to the relative size and configuration of the aortic cusps and remains the most widely used classification worldwide. Among the different anatomical variants described, types A, B, and C represent the most reported cases, whereas other subtypes are considerably less frequent. In the present case, the valve morphology appeared to correspond to type C, characterized by two larger and two smaller cusps.

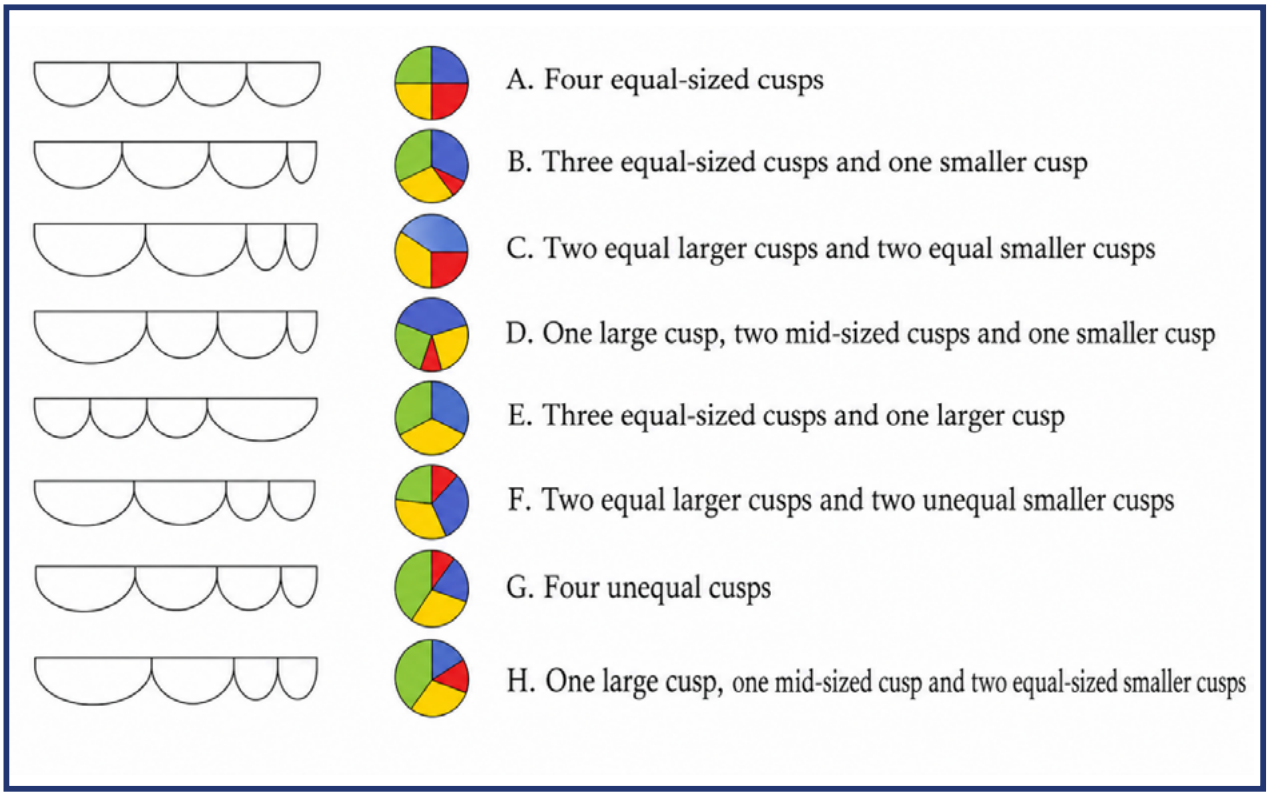

FIGURE 4. Modified Classification of Hurwitz and Roberts.
Image credits: created by the authors using BioRender.com. AI-assisted graphical optimization tools were used during figure preparation.

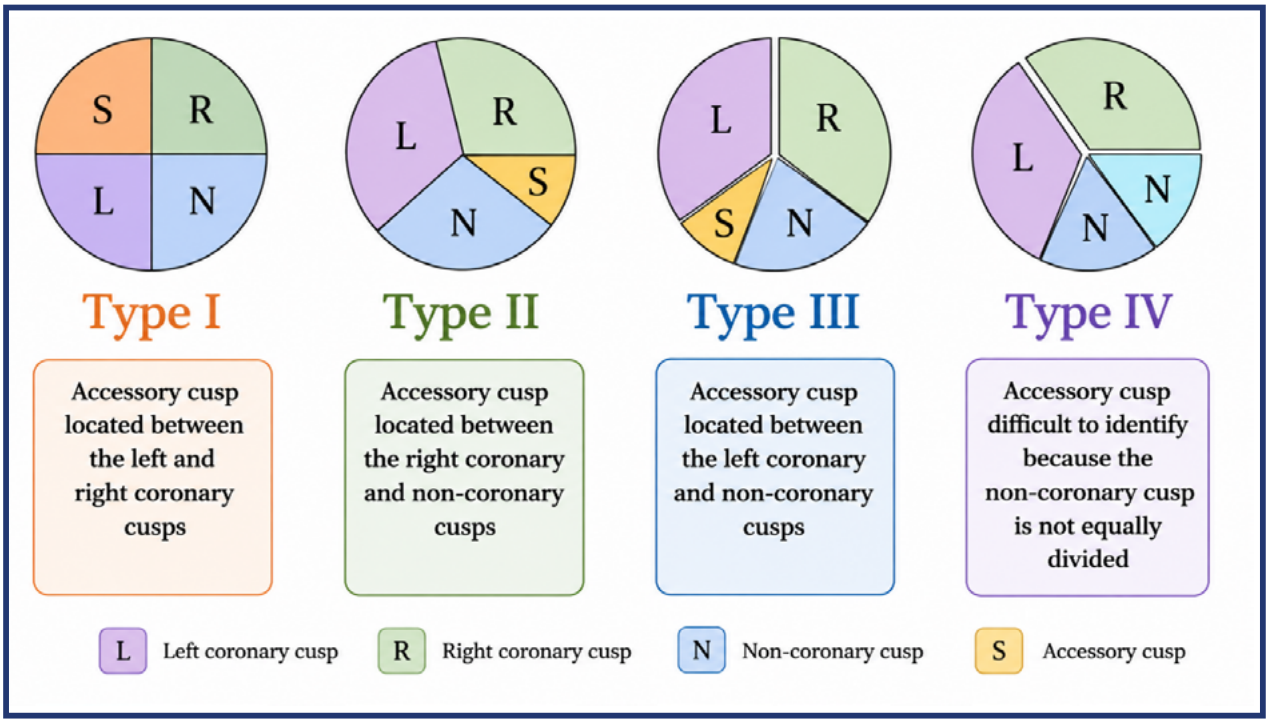

FIGURE 5. Nakamura classification.
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The Nakamura classification was later proposed as a complementary anatomical system based on the location of the accessory cusp in relation to the coronary and non-coronary cusps. This classification facilitates anatomical description and may contribute to surgical planning and echocardiographic interpretation. Together, the two classification systems provide a practical framework for describing the morphological variability of QAV and improving communication among clinicians, imaging specialists, and surgeons.

Clinical manifestations depend on the functional status of the quadricuspid valve and the presence of associated abnormalities. In most cases, diagnosis is incidental, since patients may remain asymptomatic until the sixth decade of life. The most frequently reported symptoms include palpitations, precordial pain, fatigue, asthenia, adynamia, lower extremity edema, syncope, and, in extreme cases, sudden cardiac death.[11]

Although QAV does not always produce hemodynamic compromise, approximately 44% of patients exhibit some degree of hemodynamic abnormality. Tutarel and Westhoff-Bleck demonstrated that the most common finding is aortic regurgitation, occurring in approximately 75% of cases, as observed in our patient. This is followed by regurgitation associated with aortic stenosis in 8.4% of cases, whereas isolated stenosis is extremely rare, with an incidence of 0.7%.[7]

Diagnosis is often made incidentally during cardiac surgery, as occurred in our patient.

Computed tomography angiography has demonstrated high accuracy compared with conventional coronary angiography. It allows precise assessment of QAV morphology, failed cusp coaptation, significant aortic regurgitation, coronary ostial location, aortic dimensions, and coronary artery status.[12]

Cardiac magnetic resonance imaging provides additional information regarding the severity of regurgitation. Patients with a regurgitant fraction greater than 33% generally require valve replacement, as well as left ventricular size, identification of aberrant coronary ostia, and associated anomalies.

Two-dimensional transthoracic echocardiography provides valuable information regarding aortic valve morphology, aortic root dimensions, and the left ventricule size.

Two-dimensional transesophageal echocardiography became available in the 1970s; however, it was not until 1984 that it was first used to diagnose QAV, when Herman described the classic parasternal short-axis image. In diastole, the valve exhibits the characteristic X-shaped closure pattern, unlike the Y-shaped closure of a normal tricuspid aortic valve. In systole, the valve

opening appears rectangular rather than triangular. Additionally, this modality provides further details on valve morphology, including cusp prolapse.[12]

Surgical indications include severe aortic regurgitation, severe aortic stenosis, or dysfunctional QAV associated with other lesions, such as left coronary ostial obstruction.[8] The goal of aortic valve repair is to restore adequate cusp coaptation and maintain a low transvalvular gradient without turbulent flow, thereby ensuring favorable long-term durability.

The most commonly performed repair technique is tricuspidization of the aortic valve. Song et al. reported successful tricuspidization in eight consecutive patients with at least moderate aortic regurgitation. Key surgical aspects included pericardial cusp reconstruction, reduction of the sinotubular junction, and commissure coaptation suturing.[13]

In our case, aortic valve replacement was selected due to severe structural abnormalities of the native valve cusps.

CONCLUSION

A quadricuspid aortic valve is an exceptionally rare congenital cardiac anomaly that is frequently identified incidentally during imaging studies or at the time of surgery. Despite its rarity, it carries important clinical implications because of its association with progressive valvular dysfunction, particularly aortic regurgitation, as well as other congenital cardiovascular abnormalities.

This case underscores the importance of maintaining a high index of suspicion in patients with valvular heart disease. It highlights the value of multimodal imaging techniques and intraoperative assessment in establishing an accurate diagnosis. Early recognition and timely surgical intervention are essential to achieve favorable clinical outcomes in patients with significant valvular dysfunction.

To the best of our knowledge, this report represents one of the few documented cases of a quadricuspid aortic valve from southern Colombia. It contributes to the limited body of literature regarding this uncommon condition.

Ethical considerations

Informed consent for treatment and open-access publication was obtained or waived from all participants in this study. Committee on Ethics, Bioethics, and Research issued approval 04-03.

Declaration

The authors declare no conflicts of interest.

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OPINION ARTICLE

CAROTID REVASCULARIZATION FOR NEUROCOGNITIVE BENEFIT: MYTH OR REALITY?

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While stroke is a well-known cause of cognitive impairment, the relationship between carotid artery stenosis and cognitive function in individuals remains highly unclear due to methodological heterogeneity across studies evaluating cognitive benefit following carotid revascularization.

Indeed, when carotid stenosis is classified as symptomatic or asymptomatic, the patient's cognitive status is usually not taken into account. In this context, the impairment may be either pre-existing or progressive and will be closely linked to declines in cerebral perfusion and function.[1] On the other hand, the cognitive issues experienced by patients are sometimes subtle and not severe enough to interfere with their daily activities; consequently, they go unnoticed and are underestimated even by their closest family and friends. The use of revascularization to improve function remains a subject of debate due to the lack of standardization in research protocols and the diversity of assessment tests employed. Therefore, if this relationship is not clear to us, the question arises: could we expect any change after surgery? Or, more importantly, is it worth performing in terms of neurocognitive outcomes?

The pathophysiology of cognitive dysfunction is quite complex, as multiple factors can influence it. Vascular mechanisms (cerebral hypoperfusion, silent cerebral infarction, or silent embolization) could be involved; accordingly, we could assume that the revascularization procedure might improve cognitive function primarily by restoring cerebral blood flow, correcting chronic cerebral hypoperfusion, and ultimately reducing microemboli formation.[2,3] However, findings regarding changes in cognitive function post-surgery are remarkably contradictory. Some trials report improvement, whereas others report no changes or even subsequent functional decline.[4-6] Differences in study design, small sample sizes, and inconsistent selection of cognitive tests could account for these significant discrepancies and the lack of a definitive conclusion. Furthermore, more recent studies focus solely on the cognitive deficit attributable to carotid stenosis, overlooking the scope of all other mental and cognitive correlations that might be involved. Evidently, other aspects would seem to be of interest when indicating revascularization.

Neurocognitive impairment or dementia entails a reduction in mental activities, memory, judgment, and problem-solving capacity. Its association with decreased cerebral perfusion is evident, as are the hemodynamic consequences of carotid stenosis and its subsequent resolution. Critical

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brain regions (adjacent to the middle cerebral artery) are compromised, reflecting delayed blood flow to vulnerable areas and correlating the cognitive deficit with reduced oxygen and nutrients delivered to the neural network (memory, attention, and processing speed).[2] Following revascularization, better-perfused brain areas have been documented. Pre-existing lesions, such as white matter hyperintensities, cortical atrophy, and lacunar infarcts, have become negative predictors of postoperative clinical improvement.[7,8] However, the clinical benefit in this group of patients remains unclear, as does the extent to which pre-existing lesions may influence more or less favorable outcomes. Despite the acknowledged limitations regarding heterogeneity in non-randomized studies, carotid endarterectomy / carotid artery stenting (CEA/CAS) rarely improves overall late cognitive function in asymptomatic patients (< 2%).[1]

Although the significant association between cognitive impairment and carotid stenosis in asymptomatic patients is widely reported, it does not establish into a proven causal relationship and does not automatically imply an etiological link, since, to date, there is still no clear evidence that such stenosis causes cognitive decline. However, patients with severe carotid lesions and impaired cerebrovascular reserve might be more likely to present cognitive impairment, even in the long term. This raises the need to evaluate vulnerable patient subgroups that might benefit most from interventions to prevent or reverse cognitive decline.[9]

The assessment of cognitive impairment in the context of cerebrovascular disease remains a source of controversy, due to the lack of tools specifically designed and validated for this population. The Mini-Mental State Examination (MMSE), developed by Marshall Folstein and colleagues in 1975, has historically been one of the most widely used tests for global cognitive assessment in clinical practice. Its widespread dissemination is due to its brevity, ease of administration, and utility as a screening instrument. However, it presents significant limitations, particularly in detecting mild cognitive impairment, due to its lower sensitivity in assessing executive functions, complex attention, and other higher-order domains.[10] On the other hand, the Montreal Cognitive Assessment (MoCA), developed by Ziad Nasreddine in 2005, was designed to improve the early detection of mild cognitive impairment. This tool explores multiple cognitive domains more comprehensively—including memory, attention, executive functions, visuospatial skills, language, and orientation—which grants it greater sensitivity, especially in early stages and in domains frequently compromised in vascular disease.[11] Although both tests are widely used, their diagnostic performance varies with the assessed domain and the patient's clinical characteristics. In the context of post-stroke cognitive impairment, some studies have shown comparable performance between the two tools; nevertheless, accumulated evidence suggests that the MoCA exhibits greater sensitivity for detecting subtle deficits, particularly in executive functions, attention, and visuospatial skills.[12] In contrast, the MMSE tends to underestimate cognitive compromise in early stages. These aspects acquire special relevance in patients with transient ischemic attack and stroke, in whom early detection of cognitive impairment has prognostic and therapeutic implications. In this group, the MoCA has demonstrated greater discriminative capacity, identifying alterations that the MMSE fails to detect.[12-15] Similarly, in vascular dementia, the MoCA has evidenced better diagnostic parameters.[14] Nonetheless, both tools present limitations, including the influence of educational level and sociocultural factors on the results. Furthermore, neither test alone allows for a comprehensive assessment of the complexity of vascular cognitive impairment, which is characterized by a heterogeneous compromise across multiple domains. In this context, although the MoCA could be considered more suitable for initial screening, its use should be integrated into a multimodal approach that includes more comprehensive neuropsychological evaluations.[16,17] Combining both tools can improve diagnostic accuracy and provide a more comprehensive assessment of cognitive function. Future studies should focus on standardizing specific protocols and validating instruments with greater diagnostic precision and long-term prognostic value.

Regarding medical treatments with neuroprotective effects, aggressive medical therapy has been linked to a beneficial effect by reducing the incidence of stroke/TIA in patient populations with asymptomatic carotid stenosis.[18,19] However, standardized therapeutic regimens are lacking, both in dosing and in the populations under study. Some studies indicate that combining statin therapy with surgery could improve cognitive outcomes, while others report no significant effects. Preoperative use has been associated with a lower incidence of postoperative cognitive dysfunction (POCD), probably due to its neuroprotective effect, and its utilization could be justified by its direct impact on the pathophysiological processes of cognitive impairment in carotid stenosis,

chronic cerebral hypoperfusion, and the effects of microembolization originating from unstable plaques. Its efficacy and use in reducing major adverse cardiovascular events are well established, making statins indispensable in both primary and secondary prevention strategies. However, variability in the findings highlights the need for standardized tests and long-term follow-up to accurately assess the cognitive impact of revascularization accurately. Dexmedetomidine (DEX), an alpha-2 adrenergic agonist, is used in anesthesia for better sedation and for the management of postoperative delirium and chronic nerve compression pain. A randomized study demonstrated improvements in MMSE and MoCA scores following carotid endarterectomy and DEX use, primarily related to brain-derived neurotrophic factor (BDNF) and lactate levels.[20] The use of nimodipine, a calcium channel blocker and cerebral vasodilator, was promoted to improve memory and sensorimotor function associated with aging, as well as neurological deficits following ischemic stroke and subarachnoid hemorrhage.[21] Its neuroprotective effect likely contributes to combined perioperative strategies alongside carotid revascularization. Further clinical trials with larger sample sizes will be required to optimize dosage and administration strategies.

But the final question, from my perspective and within this context of uncertainty, is: carotid endarterectomy or endovascular treatment (carotid stenting) to improve neurocognitive impairment? Certain considerations must be clarified.

Based on current evidence, revascularization could benefit patient subgroups with high-risk characteristics (ulcerated and unstable plaques, microembolism, silent infarcts). Individual selection would seem to be the most recommended approach. Indiscriminate use in asymptomatic patients remains highly controversial, as the risks of the procedure and subsequent restenosis must be weighed.[22] First, the neurocognitive benefit of carotid endarterectomy is related to the improvement of chronic hypoperfusion, especially in patients with mild cognitive impairment, particularly in the areas of attention and memory.[23] Very elderly patients (>80 years old) would not benefit significantly, likely due to their limited vascular plasticity and prior decline.[24] However, the benefit of their treatment should be weighed against postoperative cognitive decline and a probable cerebral hyperperfusion syndrome, which has an observed incidence between 6% and 30% of cases, where the resulting edema and cortical brain damage could determine even greater cognitive impairment.[19] Factors such as prolonged carotid clamping, diabetes, or the degree of previous carotid stenosis have been linked to this condition.[25]

Regarding endovascular treatment, carotid artery stenting has demonstrated greater benefits in visual, spatial, executive, and motor functions. This difference compared to endarterectomy is not entirely clear, though it is probably related to the type of flow restoration.

The truth is that both procedures appear to be safe. Yet, they are dependent on factors such as age, comorbid conditions (hypertension, diabetes, prior cognitive deficit, psychiatric disorders), prior microvascular disease, lesion laterality, and the complications inherent to each procedure, which affect the rehabilitation of each patient.

In our experience, we recently and prospectively estimated cognitive performance in asymptomatic and symptomatic patients using two versions of neurological tests.[26] We used both the MoCA and the MMSE to assess cognitive function in relation to the performed carotid endarterectomy. Although a larger sample size and a longer follow-up period are required, our main finding was that carotid revascularization may improve language function in asymptomatic patients with severe carotid disease, as assessed by the MoCA test. This finding could not be corroborated with the MMSE. This result probably aligns with the original MoCA study and other studies, which showed that the MoCA has higher sensitivity than the MMSE for detecting subtle cognitive impairment.[11,12] Furthermore, we must consider that language assessment with the MMSE is more superficial, which could explain the lack of improvement on that test. This promising finding could spur additional studies to evaluate language and other cognitive domains in this group of patients.

CONCLUSION

Given the current information, it is difficult to recognize the neurocognitive impact of carotid revascularization. Highly heterogeneous populations and treatments suggest that the effectiveness of these interventions would depend on proper patient selection and on individual factors such as age, vascularization, or prior cognitive status. Certain types of lesions may predict more favorable or adverse outcomes, as underlying brain pathology can influence the treatment response.

On the other hand, many tools for assessing cognitive status seem insufficient for evaluating specific, significant impairment in each domain. Future research could identify vulnerable subgroups (for example, those with impaired cerebrovascular

reserve) or provide stronger evidence that silent embolization in patients with carotid stenosis causes cognitive impairment. To date, there is no conclusive evidence supporting that interventions in patients with severe carotid stenosis can prevent or reverse cognitive impairment.

Declaration

The author declares no conflicts of interest.

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MIGUEL ÁNGEL LUCAS (1933-2026)

A gladiator of our profession

Miguel Ángel Lucas was born on February 15, 1933. He earned his medical degree in 1956 from the University of Buenos Aires School of Medicine. In 1955, while serving on call as a senior intern at the Salaberry Hospital, he treated a patient with a gunshot wound to the chest. This defining moment sealed his destiny as a vascular surgeon. In 1956, he joined the Surgery Service of the Hospital Militar Central Cirujano Mayor Dr. Cosme Argerich, under the guidance and mentorship of Dr. Hugo Mercado. In 1960, he joined the cardiovascular surgery team at what was then the Policlínico Ferroviario Central. Three years later, alongside Dr. Félix Cantarovich and Dr. Roque Ruiz, he performed the first deceased-donor kidney transplant.

He became a founding member of the Argentine College of Cardiovascular Surgeons (CACCV) in April 1975.

In 1977, the Sanatorio San Patricio, where Dr. Lucas served as Chief of Cardiovascular Surgery, established a transplant program that went on to complete 200 procedures.

He served as Director of the Postgraduate Cardiovascular Surgery Residency Program at the Universidad del Salvador from 1977 to 1999. As a member of the Argentine Academy of Surgery, he presented Dr. Juan Carlos Parodi's historic first case of aortic endoprosthesis on November 28, 1990.

He served as President of the Argentine Association of Angiology and Cardiovascular Surgery and the CACCV Evaluation Board from 2000 to 2005, and Director of the *Argentine Journal of Cardiovascular Surgery* from 2005 to 2012. He was also a member of the Editorial Board of several prestigious journals, including the *Annals of Vascular Surgery, the International Journal of Vascular Surgery,* the *Anales de Cirugía Vascular,* the *Archivos de Cirugía Vascular*, and the *Actas Cardiovasculares*.

A passionate supporter of Club Atlético Huracán, he shared his life with María Teresa, "Chiquita", and was a devoted father to Stella Maris, Miguel Ángel, Héctor, and Luis Fernando.

Dr. Lucas represented our country globally through his involvement with the International Society for Cardiovascular Surgery. He was a master mentor to hundreds of renowned surgeons, an advisor to the younger generations, an

undisputed driving force behind the advancements in our specialty, and the *alma mater* of the CACCV in its pursuit of excellence—rigorous in his judgments, yet deeply kind to his pupils.

In his 2005 book, *Anecdotario cardiovascular* (Cardiovascular Anecdotes), he gifted us countless stories featuring almost all the leading figures of cardiovascular surgery, compelling us to carry forward their legacy. Distant from mere protocol and formality, through his unshakeable faith, he helped us grow, forced us to believe, and showed us the path: selflessness, commitment, responsibility, and, above all, unconditional love for one's neighbor and for the simpler things in life.

Miguel Ángel, this is my humble and deeply emotional tribute. That brilliant generation of gladiators is fading, but it does so in peace. We carry on your fight.

We shall not yield, not even in defeat!

Dr. Juan Esteban Paolini

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