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Scientific letters

Exertional dyspnea following lumbar microdiscectomy

Disnea de esfuerzo tras microdiscectomía lumbar

To the Editor,

We report the case of a 50-year-old woman who presented to the emergency department with dyspnea and no known history except for a recent microdiscectomy for a herniated right L4-L5 lumbar disc. A week after surgery, she developed progressive dyspnea, even on minimal exertion. There were also signs of peripheral congestion and orthopnea.

On physical examination, the patient was hemodynamically stable. Notable findings were jugular venous distension, the Kussmaul sign, a pronounced carotid pulse, and a systolic murmur in the aortic pulmonary area with a split S2 and bibasilar crackles. Palpation revealed a soft abdomen and an abdominal murmur with no pain or palpable masses. Pitting edema was visible up to the pretibial region on the lower extremities.

Laboratory tests showed elevated D-dimer (4183 ng/mL) and N-terminal fragment of brain natriuretic peptide (NT-proBNP) (995 pg/mL) levels. There was blunting of both costophrenic sinuses on chest radiography. The electrocardiogram showed sinus tachycardia (110 bpm), while bedside cardiac ultrasound showed slightly dilated right cavities with normal functioning, although we could not rule out an ostium secundum-type atrial septal defect. There were no signs of heart valve disease or pericardial effusion. Given the elevated D-dimer levels, computed tomography of the pulmonary arteries was performed to rule out pulmonary thromboembolism.

The initial clinical diagnosis was a decompensated atrial septal defect following lumbar surgery. The patient underwent a complete transthoracic and transesophageal echocardiographic examination, which ruled out this defect and showed normal cavities. The only other significant finding was high estimated cardiac output (8.9 L/min). Considering the above, a tentative diagnosis of high-output heart failure was considered. Right heart catheterization showed a mean pulmonary artery pressure of 29 mmHg, a right atrial pressure of 10 mmHg, a right ventricular pressure of 4 mmHg, and a pulmonary capillary pressure of 18 mmHg. Multilevel venous blood gas sampling revealed an inferior vena cava oxygen saturation of 88%, indicating a possible arteriovenous shunt in the lower body. Computed tomography angiography of the aorta (figure 1) showed a right ilio-iliac arteriovenous fistula (AVF) caused by perforation of the anterior part of the annulus fibrosus and the common vertebral ligament during curettage of the disc space, which extended as far as the retroperitoneal vascular structures. The injury probably did not affect the entire vascular wall, but would have led to the formation of the AVF. There were 2 treatment options: endovascular surgery or classic open surgery. We chose endovascular surgery, as it is a less invasive procedure that is widely used at our hospital.

The patient progressed favorably. She remained asymptomatic, was discharged, and is currently in New York Heart Association functional class I. Informed consent was obtained for the publication of this case report.

Dyspnea is a common symptom and the differential diagnosis is therefore broad. High-output HF is a rare condition with uncertain prevalence.[1,2] It is characterized by high cardiac output, low systemic vascular resistance (due to peripheral vasodilation or, as in this case, an AVF), and a low arteriovenous oxygen difference. Its most common causes are listed in table 1.

AVF can be congenital or acquired. Acquired AVF secondary to lumbar disc surgery is uncommon, with some series reporting a prevalence $< 0.04\%$.[3,4]

The most common clinical manifestations are abdominal murmur, dyspnea, tachycardia, edema of the lower extremities, and jugular venous distention. If the fistula causes a notable shunt, the Water-Hammer pulse is normal and similar to that seen in aortic insufficiency. In addition, the extremities are often well perfused and warm due to peripheral vasodilation.

A detailed history and thorough physical examination are essential for diagnosis. Analytical data such as NT-proBNP and high-sensitivity troponin I levels and echocardiographic findings are useful. Right heart catheterization with invasive measurement of cardiac hemodynamics has been recommended for patients with clinical heart failure and echocardiographic findings consistent with indirectly assessed high cardiac output.[1] High-output heart failure has traditionally been defined as symptoms in the context of a cardiac index > 4 L/min/m^2 or a cardiac output > 8 L/min.[1]

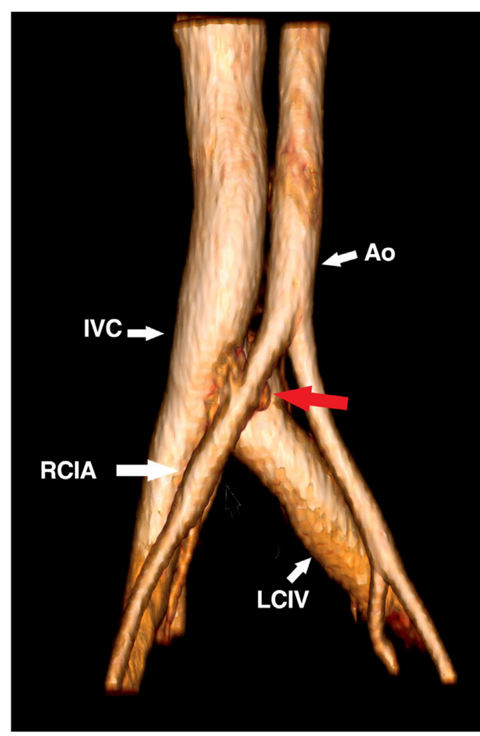

Figure 1. Three-dimensional volume reconstruction showing an ilio-iliac arteriovenous fistula (red arrow). Ao, aorta; IVC, inferior vena cava; LCIV, left common iliac vein; RCIA, right common iliac artery.

Table 1
Most common causes of high-output heart failure[2]

Cause	Frequency, %	Symptoms	Signs	Specific treatment
Obesity	31	Dyspnea, tachycardia	Body mass index > 30	Lifestyle and pharmacological measures, bariatric surgery
Liver cirrhosis	23	Asthenia, increased waist circumference, dyspnea	Alcohol abuse, viral hepatitis, obesity, autoimmune diseases, abdominal distention, mucocutaneous jaundice, gastrointestinal bleeding	Liver transplant, dual treatment with antiminerals or corticosteroids and loop diuretics
Arteriovenous shunts	23	Dyspnea, orthopnea, edema, palpable thrills, murmur over AVF	Hereditary hemorrhagic telangiectasia with mucocutaneous or gastrointestinal bleeding episodes. History of surgery in the case of iatrogenic AVF	In the case of congenital AVF, treatment of underlying cause (medical treatment, invasive or surgical embolization) In the case of acquired AVF, surgical or percutaneous closure or reduction
Pulmonary diseases	16	Dyspnea, wheezing	COPD, bronchiolitis, bronchiectasis, interstitial diseases	Aerosol therapy, noninvasive ventilation, mucolytics
Myeloproliferative disease	8	Tiredness, dyspnea	Fever, increased periods of bleeding, splenomegaly, peripheral blood smear abnormalities	Chemotherapy, hematopoietic stem cell transplant
Hyperthyroidism	Variable, not recorded in studies	Tachycardia, palpitations, dyspnea	Fever, tremor, hyperreflexia, hyperactivity, goiter	Antithyroid hormones, radiotherapy, surgery
Sepsis	Variable, not recorded in studies	Tachycardia, tachypnea, warm well-perfused extremities	Fever, chills, fatigue, loss of appetite, palpitations, altered mental status	Life support, targeted antibiotic therapy
Anemia	Not recorded in studies	Tachycardia, asthenia	Mucocutaneous pallor, external bleeding, pain due to expanding hematoma, brain fog	Specific treatment of cause, iron replacement
Beriberi	Not recorded in studies	Dyspnea, orthopnea, palpitations, peripheral edema with burning pain	Malnutrition, alcoholism	Thiamine replacement for at least 2 weeks
Paget disease	Not recorded in studies	Osteoarthritic pain, neuropathy	Bone deformation, sensory and motor deficit in cases of spinal cord involvement	Bisphosphonates

Finally, it is important to treat the heart failure symptoms and the underlying cause. Surgical or endovascular repair is the definitive treatment for acquired AVF, as when performed early it reverses cardiac remodeling.[1]

Heart failure with preserved ejection fraction was included in the differential diagnosis, as it can be caused by high cardiac output. It is rare and usually has a reversible trigger (eg, anemia, high cell turnover, previous treatment). A high index of clinical suspicion and appropriate use of multimodal imaging combined with invasive diagnostic and therapeutic techniques are important.

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AUTHORS' CONTRIBUTIONS

A.B. Rojas Brito is the lead author of this article. S.C. Huerta edited and oversaw the article and was involved in diagnosing the patient. E.D. Pérez Nogales and B. Saiz Udaeta were involved in diagnosis and treatment. J.M. Rubio García prepared the 3-dimensional volume reconstruction.

CONFLICTS OF INTEREST

None.

STATEMENT

This case report was selected for publication in *Revista Española de Cardiología* from among all those received for the 2022 edition of the League of Clinical Cases of the Spanish Society of Cardiology.

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What have we learned from robotic-percutaneous coronary intervention so far? Early experience in a tertiary center

¿Qué hemos aprendido de la revascularización asistida por robótica? Experiencia inicial de un centro terciario

To the Editor,

In recent years, robotic-assisted percutaneous coronary interventions (R-PCI) have been used as a feasible, effective, and safe alternative to manual PCI.[1] The initial results have been favorable,[1] and in the last decade, despite the complexity of robotic procedures increasing their difficulty,[2] these good results have persisted,[3] with the added benefit of minimized radiation exposure and reduced orthopedic problems derived from the lead apron.[4,5]

Because this technology continues to be introduced in catheterization laboratories, evidence of day-to-day R-PCI is scarce. Therefore, we present a retrospective registry of the first 58 consecutive R-PCI cases (64 coronary stenosis) performed in a tertiary center between June 2021 and January 2022. All patients had severe coronary artery disease (CAD) with an indication for revascularization due to symptoms, induced ischemia, or previous diagnosis of severe CAD in a high-risk territory (either on coronary computed tomography or a previous angiogram). All procedures were performed with the Robotic CorPath 200 System (Corindus Vascular Robotics, United States), where a bedside sterile cassette engaged to the guiding catheter allows remote control of wires and devices from the control console. All patients signed all pertinent informed consent forms both for tests and publication, and the work was approved by the ethics committee of our center.

All procedures were performed under conscious sedation. The patients were followed-up after the procedure, and events, including death, myocardial infarction (MI), angina, bleeding, stroke, heart failure decompensation, or renal function impairment were recorded.

The median interquartile range age of the patients was 64 [54-77] years and 43 (74.1%) were male. The prevalence of cardiovascular risk factors was high: 67.2% had hypertension, 29.3% diabetes mellitus, 69% dyslipidemia, and body mass index was 27.81 [24.83-31.49] kg/m^2; 43 (74.1%) had a prior history of CAD, with a median ejection fraction of 55% [45%-60%].

Twenty patients (34.5%) were symptomatic with induced ischemia on stress imaging. Thirty-eight (65.5%) were staged procedures of non-culprit lesions in patients with a prior MI. Except for 3 cases, all interventions were performed through the radial approach (94.8%), and we treated a total of 64 stenotic lesions localized either in the left anterior descending (31.2%), circumflex (23.4%), right (31.2%), or side coronary branches (14.2%). When simultaneously measuring radiation (microGy/

Table 1
Procedural characteristics of overall and first and second half of robotic interventions

		First quarter	Second quarter	*P*	N
Patients	n = 64	n = 31	n = 33		
AHA lesion:				.776	64
A	11 (17.2)	6 (19.4)	5 (15.2)		
B1	20 (31.2)	11 (35.5)	9 (27.3)		
B2	20 (31.2)	8 (25.8)	12 (36.4)		
C	13 (20.3)	6 (19.4)	7 (21.2)		
Complex lesion	33 (51.6)	14 (45.2)	19 (57.6)	.458	64
Number of vessels treated	1.12 (0.33)	1.07 (0.26)	1.17 (0.38)	.235	58
Number of stents per patient	1.00 [1.00-2.00]	1.00 [1.00-1.00]	1.00 [1.00-2.00]	.124	58
Length of stenting, mm	21.0 [17.5-32.0]	20.0 [16.0-28.0]	23.0 [18.0-34.0]	.178	63
Mean diameter, mm	2.75 [2.62-3.00]	2.75 [2.62-3.00]	2.75 [2.62-3.00]	.877	63
Contrast, mL	170 [125-225]	190 [150-242]	160 [105-190]	.016	58
Fluoroscopy time	16.0 [11.0-22.9]	19.0 [15.0-28.0]	14.5 [9.20-22.0]	.077	58
Procedural time, min	74.0 [53.0-105]	88.0 [62.0-109]	64.0 [45.0-79.8]	.011	58
PDA, microGy/m^2	9532 [5155-12 552]	9532 [4783-11 344]	9147 [5534-13 834]	.461	58
Need to change guiding catheter	8 (12.5)	5 (16.7)	3 (9.38)	.467	64
Manual conversion	6 (9.38)	5 (16.1)	1 (3.03)	.099	64
Intraprocedural complications	4 (6.25)	4 (12.9)	0 (0.00)	.053	64
Successful R-PCI	61 (95.3)	29 (93.5)	32 (97.0)	.607	64

AHA, American Heart Association; PDA: Product dose area; R-PCI, robotic percutaneous coronary intervention.
Values are shown as No. (%) or median interquartile range.