Iliac Stent Migration to the Right Atrium—Late Detection, a Complex Clinical Problem

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INTRODUCTION

Stent migration is a rare but serious complication of venous stent placement. It can be associated with arrhythmia, thrombosis, embolism, and vascular and/or organ perforation. No clear guidelines exist on managing venous stent migration. However, consensus on approaches to management include surveillance imaging, endovascular retrieval, and, if needed, surgical removal. This case demonstrates how multimodality imaging, including echocardiography, computed tomography (CT), venography, and fluoroscopy, can guide the multidisciplinary management of migratory iliac venous stent at multiple stages.

CASE PRESENTATION

A 38-year-old man with attention deficit hyperactivity disorder, morbid obesity (body mass index, 46.2; body surface area, 3.1 m^2), and chronic bilateral lower extremity lymphedema presented to the office with intermittent left chest pain, palpitations, and fatigue for several weeks. Five months prior, the patient had undergone bilateral iliac venous stent placement for vein decompression. At that time, bilateral iliac venograms (Figure 1A) with intravascular ultrasound were performed. There was at least 50% stenosis of the iliac veins noted bilaterally, likely due to Rokitansky narrowing, a phenomenon in which a fibrous sleeve of the vessel causes perivenous luminal constriction. Measurements were obtained using intravascular ultrasound, with the widest reference diameter 16.6 mm in the right iliac vein (Figure 1B). A single 16 mm diameter × 10 cm long self-expanding venous stent was deployed on the left extending from the iliac vein confluence down across the narrowing with a set of nested 16 and 14 mm diameter stents on the right extending from the iliac vein confluence to the level of the inguinal ligament. Completion fluoroscopy with venogram (Figure 1C and D) demonstrated resolution of narrowing on both sides. The patient was discharged on warfarin and switched to rivaroxaban at 1 month follow-up when improvement of edema was noted.

The patient reported that they experienced symptoms of severe chest pain on the night following the procedure. Records suggested that after basic negative workup, the patient was reassured that there was no active cardiopulmonary process and advised to follow up as an outpatient. No additional imaging studies were performed.

At 5 months postintervention, the patient continued to have chest pain and palpitations. Exam was unremarkable except for sinus tachycardia at 120 bpm. Electrocardiogram showed no arrhythmia (Figure 2). Twenty-four-hour Holter monitoring showed sinus tachycardia.

A transthoracic echocardiogram (TTE) revealed a hyperechoic mesh-like mobile object in the right atrium (RA). Left ventricular systolic function was normal (Figure 3A, Video 1), and a small

VIDEO HIGHLIGHTS

Video 1: Two-dimensional TTE, parasternal long-axis view, demonstrates normal left ventricular systolic function and a small pericardial effusion.

Video 2: Two-dimensional TTE, right ventricular inflow tract view without (*left*) and with (*right*) color-flow Doppler, demonstrates normal right heart chamber dimensions and normal tricuspid valve on the left, with mild tricuspid regurgitation demonstrated on the right. The migratory stent is partially visualized in the RA and IVC.

Video 3: Two-dimensional TTE, apical 4-chamber view without (*left*) and with (*right*) color-flow Doppler, demonstrates the venous stent as a fixed, hyperechoic round object within the RA. No flow disturbance is noted.

Video 4: Two-dimensional TTE, subcostal view without (*left*) and with (*right*) color-flow Doppler, demonstrates the venous stent, which is mobile within the RA and fixed within the IVC. The *right panel* demonstrates laminar flow without the suggestion of obstruction or shunting.

Video 5: Preoperative two-dimensional TEE, midesophageal bicaval view, X-plane display, demonstrates the stent within the RA and extending into the IVC.

Video 6: Postoperative two-dimensional TEE, midesophageal bicaval view, X-plane display, demonstrates successful removal of the stent from the RA.

Video 7: Follow-up two-dimensional TTE, subcostal view without (*left*) and with (*right*) color-flow Doppler, demonstrates stable position of the retained stent within the IVC and laminar flow without the suggestion of obstruction.

View the video content online at www.cvcasejournal.com.

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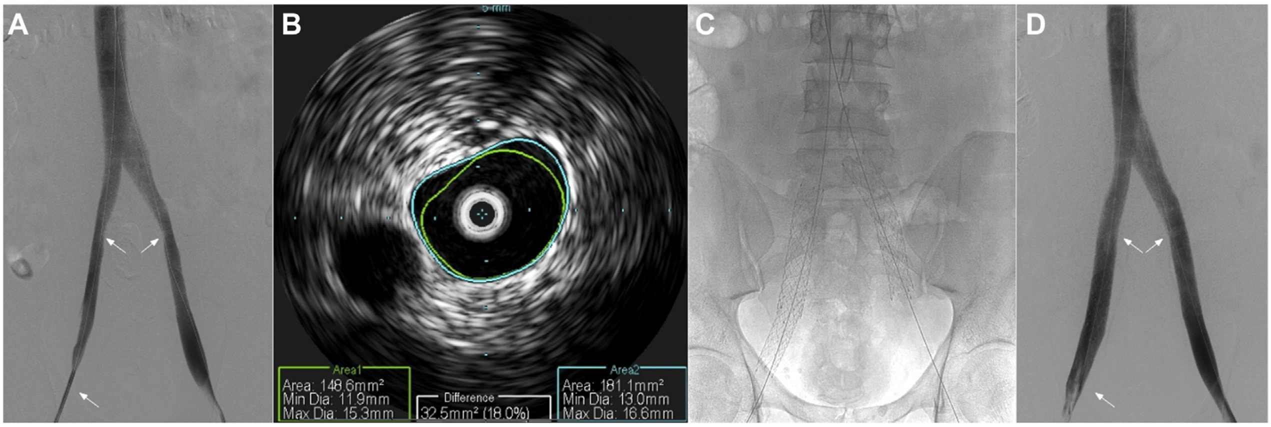

Figure 1 **(A)** Venogram with fluoroscopy, anterior-posterior view, demonstrates narrowing of the bilateral iliac veins (*arrows*) prior to stent placement. **(B)** Intravascular ultrasound of the right common iliac vein demonstrates a maximal venous diameter of 16.6 mm. **(C)** Fluoroscopy demonstrates the newly placed stents extending adequately across bilateral target lesions. **(D)** Postprocedure venogram demonstrates reduced vessel narrowing and improvement in venous flow.

Figure 2 Twelve-lead electrocardiogram on initial presentation demonstrates sinus tachycardia and poor R-wave transition without acute ischemic abnormalities.

pericardial effusion was present. The tricuspid valve was structurally intact (Figure 3B) with mild regurgitation (Figure 3C, Video 2), and the stent appeared distant from the valve. A hyperechoic ring was present in the RA (Figure 3D, Video 3) adjacent to the roof, abutting the interatrial septum and extending into the inferior vena cava (IVC; Figure 3E, Video 4).

Based on these findings, the patient was sent to the emergency department for evaluation. STAT CT of the chest/abdomen/pelvis without contrast (Figure 4) confirmed the presence of a stent-like object in the RA, which was determined to be the right iliac venous stents given their absence from the iliac vein in the pelvic axial view. It was difficult to determine the exact positioning of the cephalad end of the intra-atrial stent, but there was concern that it had penetrated a part of the myocardium and caused a small amount of hemopericardium (as indicated by the red arrow in Figure 4, sagittal view).

Heparin infusion was initiated. After multidisciplinary consultation with vascular and cardiothoracic surgeons, a decision was made to proceed by endovascular approach due to lower risk and quicker recovery. After confirming the positions of both migratory stents within the distal IVC and RA by fluoroscopy (Figure 5), a snare was introduced to attempt retrieval. There was significant resistance upon tugging the stents, during which the patient expressed pain. After 2 failed attempts, further efforts to snare the stents were aborted out of caution for risk of cardiac or vessel rupture. The patient subsequently underwent median sternotomy with surgical explantation of the stent using three-dimensional transesophageal echocardiogram (TEE) guidance. Three-dimensional TEE was used to define the relative position of the stent within the RA and IVC (Figure 6, Video 5). Cardiac surgeons were able to remove the intra-atrial portion but were forced to abandon the intrahepatic stent,

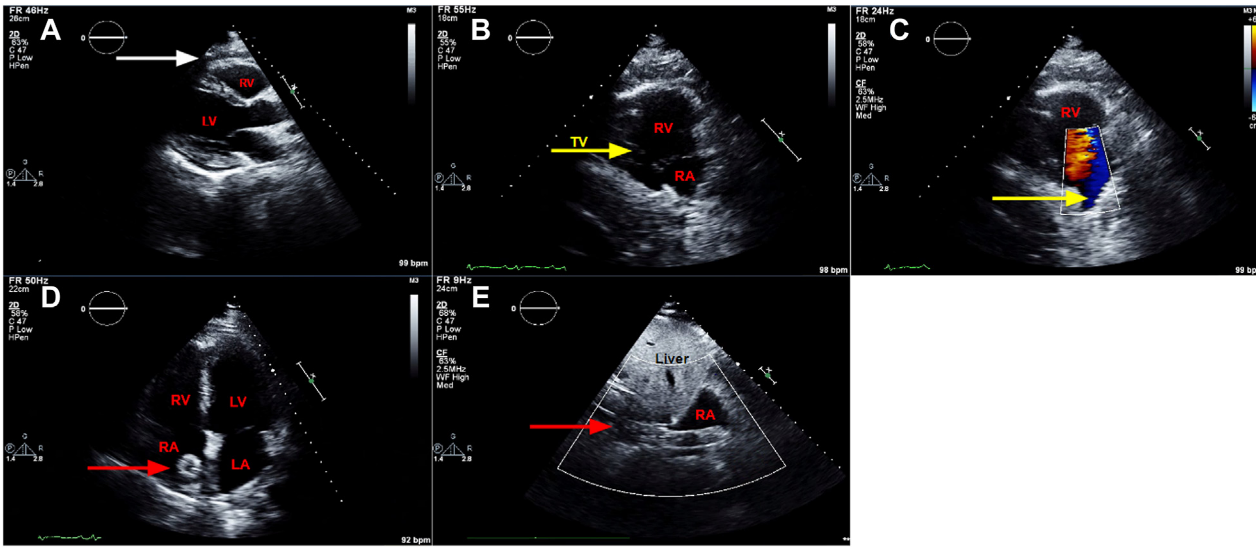

Figure 3 **(A)** Two-dimensional TTE, parasternal long-axis view, systolic phase at initial presentation, demonstrates a small pericardial effusion (*white arrow*) and normal biventricular dimensions. **(B)** Right ventricular inflow tract view demonstrates a structurally normal tricuspid valve (*yellow arrow*). **(C)** Right ventricular inflow tract view with color-flow Doppler demonstrates mild tricuspid regurgitation and a partial view of the migratory stent (*yellow arrow*). **(D)** Apical 4-chamber view demonstrates a hyperechoic ring-shaped object (*red arrow*) in the RA. **(E)** Subcostal view demonstrates the stent within the hepatic IVC (*red arrow*). *LA*, Left atrium; *LV*, left ventricle; *RV*, right ventricle; *TV*, tricuspid valve.

Coronal view (chest) Sagittal view (chest) Transverse view (pelvis)

Figure 4 Computed tomography chest/abdomen/pelvis without contrast demonstrates a stent-like object extending from the RA into the IVC (*arrows, coronal and sagittal view*). In the pelvic axial view, the left iliac stent (*arrow*) was noted in a normal anatomic position, but its right iliac counterpart was absent (*red box*). *PA*, Pulmonary artery.

which appeared to have developed scar tissue as it was enmeshed in the vascular intima (Figure 7).

Postoperative TEE confirmed removal of the stent from the RA (Figure 8, Video 6). The patient was transitioned back to warfarin, and the remainder of the hospital course was uncomplicated.

Postoperative course was complicated by postpericardiotomy syndrome at 6 weeks postprocedure, which responded to ibuprofen, colchicine, and prednisone, as well as a small mediastinal hematoma that was closely monitored and improved on subsequent imaging. The patient was maintained on anticoagulation due to risk of thrombosis.

Follow-up TTE at 2 and 5 months showed stable presence of the retained segment of the stent within the IVC (Figure 9, Video 7).

DISCUSSION

Stent migration is a critical complication that must be recognized early due to risks of arrhythmia, thrombosis, and perforation. Patients will typically present with nonspecific symptoms like chest pain, palpitations, and dyspnea. Although estimated to be ~3%, the true incidence rate is unclear as most cases are thought to be underreported; 41% of cases have been found to be asymptomatic and

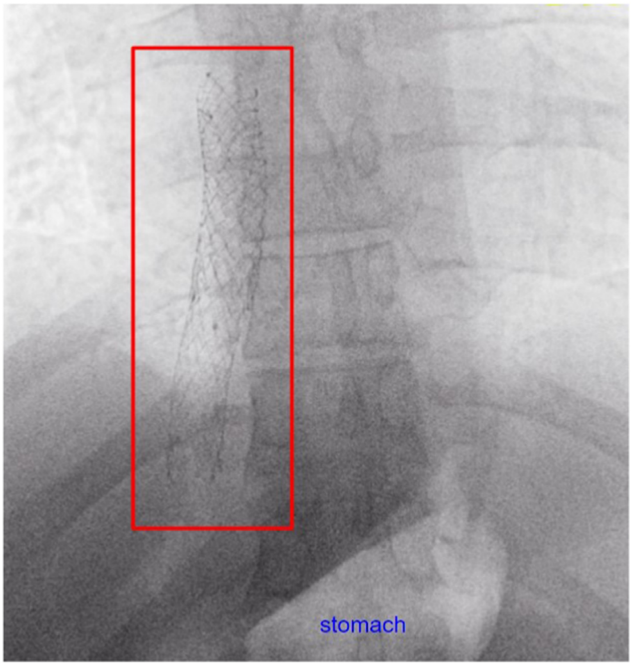

Figure 5 Fluoroscopy during endovascular stent retrieval demonstrates the migratory iliac stent (*box*) within the thorax to the right of the heart. Oral contrast highlights the stomach location for comparison.

incidental.[1] Studies show that incorrect sizing is the leading cause of migration, particularly when stents are narrower and shorter.[1,2] One review showed that 82.6% of migratory stents were ≤60 mm in length[2] and 93.6% were ≤14 mm in diameter.[1,3] Additionally, migration was more common when used in nonthrombotic iliac vein lesions, as veins in these cases are often more compliant[1] and thus less compressive on the stent.

On reviewing the initial sizing, we believe that our patient's stents were undersized. The widest portion in the right iliac vein was measured at 16.6 mm, for which a nested set of 16- and 14-mm stents were placed. No literature describes the appropriateness of stent overlap in these cases, including indication, ideal length of overlap, and associated risk of stent migration. However, some clinicians, including our vascular surgery team, routinely place stents that are 2 mm oversized, with an overlap of 1 cm and a 5-mm margin past the lesion.[4] The patient should have been given a stent that was at least 1 size larger than the lesion and avoided the use of overlapping stents to reduce risk of embolization. In this case, we would have recommended a single, extralong, 18-mm wide stent for this patient's right iliac vein if possible.

Migratory destination is also important to note as specific anatomical locations are associated with unique complications. Iliac venous stents can migrate anywhere from within the IVC to the liver, right heart, and even the pulmonary artery. In a patient with right atrial destination, assessment for injuries of the interatrial septum, left-to-right shunt physiology, pulmonary embolism, tricuspid valve injury, and regurgitation should be considered and assessed with echocardiography. If CT is preferred, a cardiac-gated contrast-enhanced CT could be performed to better characterize stent position, which will assist decision-making for surgical versus endovascular removal.

No guidelines exist for the management of venous stent migration, leading to high variability in type and timing of approach. Based on the 2018 Society for Vascular Surgery practice guidelines, recommendations for the follow-up of superficial and deep venous interventions were decidedly deferred in favor of arterial procedures, which are higher in volume and complexity.[5] Clinicians typically deliberate between surveillance, endovascular retrieval, and surgical extraction. If asymptomatic and incidental, migratory stents could be monitored by intermittent sonography. Currently stent patency is monitored by ultrasound at 6 months and 1 year after placement.[6,7] Stent migration surveillance can be conducted similarly using venous sonography and/or echocardiography. One systematic review found that many clinicians used duplex sonography or CT angiography at varying intervals postprocedure to check for migration,[6,7] with initial imaging ranging from 1 day to 6 weeks after placement, then at 3 months, 6 months, and 1 year.[6,7] Our surgeons typically follow up with the patient 1 to 2 weeks postprocedure, with surveillance imaging at 6 weeks and every 6 months thereafter.

In hindsight, this is a case of late detection of stent migration. While our patient reported feeling severe chest pain the night following stent placement, they did not obtain imaging for another 5 months. Cardiac imaging like echocardiography would have revealed that migration had occurred very early postprocedure, which would have allowed for a successful endovascular intervention. Endovascular retrieval is done in 85% of such cases,[8] which typically has a 90% success rate and lower mortality than a surgical approach.[8,9] By the time our patient was sent for intervention, snaring was unsuccessful due to buildup of scar tissue in the retained stent, ultimately leading to open-heart surgery. In our patient, we would have recommended STAT echocardiography upon presentation with cardiac symptoms given recent venous stent placement. In stable patients, we otherwise endorse surveillance imaging using duplex sonography or CT at 6 weeks, 6 months, and 1 year to monitor for migration. This case serves to inform that stent migration should be considered among differential diagnoses when assessing patients with nonspecific cardiac symptoms and any history of venous stent placement. It also highlights the role that point-of-care echocardiography could play in rapid assessment and early management.

CONCLUSION

Stent migration is a rare but serious complication of venous stent placement. It carries risks of arrhythmia, thrombosis, embolism, and perforation. In all patients presenting with nonspecific cardiac symptoms and any history of venous stent placement, migration should be considered among differential diagnoses and evaluated with stat echocardiography.

ETHICS STATEMENT

The authors declare that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans.

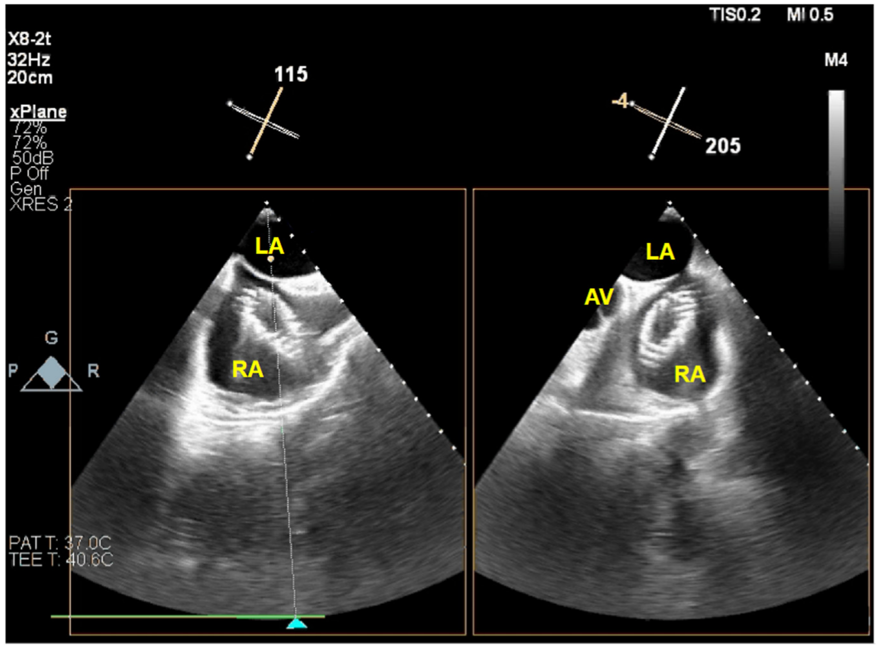

Figure 6 Preoperative TEE, midesophageal bicaval view, X-plane, demonstrates the stent within the RA with one end abutting the interatrial septum. *AV*, Aortic valve; *LA*, left atrium.

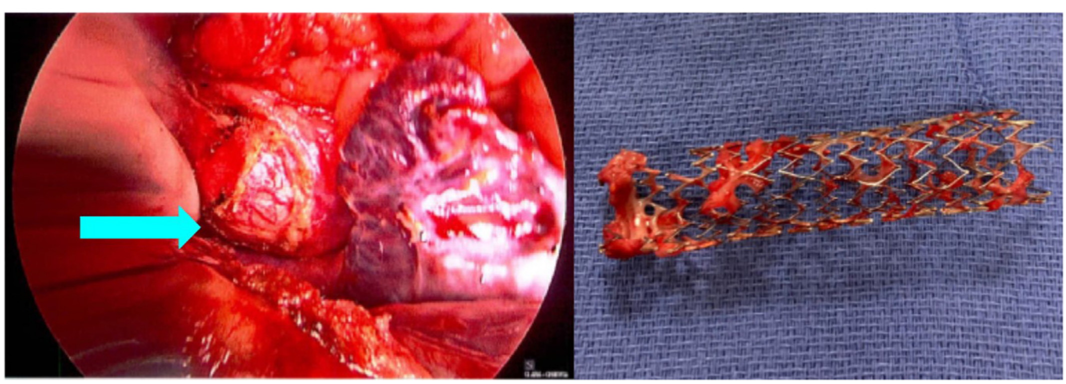

Figure 7 Intraoperative right atriotomy in situ (*left*) and ex vivo (*right*) photographs demonstrate the migratory right iliac vein stent abandoned within the IVC (*arrow*) while the other stent was successfully removed from the RA.

CONSENT STATEMENT

The authors declare that since this was a non-interventional, retrospective, observational study utilizing deidentified data, informed consent was not required from the patient under an IRB exemption status.

FUNDING STATEMENT

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DISCLOSURE STATEMENT

The authors report no conflict of interest.

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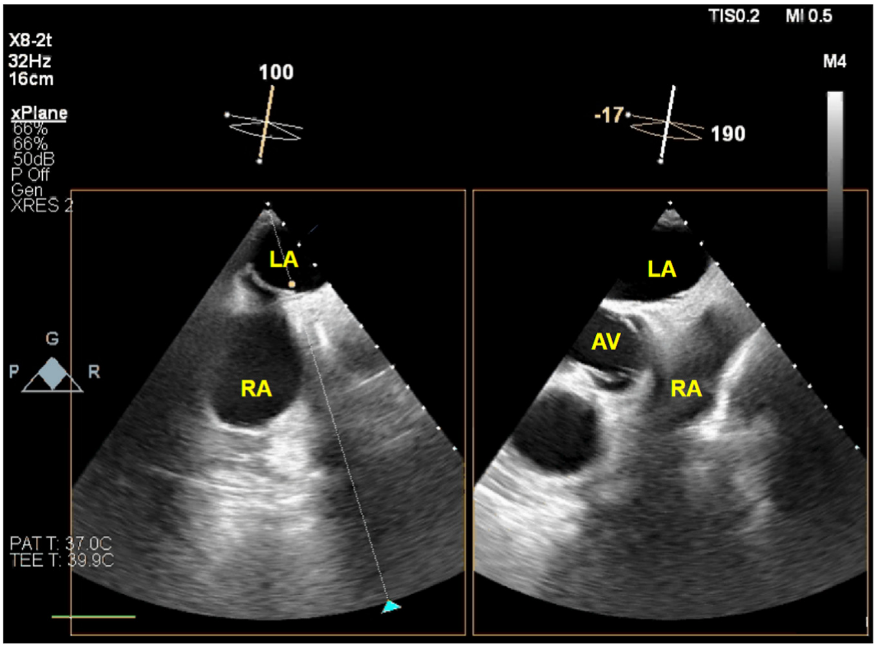

Figure 8 Postoperative TEE, midesophageal bicaval view, X-plane, demonstrates that the migratory stent was successfully removed from the RA. *AV*, Aortic valve; *LA*, left atrium.

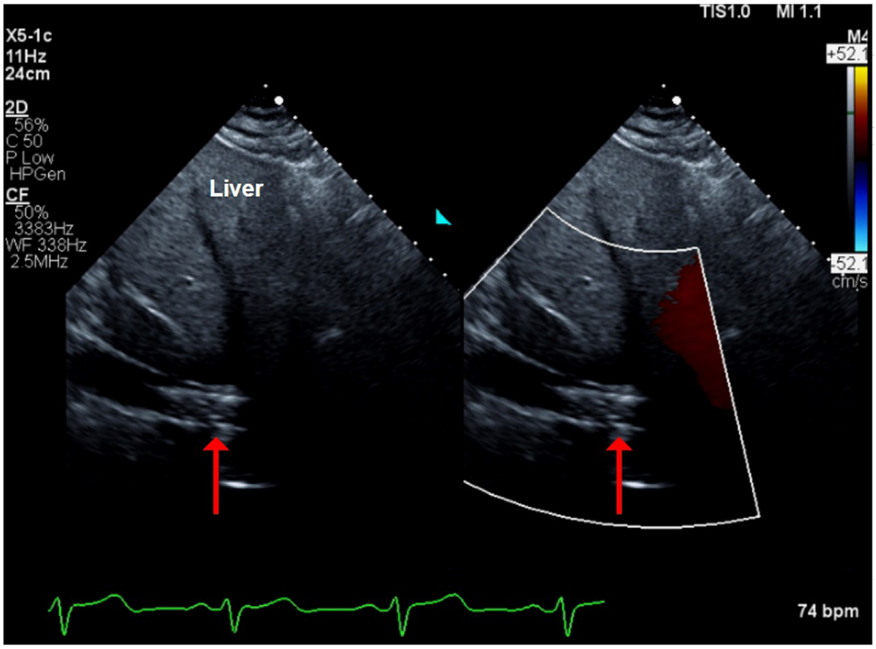

Figure 9 Two-dimensional TTE, subcostal view without (*left*) and with (*right*) color-flow Doppler obtained at follow-up demonstrates the retained segment of the migratory iliac stent (*arrows*) in stable position within the IVC.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.case.2023.08.006.

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