A baffling case of inferior vena cava filter removal in a patient with transposition of the great arteries

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ABSTRACT

A 47-year-old man with a history of transposition of the great arteries after a Mustard atrial switch procedure and prior inferior vena cava filter placement for venous thromboembolism presented for removal before being listed for orthotopic heart transplantation in anticipation of cardiopulmonary bypass cannulation. The filter was retrieved using a right transjugular approach without disruption of his existing atrial baffle. Contingency planning in the event of unsuccessful baffle navigation included a transfemoral everted filter approach. A thorough understanding of unique patient anatomy and multidisciplinary team approach is critical to safe procedural intervention in patients with congenital cardiovascular anomalies. (J Vasc Surg Cases Innov Tech 2024;10:101503.)

Keywords: Congenital anomaly; IVC filter; Transposition of the great vessels; Venous thromboembolism

Transposition of the great arteries (TGA) is a congenital heart defect in which the pulmonary artery is connected to the left ventricle and the aorta is connected to the right ventricle, resulting in parallel circulations and severe neonatal cyanosis in the absence of a mixing lesion such as an atrial or ventricular septal defect. The first surgical repairs were reported in 1959 by Senning[1] and in 1964 by Mustard.[2] Both repairs involved creation of a baffle, in which deoxygenated blood is directed from the cava to the left ventricle and lungs via the pulmonary artery and oxygenated blood is directed to the right side of the heart and delivered systemically through the aorta (Fig 1, *A*). The Mustard procedure typically uses synthetic material (Fig 1, *B*) and the Senning procedure an autograft for baffle creation. Although immediately effective in the correction of cyanosis, this "physiologic repair" results in a permanent connection of the right ventricle to the systemic circulation and, eventually, in systemic ventricular failure in many patients, with a transplant-free survival of 76% at 20 years after the indexed procedure.[3] This pitfall led to the development of the arterial switch procedure, a so-called anatomic repair first performed by Jatene et al[4] in 1975. However, this did not become the standard of care until the 1990s, leaving a significant proportion of the current adult congenital heart disease population with systemic right ventricles that are still prone to ventricular dysfunction.[3,4] Patients with congenital heart disease are at an increased risk of venous thromboembolism (VTE).[5] In the setting of VTE necessitating inferior vena cava (IVC) filter placement, a thorough understanding of this complex anatomy is crucial for all providers involved in the procedural care of this unique patient population. Descriptions of IVC filter placement and retrieval in patients with anatomical variants are scattered throughout the literature.[6] Such studies have been reported of patients with IVC duplication,[7-10] IVC transposition,[11] patent foramen ovale,[12-16] atrial septal defects,[17] and patent ductus venosus.[18] To the best of our knowledge, no cases of IVC filter placement and removal in a patient with dextro-TGA have been described. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

A 47-year-old man with a history of dextro-looped TGA underwent a Mustard procedure at 6 months of age and subsequent revision at 9 years of age. At 40 years of age, he developed multiple deep venous thrombi and pulmonary emboli, ultimately requiring Bard Denali IVC filter placement. His cardiac course was complicated by severe systemic right ventricular dysfunction, sick sinus syndrome, and associated arrhythmias, leading to his listing for orthotopic heart transplantation. In preparation for femoral cannulation for cardiopulmonary bypass, he was referred to vascular surgery for IVC filter removal 7 years after device placement. Preoperative imaging revealed the filter was well centered in the cava with no strut penetration and unclear communication between the superior vena cava and IVC. Multidisciplinary preprocedural collaboration occurred among pediatric cardiology, cardiac surgery, interventional radiology, and vascular surgery.

He was taken to the operating room in conjunction with pediatric interventional cardiology for right heart catheterization and IVC filter removal. Preprocedure contrast-enhanced computed

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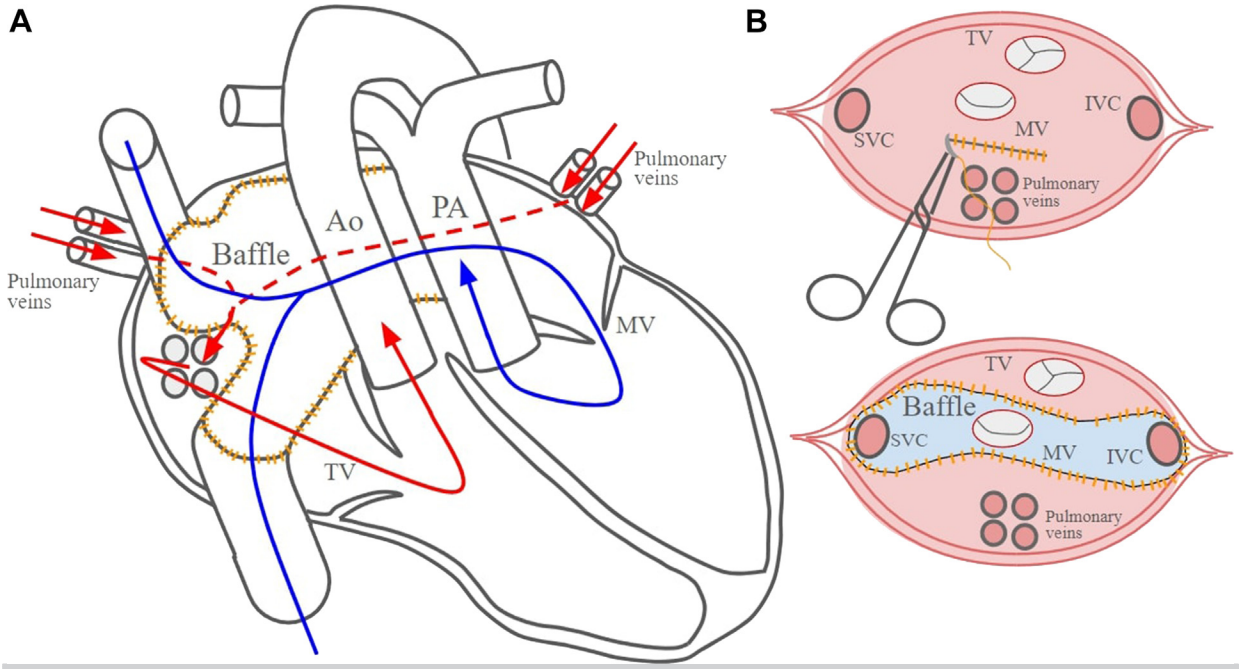

Fig 1. A, Schematic diagram of patient's anomalous anatomy. **B,** Cross-sectional view of the atria depicting the baffle suture line. *Ao,* Aorta; *IVC,* inferior vena cava; *MV,* mitral valve; *PA,* pulmonary artery; *SVC,* superior vena cava; *TV,* tricuspid valve.

tomography of chest, abdomen, and pelvis demonstrated patency of the common femoral veins, iliac veins, and IVC. Under moderate anesthesia, the right internal jugular vein and right common femoral vein were accessed with 5F sheaths. Diagnostic right heart catheterization was performed by cardiology. Following completion, a 0.035-in. Glidewire (Terumo Interventional Systems) and 5F Impress vertebral catheter (Merit Medical) were used to navigate the atrial baffle into the IVC. A venogram was performed, which confirmed caval patency and no filter debris (Fig 2). An Amplatz Super Stiff wire (Boston Scientific) was placed distal to the filter without issue. A coaxial 12F × 80 cm Performer sheath (Cook Medical) was placed within a 14F × 80 cm Performer sheath (Cook Medical) and advanced into the IVC. The filter was snared using a 25-mm Gooseneck snare (Medtronic), and the sheaths were carefully walked over the filter, allowing for smooth device separation from the vessel wall. The baffle was kept within the field of view for the entirety of this portion of the procedure to assess for any evidence of disruption. The filter was then removed, along with the 12F sheath. A venogram of the cava and right atrium was performed, which again demonstrated no venous thrombus or disruption and a normal-appearing baffle (Fig 3). The remaining guidewires and catheters were removed, and manual pressure was used to close the puncture site. The patient was discharged from the hospital the same day, his immediate postoperative course was uncomplicated, and he was ultimately transitioned from apixaban to warfarin in the outpatient setting in anticipation of his pending cardiac transplantation.

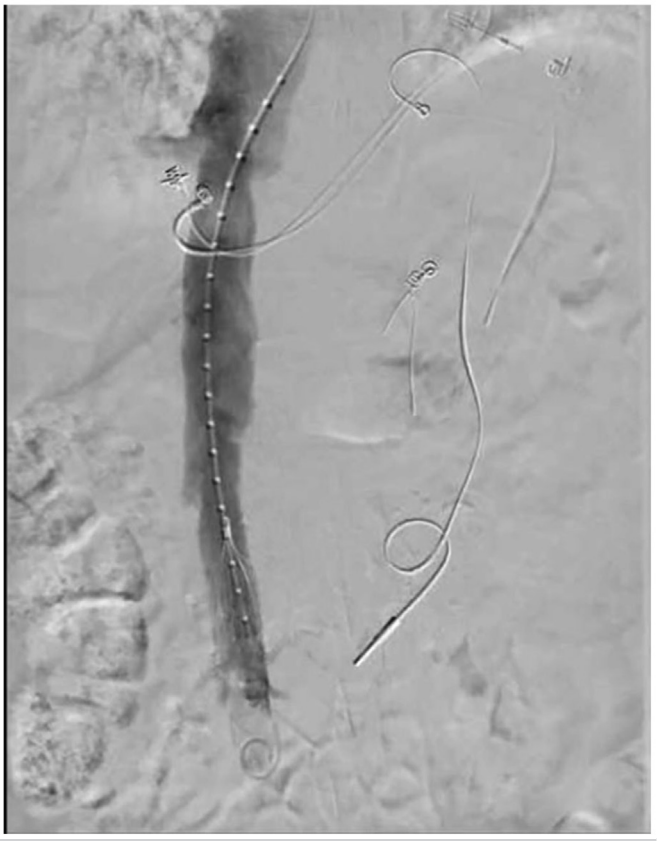

Fig 2. Preoperative venogram demonstrating a patent filter without debris or thrombus.

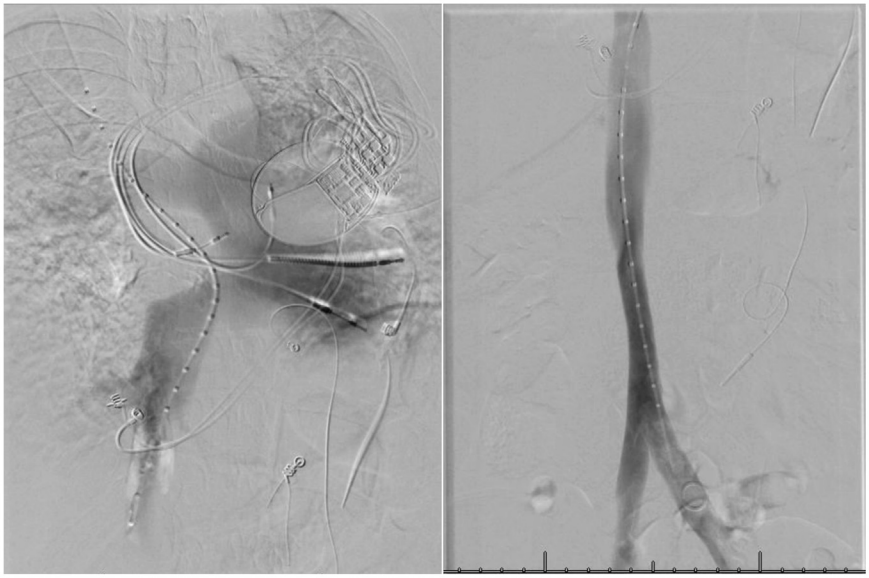

Fig 3. Intraoperative venogram following filter retrieval demonstrating the intact baffle (**Left**) and patent inferior vena cava (IVC; **Right**).

DISCUSSION

TGA is a rare congenital heart anomaly, and before the development of atrial switch procedures in the late 1950s, death for these patients was guaranteed. However, despite its immediate success, patients with TGA and atrial switch remain at risk of significant complications, including arrhythmias, baffle leaks, ventricular dysfunction, and sudden cardiac death.[19] Likewise, the literature demonstrates an increased VTE risk for patients with congenital heart disease, particularly those requiring surgical correction and cardiopulmonary bypass. Despite this, there lacks detail regarding the nuances of IVC filter placement and removal in this anatomically unique demographic.

The primary concern with our patient was avoiding disruption of the baffle and safely removing the filter. The baffle was kept in view throughout the duration of the procedure, and a postprocedural venogram was obtained to confirm no injuries had been missed. Although this was successfully performed with the traditional transjugular approach, alternative planning included transfemoral access. In this previously described technique, the underside of the filter is grasped, and the filter is everted into the sheath and removed in a retrograde fashion through the groin. With Option ELITE filters (Argon Medical Devices), the eversion technique can be limited by filter fracture, often requiring additional steps to remove the retained fractured components of the filter.[20] This option, however, provides a bailout alternative for filter removal when anomalous anatomy makes the traditional approach difficult or altogether impossible.

Additionally, the risk of VTE should be considered. For our patient, a preretrieval venogram was obtained, which demonstrated no residual clots before filter removal. Likewise, the patient's home apixaban therapy was continued throughout the perioperative period to avoid interruption of therapeutic anticoagulation.

In anatomically complex patients, a multidisciplinary team approach is imperative. For our case, preprocedural collaboration occurred among pediatric cardiology, cardiac surgery, interventional radiology, and vascular surgery. Cardiac surgery was standing by in case of the filter becoming lodged in an intracardiac location, because open surgical retrieval, although high risk, could have been potentially necessary in this instance. No complications arose with navigating around the baffle in our case; however, if the filter retrieval became complicated, adjunctive devices such as forceps and larger sheaths would have been used. Likewise, an assumed high risk of complications can necessitate additional equipment such as endovascular occlusion balloons and possible stenting in the event of injury to the IVC during filter removal.

CONCLUSIONS

We described the case of IVC filter removal in a patient with TGA after a Mustard atrial switch. Although safe filter removal can be achieved in patients with aberrant anatomy, careful anatomic planning is paramount.

DISCLOSURES

None.

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