A 47-year-old woman with a history of paroxysmal atrial fibrillation presented with seizure. She noted progressive fatigue in the preceding 6 months. The week before admission, she had worsening headaches and increased irritability. On the day of admission, she developed an episode of grand-mal seizure. MRI of the brain revealed a round lesion in the left frontal lobe measuring 11 cm by 15 mm with an extensive halo of T2 hyperintensity surrounding the lesion and minimal inherent T1 high signal along the border. The lesion was suspicious for an abscess. She was taken to the operating room for biopsy. Craniotomy and corticectomy revealed an abscess cavity with a large amount of purulent material. Culture of the purulent drainage grew *Streptococcus intermedius*. She was started on penicillin G and metronidazole.

A transthoracic echocardiogram revealed normal right and left ventricular size and function (Movie I in the online-only Data Supplement). There was mild left atrial enlargement without evidence for significant valvular abnormalities. Doppler interrogation of the septum in the subcostal view revealed abnormal color flow in the inferoposterior part of the interatrial septum suspicious for a left-to-right shunt (Figure 1 and Movie II in the online-only Data Supplement). Chest x-ray to confirm placement of a peripherally inserted central catheter line showed the tip of the line overlying a left-sided superior vena cava (Figure 2).

To further characterize her anatomy, a cardiac MRI was obtained. MRI with gadolinium contrast revealed a persistent left superior vena cava (PLSVC) opening into the left atrium (Figure 3). MRI also showed complete unroofing of the coronary sinus (Figure 4), which directly communicated with the left atrium and formed a left-to-right shunt. The coronary sinus was enlarged and measured 13 mm at its opening to the right atrium. The Qp/Qs shunt ratio was 1.8 to 1, indicating significant left-to-right shunting (Figure 5A and 5B).

The patient’s left-sided peripherally inserted central catheter line was removed, and a new right-sided peripherally inserted central catheter line was placed for long-term antibiotic administration. After discharge, anaerobic cultures grew *Capnocytophaga* and treatment was changed to ertapenem. She completed an 8-week course of antibiotics. Repeat MRI of the brain revealed

**Figure 1.** Transthoracic echocardiogram images in the subcostal view with Doppler interrogation of the septum revealed an abnormal color flow in the interatrial septum (arrow). LA indicates left atrium; LV, left ventricle; and RA, right atrium.
showed no evidence of abscess recurrence (Figure 6). She was left with no neurological deficit. About 4 months after her initial presentation, she underwent definitive surgical repair. She did well post-op, and has returned to performing all her regular activities.

Discussion

Congenital heart conditions with right-to-left shunting are known to predispose patients to the development of cerebral abscess and thromboembolic events. Transient bacteremia from oropharyngeal flora can occur with tooth brushing or simple dental procedures. These organisms cannot survive the oxygen-rich environment of the pulmonary circulation and are eliminated by alveolar macrophages or the lymphatic system. A right-to-left shunt allows these organisms to bypass the lung and directly enter the arterial circulation and reach the brain.

PLSVC occurs in \( \approx 0.3\% \) of the general population and in 4% to 10% of patients with congenital heart disease.\(^1\) It is the most common form of anomalous system venous return. In \( \approx 90\% \) of the cases, PLSVC drains into the right atrium via the coronary sinus and does not lead to any shunt. In the remaining 8% to 10% of cases, the PLSVC connects directly to the left atrium.

The left cardinal vein is a transient embryological structure that usually joins the right cardinal vein to form the superior vena cava. Its distal tract persists as the coronary sinus.\(^2\) PLSVC occurs when the left cardinal vein fails to regress.

PLSVC that drains into the left atrium is often associated with unroofing of the coronary sinus. An unroofed coronary sinus communicates with the left atrium, in addition to its normal communication with the right atrium. The morphological types of unroofed coronary sinus syndromes have been classified into 4 groups, as follows:\(^3:\) type I, completely unroofed with PLSVC; type II, completely unroofed without PLSVC; type III, partially unroofed mid portion; and type IV, partially unroofed terminal portion. This patient’s MRI finding is consistent with a type I defect.

The PLSVC carries \( \approx 20\% \) of systemic venous return. Patients can be acyanotic if there is also left-to-right shunting.
The degree of left-to-right shunt depends on the number and size of veins connecting the PLSVC to the right-sided venous system, relative impedance of flow into each ventricle, and coexisting cardiac defect. In this case, the patient was acyanotic because there was significant left-to-right shunting through a dilated unroofed coronary sinus.

In placing central venous lines in patients with a PLSVC that drains into the LA, it is important to avoid using the left upper extremity veins, because these preferentially drain into the PLSVC. If a central venous line is needed, any infusion should be filtered and a right-sided line is preferred. Occasionally, there are bridging veins between the PLSVC and the right superior vena cava. These connections should be ruled out before placement of right-sided central lines.

Because the coronary sinus and the left-sided superior vena cava are posterior structures, precise diagnosis with transthoracic echocardiography can be difficult because of the limited windows. Nonetheless, there are often clues, such as abnormal Doppler flows or a dilated coronary sinus, that should prompt further investigation.

MRI allows better visualization of the great arteries and veins. It can also provide accurate anatomic details about the location and size of various cardiac defects. Moreover, shunt volumes can be accurately quantified by the use of phase-contrast MRI.

Surgical correction is indicated if complications related to the right-to-left shunt occur. Although not as well studied, endovascular approaches using the Amplatzer occluder or coil embolization have been reported for the treatment of right-to-left shunt in patients with PLSVC.

Disclosures
None.

References

Figure 5. Flow quantification using cardiac MRI. A, Blood flow through the AO and the PA were selected for quantification. B, The forward flow through the AO was 3.35 L/min, and the flow through the PA was 6.17 L/min. The calculated shunt ratio (Qp/Qs) was 1.84. AO indicates aorta; PA, pulmonary artery.

Figure 6. Left, MRI of the brain on presentation showing a round lesion in the left frontal lobe suspicious for an abscess (white arrow). Right, Repeat MRI of the brain 8 weeks after abscess drainage showing postsurgical changes without evidence of abscess recurrence.
Cerebral Abscess Due to Persistent Left Superior Vena Cava Draining Into the Left Atrium
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