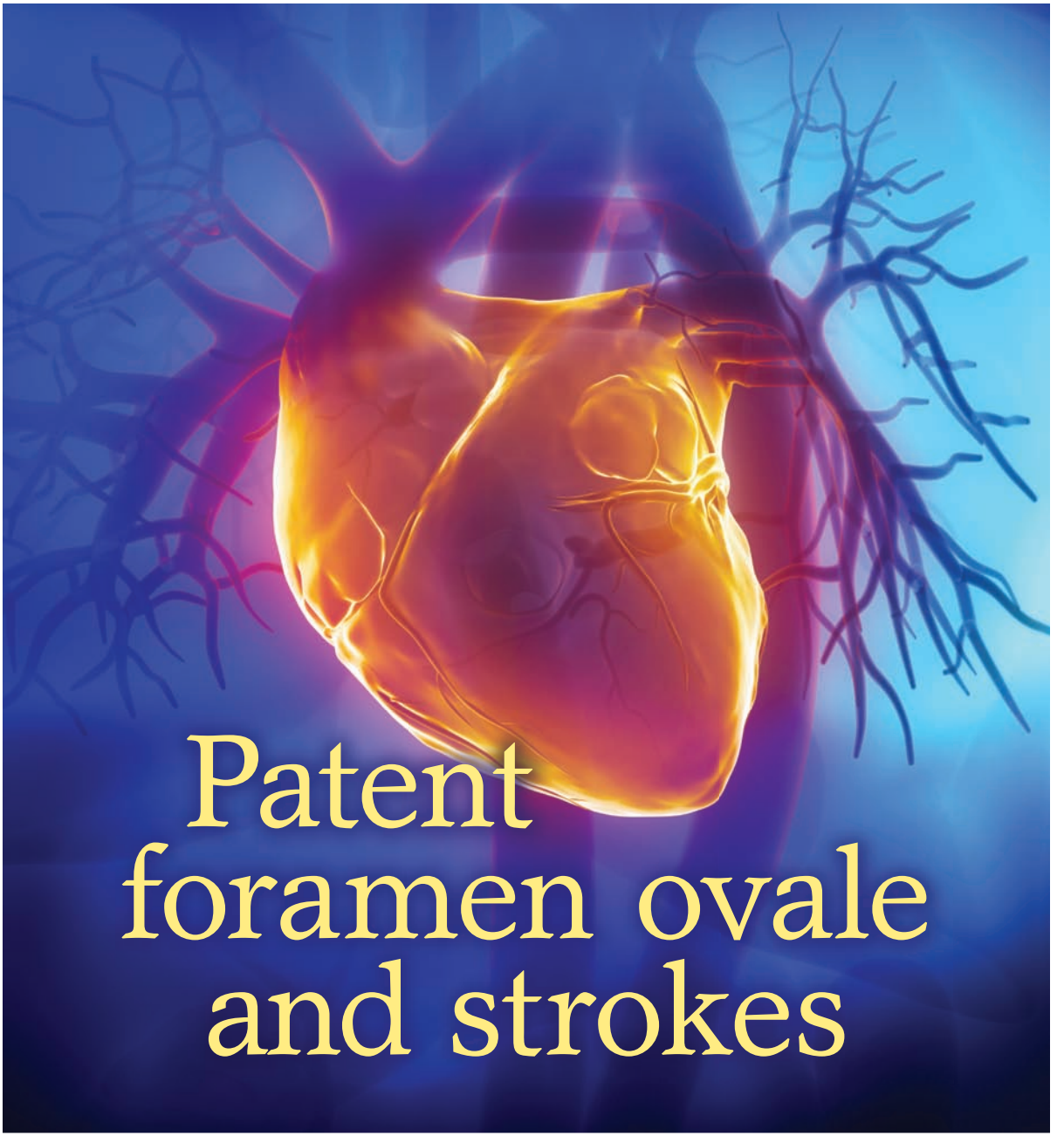

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Patent foramen ovale and strokes

Most patients with PFO are asymptomatic.

By Carolyn E. Smith, BSN, RN

MR. L, 43, is sitting at home watching a football game when he experiences bitemporal hemianopsia (visual loss involving the temporal half of each visual field). The visual deficit resolves within a few minutes without any recurrence or additional symptoms. He doesn't have a history of vision problems, but he does have a history of hypertension and migraine headaches. Mr. L occasionally drinks alcohol but has never smoked. Overall, he's in good health.

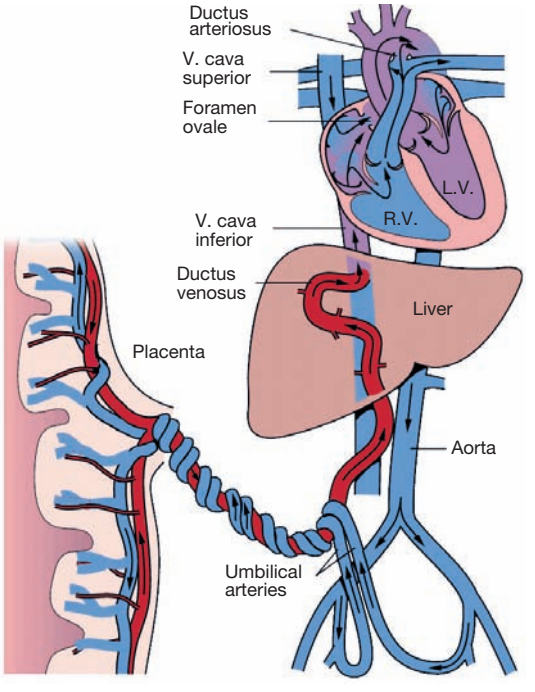
Mr. L follows up with his healthcare provider. An ophthalmologic exam and bloodwork results are normal. Because of Mr. L's history of hypertension, the healthcare provider discusses the possibility of a transient ischemic attack (TIA) and refers him to a neurologist.

After examining Mr. L, the neurologist refers him to a cardiologist, who orders a transesophageal echocardiogram (TEE). Mr. L and his wife are shocked to learn that the TEE shows the presence of a "hole in the heart," or a patent foramen ovale (PFO).

A foramen ovale is a small oval opening with a flaplike valve located between the right and left atria that's present during fetal development.[1] (See *Following fetal circulation* and *A closer look at the foramen ovale*.) By the time of birth, when pulmonary circulation is established, a fibrotic

Following fetal circulation

The fetus receives oxygenated blood from the placenta through the umbilical vein. Part of the received blood passes through the hepatic sinusoids, whereas most of the incoming blood passes through the ductus venosus into the inferior vena cava. At the inferior vena cava, the oxygen-rich blood from the placenta mixes with blood from the caudal portions of the fetus. The mixed stream of blood enters the right atrium and crosses the interatrial membrane through the foramen ovale into the left atrium. At the left atrium, the blood is mixed again with poorly oxygenated blood from the pulmonary veins and then passes through the left ventricle to the aorta. Blood from the superior vena cava and a small amount of blood from the inferior vena cava are diverted into the pulmonary artery, where the blood is shunted into the descending thoracic aorta through the ductus arteriosus. The resultant mixed blood goes into the abdominal aorta, to the circulation of the viscera and lower extremities, reaching the placenta through the umbilical arteries for oxygenation.



Souce: Ulfacker R. *Atlas of Vascular Anatomy: An Angiographic Approach.* 2nd ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010.

process has begun to close the foramen ovale. Complete fibrosis of the opening occurs within the first year or two of life.[2]

For some individuals, however, an opening in the atrial septum persists as a result of improper septal formation (atrial septal defect).[1] If large enough, a PFO can cause left-to-right intracardiac shunting of blood (see *Picturing PFO*).[3] Although most patients with a PFO are asymptomatic, complications can occur and increase a patient's risk of cerebrovascular events.[2,4]

It's estimated that 25% to 27% of the population has a PFO, but only a small percentage ever exhibit signs and symptoms of the defect.[5]

Both men and women develop PFO, but the incidence of diagnosis is slightly higher in men. White men are at the highest risk for PFO, followed by White women, then Black men.[6]

Even though the prevalence of PFO declines with age (because PFO is diagnosed more often in infants and children than in adults), its size increases from a mean of 3.4 mm in the first decade of life to 5.8 mm in the 10th.[3] It's theorized that this is because the foramen ovale valve stretches with age.

PFOs vary in shape and size among individuals. Why the opening doesn't close completely after birth isn't known, but because of improved diagnostic studies, more cases of PFO are being discovered in adulthood.[7]

Possible complications

Most PFOs are considered benign.[5] However, one serious risk is that a PFO can become a pathway for venous to arterial transit of paradoxical emboli via right-to-left shunting. This occurs when the pressure in the right atrium surpasses the pressure in the left atrium. A transient right-to-left gradient occurs in normal individuals during early ventricular systole and with the Valsalva maneuver.[4] For this reason, PFO increases the risk of cerebrovascular events, especially in patients who've previously had a cryptogenic stroke.[5,8]

Approximately 30% to 40% of ischemic strokes are cryptogenic, which means that no cause of the stroke could be identified despite extensive vascular, cardiac, and serologic evaluation.[9] A PFO should be suspected in any patient under age 55 who experiences an acute ischemic stroke and who has no known risk factors.

Recognizing PFO

Although most patients with PFO are asymptomatic, PFO and right-to-left cardiac shunting may be associated with other health problems including migraine and vascular headache. However, the most important potential clinical manifestations of PFO are signs and symptoms of acute ischemic stroke due to a paradoxical embolism.[4]

Mr. L from our case study experienced a sudden temporary visual deficit, which may have been a sign of a TIA caused by his undiagnosed PFO. Other signs and symptoms associated with TIA or acute ischemic stroke include sudden onset of:

- paresis or paralysis
- ataxia or vertigo
- sensory deficits
- cognitive impairment
- aphasia or dysphasia.[10]

The most common diagnostic studies used to detect PFO are transthoracic echocardiography (TTE), TEE, and transcranial Doppler (TCD).[2] TTE, TEE, and TCD are used in conjunction with agitated saline contrast injection, also known as a "bubble study," which can detect transient right-to-left shunting associated with PFO.[4] TEE with agitated saline contrast injected at rest, with cough and following Valsalva, is usually considered the most definitive diagnostic study for PFO.[4]

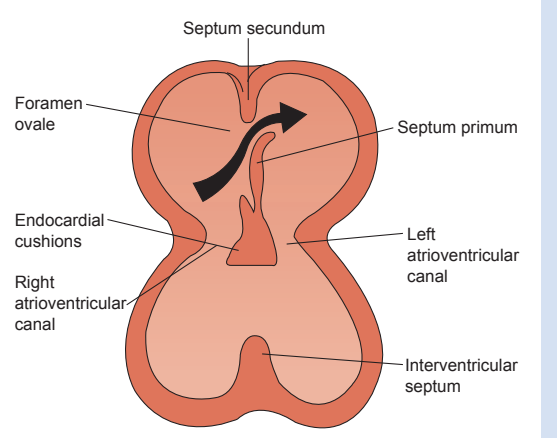
Treating PFO

The treatment plan depends on the patient's age, clinical status, presence of other stroke risk factors, and comorbidities. Many patients don't need treatment but follow-up is encouraged. Even in the patient presenting with signs and symptoms of stroke, the risks and benefits of PFO treatment must be weighed carefully.[8]

No conclusive evidence exists to support pharmacologic therapy, but if the patient experiences ischemic stroke, antiplatelet therapy such as aspirin is recommended to help decrease the risk of stroke recurrence. If the patient has TIA or stroke recurrence despite antiplatelet therapy, anticoagulation is recommended.[4]

Percutaneous or surgical PFO closure may be indicated if stroke recurs despite anticoagulation.[5]

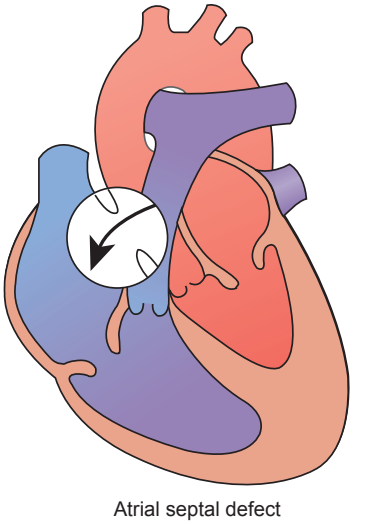
A closer look at the foramen ovale[1]



Partitioning of the atria takes place during the fourth and fifth weeks of development. Occurring in two stages, it begins with the formation of a thin, crescent-shaped membrane (septum primum). This is followed by the development of a second membrane (septum secundum). As the septum secundum develops, it overlaps an opening in the upper part of the septum primum, forming the foramen ovale, an oval opening with a flaplike valve. The foramen ovale allows blood from the umbilical vein to pass into the left heart, bypassing the lungs.

Picturing PFO[1]

In PFO, blood is shunted from left to right.



Atrial septal defect

Serious complications are rare, but patients should be assessed for cardiac dysrhythmias, venous thromboembolism, and acute myocardial infarction or stroke after closure.

Nursing considerations

A diagnosis of PFO can be a source of great anxiety for patients and their families. Patient and family education can help decrease that anxiety.

Provide patients with oral explanations and printed educational materials to help them cope with a newly diagnosed PFO. Teach patients how to help prevent deep vein thrombosis and subsequent embolism; for example, by avoiding long periods of standing or prolonged sitting with the lower extremities in a dependent position. Also teach patients about risk factor modification, such as smoking cessation, to help decrease stroke risk. Educate patients and their families about the warning signs of a stroke and the need to call 911 immediately. Collaborate with the healthcare provider to review possible treatment plans and emphasize the importance of following the treatment as prescribed.

Following up with Mr. L

Mr. L was diagnosed with a PFO, but didn't require any further treatment. He's being monitored by his healthcare provider and a cardiologist as needed.

PFO is a condition that may be present in patients of all ages. Even though patients may be asymptomatic with no significant medical or surgical history, a PFO has the potential to lead to stroke. Educating patients with PFOs can help them stay healthy ❖

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