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Case Report

Renal infarction caused by paradoxical embolism through a patent foramen ovale

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Abstract

A 48-year-old man presented with acute right flank pain. A computed tomography scan revealed right renal infarction. Because he had no thrombosis in the renal vessels and no clear embolic source, a further examination was performed to find the cause of the renal infarction. On transesophageal echocardiography, a right-to-left shunt during the Valsalva maneuver established a diagnosis of patent foramen ovale. This is a case of paradoxical embolism through a PFO leading to renal infarction.

Introduction

A patent foramen ovale (PFO) can act as a pathway for a thrombus from the peripheral veins, bypassing the lungs and entering the systemic circulation [1]. A paradoxical embolism is an uncommon but increasingly recognized cause of embolic events. A cerebral event is the usual presenting symptom in patients with PFO. Systemic, non-cerebral, paradoxical embolisms occur less frequently, accounting for 5%–10% of all paradoxical embolisms [2]. Renal infarction secondary to paradoxical embolism has rarely been described, and paradoxical embolism involving kidneys has been reported to commonly involve multiple organs, such as the lung, kidneys, and brain [3]. Here, we report a case of a paradoxical embolism caused by PFO involving only kidneys.

Case report

A 48-year-old Korean man was referred to our hospital with sudden right flank pain that had begun 10 days earlier. The patient did not have hypertension, diabetes, or dyslipidemia. He had been diagnosed with idiopathic thrombocytopenic purpura (ITP) 10 years earlier, but his platelet counts had been stable ($>$ 50,000/μL) with no significant bleeding, over the past 10 years. He had undergone a hemorrhoidectomy two months earlier. He was a 30-pack-year smoker and an occasional drinker, with no noteworthy family medical history. On admission, the patient's blood pressure was 107/68 mm Hg and his pulse rate was 78 beats/minute. His respiratory rate and body temperature were 18 breaths/minute and 36.3 °C, respectively. A physical examination revealed clear breath sounds and a regular heartbeat with no murmur. There was no tenderness on either side of his lower back. His neurologic findings were normal, and neither edema nor bruising was found on the lower extremities. Blood test results showed a low platelet count (white blood count 6,800/μL, hemoglobin 12.4 g/dL, platelet 63,000/μL), and his serum creatinine was 0.83 mg/dL and blood urea nitrogen 13.0 mg/dL. Urine microscopy revealed mild hematuria (red blood cell count 3–5/HPF) and

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pyuria (white blood cell count 11–20/HPF). His levels of antithrombin III activity, plasminogen activity, protein C activity, coagulation factor VIII activity, homocysteine, lupus anticoagulant, and anticardiolipin antibody were within the normal ranges, suggesting no abnormality of the coagulation system. A contrast-enhanced abdominal computed tomography (CT) scan was performed in the previous hospital, showing no stones, but a wedge-shaped perfusion defect was detected in the right kidney, suggestive of renal infarction (Fig. 1). Contrast-enhanced abdominal magnetic resonance (MR) angiography was performed to exclude the possibility of a renal artery thrombus or dissection. Both renal arteries were patent, with no significant stenosis or atherosclerosis (Fig. 2A) but several cortical scars were detected on the left kidney (Fig. 2B). Because the patient's renal arteries were intact despite acute renal infarction, the filling defect was suspected to be caused by embolization, and the cortical scars on the left kidney suggested the possibility of previous recurrent renal infraction. A duplex lower extremity vein scan showed no obvious thrombosis in the deep venous system, which is a frequent potential source of an embolism. Chest contrast-enhanced CT showed no evidence of a pulmonary thromboembolism. Electrocardiography showed a normal sinus rhythm, and transthoracic echocardiography revealed no thrombus, but normal left ventricular function. However, a contrast study and bubble test during transesophageal echocardiography revealed a small PFO (Fig. 3A). From these findings, a paradoxical embolism through a small PFO was confirmed as the cause of the patient's multifocal renal infarction. The patient had been given intravenous heparin for his renal infarction in the previous hospital. During the heparin treatment, he developed hemorrhoidal bleeding, and underwent hemorrhoid ligation and discontinued anticoagulation. Therefore, PFO closure was planned to prevent further embolic events and bleeding complications, which can recur under anticoagulation therapy.

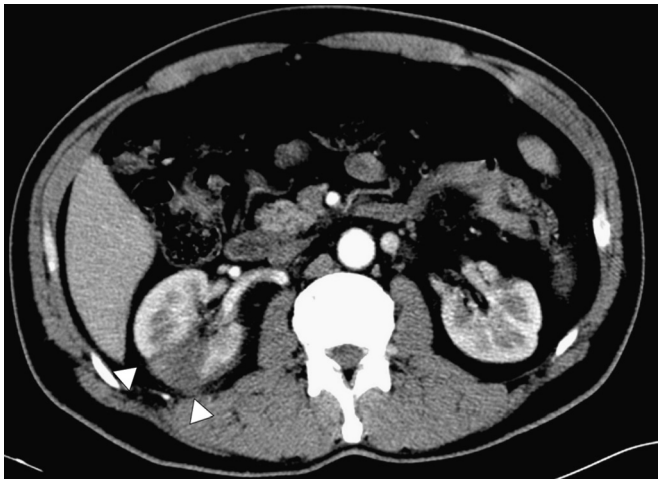

Figure 1. Contrast-enhanced abdominal computed tomography imaging. Wedge-shaped perfusion defect is shown in the right kidney (arrowheads).

Discussion

The diagnosis of acute renal infarction is often missed or delayed because the disease is both rare and has a nonspecific clinical presentation. In a patient with an increased risk of thromboembolism, unexplained flank pain should raise a suspicion of acute renal infarction [4]. Diagnostic tests should be considered for patients who are at risk of systemic embolization and present with symptoms suggestive of renal infarct. A contrast-enhanced CT scan should be performed to look for renal infarction, for which the classic finding is a wedge-shaped perfusion defect. Two major causes of renal infarction are thromboemboli, which usually originate from a thrombus in the heart or aorta and *in situ* thrombosis of a renal artery or renal artery dissection, which is less common [5]. The major sources of a clot embolism include the left atrium during atrial fibrillation, a left ventricular thrombus in patients with myocardial infarction, and thromboemboli originating from complex plaques in the aorta. Other potential embolic sources include valvular vegetations in patients with infective endocarditis and, rarely, paradoxical embolism through a PFO [6]. The foramen ovale, which allows blood to flow across the atrial septum in the fetal stage, normally closes shortly after birth. However, in approximately 25% of

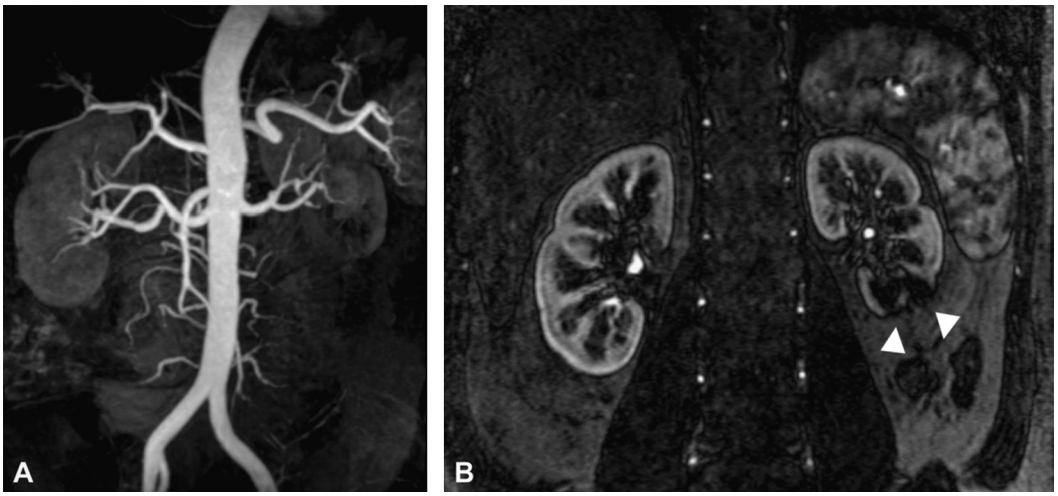

Figure 2. Magnetic resonance angiography imaging. Both renal arteries were patent but several cortical scars were detected. (A) There were no thrombosis and atherosclerotic changes in the renal vessels. (B) Several cortical scars on the left lower pole of the kidney were shown (arrowheads).

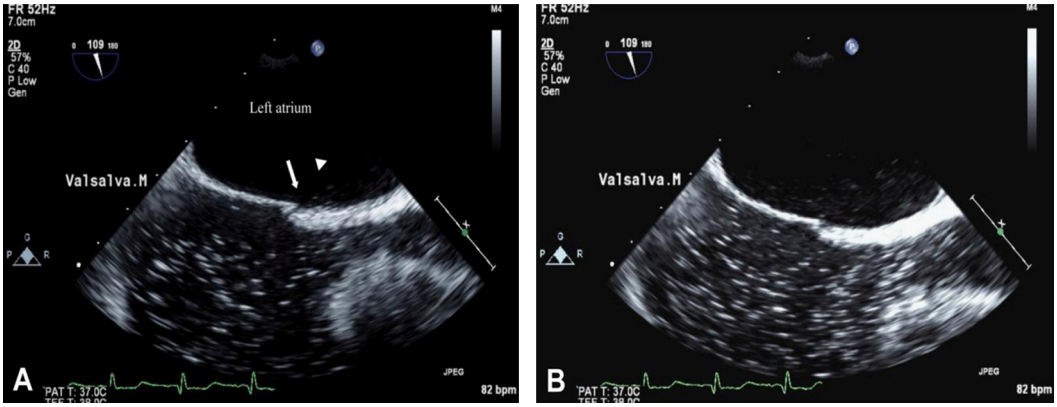

Figure 3. Bubble contrast transesophageal echocardiography. Agitated saline was injected via a peripheral vein and the bubbles reached the right atrium. (A) Opacification of the right atrium was seen initially and the bubbles (arrowhead) passed into the left atrium through the small opening in the PFO (arrow) during the Valsalva maneuver. (B) Many bubbles were seen in the left atrium at the end of a sustained Valsalva maneuver.

adults, closure of the foramen ovale is incomplete. When a right-to-left shunt exists across the PFO, thrombi, and vasoactive substances formed in the right-side venous circulation can bypass the lung filter and enter the left arterial system, causing a paradoxical embolism [7]. Although the vast majority of people with PFO are asymptomatic, the presence of PFO has been implicated in stroke, migraine headache, decompression sickness, high-altitude pulmonary edema, and platypnea-orthodeoxia syndrome [8]. Although ischemic events can occur in most organs, including the brain, eyes, kidneys, spleen, and intestines, and in the upper and lower extremities, stroke is the most usual common manifestation of paradoxical embolism. The prevalence of PFO is estimated to be 45% among patients with cryptogenic stroke or transient ischemic attacks [9]. In a recent study the most common reason for the primary referral of patients with PFO-related conditions for PFO closure ($n=416$) was cryptogenic stroke ($n=219$). Noncerebral paradoxical embolism was rare ($n=12$) and 75% of noncerebral embolisms were myocardial infarctions ($n=8$) [1]. Whereas myocardial infarction is a rare complication of paradoxical embolism through PFO, there are even fewer reports of renal infraction in patients with PFO [10]. Most patients reported with paradoxical renal infarction present with multiorgan involvement and have multiple acute ischemic symptoms, such as dyspnea and abdominal pain [11]. This case is unique in that the patient had acute flank pain and the embolism was confirmed only in the kidneys, with no other organ involvement. Secondary prophylaxis for a paradoxical embolism can involve pharmacotherapy or the closure of the right-to-left shunt, which can be performed surgically or with a transcatheter procedure [12]. The efficacy of the devices used to prevent recurrent systemic arterial embolisms, and in particular cerebrovascular embolisms, is unknown but is currently under investigation in large-scale clinical trials [8]. Closure of the PFO after the first embolism is recommended for patients at high risk of recurrent embolic events. The risk factors associated with embolic recurrence include atrial septal aneurysm, high shunting volume, and shunting at rest. Other risk factors include large PFO (more than 3.4 mm), higher mobility of the PFO valve, a well developed Eustachian valve, a Valsalva maneuver immediately prior to event, and a history of recurrent embolic events [13]. Bissessor et al. reviewed 70 percutaneous PFO procedures prospectively. PFO can be closed percutaneously with a low rate of significant residual shunting and very few complications. After closure of the PFO, no patient experienced a recurrent paradoxical embolic event during the medium-term (up to four years) follow-up period [9].

In this case, the patient also had long-standing ITP when his renal infarction occurred. His platelet count had not changed for 10 years, without treatment. Given that his coagulation profile was normal and there was no thrombosis in the renal artery, it is unlikely that ITP was associated with his renal infarction. Because he had no obvious source of emboli, we used contrast echocardiography and a bubble test during the Valsalva maneuver to examine the possibility of a paradoxical embolism and confirmed the diagnosis of paradoxical renal infarction caused by PFO. The patient has two risk factors for recurrent embolic event. Echocardiography shows that he has a shunting not only at Valsalva but also at rest. And the patient was suspected of having had recurrent renal infractions in the past based on MR angiography findings. So, secondary prophylaxis was required to prevent additional embolisms. Because he suffered hemorrhoidal bleeding during heparin treatment and his platelet count was low, the insertion of a transcatheter PFO closure device was planned, considering the potential problems associated with maintaining oral anticoagulation therapy.

In conclusion, the role of PFO as a source of ischemic events in various organs is becoming increasingly evident. This case suggests that renal infarction can be caused by a paradoxical embolus from a PFO. Paradoxical embolism is a rare cause of renal infarction, but immediate recognition of a paradoxical embolus is very important so that anticoagulation or device closure can prevent further embolic infarctions in other organs, as well as in the kidneys. If renal infarction occurs repeatedly, with no evident cause of the thromboembolism or during anticoagulation therapy, a paradoxical embolism through a PFO should be considered.

Conflict of interest

No conflict of interest

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