Atrio-Esophageal Fistula as a Complication of Percutaneous Transcatheter Ablation of Atrial Fibrillation

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Background—Radiofrequency ablation for atrial fibrillation is becoming widely practiced.

Methods and Results—Two patients undergoing circumferential pulmonary vein ablation for atrial fibrillation in different centers developed symptoms compatible with endocarditis 3 to 5 days after the procedure. Their clinical condition deteriorated rapidly, and both suffered multiple gaseous and/or septic embolic events causing cerebral and myocardial damage. One patient survived after emergency cardiac and esophageal surgery; the other died of extensive systemic embolization. An atrio-esophageal fistula was identified in both patients.

Conclusions—Atrio-esophageal fistulas can occur after catheter ablation in the posterior wall of the left atrium. This diagnosis should be excluded in any patient with symptoms or signs of endocarditis after left atrial ablation, and expeditious cardiac surgery is critical if the diagnosis is confirmed. Lower power and temperature settings for applications of radiofrequency energy along the posterior left atrial wall may prevent further cases of fistula formation. **(*Circulation*. 2004;109:2724-2726.)**

Key Words: arrhythmia ■ ablation ■ surgery ■ fistula

Catheter ablation of atrial fibrillation (AF) has become an important therapy in recent years. As with all evolving techniques, unexpected complications may occur. This article describes 2 cases of atrio-esophageal fistula that occurred at 2 centers shortly after percutaneous circumferential pulmonary vein ablation (CPVA).

Methods

The ablation procedure has been described in detail elsewhere.[1–3] Briefly, reconstructions of the left atrium (LA) and pulmonary vein (PV) ostia are created with a 3D mapping system. Radiofrequency energy is delivered with an 8-mm-tip catheter (Navistar, Biosense Webster) in a circumferential fashion, 1 to 2 cm from the left- and right-sided PVs, to result in voltage abatement inside the encircling ablation lines. Ablation lines are also created on the posterior wall between the circumferential lesions and between the left inferior PV and mitral valve. In addition, when individual veins arise from separate ostia, an ablation line sometimes is created between the ipsilateral PVs.

Case 1

A 36-year-old man with drug-refractory chronic AF underwent CPVA in January 2004 in Milan, Italy (Figure 1, left). LA diameter was 33 mm, and left ventricular ejection fraction was 55%. The procedure was well tolerated and uneventful. Radiofrequency generator settings were standard for the laboratory, with a temperature limit of 60°C and a maximum power output of 100 W. There were no instances of tissue carbonization, and the catheter was free of thrombus at the end of the procedure. The patient was discharged the following day. Medications at the time of discharge consisted of calciparin, warfarin, irbesartan, amiodarone, and digoxin.

On the third postprocedural day, the patient presented to his local hospital with fever, pleuritic chest pain, grossly elevated white cell count and inflammatory markers, and convulsions. Cerebral CT showed signs of patchy bilateral ischemia and infarction. Transthoracic echocardiography (TTE) did not show any evidence of vegetations, and therapy with intravenous antibiotics was begun. On day 12, the patient developed chest pain and anterolateral ST-segment elevation on the ECG. TTE showed gas bubbles in the LA. Coronary angiography showed occlusion of the left anterior descending artery, which was subsequently stented. The patient lost consciousness and developed left-sided hemiparesis. CT scanning suggested an atrio-esophageal fistula with pneumomediastinum. A head CT demonstrated extensive ischemic changes consistent with cerebral air emboli.

The patient underwent emergency surgery. Cardiopulmonary bypass was instituted, and through a standard left atriotomy, a 1-cm laceration in the posterior wall of the LA was visible immediately medial to the left PV ostia (Figure 2, left). There were no overlying vegetations. The laceration was repaired with pledgeted sutures and a bovine pericardial patch. The esophagus was isolated in the neck with an absorbable purse-string suture. A mediastinal drain was placed adjacent to the lower part of the esophagus, and a feeding gastrostomy was inserted. Continuous mediastinal and pericardial

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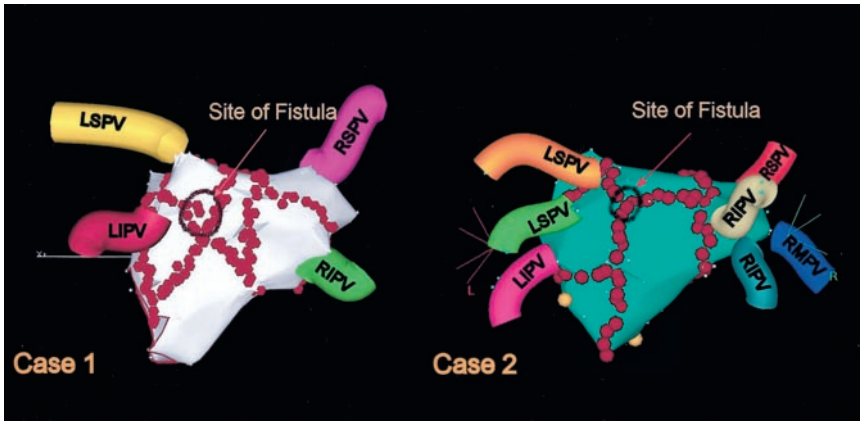

Figure 1. Three-dimensional anatomic maps of LA and PVs from a posteroanterior view. Red tags indicate sites at which radiofrequency energy was applied, generally for a total of 20 to 30 seconds at each site. Approximate location of atrio-esophageal fistula that later occurred in cases 1 (left) and 2 (right) is circled. LIPV indicates left inferior PV; LSPV, left superior PV; RIPV, right inferior PV; RMPV, right middle PV; and RSPV, right superior PV.

lavage was performed with diluted iodine solution for 5 days. The patient had a stormy postoperative course, complicated by *Lactobacillus mediastinitis*, which responded to appropriate antibiotic therapy.

TTE performed on postoperative day 21 showed a left ventricular ejection fraction of 50% and apical hypokinesis. Water-soluble contrast studies showed recanalization of the esophagus, with mild proximal narrowing at the site of the purse-string suture, and a small distal leak of contrast.

Two months after the procedure, the patient was able to eat and drink, but there was residual left hemiparesis. Repeated TTE on postoperative day 54 showed aneurysmal dilatation of the left ventricular apex, with an ejection fraction of 40%.

Case 2

A 59-year-old man with drug-refractory, lone paroxysmal AF and flutter underwent CPVA and ablation in the cavotricuspid isthmus in January 2004 in Ann Arbor, Mich (Figure 1, right). The LA diameter was 29 mm, and ejection fraction was 50%. Radiofrequency generator settings were standard for the laboratory, with a temperature limit of 55°C and a power limit of 70 W. The procedure was uneventful and well tolerated. The patient was discharged from hospital the next day. Medications on discharge consisted of enoxaparin, warfarin, and amiodarone.

Two days after the procedure, the patient developed chest pain and fever. TTE at that time was unremarkable, with no pericardial effusion or evidence of vegetations. He was treated with nonsteroidal antiinflammatory drugs with some improvement in symptoms. Three weeks after the procedure, while in Hawaii, he had rapid onset of profound weakness and rigors. He collapsed and was admitted to a local hospital where he had a temperature of 40°C and a grand mal seizure. Cerebral CT was unremarkable. Blood cultures were positive for α-hemolytic streptococci, micrococcus species, and nonhemolytic streptococci. TTE showed no evidence of valvular or LA vegetations.

Broad-spectrum antibiotic therapy was initiated, and the patient was transferred to a tertiary care hospital. A transesophageal echocardiogram showed a 1.2-cm pedunculated mass on the posterior wall of the LA. He was treated with parenteral vancomycin, cefepime, and gentamicin. Cardiac enzymes confirmed acute myocardial infarction, although his ECG showed only nonspecific ST-T–wave abnormalities.

Circulatory collapse, respiratory failure, and coma developed, requiring inotropic support and ventilation. Cerebral CT showed widespread ischemic changes consistent with multiple emboli. His condition steadily deteriorated, and the family decided to withdraw life support, shortly after which he died.

Cardiopulmonary postmortem examination demonstrated an atrio-esophageal fistula on the posterior wall of the LA, near the left superior PV, with adherent vegetation (Figure 2). Cultures were sterile, but microscopic examination showed granulation tissue and Gram-positive cocci. There were multiple areas of myocardial infarction consistent with septic coronary embolization.

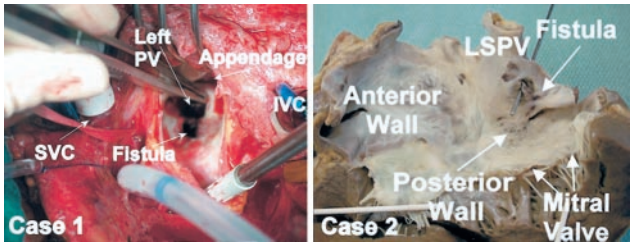

Figure 2. Anatomic demonstration of atrio-esophageal fistulas. Left, Case 1: Intraoperative photograph taken from patient's right side with head to left, highlighting atrio-esophageal fistula arising medial to left PV ostia. Two distinct ostia cannot be seen because veins are empty and walls have collapsed. Right, Case 2: Formalin-fixed LA was incised near left superior PV and opened in book fashion, with anterior wall on left and posterior wall on right. Probe passes through fistula, which was on posterior wall near left superior PV. IVC indicates inferior vena cava; SVC, superior vena cava; and LSPV, left superior PV.

Discussion

Atrio-esophageal fistula is a recognized complication of intraoperative radiofrequency ablation of AF, with an incidence reported to be as high as 1%.[4] Our cases demonstrate that this complication may also result from percutaneous radiofrequency catheter ablation in the LA.

The CPVA technique used in these patients has been performed in a combined total of 4360 patients in the 2 laboratories, yielding a prevalence of 0.05%. Therefore, the risk of an atrio-esophageal fistula with this technique appears to be very low. Nonetheless, because atrio-esophageal fistulas have devastating consequences and are often fatal, all possible measures must be taken to avoid this complication.

Clinical Presentation

These cases share similarities. Both patients developed clinical features of pericarditis 2 to 3 days after the procedure, with TTE being unremarkable. Both patients subsequently developed fever and convulsions. Multiple cardiac and cerebral emboli characterized the latter phase of the process. Massive hematemesis has been reported in prior studies but was absent in both patients in this report, suggesting that the fistulas may have been covered by a 1-way valve. The atrial dimensions of both patients were relatively small, and it is possible that this predisposed them to fistula formation.

Diagnosis

Endocarditis should be excluded in any patient presenting after a catheter ablation procedure with fever, pericarditis-type chest pain, or signs or symptoms of systemic embolization. A registry of >3000 ablation procedures did not document a single case of endocarditis[5]; however, there are isolated case reports of endocarditis occurring at sites of previous ablation.[6,7] In our cases, the fistula acted as the point of entry for organisms from the upper gastrointestinal tract.

Patients who have undergone catheter ablation along the posterior aspect of the LA presenting with a clinical picture of endocarditis should have an atrio-esophageal fistula excluded. Transesophageal echocardiogram should be avoided because, if a fistula is present, instrumentation of the esophagus may cause rapid deterioration and even death, as highlighted in previous surgical cases.[8,9] Similarly, esophagoscopy is contraindicated because gas insufflation may result in massive air embolism and/or barotrauma to the damaged tissue, resulting in massive hemorrhage. Noninvasive imaging such as MRI, TTE, or CT is preferable. Thoracic CT scan with water-soluble contrast appears to be particularly helpful for identifying the fistula and pneumomediastinum.

Management

Antimicrobial therapy alone appears not to improve the situation, and widespread gaseous or septic embolization will continue without prompt surgical intervention. Definitive treatment should be expedited once the diagnosis has been confirmed because rapid deterioration and death are likely.

Prevention

Radiofrequency generator settings and lesion sets for AF ablation have evolved through experience, reaching a point at which the procedure can now be safely performed in a relatively short period of time with success rates of between 80% and 90%.[1–3]

LA wall thickness varies considerably, averaging ≈4 mm in the true LA but decreasing to 2.5 mm at the VA junctions.[10] In both patients, the fistulas occurred in a region where ablation lines overlap, particularly in small atria (Figure 1). Previous reports of atrio-esophageal fistulas after intraoperative radiofrequency ablation of AF suggested that overlapping lines in the posterior wall may have been responsible for esophageal injury.[9]

Reversible thermal injury of the esophagus has been reported after ingestion of hot liquids or solids,[11] and it is possible that subclinical thermal injury to the esophagus during LA ablation may go recognized. Further studies are required to monitor temperature changes in the esophagus during the creation of lesions. We recommend that lower generator settings of 50 W and 55°C be used during ablation in the posterior wall to avoid excessively deep lesions and subsequent esophageal injury. In addition, the transverse posterior line should be placed at the roof, where the atrium tends to be thicker and is not in direct contact with the esophagus.

Conclusions

Catheter ablation along the posterior aspect of the LA is associated with a small but real risk of atrio-esophageal fistula. Rapid diagnosis and surgical therapy may prevent death. We hope that minimizing the amount of ablation along the posterior aspect of the LA and decreasing the power of radiofrequency energy applications will avoid any further instances of atrio-esophageal fistulas.

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