


Pericardioesophageal Fistula Following Left Atrial Ablation Procedure

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ABSTRACT

We present a case of pericardioesophageal fistula formation in a 40 year old male who 23 days after undergoing a repeat ablation procedure for atrial fibrillation developed chest pressure, chills and diaphoresis. After initial labs and tests that demonstrated no evidence for acute myocardial ischemia, the patient underwent CT angiography of the chest. The study revealed pneumopericardium and a pericardial effusion. Suspicion was raised of perforation of the posterior left atrial myocardial wall with injury to adjacent esophagus. Water soluble contrast with transition to barium sulfate esophagram subsequently performed identified a perforation further affirming the postulate of a fistulous communication between the esophagus and pericardium. Transthoracic echocardiogram confirmed pericardial effusion but did not demonstrate myocardial defect. Endoscopic management was preferred and an esophageal stent was placed. Follow up esophagram showed an intact esophageal stent without evidence of extravasation.

CASE REPORT

CASE REPORT

A forty year old male presented to a local community hospital for complaint of chest pressure, chills, and cold sweats. Past medical history revealed significant cardiac history of multiple radiofrequency ablations for atrial fibrillation. Initial workup concerning for acute myocardial infarction, revealed a negative troponin I value (0.023, ref < 0.03) and EKG being positive for atrial fibrillation. The patient was transferred to the region's tertiary academic medical center where the ablation had been performed 23 days prior. Upon admission, repeat workup demonstrated negative cardiac biomarkers and chest x-ray (Figure 1).

CT angiography of the chest demonstrated a moderate sized pericardial effusion, no extravasation of IV contrast, and pneumopericardium located anteriorly and posteriorly in the pericardial sac (Figure 2). No signs of trauma or thoracic surgery were identified from the CTA. The posterior collection of air within the pericardial sac was adjacent to the

esophagus, and there was concern for fistula formation secondary to injury during ablation therapy. Therefore, a water soluble contrast esophagram was recommended as a traditional barium sulfate esophagram study would pose risk to mediastinitis if an esophageal perforation was present. The water soluble contrast esophagram was subsequently performed. No extravasation was identified with Iohexol 300, and transition to a Barium Sulfate suspension (60% w/v, 41% w/w) occurred. However, upon complete distension of the esophageal lumen with the Barium Sulfate suspension, extraluminal contrast was demonstrated indicating a leak with fistulous tract (Figure 3). Transthoracic echocardiogram identified a moderately sized pericardial effusion but was unable to resolve a myocardial wall defect of the left atrium (Figure 4).

Because the esophageal perforation was small and no gross contamination of pleural spaces was identified on CTA, less invasive endoscopic management was performed (Figure 5). Endoscopy validated an esophageal leak as evident by an area of irregular mucosa with bubbling of previously ingested

barium contrast material. An endoluminal stent was placed under fluoroscopic guidance (Figure 6), of which the imaging also showed an area of high density in the mediastinum representing barium retention. Follow up esophagram status post placement of esophageal stent demonstrated free flow of contrast material through the stent without evidence of extravasation (Figure 7).

Follow Up: Seven months after the acute episode, the patient had returned to performing daily activities and hobbies that he enjoys with minimal disability.

DISCUSSION

Etiology and demographics

Left atrio-esophageal fistula (LAEF) has become a recognized morbid complication of ablative therapies for atrial fibrillation. LAEF is the most severe complication directly stemming from the ablative procedure, but another recognized morbid pathology, the pericardioesophageal fistula which we report can too occur. It is uncertain how fistulous formation occurs, but belief that thermal injury to the esophagus may initiate an inflammatory cascade has been proposed [1]. Further degradation of tissue boundaries allow for communication with the adjacent left atrium, as the measured distance approximates 5mm [2]. Another plausible etiology may stem from direct perforation of the RFA catheter through the posterior left atrial wall; however, one would suspect a more rapid decline in patient equilibrium. Yet, the majority of patients elicited symptoms 17 days post treatment, which is congruent with our case patient [3].

Clinical and imaging findings

A myriad of clinical manifestations have been reported, including chest pain, fever, sepsis, hematemesis, seizures, and stroke. Not surprising, esophageal gas and ingested contents entering the central vascular system are the most dire. Thus, neurologic symptomatology is a common presentation of disease as validated by Finsterer et al [4]. Though awareness of LAEF has increased, a nationwide survey of electrophysiologists and cardiac surgeons indicated it remains a rare disease with only a 0.03% incidence [5].

As many patients post ablative therapy present with chest pain, imaging typically initiates with a chest x-ray. The chest radiograph can indicate significant abnormalities, such as, lucency surrounding the heart restricted to below the ascending aorta and pulmonary trunk, or be negative as was our case patient (figure 1). CT Angiography (CTA) of the chest with thin sections is the best imaging modality for diagnosis (figure 2). The CTA findings may range from an pericardioesophageal fistulous communication, which is illustrated in our case by pneumopericardium and hemopericardium, versus active extravasation of contrast from the atrium into adjacent spaces that include the pericardial sac and esophagus. Furthermore in controlled cases, the fistulous communication of the esophagus and surrounding structures can be confirmed by water soluble contrast esophagram examination. It is not recommended to perform CT angiography of the chest with additional oral contrast, as

findings of extravasation of contrast from the atrium may be confused with contrast in the esophageal lumen [6].

Treatment and prognosis

Typically, treatment of LAEF is open thoracic surgical repair [7,8]. In cases of contained esophageal perforations, such as the current case, some suggest a non surgical approach with an esophageal covered stent will suffice [9, 10]. Therefore, the esophagram is highly useful in both the initial confirmatory diagnosis and the follow up examination to establish occlusion of the leak.

Complications do occur and can convolute the prognosis. Factors to consider include infarction of the involved pulmonary veins, which are also targeted during radiofrequency ablation, and can occlude from thrombosis or stenosis [11]. Also, neurologic symptoms, such as cerebral infarction or altered mental status changes from infectious processes such as meningitis are commonly identified in this particular patient population [12]. Lastly, mortality in some reviews has reached 67% [13].

Differential diagnosis

The differential diagnosis for acute or threatened esophageal perforation includes: Esophageal cancer, esophagitis, transection from trauma, foreign bodies, Mallory-Weiss lacerations (table 2) [14].

Additional complications

Aside from pericardioesophageal fistula formation or left atrial esophageal fistulous communication, other complications can occur in the wake of atrial fibrillation ablation. These complications are divided into their end organ systems, which include cardiac, vascular, neurologic, pulmonic, and gastrointestinal (table 3) [15,16,17,18]. The most common complication is esophageal ulceration with variable incidences approaching 10% and ranging upwards as high as 57% [18], which is 300 to nearly 2,000 times more common than left atrial esophageal fistula formation.

In conclusion, tissues adjacent to the left atrium are susceptible to injury after radiofrequency ablation for treatment of atrial fibrillation. Still thought to be rare, left atrio-esophageal fistula is a feared complication that can present slowly and have dire consequences. CTA of the chest is the test of choice for diagnosis, because it can illustrate extravasation of contrast from the left atrium into esophagus via a fistulous tract. In some instances, the fistula may only form between the esophagus and the pericardial sac, a result of thermal injury to the neighboring tissues. Confirmation with a fluoroscopic esophagram can be helpful in special cases. Treatment depends on extent of injury and ranges from open thoracic surgery to endoscopic placement of esophageal stent.

TEACHING POINT

For patients presenting in emergency situations with chest pain after recent radiofrequency ablation for atrial fibrillation treatment, one should consider CT angiography of the chest as it can aide in diagnosis of complications from the procedure;

such as, pericardioesophageal fistula formation or the even more serious and lethal condition of a left atrial esophageal fistulous communication.

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FIGURES



Figure 1: 40 year old male with pericardioesophageal fistula. Frontal, semi-erect, portable chest radiograph demonstrates mild cardiac enlargement without evidence of pulmonary edema, pleural effusion or focal consolidation.

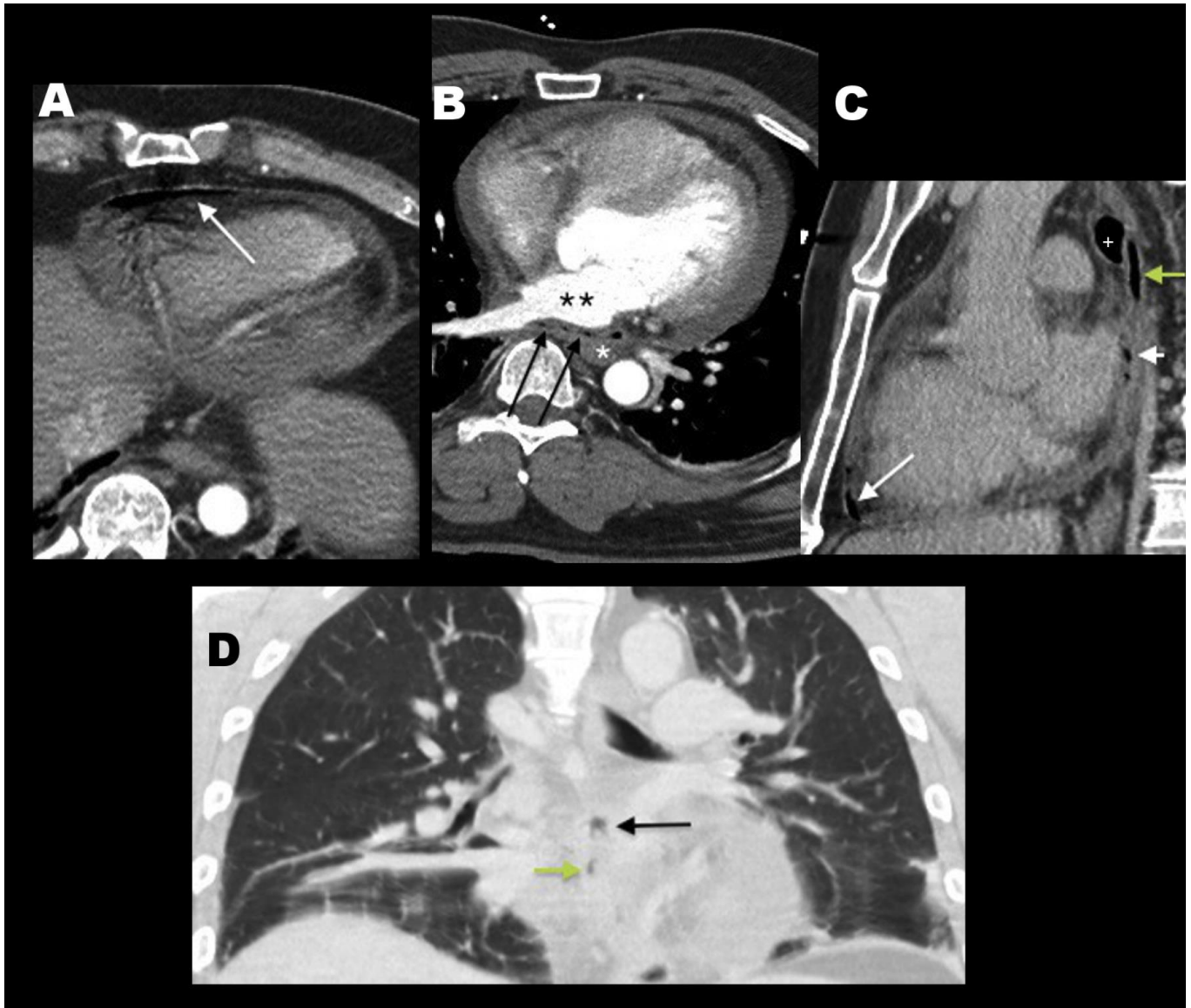


Figure 2: 40 year old male with pericardioesophageal fistula. CT Angiography of the chest with multiple phases of contrast. Axial CECT at the level of the heart apex demonstrates an air fluid level within the pericardial sac indicating a pneumopericardium (arrow) within a pericardial fluid collection (A). Axial early arterial phase CECT at the level of the left atrium shows gas (arrows) within the pericardium bordered by the esophagus (*) and the left atrium (**), notice no contrast extravasation into the pericardial sac (B). Sagittal portovenous phase CECT through the left atrium demonstrates the left main bronchus (+), esophageal air (yellow-green arrow), and pneumopericardium (white arrow) (C). Coronal portovenous phase CECT through the posterior left atrium shows esophageal gas (yellow-green arrow) and adjacent pericardial gas (black arrow) (D). (Toshiba Aquilion, 120 kVp, 369 mA, ST = 3mm, Mediastinum W = 400 and L = 40, Lung W = 1465, level = (-) 498, 100mL Iohexol 300)

Figure 3 (right): 40 year old male with pericardioesophageal fistula. Water soluble contrast esophagram followed by thin barium sulfate suspension. After evaluation with water soluble contrast (Iohexol 300) which demonstrated no extravasation or luminal disruption, a Barium sulfate suspension (60% w/v, 41% w/w) in LPO position, demonstrated small amount of contrast extravasation (arrow) medial to esophageal lumen (A). Further evaluation of the esophagram with Barium Sulfate suspension (60% w/v, 41% w/w) in the RAO position with a magnified view of the extra-luminal contrast (perforated circle) (B).

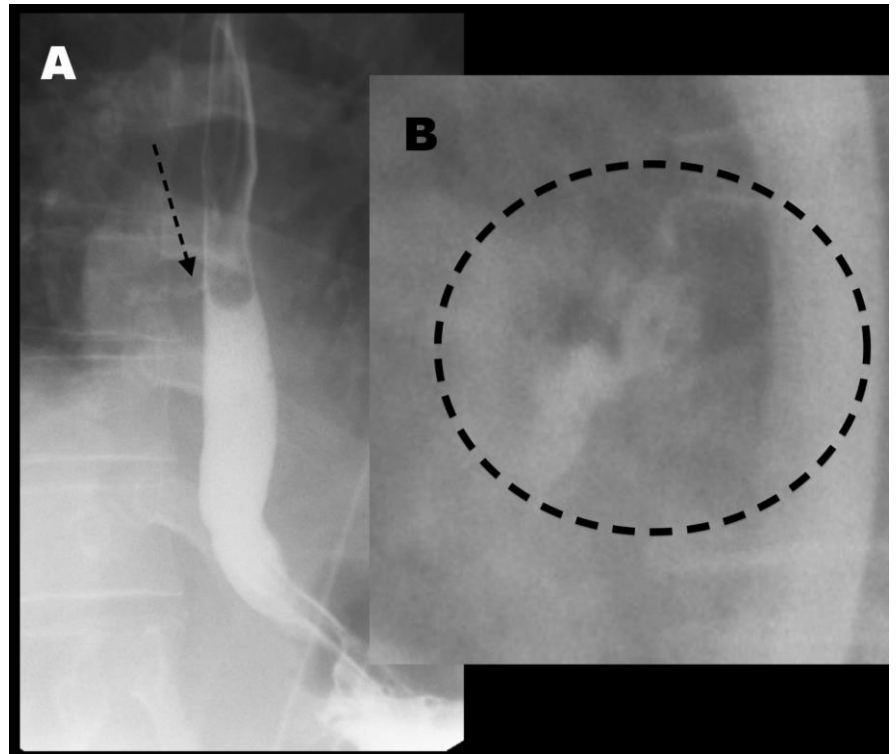


Figure 4 (left): 40 year old male with pericardioesophageal fistula. Transthoracic echocardiogram via an apical window demonstrates a 4 chamber image of the heart. Hypochoic collection surrounds the heart representing a pericardial effusion (arrow).

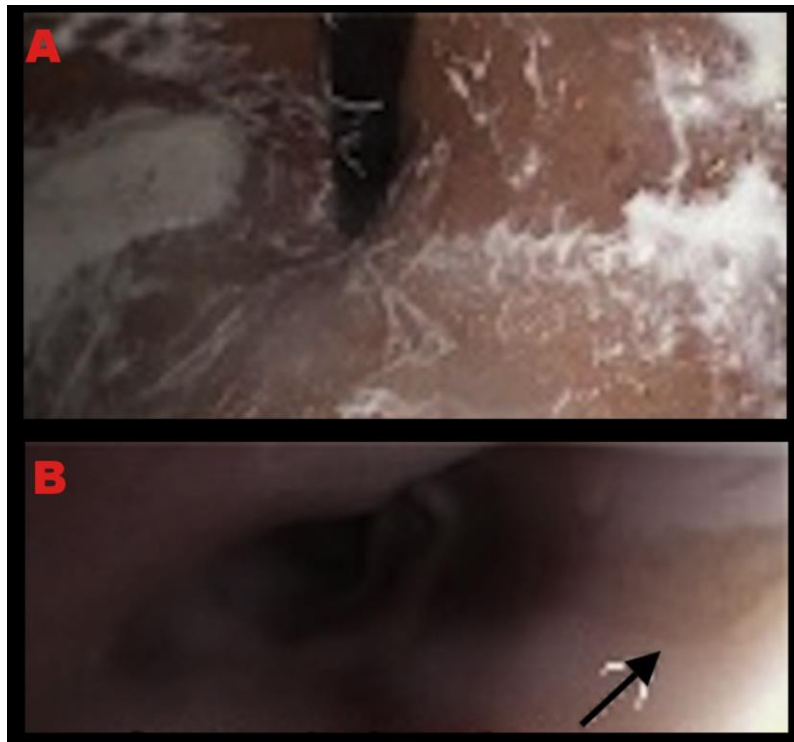


Figure 5: 40 year old male with pericardioesophageal fistula. Endoscopic images obtained during placement of esophageal stent were performed utilizing a Pentax EG-2990I endoscope. Retroflexed view of fundus demonstrates no inflammatory irregularity of mucosa and is coated by recent ingestion of barium (A). Mid esophagus mucosal irregularity at level of corresponding leak (arrow) (B).

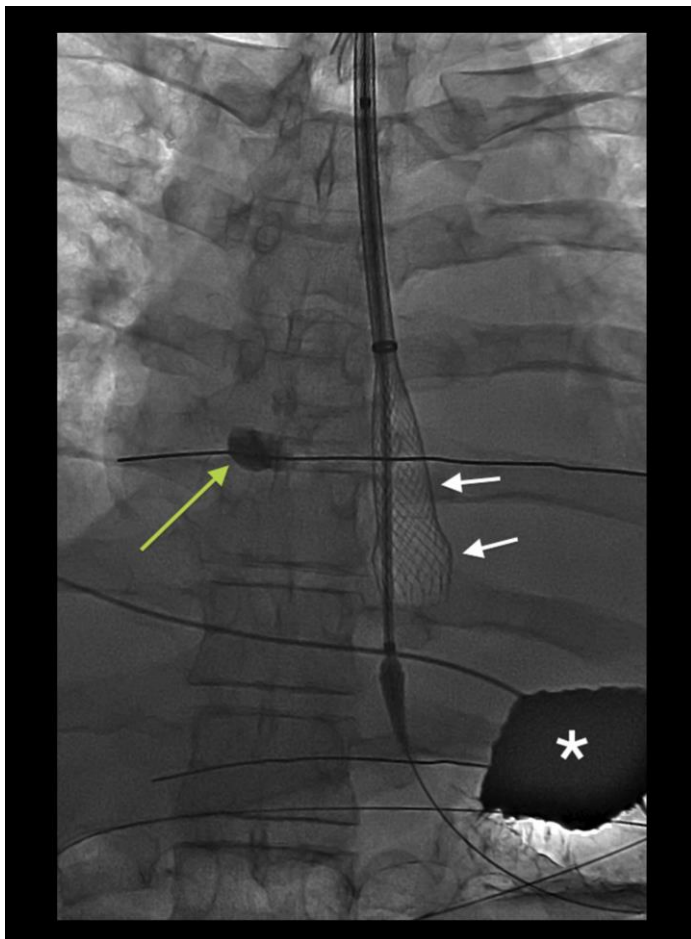


Figure 6 (left): 40 year old male with pericardioesophageal fistula. Single, frontal, fluoroscopic image illustrates interval placement of an esophageal stent (white arrows). Retained contrast in the gastric lumen (*) and extravasated contrast outside of the esophageal lumen (yellow-green arrow) are also visible.



Figure 7: 40 year old male with pericardioesophageal fistula. Repeat water soluble contrast (Iohexol 300) esophagram demonstrates patent esophageal stent, the retained barium collection (perforated circle) from prior extravasation, and no evidence of new extra-luminal contrast extravasation.

ETIOLOGY	Uncertain, but likely thermal injury that initiates an inflammatory cascade
INCIDENCE	0.03% rate of fistulous formation due to complication from radiofrequency ablation
GENDER RATIO	Unknown
AGE PREDILECTION	Unknown
RISK FACTORS	Radiofrequency catheter ablative therapy for atrial fibrillation
TREATMENT	Open thoracic surgical repair versus endoscopic esophageal stent placement
PROGNOSIS	Mortality approaches 67%
IMAGING FINDINGS	<p><u>Chest Radiograph:</u></p> <ul style="list-style-type: none"> - Variable normal to pneumopericardium, mediastinal widening <p><u>CT Angiography Chest:</u></p> <ul style="list-style-type: none"> - Pneumopericardium, Hemopericardium, Active extravasation of contrast from left atrium into surrounding structures <p><u>Esophagram:</u></p> <ul style="list-style-type: none"> - Extravasation of oral contrast from esophagus

Table 1: Summary table for left atrio-esophageal fistula

DDX	CT FINDINGS	RADIOGRAPHIC FINDINGS	FLUOROSCOPIC FINDINGS
ESOPHAGITIS	Diffuse, circumferential esophageal wall thickening Mucosa enhancement	Ambiguous	Strictures Webs
LEFT ATRIO- ESOPHAGEAL FISTULA	Active extravasation of contrast Pneumopericardium Hemopericardium	Ambiguous, but may visualize pneumopericardium	Active extravasation
PERICARDIOESOPHAGEAL FISTULA	Pneumopericardium Hemopericardium	Ambiguous but may visualize pneumopericardium	Active extravasation
FOREIGN BODY IMPACTION	Helpful in locating tiny foreign bodies May detect sequelae - laceration	If radio-opaque, easily visualized. If lucent, then mass effect	Filling defect, complete or incomplete.
MALLORY-WEISS TEAR & BOERHAAVE SYNDROME	Pneumomediastinum Peri-esophageal fluid collections	Subcutaneous emphysema Pneumomediastinum	Test of choice in determining perforation site and extent
ESOPHAGEAL CANCER	Wall thickening at the GE junction Helps identify Lymphadenopathy / metastatic disease	Mass with or without mass effect	Intra-luminal mass stricture
TRAUMA: - PENETRATING - BLUNT	Wall thickening Pneumomediastinum Peri-esophageal fluid	Subcutaneous emphysema Pneumomediastinum	Extravasation of contrast
DISSECTION s/p ESOPHAGOGASTROSCOPY	Pneumomediastinum Peri-esophageal fluid	Subcutaneous emphysema Pneumomediastinum	Extravasation of contrast

Table 2: Differential diagnosis table for acute or threatened esophageal perforation

SYSTEM	PATH	INCIDENCE (%)	IMAGING
CARDIAC	Pulmonary vein stenosis	0.5	CT Angiography
	Pericardial effusion	0.7	CXR, CT, Echocardiography,
	Cardiac Tamponade	1	Clinical signs
	Cardiac valve damage	0.2	CT Angiography, Echocardiography
VASCULAR	Arteriovenous fistula	0.4	CT Angiography
	Femoral artery pseudoaneurysm	0.5	CT Angiography, Ultrasonography
	Groin hematoma		Clinical signs, CT, Ultrasonography
	DVT/ PE	0.15	Clinical signs, Ultrasonography, CT Angiography, Nuclear Medicine V/Q, CXR
NEUROLOGIC	Stroke	0.4	Clinical signs, NECT, CT Angiography, MRI
	Transient ischemic attack	0.4	Clinical signs, MRI
	Phrenic nerve injury	0.4	CXR, CT
	Diaphragmatic paralysis	0.3	Fluoroscopy
INFECTIOUS	Sepsis	0.1	Clinical Signs
	Endocarditis	0.1	CXR, CT, Ultrasonography
PULMONARY	Pneumothorax	0.2	CXR, CT
	Hemothorax	0.2	CXR, CT
GASTROINTESTINAL	Esophageal ulceration	9.6 – 57.1	CT, Fluoroscopy

Table 3: Additional complications along with incidence and imaging detection that can result from Atrial Fibrillation Ablation therapy

ABBREVIATIONS

CECT = contrast enhanced computed tomography
 CT = computed tomography
 CTA = computed tomography angiography
 EKG = electrocardiogram
 IV = intravenous
 LAEF = Left atrio-esophageal fistula
 NECT = Non-enhanced computed tomography

KEYWORDS

Left atrio-esophageal fistula, Pericardioesophageal fistula, CT angiography

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