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Surgical repair of an esophageal perforation after radiofrequency catheter ablation for atrial fibrillation

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ABSTRACT

Recent reports have described the incidence of atrioesophageal fistulas (AEF), often resulting in death, from radiofrequency (RF) catheter ablation of atrial fibrillation (AF).[1] Cases of esophageal perforation without concomitant AEF have not been described as extensively.[1] The precise mechanisms leading to esophageal injury after catheter ablation without involvement of the left atrium are not fully understood. The surgical approach to treat esophageal perforation is strongly recommended.[2] However, a unified surgical treatment approach has not yet been established. We describe a case of successful surgical repair of an esophageal perforation after ablation using surgical repair in combination with an omental wrap.

1. Case presentation

A 72-year-old woman was referred for elective pulmonary vein isolation for symptomatic paroxysmal AF refractory to anti-arrhythmic drug therapy. RF catheter ablation was performed under mild anesthesia using a 3-dimensional navigation system (CARTO 3 V3.2 EP Navigation System; Biosense Webster, Diamond Bar, CA, USA). The left atrium (LA) was accessed through a single transseptal puncture and a deflectable Agilis (St Jude Medical, St. Paul, MN, USA) and a SL1 (St. Jude Medical) sheath were advanced into the LA through the same puncture site. A 20-pole circular mapping catheter (Lasso Biosense Webster) and a 3.5 mm Thermocool ablation catheter (Biosense Webster) were then placed into the LA for mapping and ablation, and the SL1 sheath withdrawn to right atrial level. RF energy was delivered in unipolar mode using a Stockert RF generator (Biosense Webster) with power of up to 30 W and a maximum temperature of 50 °C. The maximum power at the posterior wall was 25 W. The saline irrigation speed as predefined by the manufacturer was 30mL/min and 17 mL/min, respectively. Circumferential ablation at the atrial level of the PV antrum was performed around the ipsilateral PVs. The procedural endpoint was PVI as confirmed by the Lasso catheter. Individual lesions were created by the Thermocool ablation catheter using the deflectable Agilis sheath for 30–40 seconds and a starting power of 15W per lesion. Up-titration of power was guided by persistence of local EGMs on the ablation catheter (Fig. 1). Esophageal temperature monitoring and intracardiac echocardiography (ICE) were not available during ablation. The total procedure time was 2 hours and 9 minutes, and total left atrial ablation time was 18 minutes and 40 seconds. The patient was discharged the next morning without any complaints. Prophylactic treatment with proton-pump inhibitors was initiated for six weeks. 16 days after RF catheter ablation, the patient presented herself to the emergency room with shortness of breath, severe and frightening chest pain accompanied by coughing and chills for the last 72 hours. A white blood cell count of 10.100/μL and an elevated C-reactive protein (CRP) level of 92.5 mg/l were noted. The patient was admitted with the suspicion of a respiratory tract infection. The next day, the white blood cell count raised to 16.640/μL and the CRP-levels doubled to 185.2 mg/l. Small pericardial fluid collection was detected by bedside echocardiography. The electrophysiologist on call was consulted and a computed tomography (CT) scan of the chest with oral contrast was

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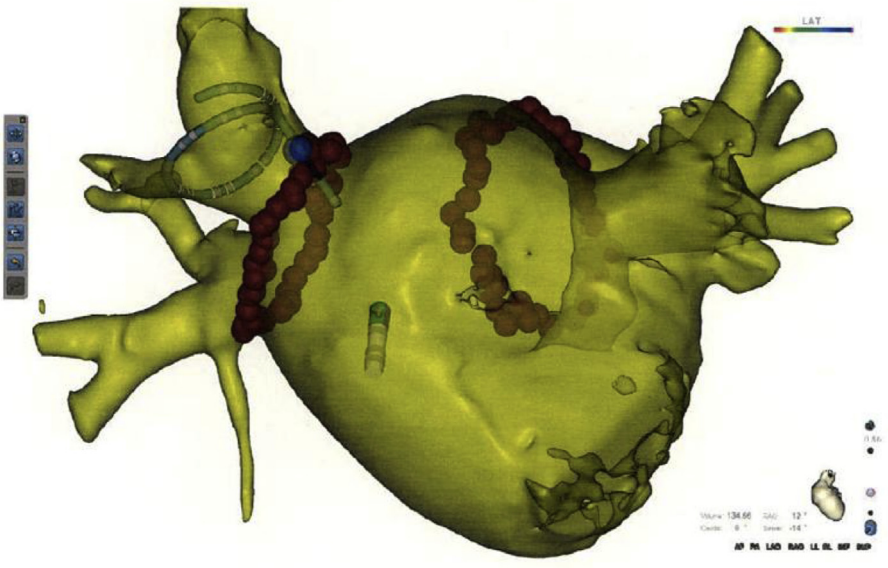

Fig. 1. Electroanatomical map showing sites of ablation The electroanatomical map showing the sites of ablation for the patient during pulmonary vein isolation. The red dots represent sites of ablation. The total procedure time was 2 hours and 9 minutes, and total left atrial ablation time was 18 minutes and 40 seconds.

immediately obtained. The CT-scan showed a contained mid esophageal perforation: there was leakage of both oral contrast media and air into the middle/posterior mediastinum resulting in a small pneumomediastinum (Figs. 2 and 3). An esophageal perforation was suspected as a complication of RF catheter ablation. After interdisciplinary discussing with cardiac and visceral surgeons, gastroenterology, and radiology services, the decision was made to proceed with emergent surgical repair. The surgical repair

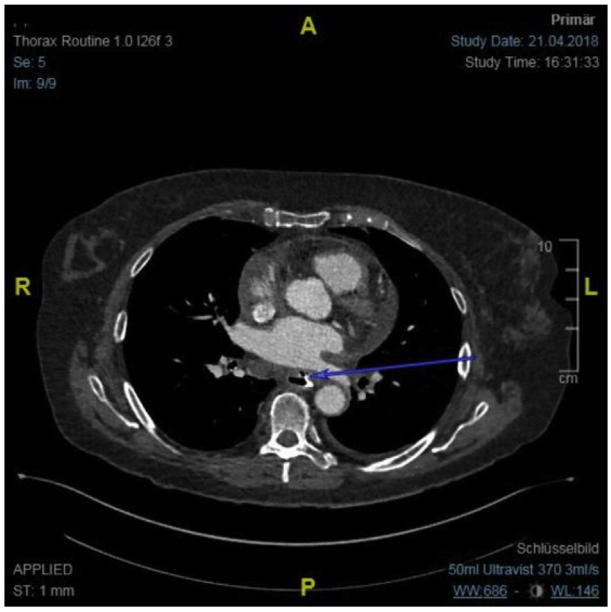

Fig. 2. Computed tomography (CT) scan of the chest with oral and intravenous contrast showing contained esophageal perforation CT scan with contrast done 17 days after the ablation shows a mid esophageal perforation. There is extravasation of oral contrast media from the esophagus (blue arrow) into the mediastinal space in short distance to the left superior pulmonary vein. There is no visible connection to the left atrium or the pulmonary veins.

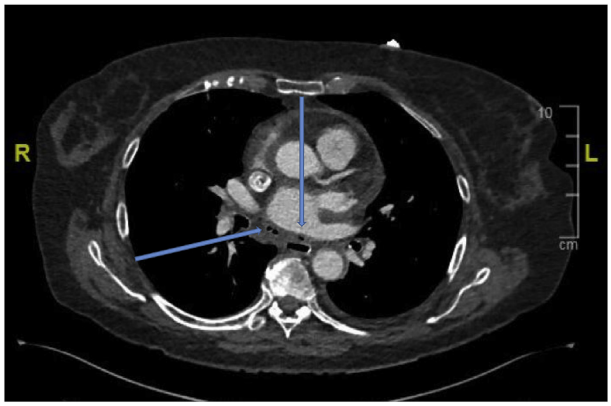

Fig. 3. Computed tomography (CT) scan of the chest with oral and intravenous contrast showing pneumomediastinum The same CT chest is shown. The mid esophageal perforation with extension into the mediastinal space results in a small amount of pneumomediastinum (blue arrows).

was performed by a team of cardiac and visceral surgeons after prophylactic arterio-venous cannulation, a standby cardiopulmonary bypass in case of LA involvement was instituted. The strategy was to enable closure of the LA communication as a priority. Urgent right anterolateral thoracotomy revealed that the posterior pericardium was still adherent to the esophageal wall at the level of the LA. The esophagus was separated and a small perforation (2×2 mm) was identified on the anterior wall of the esophagus without any involvement of the LA, the pulmonary veins or the pericardium. There was no remarkable contamination of the surrounding mediastinal tissue. Surgical drainage of the pericardium was performed by the cardiac surgeon. A primary repair of the esophagus was done by the visceral surgeons consisting of a vertical esophagomyotomy to fully expose the damaged mucosa and secure closure of the mucosa and muscularis. To reinforce primary repair, covering tissue was placed between the LA and the esophagus using a vascularized omental wrap. Using a separate

minilaparotomy, the greater omentum was mobilized and the omental pedicle was based on the right gastroepiploic artery and vein, respectively. This was unbound from the greater curvature of the stomach and the transverse colon and passed through a diaphragmatic aperture into the chest. The pedicled omental flap was then wrapped around the esophagus at the level of the repair between the esophagus and the LA. Follow-up chest CT performed 5 days later again with oral contrast media showed no evidence of leakage. The patient recovered fully without any sequel from this large abdomino-thoracic surgery, and no further AF-episodes were documented during a 6-month follow-up period.

This case describes the serious complication of esophageal perforation without concomitant AEF after RF catheter ablation of AF. The complication was detected early and successfully treated with primary surgical repair in combination with an omental wrap. We report three major findings: First, this case helps to further elaborate the mechanism of lesion formation in the esophageal mucosa due to RF catheter ablation in the LA. Second, this case reinforces the importance of close postoperative follow-up and a low threshold for immediate evaluation of patients with symptoms of any kind suggestive of esophageal trauma or perforation. Delayed diagnosis and consequent late initiation of treatment attributes to the high mortality rate of esophageal injury after RF catheter ablation. Thus, follow-up should be led by the treating electrophysiologists to overcome the lack of clinical awareness among other health care providers for this rare complication. Third, early surgical approach to esophageal injury is considered crucial. However, the best surgical technique with or without using cardiopulmonary bypass is unknown. Apart from early diagnosis, the peculiarities of surgical management in this case, namely the combined surgery on prophylactic cardio-pulmonary bypass standby in conjunction with the mobilization and use of an omental pedicle wrap to cover the lesion may have accounted for the successful outcome.

While the prevalence of atrio- and pericardial-esophageal fistula have been extensively described, esophageal perforation with no fistula formation is by far less common. In a survey aggregating 191′215 RF catheter ablation, only 4 patients were reported to have esophageal perforation without fistula formation [1]. Our case corroborates the theory of the creation of an inside-out lesion, meaning that burns initially develop in the esophageal mucosa and progress toward the LA facilitating fistula. The geometry of lesions formed by irrigated catheter is teardrop-shaped with the largest lesion projected deeper into tissue leading to esophageal injury first [3]. This was recently demonstrated in vivo in animal models [3] and was also observed in a single case report, where a patient refused surgery and serial CT images documented the progression of an esophageal ulcer to complete fistulization to the LA [4]. The limited effectiveness of preventive measures, makes a high index of suspicion and early recognition and treatment of paramount importance. Improved awareness will likely allow a greater proportion of patients, similarly as in this case, to be diagnosed and treated before the development of AEF. Regarding the diagnostic modality of choice, CT scan has the best capacity to detect esophageal injury [4]. The combined use of intravenous and especially oral contrast is useful, however some esophageal perforations may just be diagnosed by a pneumomediastinum. Endoscopic evaluation is contraindicated due to possible development of air or food embolism leading to neurological injury or even death. However, very early endosonography post-ablation (within 48 hours) may play a role in risk stratification, as patients with mediastinal changes (in 27% of cases only identified by endosonography) might be candidates for a closer clinical and endosonographic follow-up [5]. Despite the controversies in the management of esophageal complications after RF ablation, there is consensus that an early surgical approach to esophageal injury should be strongly considered regardless of evidence of fistula [2]. Although single case reports with conservative management of esophageal injury were reported, mortality of AEF is nearly 100% if left untreated [5]. Surgical procedures have varied, mainly consisting of esophageal stenting or primary repair with or without using cardiopulmonary bypass [2,6,7]. The biggest concern of esophageal stenting is infection, persistent fistula and migration [2]. Regarding primary surgical repair of esophageal injury after RF ablation, different options according to the clinical extent of the injury have been described. They range from an extrapericardial approach without the need for cardiopulmonary bypass [6], to left atrial repair followed by repair of the esophagus with cardiopulmonary bypass [7]. The use of cardiopulmonary bypass varies. Nonetheless, in case of LA involvement, intracardiac access is likely the only method to prevent a lethal outcome. Interposing tissue between the repaired esophagus and the LA appears to result in fewer postoperative complications [2,6,7]. Most often muscle flaps or pericardium were used [6]. Hartmann et al. described the use of an omental wrap before [7].

Three limitations of the present case merit consideration. One, lesions were created in a time-based fashion with fixed power, which may lead to delivering energy that is potentially more than optimal, which in turn may contribute to esophageal injury. Second, esophageal temperature monitoring and ICE were not available during ablation. Both modalities have potential value in the ascertainment of lesion creation, which could be of use to guide power titration and thus prevent thermal injury to the esophagus.

Our case reinforces the importance of close postoperative follow-up and a low threshold for immediate evaluation of patients with symptoms suggestive for esophageal perforation. A CT scan with intravenous and oral water-soluble contrast material is the diagnostic modality of choice. An early surgical approach to esophageal perforation should be strongly considered. However, a unified approach to treatment has yet to be established.

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None.

Abbreviations

AF	atrial fibrillation
RF	radio frequency
LA	left atrium
CT	computed tomography
AEF	atrioesophageal fistula

Authors' contributions

PB analyzed and interpreted the data, drafted the manuscript and made critical revision of the manuscript for important intellectual content. MK, CS made critical revision of the manuscript for important intellectual content and analyzed the data. TD, DO, OR, UR, MR, SO, cared for the patient in the inpatient and outpatient clinic, made critical revision of the manuscript for important intellectual content and analyzed the data.

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