Thoracoscopic stapler-closure of left atrial appendage and epicardial clamp-isolation of pulmonary veins in a patient with non-valvular atrial fibrillation and short bowel: a case report

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Background
Thromboembolic occlusion of the superior mesenteric artery (SMA) is a serious event in patients with atrial fibrillation (AF). Extensive bowel resection is frequently required, and the resulting short bowel syndrome hampers the intake of anticoagulant or anti-arrhythmic medication.

Case summary
We report the case of thoracoscopic surgery consisting of stapler-closure of the left atrial appendage and bilateral epicardial clamp-isolation of the pulmonary veins performed in a 66-year-old male patient with symptomatic persistent non-valvular AF who became unable to take in anticoagulants or anti-arrhythmic drugs because of thromboembolic SMA occlusion and subsequent total resection of the small intestine. The patient has been free from thromboembolic or arrhythmic symptoms during 6 months of follow-up despite taking no anticoagulant or anti-arrhythmic drugs. Electrocardiographic monitoring demonstrated a stable sinus rhythm for 48 h at postoperative Months 3 and 6. Echocardiography manifested an improvement of the left ventricular ejection fraction from a preoperative value of 44–69% at postoperative Month 6.

Discussion
The present technique may contribute to treating patients with symptomatic non-valvular AF and a complication similar to that of the present case.

Keywords
Non-valvular atrial fibrillation • Superior mesenteric artery occlusion • Short bowel syndrome • Left atrial appendage closure • Pulmonary vein isolation • Thoracoscopic surgery • Case report

Learning points
• Short bowel syndrome resulting from occlusion of the superior mesenteric artery renders treatments using anticoagulants or anti-arrhythmic drugs very difficult in patients with atrial fibrillation.
• Transcutaneous techniques of device implantation in the left atrial appendage (LAA) or rhythm control are inapplicable in patients who are unable to take in anticoagulants.
• Stapler-closure of the LAA and epicardial clamp-isolation of the pulmonary veins are thoracoscopically feasible and applicable in such patients.

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Introduction

Acute occlusion of the superior mesenteric artery (SMA) diffusely damages the bowels and often results in extensive bowel resection. 1,2 Short bowel syndrome (SBS) renders not only the absorption of nutrients but also of important drugs, such as anticoagulants, extremely difficult in patients with atrial fibrillation (AF). 3,4

We report our clinical experience with the thoracoscopic closure of the left atrial appendage (LAA) and bilateral epicardial isolation of the pulmonary vein (PV) performed in a patient with symptomatic persistent AF, who was unable to take in prophylactic antiocoagulation or antiarrhythmic drugs due to SBS complicated by a thromboembolic SMA occlusion and subsequent total resection of the small intestine.

Timeline

| Date               | Event                                                                 |
|--------------------|-----------------------------------------------------------------------|
| 6 June 2017        | Acute-onset left abdominal pain                                       |
| 13 June 2017       | Recurrence of abdominal pain, diagnosis of superior mesenteric artery occlusion and panperitonitis, emergency extensive bowel resection |
| 20 June 2017       | Central venous port placement                                         |
| 28 September 2017  | Central venous port placement                                         |
| 28 September 2017  | Thoracoscopic epicardial pulmonary vein clamp-isolation and left atrial appendage staple-closure |
| 20 July–August 2017| Central venous port placement                                         |
| 13 October 2017    | Discontinuation of heparin, discharge from hospital                   |
| 1 November 2017    | Enhanced computed tomography (no clot in the left atrium)            |
| 5 December 2017    | Electrocardiographic monitoring (sinus rhythm for 48 h)              |
| 1 April 2018       | Electrocardiographic monitoring (sinus rhythm for 48 h) and echocardiography (normalized left ventricular ejection fraction) |
| 13 October 2017    | Discontinuation of heparin, discharge from hospital                   |
| 1 November 2017    | Enhanced computed tomography (no clot in the left atrium)            |
| 5 December 2017    | Electrocardiographic monitoring (sinus rhythm for 48 h)              |
| 1 April 2018       | Electrocardiographic monitoring (sinus rhythm for 48 h) and echocardiography (normalized left ventricular ejection fraction) |

Case presentation

The patient, a 66-year-old man, developed acute-onset pain in the left abdomen but the symptom abated in a few days. A week later, the patient was carried to a nearby medical centre due to the recurrence of excruciating pain with serious diarrhoea. He was in shock with a base excess of -5.4. Palpation of the abdomen demonstrated strong muscular defence indicating panperitonitis. Emergency enhanced computed tomography revealed a total occlusion of the SMA trunk, significant dilatation of the intestine, and infarctions in the right kidney and spleen (Figure 1). Electrocardiography showed continuous AF (Figure 3). Echocardiography manifested 35 mm of the left atrial diameter, 44/78 mL of the left ventricular end-systolic/diastolic volume, and 44% of the left ventricular ejection fraction computed by the modified Simpson's method. No valvular regurgitation was observed except for mild one via the tricuspid valve. Acute thromboembolic occlusion of the SMA caused by persistent non-valvular AF was diagnosed although no clots remained in the LAA. An emergency total intestinal resection from the jejunum to ileum and right hemicolectomy was performed, because the small intestine was entirely necrotic from the Treitz' ligament and multiple intestinal perforations were observed. The patient received central venous port placement for treatment with hyperalimentation. Because the patient had a CHA2DS2-Vasc score of 4 (previous thromboembolism, age > 65 years, and renal dysfunction) warfarin was tentatively administered, but the international normalized ratio did not exceed 0.9. Moreover, the patient often complained of AF symptoms, but cardioversion was ineffective in maintaining the sinus rhythm.

The patient was referred to us for thoracoscopic surgery for LAA management and rhythm control and underwent the operation 3 months after the bowel resection. Under general anaesthesia via a double-lumen endotracheal tube that allows for a hemipulmonary collapse, the patients were placed in the supine position. Intraoperative transoesophageal echocardiography confirmed that clots in the LAA, which could cause a procedure-related thromboembolism, were absent (Figure 2). Thoracoscopic procedures were completed through four ports in each side (Supplementary material online, Video S1). Pulmonary vein isolation was conducted using radiofrequency bipolar epicardial coagulators (Isolator Synergy Clamps and Isolator Transpolar Pen, Atricure, USA) as recommended in the expert consensus guideline for reliable safety and transmurality, 4 and the LAA was closed with an automatic, cut-and-staple device (ECHelon FLEX™ Powered ENDOPath™ Stapler 60, ETHICON, USA). Surgery started from the left side to close the LAA and isolate the left PVs and, and moved to the right side to isolate the right PVs. Intraoperative transoesophageal echocardiography confirmed a flat closure of the LAA (Figure 2). The operation was uneventfully completed in 55 min.

After surgery, heparin was administered for 2 weeks to maintain the activated clotting time at around 150 s, then was discontinued. At postoperative Month 1, enhanced computed tomography showed no clot formation in the left atrium. At present, the patient has complained of no thromboembolic or arrhythmic symptoms for 6 months after surgery despite not being on any anticoagulant or anti-arrhythmic medication, and electrocardiographic monitoring demonstrated a stable sinus rhythm (Figure 3) for 48 h at postoperative Months 3 and 6. Echocardiography at postoperative Month 6 demonstrated a cardiac function improved from the preoperative one: 30 mm of the left atrial diameter, 23/74 ml of the left ventricular end-systolic/diastolic volume, and 69% of the left ventricular ejection fraction.

Discussion

Today, not only conventional warfarin but also various non-vitamin K antagonist oral anticoagulants are available to prevent thromboembolism in patients suffering from AF. Anticoagulants are absorbed from the stomach and proximal part of the small intestine. 5–7 Buchholz et al. 8 reported that a functional small intestinal length
above 60 cm was a favourable determinant for the use of rivaroxaban. The present patient was rescued with total resection of the small intestine, and therefore, it was extremely difficult for him to take in food or anticoagulants despite a high CHA2DS2-Vasc score (4: ischaemic stroke risk of 4.8% per year and stroke/TIA/peripheral embolus risk of 6.7% per year).\textsuperscript{9} Transcutaneous implantation of an LAA-closure device, such as the Watchman or Amplatzer,\textsuperscript{10,11} might have been an option, but our simple cutting method was considered better because clot formation on such devices, reportedly not uncommon,\textsuperscript{12} must be treated with anticoagulants.
Transcutaneous catheter-based ablation was not suitable in the present case for two reasons. First, anticoagulation is required after the catheter-ablation until the endothelial lesions heal. In contrast, the present technique isolates the PVs swiftly from the epicardial side, and therefore, the endothelial damage is negligible. Second, AF may recur. If AF recurs, patients are exposed again to thromboembolic risks, which increase with age. Atrial fibrillation may recur in the present case as well, but the thromboembolic risks continue to remain low thanks to the removal of the LAA.

**Figure 3** Electrocardiographs before (top) and after (bottom) surgery.

**Conclusion**

Although the present therapeutic strategy is not listed in the guideline for management of AF-associated SMA thromboembolism, the present case suggests that our thoracoscopic technique consisting of stapler-closure of the LAA and bilateral epicardial clamp-isolation of the PVs might be a viable treatment in patients suffering from symptomatic non-valvular AF and a complication similar to that of the present patient.
Supplementary material

Supplementary material is available at European Heart Journal - Case Reports online.

Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

Conflict of interest: none declared.

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