

# World Journal of *Clinical Cases*

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## Contents

Thrice Monthly Volume 10 Number 12 April 26, 2022

### EVIDENCE REVIEW

- 3639** Tilt and decentration with various intraocular lenses: A narrative review  
*Chen XY, Wang YC, Zhao TY, Wang ZZ, Wang W*

### REVIEW

- 3647** Role of zonula occludens in gastrointestinal and liver cancers  
*Ram AK, Vairappan B*

### MINIREVIEWS

- 3662** Pathophysiological mechanisms of hepatic stellate cells activation in liver fibrosis  
*Garbuzenko DV*

### ORIGINAL ARTICLE

#### Retrospective Cohort Study

- 3677** Predictors of unfavorable outcome at 90 days in basilar artery occlusion patients  
*Chiu YC, Yang JL, Wang WC, Huang HY, Chen WL, Yen PS, Tseng YL, Chen HH, Tsai ST*

#### Retrospective Study

- 3686** Role of multidetector computed tomography in patients with acute infectious colitis  
*Yu SJ, Heo JH, Choi EJ, Kim JH, Lee HS, Kim SY, Lim JH*
- 3698** Efficacy and prognostic factors of neoadjuvant chemotherapy for triple-negative breast cancer  
*Ding F, Chen RY, Hou J, Guo J, Dong TY*
- 3709** Relationship between subgroups of central and lateral lymph node metastasis in clinically node-negative papillary thyroid carcinoma  
*Zhou J, Li DX, Gao H, Su XL*
- 3720** Nomogram to predict postoperative complications in elderly with total hip replacement  
*Tan XJ, Gu XX, Ge FM, Li ZY, Zhang LQ*
- 3729** Flap failure prediction in microvascular tissue reconstruction using machine learning algorithms  
*Shi YC, Li J, Li SJ, Li ZP, Zhang HJ, Wu ZY, Wu ZY*

#### Observational Study

- 3739** Surgery in platinum-resistant recurrent epithelial ovarian carcinoma  
*Zhao LQ, Gao W, Zhang P, Zhang YL, Fang CY, Shou HF*

- 3754** Anorectal dysfunction in patients with mid-low rectal cancer after surgery: A pilot study with three-dimensional high-resolution manometry

Pi YN, Xiao Y, Wang ZF, Lin GL, Qiu HZ, Fang XC

#### Randomized Controlled Trial

- 3764** Effect of wrist-ankle acupuncture on propofol dosage during painless colonoscopy: A randomized controlled prospective study

He T, Liu C, Lu ZX, Kong LL, Li Y, Xu Z, Dong YJ, Hao W

#### META-ANALYSIS

- 3773** Melatonin intervention to prevent delirium in hospitalized patients: A meta-analysis

You W, Fan XY, Lei C, Nie CC, Chen Y, Wang XL

- 3787** Risk factors for hospital readmissions in pneumonia patients: A systematic review and meta-analysis

Fang YY, Ni JC, Wang Y, Yu JH, Fu LL

#### CASE REPORT

- 3801** Anti-programmed death 1 antibody in the treatment of coexistent *Mycobacterium fortuitum* and lung cancer: A case report

Zhang CC, Chen P

- 3808** Acute pancreatitis-induced thrombotic thrombocytopenic purpura: A case report

Wang CH, Jin HF, Liu WG, Guo Y, Liu Z

- 3814** Successful management of life-threatening aortoesophageal fistula: A case report and review of the literature

Zhong XQ, Li GX

- 3822** Isolated coagulopathy without classic CRAB symptoms as the initial manifestation of multiple myeloma: A case report

Zhang Y, Xu F, Wen JJ, Shi L, Zhou QL

- 3828** Evaluation of intracoronary function after reduction of ventricular rate by esmolol in severe stenotic myocardial bridge: A case report

Sun LJ, Yan DG, Huang SW

- 3834** Pediatric living donor liver transplantation using liver allograft after *ex vivo* backtable resection of hemangioma: A case report

Li SX, Tang HN, Lv GY, Chen X

- 3842** Kimura's disease in soft palate with clinical and histopathological presentation: A case report

Li W

- 3849** Combined targeted therapy and immunotherapy in anaplastic thyroid carcinoma with distant metastasis: A case report

Ma DX, Ding XP, Zhang C, Shi P

- 3856** Successful multimodality treatment of metastatic gallbladder cancer: A case report and review of literature  
*Zhang B, Li S, Liu ZY, Peiris KGK, Song LF, Liu MC, Luo P, Shang D, Bi W*
- 3866** Ischemic colitis after receiving the second dose of a COVID-19 inactivated vaccine: A case report  
*Cui MH, Hou XL, Liu JY*
- 3872** Cryoballoon pulmonary vein isolation and left atrial appendage occlusion prior to atrial septal defect closure: A case report  
*Wu YC, Wang MX, Chen GC, Ruan ZB, Zhang QQ*
- 3879** Surgical treatment for a combined anterior cruciate ligament and posterior cruciate ligament avulsion fracture: A case report  
*Yoshida K, Hakozaiki M, Kobayashi H, Kimura M, Konno S*
- 3886** Successful robot-assisted partial nephrectomy for giant renal hilum angiomyolipoma through the retroperitoneal approach: A case report  
*Luo SH, Zeng QS, Chen JX, Huang B, Wang ZR, Li WJ, Yang Y, Chen LW*
- 3893** Cryptococcal antigen testing of lung tissue homogenate improves pulmonary cryptococcosis diagnosis: Two case reports  
*Wang WY, Zheng YL, Jiang LB*
- 3899** Combined use of extracorporeal membrane oxygenation with interventional surgery for acute pancreatitis with pulmonary embolism: A case report  
*Yan LL, Jin XX, Yan XD, Peng JB, Li ZY, He BL*
- 3907** Dynamic navigation system-guided trans-inferior alveolar nerve implant placement in the atrophic posterior mandible: A case report  
*Chen LW, Zhao XE, Yan Q, Xia HB, Sun Q*
- 3916** Anti-glomerular basement membrane disease with IgA nephropathy: A case report  
*Guo C, Ye M, Li S, Zhu TT, Rao XR*
- 3923** Amniotic membrane transplantation in a patient with impending perforated corneal ulcer caused by *Streptococcus mitis*: A case report and review of literature  
*Hsiao FC, Meir YJJ, Yeh LK, Tan HY, Hsiao CH, Ma DHK, Wu WC, Chen HC*
- 3930** Steriod for Autoimmune pancreatitis complicating by gastric varices: A case report  
*Hao NB, Li X, Hu WW, Zhang D, Xie J, Wang XL, Li CZ*
- 3936** Antithrombotic treatment strategy for patients with coronary artery ectasia and acute myocardial infarction: A case report  
*Liu RF, Gao XY, Liang SW, Zhao HQ*
- 3944** Mesh plug erosion into the small intestine after inguinal hernia repair: A case report  
*Xie TH, Wang Q, Ha SN, Cheng SJ, Niu Z, Ren XX, Sun Q, Jin XS*
- 3951** Recurrence of infectious mononucleosis in adults after remission for 3 years: A case report  
*Zhang XY, Teng QB*

- 3959** Vertical direction impaction of kissing molars: A case report

*Wen C, Jiang R, Zhang ZQ, Lei B, Yan YZ, Zhong YQ, Tang L*

### **LETTER TO THE EDITOR**

- 3966** Comment on “Outcomes of different minimally invasive surgical treatments for vertebral compression fractures: An observational study”

*Ma L, Luo ZW, Sun YY*

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# Cryoballoon pulmonary vein isolation and left atrial appendage occlusion prior to atrial septal defect closure: A case report

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## Abstract

### BACKGROUND

In patients who suffer from both atrial fibrillation (AF) and atrial septal defect (ASD), cryoballoon pulmonary vein isolation (PVI), sequential left atrial appendage (LAA) occlusion and ASD closure could be a strategy for effective prevention of stroke and right heart failure.

### CASE SUMMARY

A 65-year-old man was admitted to our institution due to recurrent episodes of palpitations and shortness of breath for 2 years, which had been worsening over the last 48 h. He had a history of AF, ASD, coronary heart disease with stent implantation and diabetes. Physical and laboratory examinations showed no abnormalities. The score of CHA2DS2VASc was 3, and HAS-BLED was 1. Echocardiography revealed a 25-mm secundum ASD. Pulmonary vein (PV) and LAA anatomy were assessed by cardiac computed tomography. PV mapping with 10-pole Lasso catheter was performed following ablation of all four PVs with complete PVI. Following the cryoballoon PVI, the patient underwent LAA occlusion under transesophageal echocardiographic monitoring. Lastly, a 34-mm JIYI ASD occlude device was implanted. A follow-up transesophageal echocardiography at 3 mo showed proper position of both devices and neither thrombi nor leakage was found.

### CONCLUSION

Sequential cryoballoon PVI and LAA occlusion prior to ASD closure can be performed safely in AF patients with ASD.

**Key Words:** Atrial fibrillation; Atrial septal defect; Cryoballoon; Pulmonary vein isolation; Left atrial appendage occlusion; Case report

**Core Tip:** Patients who suffer from atrial septal defect (ASD) with atrial fibrillation are prone to right heart dysfunction and embolism. We report the first case treated with a 3-in-1 procedure (cryoballoon pulmonary vein isolation and left atrial appendage occlusion prior to ASD closure), which may not be performed routinely. However, for ASD patients complicated with poorly controlled atrial fibrillation and unable to tolerate long-term oral anticoagulants, this 3-in-1 procedure can be considered.

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## INTRODUCTION

Pulmonary vein isolation (PVI) has been established as a treatment for patients with atrial fibrillation (AF)[1]. Cryoballoon PVI has become a relatively simple alternative for radiofrequency ablation[2]. Left atrial appendage (LAA) occlusion is performed as an alternative treatment to oral anticoagulation in patients with non-valvular AF[3]. Atrial septal defect (ASD), as the most common congenital heart disease, may lead to right heart dysfunction and paradoxical embolism[4]. In patients who suffer from both AF and ASD, cryoballoon PVI combined with ASD closure and the LAA occlusion combined with ASD closure have been reported[5-7]. However, there has been no report on the 3-in-1 procedure (cryoballoon PVI, LAA occlusion and ASD closure), which may be effective for preventing stroke and right heart failure. Here, we report a patient who underwent sequential cryoballoon PVI, LAA occlusion and ASD closure during the same operation.

## CASE PRESENTATION

### Chief complaints

A 65-year-old man was admitted to our hospital due to recurrent episodes of palpitations and shortness of breath for 2 years.

### History of present illness

His symptoms started 2 years ago with recurrent episodes of palpitations and shortness of breath, which had worsened over the last 48 h.

### History of past illness

His past illness included AF, ASD, coronary heart disease with stent implantation and diabetes.

### Personal and family history

None.

### Physical examination

The patient's temperature was 36.6 °C, heart rate was 74 bpm, respiratory rate was 16 breaths per minute, blood pressure was 120/70 mmHg and oxygen saturation in room air was 98%. There was no filling of jugular vein; cardiac auscultation showed arrhythmia and no cardiac murmur in each valve area; and no edema was found in both lower limbs.

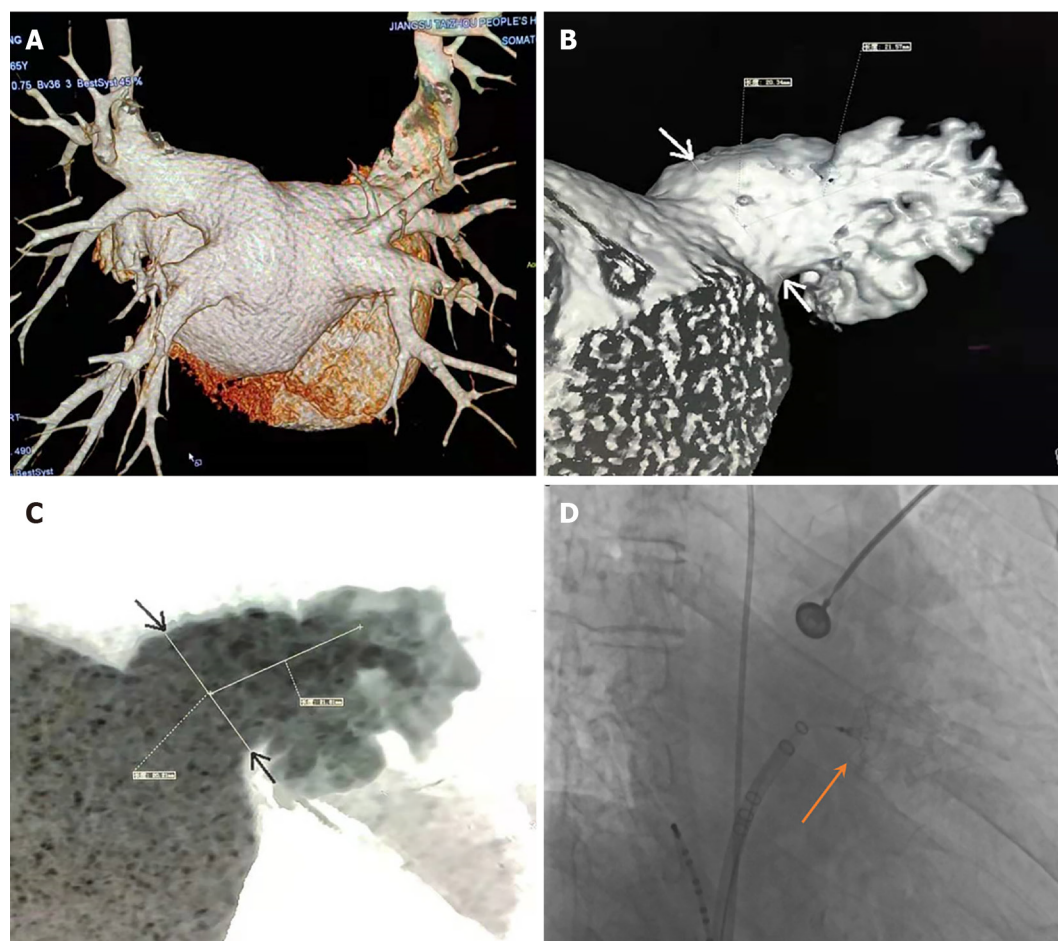
### Laboratory examinations

On admission, his blood tests including routine blood test, renal function, liver function, thyroid function and coagulation function showed no abnormalities.

### Imaging examinations

Pulmonary vein (PV) anatomy was assessed in detail by cardiac computed tomography (CT) (Figure 1A). Reconstruction and measurement of LAA and selection of suitable implantation angle and position were also completed by cardiac CT (Figure 1B-C). Electrocardiography showed AF with a





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**Figure 1** Reconstruction of pulmonary vein and left atrial appendage by cardiac computed tomography. A: Reconstruction of pulmonary vein; B: Reconstruction of left atrial appendage (LAA); C: Reconstruction and measurement of left atrial appendage (LAA); D: LAA occluder was released. Orange arrow shows LAA occluder.

ventricular rate of 76 bpm. Echocardiography showed normal left ventricular ejection fraction, moderate dilatation of the left atrium (50 mm), severe enlarged right atrium and right ventricle and moderate tricuspid regurgitation (estimated pulmonary arterial systolic pressure was 47 mmHg). Abnormal flow from the left to right atrium through the interatrial septum was found by color Doppler image. Echocardiography revealed a 25-mm secundum ASD with adequate margins for ASD closure. There were no obvious abnormalities on chest CT and abdominal color Doppler ultrasound.

#### Further diagnostic work-up: AF embolism and bleeding score

CHA2DS2VASc score was 3 (diabetes mellitus, vascular disease, age 65 years to 74 years) and HAS-BLED was 1 (age  $\geq$  65 years). He refused a long-term anti-coagulation treatment.

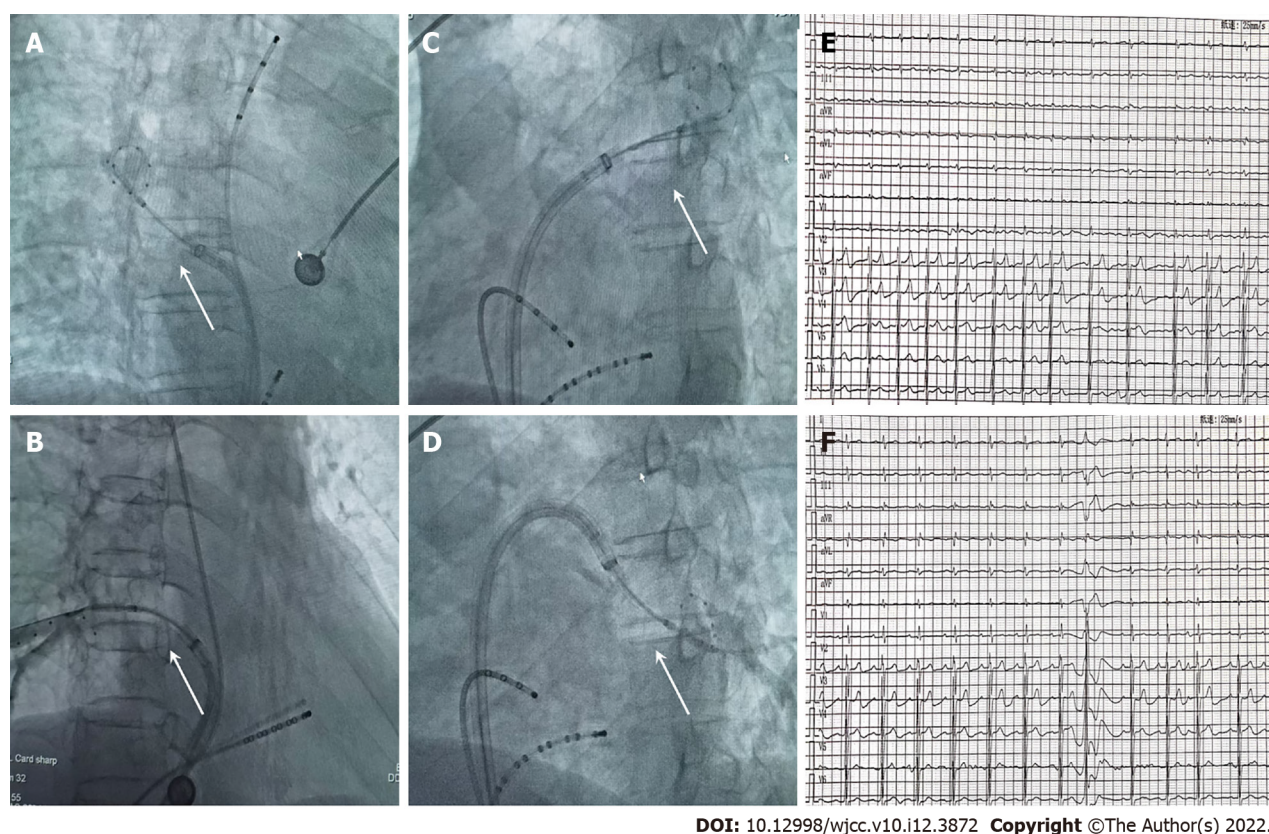
## FINAL DIAGNOSIS

AF, ASD, coronary heart disease and diabetes.

## TREATMENT

### Cryoballoon PVI

The patient had recurrent AF, which was poorly controlled with antiarrhythmic drugs, so PVI was attempted. Under general anesthesia, a 12F FlexCath steerable sheath (Medtronic Inc., Minneapolis, MN, United States) was advanced into the left atrium without transseptal puncture. A cryoballoon catheter (Medtronic Inc.) was introduced inside the 12F sheath. Following good balloon occlusion, we applied two ablation freezes for 120-180 s (Figure 2A-D). PV mapping was performed following ablation of all four PVs with a 10-pole Lasso catheter (Biosense-Webster Inc., Diamond Bar, CA, United States).



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**Figure 2 Cryoballoon ablation.** A-D: Cryoballoon ablation of all four pulmonary veins with good balloon occlusion; E-F: Preoperative and postoperative electrocardiogram. White arrows show balloon occlusion.

We used bidirectional conduction block between the left atrium and PVs[8] to conform the complete elimination of PV electrical activity. Preoperative and postoperative electrocardiograms are shown in [Figure 2E-F](#).

### LAA occlusion

Anticoagulant therapy was recommended, but the patient refused to take long-term oral anticoagulants, so LAA occlusion was selected. Following the cryoballoon PVI, the patient underwent LAA occlusion under transesophageal echocardiographic (TEE) monitoring[9]. A special sheathing canal was placed to perform LAA angiography, and a pigtail angiographic catheter was directed to the LAA with the following positions: Right anterior oblique 30° + cranial 20° and right anterior oblique 30° + caudal 20°. Suitable LAA occluder (Watchman, 3.0 cm) was selected following measurement of LAA orifice width and depth. The LAA occluder was introduced into the LAA along the sheathing canal. The position of the occluder was monitored by TEE. A pull test was conducted to determine the stability of the occluder. After suitable position of the occluder and good plugging effect were confirmed, the occluder was released ([Figure 1D](#)).

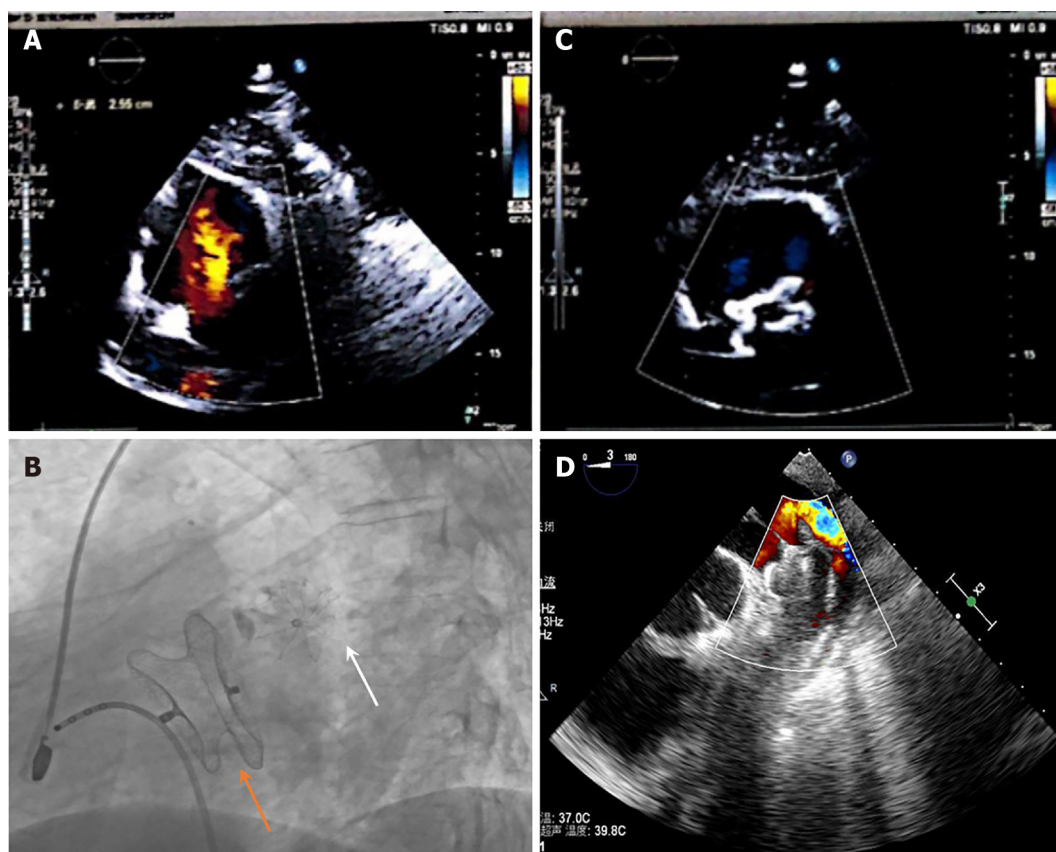
### ASD closure

The indications and benefits of atrial septal occlusion are clear. [Figure 3A](#) shows a secundum ASD by echocardiography. After cryoballoon PVI and LAA occlusion, the diameter of the interatrial defect was measured on TEE images in various planes, and a 34-mm JIYI ASD occluder device (Shanghai Shape Memory Co., Ltd, Shanghai, China) was implanted[10]. Secured and stable positioning of the occluder was confirmed through a push-pull test ([Figure 3B](#)). After unscrewing the occluder from the cable, good positioning of the device was demonstrated by a final TEE examination.

## OUTCOME AND FOLLOW-UP

The patient was subsequently treated with propafenone 150 mg three times a day for 3 mo. Antiplatelet and anticoagulation therapy (clopidogrel and rivaroxaban) was administered following the doctor's advice. Before discharge, correct device positions were confirmed by echocardiography ([Figure 3C](#)). A follow-up TEE was performed to confirm proper seating of the devices and to identify thrombi or residual leak at 3 mo ([Figure 3D](#)). Both devices were located in proper position, and neither thrombi nor





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**Figure 3 Outcome and follow-up.** A: Preoperative echocardiography for atrial septal defect (ASD); B: Final X-ray image after left atrial appendage occlusion and ASD occlusion; C: Postoperative echocardiography for ASD; D: Follow-up at 3 mo by transesophageal echocardiography. Orange arrow shows ASD occluder; white arrow shows left atrial appendage occluder.

leakage was present. Subsequently, the patient discontinued rivaroxaban and changed to aspirin and clopidogrel.

## DISCUSSION

We report an ASD patient with AF who underwent the cryoballoon PVI and LAA occlusion prior to ASD closure, which indicates that this 3-in-1 operation is feasible, but it is not recommended as a routine procedure. For patients with ASD complicated with poorly controlled AF and unable to tolerate long-term oral anticoagulants, this 3-in-1 procedure can be considered.

AF is the most common cardiac arrhythmia, which occurs in 1%-2% of the general population[11]. Since PVs were demonstrated as major sources of ectopic beats, PVI has been considered as the cornerstone for AF procedures[12]. Cryoballoon AF ablation has been established as a useful and safe method in treating paroxysmal and persistent AF, providing an alternative approach to radiofrequency ablation[13]. The incidence of AF is strikingly high in patients with ASD, even after surgical closure[14]. Furthermore, compared with the general population, patients with ASD suffer earlier from atrial arrhythmia[15]. Closure of the ASD could decrease the volume overload and reverse remodeling of the atrium[16]. In the present case, we performed cryoballoon ablation followed by closure of LAA and ASD, which we thought could maintain sinus rhythm, reverse atrium remodeling and prevent embolism.

Koermendy *et al*[17] reported that LAA occlusion through ASD or patent foramen ovale was a feasible access. Cardiac tamponade and perforation of adjacent organs could be obviated by avoiding a transseptal puncture[18]. Another advantage is not to create an iatrogenic septal defect. It is not easy to perform LAA occlusion after ASD occlusion, as the ASD occluder makes it difficult to transseptal puncture[19]. Thus, before ASD occlusion, it is necessary to evaluate the indication for LAA occlusion carefully. According to the reported guidelines, a CHA2DS2VASc score of  $\geq 2$  point is considered as an indication for LAA occlusion[20]. Our case strictly followed this standard, and as this patient refused to take long-term anti-coagulants, LAA occlusion was conducted before ASD closure.

Invasive and surgical procedures are becoming less frequent because of the improvement in percutaneous techniques, especially in cardiac interventions[21]. The present case report indicates that cryoballoon PVI and LAA occlusion prior to percutaneous ASD closure can be performed safely and can prevent several difficulties and complications. In addition, this 3-in-1 procedure was beneficial simultaneously to maintain sinus rhythm, reverse atrium remodeling and prevent embolism.

## CONCLUSION

Cryoballoon PVI and LAA occlusion prior to ASD closure can be performed sequentially in ASD patients with AF, which may not be performed routinely. However, for ASD patients complicated with poorly controlled AF and unable to tolerate long-term oral anticoagulants, this 3-in-1 procedure can be considered.

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