Recurrent atrial septal defect following closure with CardioCel: A case report

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Abstract

An atrial septal defect is a commonly seen congenital heart defect of which secundum atrial septal defect is the most common. In a patient with evidence of right ventricular failure or significant shunt, operative repair is the treatment of choice to achieve hemodynamic stability. The use of a pericardial patch is required for the closure of large atrial septal defects. Case presentation: Here we present a case of a 50-year-old male who underwent surgical closure of secundum atrial septal defect who subsequently found to have part of the pericardial patch used for repair degraded in less than a month. Conclusion: There is a paucity of long-term outcomes data following the use of the CardioCel for septal defects, with no reports of such degradation within a month to the best of our knowledge. Further study is required to identify the incidence and implications of such findings.

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Short title: Recurrent ASD with CardioCel

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Abstract

An atrial septal defect is a commonly seen congenital heart defect of which secundum atrial septal defect is the most common. In a patient with evidence of right ventricular failure or significant shunt, operative repair is the treatment of choice to achieve hemodynamic stability. The use of a pericardial patch is required for the closure of large atrial septal defects. Case presentation: Here we present a case of a 50-year-old male who underwent surgical closure of secundum atrial septal defect who subsequently found to have part of the pericardial patch used for repair degraded in less than a month. Conclusion: There is a paucity of long-term outcomes data following the use of the CardioCel for septal defects, with no reports of such degradation within a month to the best of our knowledge. Further study is required to identify the incidence and implications of such findings.

Background

In adult congenital heart defects, atrial septal defect (ASD) accounts for more than one-fourth of all cases, out of which secundum ASD accounts for almost 75% of cases. Often Secundum ASD is diagnosed when a patient is an adult as its detection is difficult due to delayed symptomatic presentation. Currently, there is a class IIa recommendation that any asymptomatic patient with an isolated Secundum ASD with evidence of right atrium (RA) enlargement, right ventricle (RV) enlargement, and net left-to-right shunt with physiological sequelae but without cyanosis is a candidate for transcatheter or surgical closure. However, when ASD closure is difficult as indicated by morphological features of large size([?]30 mm), wide rim([?]15 mm) deficiency, and multiple defects surgical closure is preferred compared to transcatheter closure. The surgical approach to Secundum ASD repair is a safe and effective operation with little to no morbidity and mortality.

Many congenital heart defects including ASD require a pericardium patch repair. Recently, CardioCel® a tissue engineered ADAPT bovine pericardial patch known to have a good outcome in terms of preventing calcification and inflammation reactions has been commonly used in cardiovascular surgery since 2014. Here we present a novel case of a patient who underwent Secundum ASD repair with CardioCel patch that failed within a with presumed degeneration of the patch.

Case Presentation

A 50-year-old male with no past medical history presented with shortness of breath in an outpatient clinic. He underwent transthoracic echocardiography (TTE) and was found to have left ventricle ejection fraction (LVEF) of 65%, moderate dilation of the RA, moderate to severe dilation of the RV, and possible ASD with positive bubble study. Subsequently, a month later he underwent left heart catheterization (LHC) and right heart catheterization (RHC) and was found to have nonobstructive coronary artery disease and significant left-to-right shunt at the atrial level. Immediately after the procedure, he underwent a transesophageal echocardiogram (TEE) which showed LVEF 60%, Secundum ASD measuring 36x24 millimeters in diameter with deficient retroaortic rim, and moderate enlargement of RA and RV. A month later patient was found to be an atrial flutter. A repeat TTE was performed before cardioversion and showed a large secundum ASD 35x25 millimeter with a left to right shunting.

In January 2021, the patient underwent evaluation for potential percutaneous closure with the device but the anatomy of ASD was such that there was no superior rim to land the device, and the patient was thought to be not a candidate for percutaneous closure. Afterwards, the patient was offered options for ASD closure through right thoracotomy as well as median sternotomy and he chose median sternotomy approach. In February of 2021, the patient underwent ASD repair. Intraoperatively, the interatrial septum was absent. There were no clefts in the mitral leaflet or tricuspid septal defect, but ASD extended to the aortic root. The large ASD was repaired with a CardioCel patch fixed in place with a running Prolene suture. Post repair TEE showed no residual shunt with saline contrast.

A month later in March 2021, the patient presented to the emergency department with heart palpitation. The patient was found to be in atrial flutter with a rapid ventricular response with HR of 135 and hypotension with blood pressure 70/40 mmHg. The patient was stabilized but remained in atrial flutter. TEE was done before cardioversion which showed LVEF 55%, Secundum ASD(see figure 1) measuring 12 x 14 millimeters with evidence of residual bidirectional shunting (figure 2, 3 and 4). It was thought that patient had degeneration

of surgical bioprosthetic ASD repair patch. The patient was discharged with close outpatient follow-up and a plan to reevaluate in six months for a possibility of transcatheter closure of a residual ASD.

Discussion and Conclusion

Both the transcatheter or surgical approach are reasonable for Secundum ASD repair but surgical closure is preferred if defect size is large, there is significant proximity to adjacent structures, history of failed percutaneous closure, inadequate atria to device size, or an associated pathology requiring cardiac surgery. Surgically there are many approaches including sternotomy, thoracotomy, video-assisted-assisted thoracoscopic surgery, and robotics. Median sternotomy is thought to be the gold standard approach and, in this procedure, the sternum is usually divided in its entirety and cannulation is via the ascending aorta and both cava. After the surgery, complications are seldom but arrhythmia, cardiac tamponade, or an infection can develop.

To our knowledge, we describe the first case in the published literature of secundum ASD closure with the bovine patch that degraded within 2 months with the redevelopment of the bidirectional shunt. In the literature, data on bioprosthetic patch degeneration are scarce; however, degradation or failure of the aortic bioprosthetic valve is well established. One of the most common causes of bioprosthetic valve degeneration is calcification. Other potential culprits include suture dehiscence, collagen fiber disruption, tissue disruption due to mechanical stress and shear forces, and inflammatory or immune response. Given the acute failure of the patch in our case, we suspect either dehiscence or host immune response caused degeneration of the ASD repair patch.

Restoration of cardiac septation in the vast majority of cases requires a patch material for reconstruction.[1] CardioCel patch is one such bovine scaffold of great interest due to greater mechanical stability and decreased cost. For instance, in one comparative study, all the bioscaffolds commonly used in cardiac surgery were compared including bovine pericardial scaffolds, cross-linked with 0.6% glutaraldehyde such as XenoLogiX, PeriGuard(r), dye-mediated photo-oxidized PhotoFix and a non-crosslinked porcine scaffold CorMatrix(r), and CardioCel(r) (decellularized, cross-linked with 0.05% monomeric glutaraldehyde, detoxified). CardioCel demonstrated greater cross-linked stability and comparable tensile strength at 12 weeks follow-up.

Previous data on CardioCel patch use in adults are sparse. In one study by Tomisic et al., they looked at 30 patients with a median age of 57 years who underwent mitral valve leaflet repair with a CardioCel patch. At a mean follow-up of 1.7 years, there were 3 deaths and 2 of them had infective endocarditis as a complication. In the pediatric population, the Cardiocel patch has been well studied. A study by Bell et al looked at 501 CardioCel implanted patches with a median follow up of 31 months which showed that a total of 14 implants require intervention and freedom from reintervention was close to 96% at 3 and 5 years. Multiple other studies looked at Cardiocel use in congenital heart disease with short term to long term follow-ups all found positive results with Cardiocel and no cases on patch degradation or reabsorption ever noted.

Studies on the CardioCel patch have not shown any cases of early degeneration. We can infer the etiology of degeneration from studies on bioprosthetic aortic valve degeneration. Currently known common culprits in bioprosthetic material degeneration are calcification, dehiscence, microstructure alteration, and host inflammatory or immune response. The dearth of published cases of degradation of patch closure may be indicative of the rarity of this complication and its need for further study.

List of abbreviations

ASD = atrial septal defect

RA = right atrium

RV – right ventricle

TTE = transthoracic echocardiography

LVEF = left ventricle ejection fraction

LHC = left heart catheterization

RHC = right heart catheterization

TEE = transesopahgeal echocardiography

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

ETHICS STATEMENT

All research meets the ethical guidelines, including adherence to the legal requirements of the United States.

References

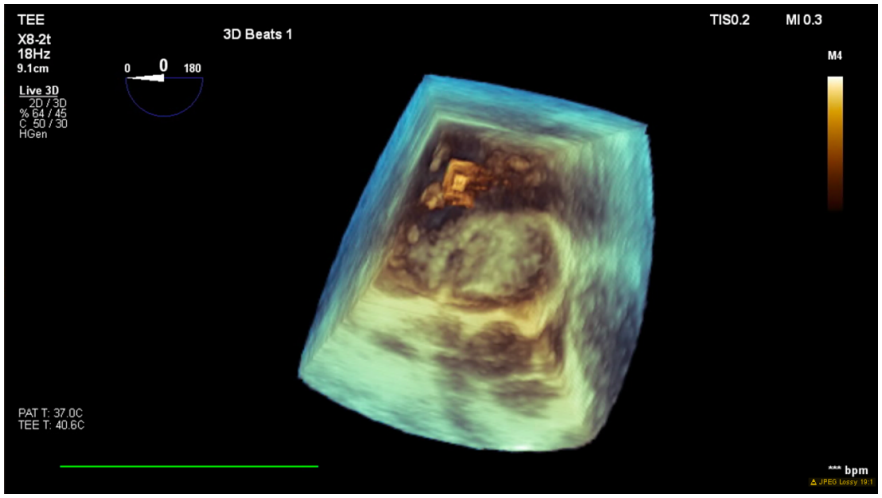


Figure 1: 3D image showing ASD secundum

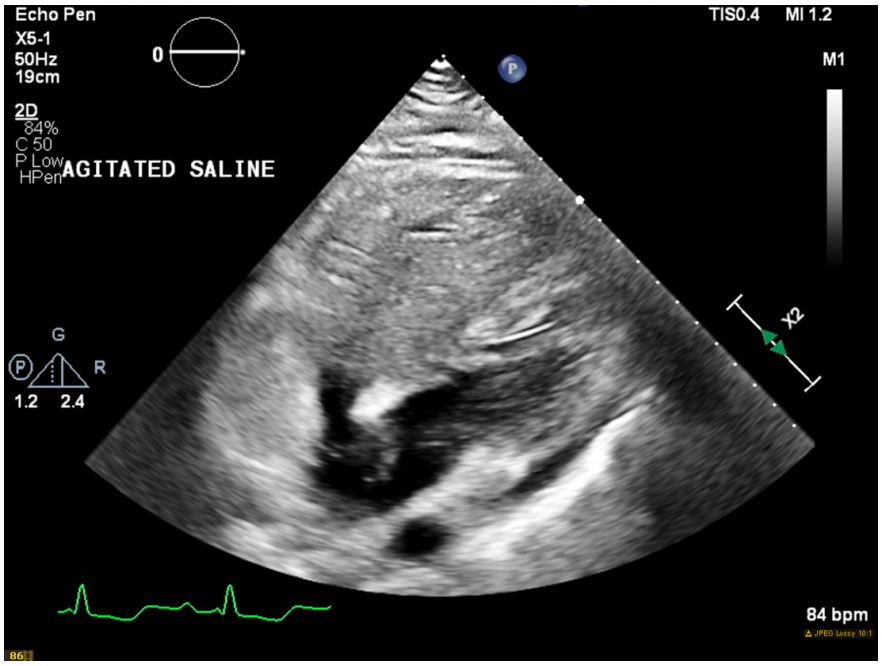
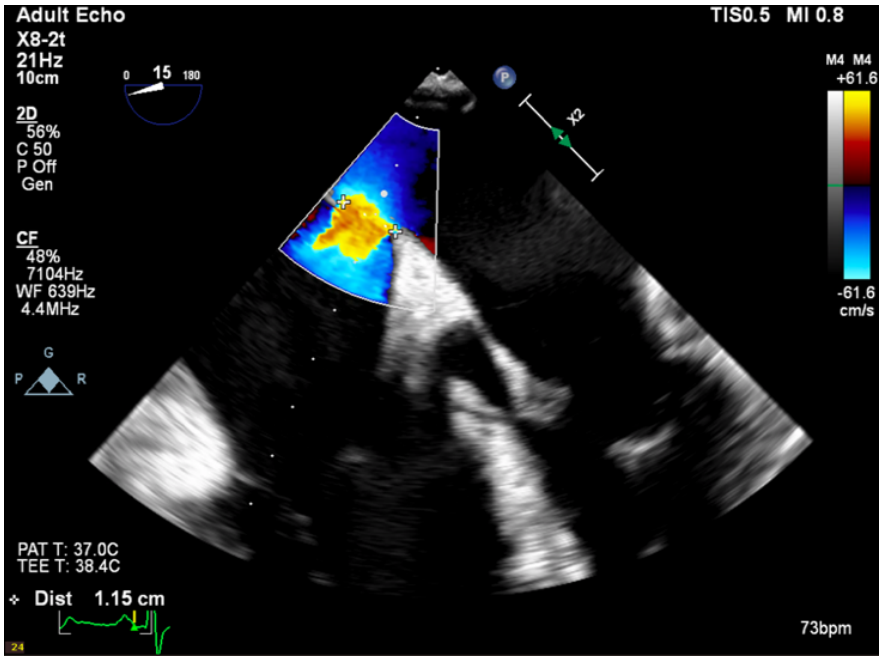


Figure 2: Subcostal view with agitated saline showing left-to-right shunt



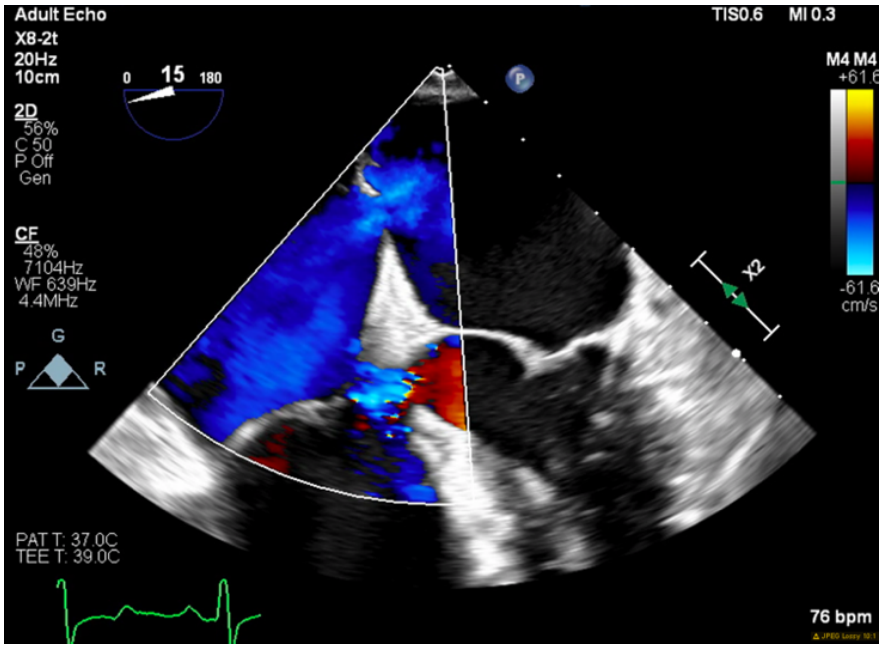


Figure 3: Four chamber view of TEE left-to-right shunt across the secundum ASD

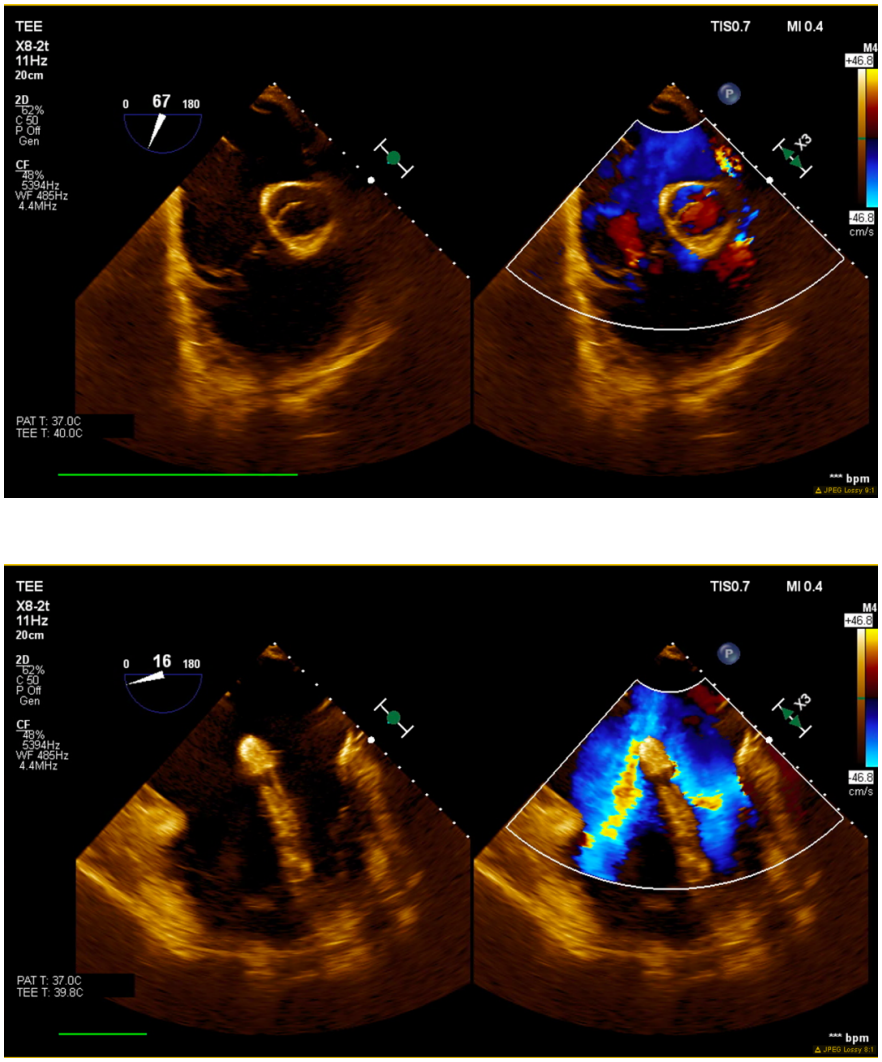


Figure 4: Color flow doppler in TEE images showing left-to-right shunt