Direct visualization of an iatrogenic septal defect in a reanimated human heart

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Introduction

Catheter access to the left atrium is required for a number of cardiac diagnostic and/or therapeutic procedures, including assessment of left atrial pressure, ablation of certain atrial tachycardias and accessory atrioventricular connections, pulmonary vein isolation for treatment of paroxysmal and persistent atrial fibrillation (AF), left atrial appendage occlusion, and some mitral valve repairs or replacements. Typically these procedures require a transseptal puncture to enter the left atrium by crossing the interatrial septum from the right atrium. Doing so inevitably creates holes and/or tears between the 2 chambers, which may be termed iatrogenic atrial septal defects (IASDs). Such defects can allow shunting of blood between the 2 atria. Fortunately, in most patients these IASDs tend to close within a short time without clinical consequences.[1] Nevertheless, postprocedurally IASDs have been seen in upwards of 87% of patients

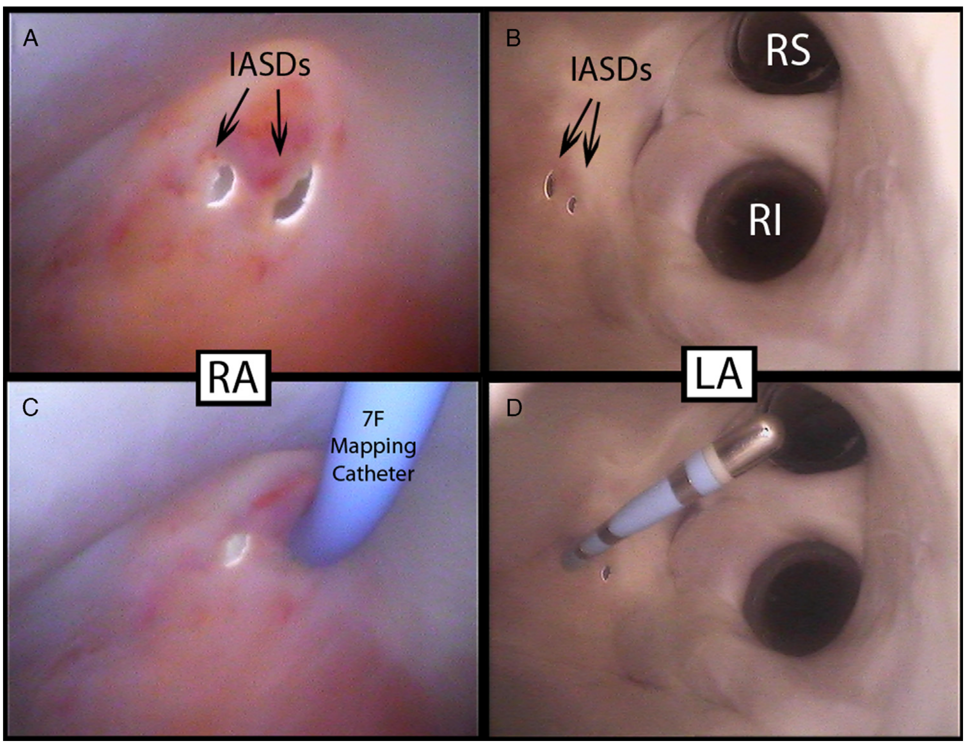

Figure 1 Two iatrogenic atrial septal defects (IASDs) imaged in a reanimated human heart from both **A:** the right atrium (RA) and **B:** the left atrium (LA). **C, D:** A 7F mapping catheter going through the most anteriorly positioned IASD. Cannulas can be seen in frames **B** and **D** where the right superior (RS) and right inferior (RI) pulmonary veins enter into the atrium; in both sets of images, the top of the image is the superior aspect of the anatomy.

KEYWORDS Atrial defects; 3D modeling; Atrial fibrillation; Heart catheterization; Persistent patency; Iatrogenic atrial septal defect
ABBREVIATIONS AF = atrial fibrillation; **IASD** = iatrogenic atrial septal defect (Heart Rhythm Case Reports 2015;1:509–510)

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KEY TEACHING POINTS

- Whether or not they are fully imaged post procedure, iatrogenic atrial septal defects (IASDs) will be present following transseptal puncture procedures. The ramifications of this defect must be weighed against the potential benefits of the procedure.
- This paper clearly illustrates how an IASD can present within a functioning human heart. These clear passages within the septum should be recognized and understood by those performing the procedure.
- In the future, direct visualization methods may provide greater insight into the frequency and size of IASDs after transseptal procedures.

1 day following the procedure, and have been noted to exist up to 18 months or longer in 15% of patients.[2]

Case report

Our laboratory was fortunate to receive, for research purposes, a human heart deemed not viable for transplantation. The donor was a 72-year-old woman who terminally suffered an intracranial hemorrhage. Previously, this patient was diagnosed with intermittent AF and had undergone an AF ablation procedure 2 months prior to organ donation. We received the heart 6 hours post cross-clamp; it was then prepared for reanimation as previously reported using Visible Heart methodologies.[3] With the heart functioning in a 4-chamber working mode, we were able to directly visualize 2 distinct IASDs in the atrial septal wall, and both were large enough to permit passage of a 7F catheter. We presume that both IASDs were residuals of the ablation procedure 2 months prior (Figure 1, and Supplemental Video, available online). In this specimen, apparent healing of the IASD had already begun to take place inasmuch as an 8.5F sheath (outer diameter of around 9.5F) was used for the transseptal puncture and, at the time of the reanimation study, the hole had healed to the point where a 7F catheter fit almost perfectly. This would suggest a contraction/healing of approximately 1 mm in diameter from the time of the procedure.

Along with the IASDs, scar tissue formation as a result of left atrial radiofrequency ablations was also observed as a result of the pulmonary vein isolation procedures, with scar lines seen on the posterior wall of the left atrium (Figure 2).

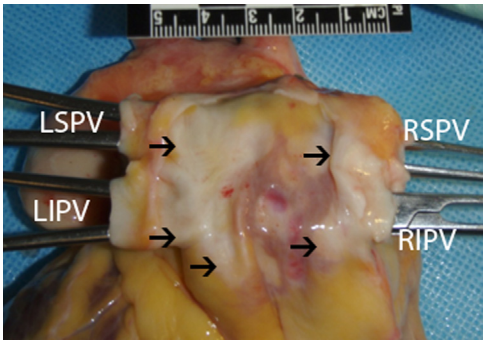

Figure 2 Cardiac ablation lines seen from the posterior aspect of the left atrium. The 2 tissue clamps are seen going through the superior and inferior pulmonary veins. Arrows indicate regions of ablation along the posterior wall and neighboring PVs. LSPV = left superior pulmonary vein; LIPV = left inferior pulmonary vein; RSPV = right superior pulmonary vein; RIPV = right inferior pulmonary vein.

Discussion

Although most procedures requiring transseptal punctures may have the inherent risk of creating IASDs, those risks must be balanced against the potential benefits of the proposed procedure. Further, if an IASD remains, it is important to consider whether or not the defect warrants subsequent placement of a closure device.

In our case, owing to the limited medical history provided with the heart, we are unable to ascertain the postprocedural anticoagulation regimen, the status of the patient postoperatively, or the rationale for the atrial ablation of a 72-year-old patient. Whether or not the IASD was a factor in the documented intracranial hemorrhage of the patient cannot be determined. However, the direct visualization of such defects provides a new perspective on IASDs that may result following a transseptal procedure. To our knowledge, only atrial septal defects have been visualized via this method previously.[4] Potentially in the future, direct visualization methods may provide greater insight into the frequency and size of IASDs after transseptal procedures.

Appendix

Supporting data

Supplementary material cited in this article is available online at http://dx.doi.org/10.1016/j.hrcr.2015.08.011.

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