Transcatheter Closure of Atrial Septal Defect (Secundum Type): The Role of Echocardiography in Evaluating Intertial Defects

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ABSTRACT
Atrial septal defects are among the most common congenital heart defects seen in the adult population. The diagnosis is usually made in children and closure is attempted before they are school age. In other cases, where the diagnosis is missed until adulthood, atrial arrhythmias and congestive heart failure are commonly seen. We report the case of an atrial septal defect (secundum type), which was diagnosed in a 72-year-old woman with paroxysmal atrial fibrillation. She also had a history of hypertension and hyperlipidemia. Transthoracic and transesophageal findings were consistent with right-sided volume overload and an atrial septal defect of approximately 1 cm in size. This was corroborated by the findings on cardiac catheterization with a shunt ratio of 1.8. The pulmonary artery pressures were within normal limits. The patient was referred for closure of the atrial septal defect. Presently, the options for septal defect closure are direct suture repair, Dacron patch repair depending on the size of the defect, and percutaneous transcatheter closure. Transcatheter closure is also available in treating selected patients with patent foramen ovale.

CASE REPORT
We report the case of a 72-year-old patient who was admitted to the hospital for evaluation of shortness of breath that began a few months prior to admission. She had a history of hypertension, hyperlipidemia, and paroxysmal atrial fibrillation for which she was on anticoagulation therapy. This dyspnea was present more with exertion and also associated with palpitations. She denied any history of chest pain, palpitations, or syncope. Her heart rate was irregular with moderate ventricular response. Auscultation of her lungs revealed no abnormality. The second heart sound was widely split and there was no variation with respiration. The remainder of her physical exam was unremarkable.

The electrocardiogram showed evidence of an incomplete right bundle branch block (Figure 1). The transthoracic and transesophageal echocardiograms both showed findings consistent with left to right atrial shunt through the interatrial septum (Figures 2 and 3). She also had right atrial and right ventricular dilatation and a somewhat elevated pulmonary artery pressure of 39 mm Hg. The atrial septal defect was approximately 1 cm in size. Saline contrast injection and color flow imagery showed a predominately left to right shunt through the interatrial septum. There were minor degenerative changes in the cardiac valves, but no other congenital abnormalities were noted.

The patient was subsequently taken for cardiac catheterization. This showed a mean right atrial pressure of 10 mm Hg. The right ventricular pressures were 36/10 mm Hg and the pulmonary artery showed pressures of 36/12 mm Hg. The oxygen saturation of the inferior vena cava was 72%, superior vena cava 70%, and the saturations increased from 75% to 79% from high to the low right atrium. Left atrial saturations were 93% and the left ventricle had a saturation of 96%. The Qp/Qs (ratio of pulmonary blood flow to systemic blood flow) was 1:8. A pulmonary angiogram was essentially normal. Coronary angiography showed a 75% left anterior descending stenosis, which was treated with angioplasty and placement of a cypher drug-eluting stent.

The findings were consistent with atrial septal defect (secundum type). Since there was no evidence of pulmonary hypertension, she was referred for percutane-

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ous closure of the atrial septal defect, which was done without any complications. On follow-up, the patient had improved remarkably and was doing well.

DISCUSSION

Atrial septal defects are the second most common congenital heart defect and the third most common abnormality diagnosed in adults. Often, patients with atrial septal defects are seen later in life with signs and symptoms of right heart failure. Diagnostic testing typically begins with transthoracic echocardiography and often precedes transesophageal echocardiography and invasive imaging. With correction of the atrial septal defect, the functional capacity and survival of patients are improved. These interventions are associated with low morbidity and result in normal life expectancy.

There are 4 distinct types of atrial septal defects: (1) primum or partial atrioventricular canal, (2) secundum (most common), (3) sinus venosus (rare), and (4) coronary sinus (very rare).1-3 The primum defect is associated with a cleft mitral valve. Sinus venous defects are associated with a higher incidence of partial anomalous pulmonary venous connection. While a complete transthoracic echocardiogram can usually detect most primum and secundum atrial septal defects, transesophageal echocardiography is the technique of choice for visualizing the sinus venous type and coronary sinus defects. In most cases, transesophageal echocardiography is done to evaluate other cardiac structures and to rule out any additional intracardiac defects. The most common variety of atrial septal defect is the secundum type. The magnitude of the shunt across the defect depends on the anatomic size and the difference in right and left heart pressures. The shunt is usually from left to right causing right-sided volume enlargement and eventually leads to pulmonary hypertension.1,2 Pulmonary hypertension usually precludes surgical correction and can be evaluated and quantitated by echo Doppler studies.

Usually patients are asymptomatic with this condition. The symptoms are based on pulmonary hypertension related to excess flow and finally reversal of shunt from right to left later on when pulmonary pressures exceed the systolic pressures. The development of atrial arrhythmias is also a common feature in these patients, prompting early diagnosis.1,2,4,5

Electrocardiograms show a normal to right axis deviation and rsR′ pattern compatible with incomplete or complete right bundle branch block suggesting an enlargement of the right ventricle in ostium secundum defects (Figure 1). However, left axis deviation is classically seen in the ostium primum defect based on the associated mitral valve abnormalities that are a common feature of the primum defect (“goose neck” deformity on angiogram).

Echocardiography shows right-sided volume overload and paradoxical motion of the interventricular
Figure 2.  A. Parasternal long axis view showing enlarged right ventricle.
B. Parasternal short axis view.
C. Apical 4-chamber view showing right sided dilatation.
D. Subcostal view with superimposed color flow showing shunting of blood from left atrium to right atrium in atrial systole.

Figure 3.  A. Atrial septal defect at this level of the fossa ovalis. Arrows indicate defect size.
B. Saline contrast injection showing presence of a negative contrast in the RA. Microbubbles are seen crossing from the LA to RA immediately after the injection (see arrow).
C. Color Doppler showing flow of blood away from transducer (blue) through the atrial septal defect from LA to RA in atrial system.
D. Spectral Doppler flow with sample volume placed at the level of the atrial septal defect. From this orientation, arrows point to flow of blood from LA to RA through the defect. Flow persists throughout the cardiac cycle and reaches a maximum velocity of approximately 1.2 m/sec during atrial systole.
septum. Transesophageal echocardiogram is especially helpful in sinus venosus defects, which are often missed on the standard transthoracic echocardiograms. Treatment is usually advised prior to onset of the pulmonary hypertension and is usually accomplished in children between 3 and 6 years of age. Older patients can also have surgery with good results as long as pulmonary hypertension has not developed and there is presence of significant shunting with pulmonary to systemic blood flow ratios generally more than 1.6:1. However, physical diagnostics, including careful auscultation of the heart, can provide essential and valuable information in patients with congenital cardiac defects. These can also provide a clue to the diagnosis prior to the development of complications or progression of disease. In atrial septal defects, the auscultatory findings consist of a widely split S2 which varies little or not at all with respiration “fixed split.” This needs to be verified in the sitting and standing positions since normal subjects may occasionally have a “fixed-split” in the supine position.

Until recently, surgical closure had been the treatment of choice for all atrial septal defects. Although a fairly safe procedure with a very low mortality rate (<1%), there are some disadvantages of surgery, namely, a sternotomy scar, a 3-5 day hospitalization, and some weeks of postoperative recovery time. The defect is usually closed with a pericardial patch or a prosthetic material. Patients usually obtain good results with surgical repair of the defect, which is done at selected centers.

Recently, an alternative method using the Amplatzer septal occluder has become available and is approved for closure of secundum atrial septal defects. In addition, studies have shown that percutaneous closure is a promising alternative for prevention of thromboembolic recurrent events in selected patients with atrial septal defects (secundum type) and in patients with patent foramen ovale. This device is implanted percutaneously in the cardiac catheterization laboratory and involves considerably less morbidity with a lower risk of complications. Transesophageal echocardiography is performed before, during, and after deployment of the device, and plays an integral role in the implantation process.

This case report underscores the usefulness of echocardiography as a diagnostic tool and the availability of percutaneous closure techniques in treatment of patients with atrial septal defects (secundum type). This technique is a safe procedure with a low annual recurrence rate in selected patients.

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REFERENCES

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