TRANSESOPHAGEAL ECHOCARDIOGRAPHIC DIAGNOSIS OF IATROGENIC CORONARY SINUS STENOSIS: A CASE REPORT

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A case is presented in which suture closure of a secundum atrial septal defect in a 4-year-old child resulted in narrowing of the coronary sinus, which produced acute myocardial failure after discontinuation of cardiopulmonary bypass. The problem was diagnosed by transesophageal echocardiography (TEE) and corrected after a return to cardiopulmonary

bypass. Myocardial function improved, and the patient was successfully weaned from bypass. The remainder of the perioperative course was benign, and the patient made a normal recovery from the operation.

Clinical summary. An otherwise healthy 4½-year-old girl weighing 16.5 kg needed repair of an asymptomatic secundum atrial septal defect and supraaortic pulmonic stenosis. Induction of anesthesia, intubation of the trachea, and placement of arterial and central venous catheters were uneventful. Transesophageal echocardiography was performed with a Siemens SI-1200 ultrasound system (Siemens Corp., Union, N.J.) with a 5 mHz biplane TEE probe, which was inserted without difficulty. The atrial septal defect was unusual in that the superior aspect of the defect was at the level of a secundum defect, but the eustachian valve was inserted on the inferior aspect of the defect, posteriorly, near the coronary sinus (Fig. 1). Ventricular contractility appeared normal. After incision and sternotomy, heparin was administered, and arterial and venous bypass cannulas were placed without difficulty. Cardiopulmonary bypass was initiated at full calculated

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Received for publication Sept. 17, 1996; accepted for publication Nov. 19, 1996.

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J Thorac Cardiovasc Surg 1997;114:493-5

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0022-5223/97 \$5.00 + 0 12/54/79336

Fig. 1. Preoperative retrocardiac four-chamber TEE image of the heart, showing the unusual eustachian valve flap (arrow) extending to the crux at the inferoposterior aspect of the atrial septal defect. The coronary sinus is just posterior to the arrow. Left-to-right atrial septal defect flow is shown in red. LA, Left atrium; LV, left ventricle; RA, right atrium; RV, right ventricle.

Fig. 2. Dilated coronary sinus. *Left*, Retrocardiac four-chamber view of the heart. The *arrow* points to the dilated coronary sinus in cross section. Echogenic suture material is noted opposite the coronary sinus, obstructing the drainage into the right atrium. Low velocity flow signals appear on color Doppler TEE in the right atrium and ventricle, but no flow was demonstrated in the coronary sinus. *Right*, Diameter of the coronary sinus at 7.4 mm. Calibration markers at 1 cm per large tick. For abbreviations see Fig. 1.

Fig. 3. Normal coronary sinus flow and caliber after surgical revision. Scan plane is similar to Fig. 2, *right*. The coronary sinus is indicated by the *arrow*. The dimension is 4 mm, and coronary sinus flow is demonstrated by color Doppler and spectral Doppler TEE. RA, Right atrium.

flows, and the patient was cooled to 28°C (esophageal temperature). Pulmonary valvotomy through a pulmonary arteriotomy and suture closure of the atrial septal defect through an atriotomy were performed after aortic cross-clamping and administration of cardioplegic solution.

During bypass, mean arterial pressure was 45 to 55 mm Hg and central venous pressure was 13 to 15 mm Hg. After a cardiopulmonary bypass time of 60 minutes and an aortic crossclamp time of 14 minutes, cardiopulmonary bypass was discontinued at an esophageal temperature of

36° C and a rectal temperature of 34.5° C. Shortly after discontinuation of bypass, analysis of an arterial blood sample revealed oxygen tension, carbon dioxide tension, pH, and ionized calcium all within the normal range. The hematocrit value was 19 mg/dl. Arterial blood pressure declined from 90/50 to 50/30 mm Hg, central venous pressure increased from 14 to 19 mm Hg, and sinus rhythm deteriorated into sinus bradycardia with T-wave depression. The heart appeared to be contracting poorly. An infusion of epinephrine was started at a rate of 0.1 μ g/kg per minute without improvement in blood pressure or heart rate.

By TEE, severe mitral regurgitation and moderate tricuspid regurgitation were noted, along with very little ventricular wall motion. The endocardial surface, especially in the left ventricle, was bright and echogenic. No intramyocardial air was identified, and valvular obstruction was not evident. The coronary sinus was unusually prominent, measuring 7.4 mm in diameter (Fig. 2), and no flow could be identified in the coronary sinus. The lumen of the dilated coronary sinus ended near the echogenic suture line of the atrial septal defect closure. Cardiopulmonary bypass was reinitiated, the aortic root was cross-clamped, and cardioplegic solution was instilled. The right atrium was opened, revealing little flow of cardioplegic solution from the coronary sinus. The atrial septal sutures were removed, thereby relieving the coronary sinus stenosis. After the atrial septum was resutured, a second TEE showed a decrease in coronary sinus diameter to 4 mm, along with color and spectral Doppler evidence of flow from the coronary sinus into the right atrium (Fig. 3). Ventricular contractility was improved. The patient was weaned from cardiopulmonary bypass after a 9-minute bypass time with a blood pressure of 100/60 mm Hg. The epinephrine infusion was discontinued before transfer to the intensive care unit. She had an uneventful convalescence and was discharged from the intensive care unit on the second postoperative day and from the hospital on the fourth hospital day.

Discussion. This is the first report of iatrogenic narrowing of the coronary sinus diagnosed through the use of TEE, without which the need to return to bypass for immediate relief of the obstruction may not have been considered or would have been delayed.

A variety of other causes of low output state were considered and ruled out. It was not until the dilated coronary sinus was seen that the true diagnosis was considered and then corrected. Coronary sinus narrowing

probably produced myocardial failure by elevating coronary venous pressure, thereby reducing net coronary perfusion pressure. Although congenital coronary sinus atresia is compatible with life because of the development of collateral drainage,¹ collateral channels probably could not provide adequate decompression in the setting of acute coronary sinus occlusion.

In recent years, intraoperative TEE has become increasingly popular in the evaluation of repair of congenital heart defects. TEE can identify residual defects that otherwise would have been undetected.²⁻⁴ In several large series, 7% to 12% of patients had immediate successful revision of their procedure in the same operative setting based on TEE evaluation after the initial repair.^{2,3} Likewise, 15% to 25% of patients have alteration of ventricular function immediately after bypass, some with a definable and treatable cause.³ However, none of the studies on the utility of TEE for intraoperative evaluation of repair of congenital heart defects lists coronary sinus occlusion as a cause of postbypass ventricular dysfunction.

In summary, we report a case of iatrogenic coronary artery stenosis during repair of an atrial septal defect in a child in which TEE was instrumental in making the diagnosis and in confirming correction. TEE contributed to a favorable outcome in the surgical management of this most straightforward of congenital heart lesions.

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