Left Ventricular-Right Atrial Fistula Following Mitral Valve Replacement

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Acquired intracardiac shunt after prosthetic valve replacement is a rare complication, and reoperation for correction of this disorder carries a high mortality rate. We report such a case of left ventricular-right atrial fistula after mitral valve replacement in which the patient died of multiple complications. Awareness, prevention, and early diagnosis are, therefore, extremely important.

Failure of expected clinical improvement after prosthetic valve replacement is usually attributed to prosthetic valve dysfunction, perivalvular leak, and residual valvular lesions. Inadvertently created intracardiac shunt is, on rare occasions, the result of the surgical procedure. We describe a case of left ventricular to right atrial fistula following mitral valve replacement.

CASE REPORT

A 74-year-old woman was transferred to our hospital in August 1983 with a diagnosis of acute mitral regurgitation. Approximately 3 weeks earlier, she had been admitted to another hospital with acute pulmonary edema. She was found to have a loud pansystolic murmur. Cardiac catheterization disclosed severe mitral regurgitation, moderate pulmonary hypertension, mild coronary artery disease, and normal left ventricular function.

A few days later, the patient underwent mitral valve replacement. At the time of surgery, she was found to have myxomatous degeneration of the mitral valve, which was excised and replaced with a #31 Carpentier-Edwards valve. Some difficulty was encountered during placement of annular sutures in the posteromedial commissural area, resulting in an endocardial laceration below the mitral annulus.

The patient had evidence of a Grade 2/6 apical holosystolic murmur in the immediate postoperative period. Recovery was complicated by chronic renal failure, atrial fibrillation, and a 3° heart block that required a permanent pacemaker.

Because of persistent congestive heart failure that was uncontrolled by medical management, the patient underwent cardiac catheterization in September 1983. This showed a left ventricular-right atrial fistula, verified by an oxygen saturation increase in the pulmonary artery. The patient was reoperated on through a right atriotomy. A small 5-mm diameter defect was located superior to the septal leaflet of the tricuspid valve and anterior to the coronary sinus. The strut of the mitral prosthesis was seen through it. The defect was closed with a Teflon patch by using interrupted pledged sutures, some of which were passed from under the septal leaflet. The patient's postoperative course was complicated by...
intraabdominal bleeding (caused by a pace-maker needle laceration of the omental vessel), and by respiratory insufficiency and renal failure. The patient died 1 month after the operation while still in the hospital.

DISCUSSION

Problems have been described pertaining to acquired left-to-right intracardiac shunts after both aortic valve replacement and mitral valve replacement.\(^2\) In a review by Silverman et al,\(^2\) left ventricular-right atrial fistula developed in five patients after mitral valve replacement alone,\(^3\) in three patients after aortic valve replacement and mitral valve replacement with mitral commissurotomy, and in seven patients after aortic valve replacement alone. Mortality was high: two of five patients died after mitral valve replacement, three of seven died after aortic valve replacement, and all patients died who had combined aortic valve replacement and mitral valve replacement with mitral commissurotomy. After prosthetic valve replacement, congestive heart failure developed in most patients (11/16) before 6 months had elapsed.

The left ventricular-right atrial fistula after mitral valve replacement is typically located superior to the septal leaflet of the tricuspid valve, near the junction of the

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**Fig. 1** Line drawing of a normal heart sectioned through the central portion of a noncoronary cusp and sinus, and posterior portion of a left coronary cusp and sinus. Note the close relationship of the anterior mitral leaflet and the membranous septum. P = post-aortic cusp; L = left aortic cusp; AM = anterior mitral leaflet; LV = left ventricle; RV = right ventricle.
ANATOMICAL RELATIONS OF AORTIC ROOT SINUS

Fig. 2 Schematic diagram of aortic root anatomy. Note the location of membranous septum under the noncoronary cusp. Anteriorly, it joins the muscular septum; posteriorly, it joins the fibrous trigone. (Modified from the original: Sud A, et al. Anatomy of the Aortic Root, Ann Thorac Surg 1984; 38(1):76-79.)

anterior leaflet. A probe passed through the fistula will appear in the aortic outflow tract beneath the annulus in the area of the noncoronary cusp. Anatomically, the defect is produced by injury to the membranous septum.5,6 The membranous septum lies immediately beneath the anterior half of the noncoronary cusp of the aortic valves (Figs. 1 and 2). Anteriorly, it merges with the muscular ventricular septum, while posteriorly, it merges with the fibrous trigone. The attachment of the tricuspid valve and the mitral valve to the membranous septum is not at the same vertical plane, resulting in a small area of membranous septum posteriorly, that separates the left ventricular outflow tract from the right atrium. Injury to this structure, either due to technical misadventure or extensive debridement of calcium during both aortic valve replacement and mitral valve replacement can potentially cause this complication (Fig. 3).

Intraoperative diagnosis of this complication should, therefore, be considered in these circumstances. As in our case and others reported,7 the surgeon is usually aware of the "error." The existence can be suspected by an increase of \(O_2\) saturation from the superior vena cava to the right ventricular inflow and by palpation of a thrill over the left ventricular outflow tract or the right atrium near the base of the heart. It can be confirmed by digital exploration through the right atrial appendage after the patient has been removed from bypass. A jet of blood can be felt coming from the left ventricle during systole.

As in congenital left ventricular to right atrial fistula, a right atrial approach is preferred for correction of this lesion (Fig. 4).8 Bicaval cannulation with snares around the
superior vena cava and inferior vena cava is done as with any atrial septal defect repair. The fistula is closed with a patch and interrupted pledgeted sutures. The tricuspid annulus is used for support inferiorly by passing sutures under the septal leaflet through the tricuspid annulus.

Prevention of this complication entails great caution during debridement of calcium or excision of a valve in the area of a posteromedial commissure. Marsten et al\textsuperscript{3} suggested a slightly asymmetric seat for the prosthetic ring to avoid injury to the atrio-ventricular septum.
REFERENCES