Cineangiographic Studies in Patients with Starr-Edwards Aortic Valves

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RECENT REPORTS of postoperative clinical and cardiac catheterization studies in patients after replacement of their aortic valves with a ball-valve prosthesis have included adequate clinical and hemodynamic measurements both at rest and during exercise.1-6 There is, however, little information regarding the competency of these valves as determined angiographically, since aortic root cineangiography was not carried out routinely. In this study, aortic root cineangiography was performed in 21 consecutive survivors of replacement of the aortic valve with a Starr-Edwards ball-valve prosthesis. Evaluation of the films has permitted certain conclusions, pertaining to the competency of ball-valve function in a consecutive series of patients and to the necessity of angiographic studies for complete postoperative evaluation.

Group Studied and Methods

The patients included in this study ranged in age from 19 to 65 years; 13 males and eight females. The postoperative catheterization studies were carried out from 1 to 26 months following insertion of the ball-valve prosthesis. Initially it was anticipated that all studies could be performed approximately 1 year or more after surgery; however, the clinical status of four patients necessitated earlier study.

Except for the first patient, who was in border-line cardiac compensation, right and left heart studies including various stress tests were carried out prior to the angiogram. A no. 7 or 8 NIH angiographic or Gentini catheter was passed either percutaneously from the right femoral artery or by cutdown through the right brachial artery. The catheter was positioned, prior to injection, in the aortic root above the metal cage of the prosthetic valve to prevent interference with ball motion during the angiogram. The patient was first placed into the left anterior oblique position.

If the first injection revealed a significant leak around the valve, the right anterior oblique projection was used during a subsequent injection of contrast material. After a small test dose to determine catheter position, from 1.0 to 1.2 cc per kilogram Renovist (diatrizoate) was injected with a pressure injector at 400 pounds of pressure per square inch. The injection of contrast media was filmed on 16 mm (60 fps) or 35 mm (30 fps) Dupont 131A Cronar base film, using a General Electric 9-6 image intensifier and camera. The film was developed commercially by standard techniques and then viewed on an analytical projector.

Careful attention was paid to the motion of the prosthesis and the ball, to the possibility of any obstruction in the outflow tract, and to any regurgitation of contrast material through or around the rim of the valve into the left ventricle (LV). Aortic regurgitation, when it was demonstrated, was graded according to the method of Colapinto and associates.7 In summary, their system grades the insufficiency on a scale of 1 to 4+. One plus regurgitation is present when a small amount of contrast material enters the LV but is completely cleared with each systole. In 2+ regurgitation, a larger amount of refluxes and is not completely cleared with each systole. In 3+ reflux increasing amounts of contrast material accumulate with each cycle and in 4+ regurgitation the entire left ventricular chamber is outlined with the first complete diastole following injection.

Results

No evidence of abnormal motion, either in the ball or in the seating of the prosthesis, was encountered in any patient. No filling defects, that could have been thrombotic material on the valves, was seen, and no visual evidence of obstruction of the left ventricular outflow tract was demonstrated. The most significant finding in this study was the frequent demonstration of some degree of regurgitation of contrast material into the left
ventricle. Only two patients had no regurgitation at all. Three had a "puff" of reflux. This grade was considered when a minute amount of contrast material appeared to pass just beneath the ball into the immediate subprosthetic area with prompt clearing during the following systole. This degree of reflux was considered to be secondary to seating of the ball and not a true leak. Seven patients were felt to have 1+ regurgitation. Because of the faint amount of contrast media present in the left ventricular outflow tract with a 1+ leak, it was not always possible to distinguish the media that passed through the valve (around the ball) from that which may have refluxed around the rim of the prosthesis. This degree of aortic regurgitation (1+) is presently believed to be of no significance and the prognosis for the particular patient is not altered by the leak.

Of the 21 patients, nine were found to have significant leaks. Three had 2+ regurgitation; five had 3+ regurgitation; and one patient had 4+ regurgitation around the prosthesis. For each of these nine patients, one or both of the cineangiographic views clearly demonstrated the point of reflux to be around the valve at the suture line. So far, four of these subjects have undergone reoperation to repair the regurgitation. In each, the leak was demonstrated at the operating table to be secondary to disruption of the suture material used to hold the prosthesis in place. Eight of nine patients with significant regurgitation around the prosthetic valves had grade II/VI aortic diastolic murmurs.

Discussion

Some leaking of contrast material about the rim of a ball-valve prosthesis is apparently not unusual in patients in whom aortic root cineangiography has been performed postoperatively. In four of nine patients studied by Judson and associates,2 and in two of five patients evaluated with angiograms by Baird and co-workers,8 some degree of aortic insufficiency was noted. In the Judson series the site of reflux was around the rim of the valve, but in the latter group the site of the leak could not be determined. Other series, although describing adequately the postoperative hemodynamic findings, have not reported angiographic data.1 4 6

The importance of including the aortogram in any postoperative evaluation of these patients cannot be overemphasized. In two of our patients with significant leaks (2+ or greater), hemodynamic findings were normal as defined in this laboratory. The true nature of their valvular dysfunction could only be accurately ascertained by evaluation of the cineangiogram. Fortunately, all of the patients with significant leaks except one short obese subject had at least grade II/VI aortic diastolic murmurs, so that the necessity for postoperative studies was clearly indicated.

The accuracy in defining the leaks around the rim of the valves was confirmed during the reoperation in four patients. The disruption and loosening of the sutures were readily visualized and were generally ascertained as being secondary to the calcified, friable tissue in which they had originally been sewn. In fact, seven of the nine significant leaks were recorded in patients who, at the time of valve replacement were found to have severely calcified leaflets and annuli. It has been shown that there is virtually no tissue ingrowth into these valve skirts so that the suture technique is of the utmost importance.8 The calcified annulus provides a poor bed for implantation and allows the sutures to "pull out" more easily than if they are placed in a tough fibrous ring. A new surgical technique, therefore was devised to deal with this problem.8

Summary

Aortic root cineangiography has been carried out in 21 consecutive survivors of replacement of the aortic valve with a Starr-Edwards ball-valve prosthesis. In nine of 21 patients, a significant leak around the rim of the prosthesis was demonstrated. In four reoperated patients, this leak was confirmed to be secondary to disruption of the suture material, usually in patients with heavily calcified an-
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nuli. Cineangiographic studies are necessary for complete postoperative evaluation of prosthetic values.

References
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