Partial ex situ surgery of the heart

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Left ventricular tumors located in the posterior wall may be difficult to excise, even if benign. Because exposure is difficult, ex situ surgery followed by autotransplantation has been suggested repeatedly.^{1,2} Also, necrosis of the posterior wall with or without an ischemic ventricular septal defect after myocardial infarction may be difficult to reach by standard exposure techniques. We report on a new technique with partial excision of the heart allowing for excellent exposure of the posterior wall and avoiding myocardial ischemia and cardioplegic arrest.

Clinical Summary

History. A 29-year-old man who previously had been healthy had to be resuscitated because of the sudden onset of ventricular fibrillation. On admission to a distant university hospital, a 3-day cardiologic workup including an electrocardiogram, Holter monitoring, echocardiography (transesophageal and transthoracic), computed tomographic scan, nuclear magnetic resonance imaging, and a left heart catheterization including coronary angiography disclosed a 3 × 4-cm mass inside the wall of the left ventricle. The

tumor was located close to the apex of the heart between the posterior descending branch of the right coronary artery and the third obtuse marginal branch of the circumflex artery; the latter gave rise to several pathologic arteries supplying the tumor. No biopsy of the tumor was performed. During his short stay in this hospital, the patient had to be resuscitated for recurrent ventricular fibrillation on various occasions despite treatment with antiarrhythmic drugs. After being transferred by helicopter, the patient was operated on the same Sunday.

Surgical technique. The pericardium was opened via a median sternotomy. There was no pericardial effusion. Cardiopulmonary bypass was instituted by cannulation of the ascending aorta and both venae cavae. The latter were cannulated as far away from the right atrium as possible to allow for their later transection (superior vena cava, 3 cm cranial to the entrance to the right atrium; inferior vena cava, immediately adjacent to the diaphragm).

On institution of cardiopulmonary bypass, cooling to 28°C (rectal temperature), and induced ventricular fibrillation, the left ventricle was vented by a catheter in the left superior pulmonary vein. Inspection of the diaphragmatic aspect of the left ventricle showed a tumor sized as described preoperatively. It was located in the left ventricular wall, protruding under the epicardial surface, which appeared to be normal. No pericardial reaction was seen. Neither by inspection nor by palpation could the tumor be isolated from the coronary sinus or the mitral valve annulus. Excision of the heart was commenced by transection of the inferior vena cava at its entrance into the right atrium, with care taken to avoid injury to the coronary sinus. After this, exposure of the posterior left ventricular wall was improved but not enough to allow for excision of the tumor, taking into account the close vicinity of the coronary sinus and the mitral valve.

Therefore, circumferential transection of the left atrium was done, starting close to the sulcus interatrialis of the site of the previous vent insertion. The incision was extended caudally first, then

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Figure 1. Intraoperative situs of the tumor. **A**, After partial ex situ mobilization of the heart, elevated outside the sternotomy incision. **B**, Magnification of the tumor attached to the left ventricular wall.

to the left up to left atrial appendage. The apex of the heart was then lifted and the roof of the left atrium was transected. Thereafter, excellent exposure of the posterior left ventricle was obtained, with the tumor accessible outside the sternotomy incision (Figure 1). For this reason, the ascending aorta, pulmonary artery, and superior vena cava were left intact.

With the heart fibrillating, the left ventricular wall was incised 5 mm toward the apex to the palpable tumor, since damage to surrounding (coronary sinus, circumflex artery) and underlying structures (papillary muscle, chordae tendineae) was deemed to be less severe. The site of incision was visually controlled by transatrial/transmitral inspection of the left ventricle. From here, the tumor was circumferentially excised, again taking care to avoid damage to the mitral valve apparatus. The third obtuse marginal branch of the circumflex artery, however, had to be sacrificed. Luckily, the mitral valve anulus had not been invaded by the tumor, which was excised at a distance of approximately 5 mm from the

ring. Continuous coronary perfusion was believed to facilitate completion of the excision in this area, because perfusion of the coronary sinus made its preparation easier.

Macroscopically, the tumor was excised in toto without infiltration of the surrounding left ventricular wall. The defect in the left ventricular wall was closed by our standard sandwich technique of applying an oversized Dacron patch inside the left ventricle and an autologous pericardial patch outside the heart. Both patches were fixed to the left ventricular wall by use of 8 single mattress sutures (3-0 polypropylene). Both the left atrium and the inferior vena cava were reconstructed by use of a continuous 4-0 polypropylene suture. After a bypass time of 85 minutes, the operation was completed in a routine fashion with the patient being transferred to the intensive care unit on minimal dynamic support. He was extubated 6 hours later and transferred to the referring hospital on postoperative day 6 in sinus rhythm with continuous application of propranolol. No postoperative arrhythmias had occurred. Postoperative nuclear magnetic resonance imaging and echocardiography showed a correctly positioned patch and good left ventricular function. The histopathologic evaluation of the tumor revealed an arteriovenous angioma with lipomatoid components. The patient is doing well 5 years after the operation and works as a truck driver.

Comment

To our knowledge, this “forme fruste” of ex situ surgery of the heart is described for the first time. In our case, it was extremely helpful. Without transection of the inferior vena cava and left atrium, exposure of the posterior left ventricular wall would have been insufficient, with the risk of damaging both the mitral valve and the coronary sinus. On the other hand, complete excision of the heart, as described by others,^{1,3,4} was not necessary, because exposure was excellent even with the ascending aorta, pulmonary arteries, and superior vena cava intact. This limited excision limits cardiopulmonary bypass time, avoids myocardial ischemia, and potentially preserves myocardial enervation. In addition, it allows for simultaneous inspection of both the inside and outside of the posterior left ventricular wall. Because of the excellent result with our first attempt at “partial ex situ surgery,” we applied the same technique successfully in 3 other patients with aneurysms of the posterior wall.

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