Cardiac reoperations remain a challenge. Reoperations in patients with a patent internal thoracic artery graft have a double challenge; the patent internal thoracic artery graft and the problem of peroperative myocardial protection. Our experience in 25 patients is described and discussed.

**KEY WORDS:** Internal thoracic artery - Reoperation - Retrograde cardioplegia.

The number of cardiac reoperations is still increasing. 1-3 A special group is this in which the patients have a patent internal thoracic artery (ITA) graft. Damage to the patent ITA graft and the problem of peroperative myocardial protection of the ITA-dependent myocardium are sometimes reasons for keeping off the reoperation.

In this report we describe our initial experience with cardiac reoperation in patients with a patent ITA-graft.

**Materials and methods**

Between January 1989 and June 1994, 25 patients with a patent ITA-graft underwent a cardiac reoperation: in 20 patients a coronary reoperation, in two patients a valve replacement after a previous myocardial revascularization with use of the ITA, and in three patients for a combined procedure.

Of the patients 19 were male and 6 female. The mean age was 58.2 ± 9.1 years (42-76). The mean interval between the initial and the reoperation was 55.6 ± 27 months.

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**Table I.—Angiographic indication for reoperation (20 patients with isolated myocardial revascularization).**

<table>
<thead>
<tr>
<th>Indication</th>
<th>N. cases</th>
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<tbody>
<tr>
<td>PA</td>
<td>3</td>
</tr>
<tr>
<td>GF</td>
<td>4</td>
</tr>
<tr>
<td>PA + GF</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
</tr>
</tbody>
</table>

PA: Progression of atherosclerosis in native coronary vessels.
GF: graft failure.

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The patients reoperated for return of angina, had minimal angina New York Heart Association classification III, despite medical therapy with CA+-entry blockers, nitrates, and β-blockers. Two patients underwent mitral valve replacement after previous myocardial revascularization, two patients a combined aortic valve and coronary bypass surgery and one patient a combined mitral valve and bypass surgery.

The angiographic indication for reoperation of the 20 patients with isolated myocardial revascularization is summarized in Table I. Of the four patients operated for graft failure, two times it concerns an early graft failure, one ITA- and one vein graft (within the six months after the initial operation).

In 22 patients there was unilateral use of the ITA-graft, in 3 patients both ITA's were used at the initial operation. The place of the used ITA-graft is summar-
TABLE II.—Localisation of the used ITA-graft at the initial operation.

<table>
<thead>
<tr>
<th>Localisation*</th>
<th>Left ITA</th>
<th>Right ITA</th>
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</thead>
<tbody>
<tr>
<td>LAD</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Cx</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Rc</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

ITA: internal thoracic artery. LAD: left anterior descending coronary artery. Cx: circumflex coronary artery. Rc: right coronary artery. *No difference was made between single and sequential grafts.

Cardiac reoperations with a patent internal thoracic artery graft

In Table II, at reoperation, 1.3 ± 0.8 new grafts were constructed, with 1.8 ± 1.4 distal anastomoses. In 7 patients, the right ITA was used as graft; four to the anterior descending coronary artery, 2 to the circumflex and one to the right coronary artery. In 9 patients the ITA-graft was recycled, five times to the anterior descending coronary artery, and four times to the circumflex coronary artery.

In the patients with mitral valve pathology (insufficiency in 2, stenosis in one patient), a CarboMedics mitral valve prosthesis was refixed because of a paravalvular leakage in one and in the other patient a CarboMedics aortic valve prosthesis was inserted because of aortic valve stenosis.

**Surgical technique**

The sternum was opened with an oscillating saw, and the aorta and the right atrium were dissected free. If necessary, vein material, the unused internal mammary artery or gastric epiploic artery is harvested. After adequate heparinization, the ascending aorta was cannulated, and cannulation for venous return was effected. A left ventricular vent was inserted through the right superior pulmonary vein, in some patients an aortic root vent was used. In 18/23 patients a retrograde coronary sinus cannula was inserted and the correct placement was verified with the balloon-inflation technique. 5

The patient was cooled to a core temperature of 30°C, the anterior surface of the heart was dissected free. The used ITA-graft was carefully dissected, starting close to where it enters the pericardium. When it was possible to clamp the ITA-graft, the patient was cooled further to a core temperature between 26° and 28°C, the aorta clamped cardioplegia (St. Thomas Hospital, 4°C) infused until a systole occurred. In 20/25 patients cardioplegia was administered retrograde, in 5 antegrade. At the time of asystole, and even during infusion of cardioplegia the ITA-pedicle and the heart was further dissected. If identification of the ITA-pedicle was difficult, the aorta was clamped and infusion of cardioplegia started already before the pedicle was clamped.

In cases where myocardial revascularization was needed, the distal anastomoses were done during a single period of aortic cross-clamping, and the proximal anastomoses were performed using a partial occluding clamp.

Before the patient was weaned from extracorporeal circulation, he or she was rewarmed to a rectal temperature of 35°C, and hematocrit was increased to a minimum value of 0.24.

**Results**

In 23/25 patients the ITA-pedicle could be identified and caused no perioperative problem. However, in one patient a hematoma, probably resulting from the dissection, formed near the ITA-LAD anastomosis, and led to the need to reconstruct this anastomosis. In two patients were the right ITA-pedicle was crossing the median line, after the sternotomy, the right ITA-pedicle was carefully dissected, and the innominate vein was divided, in order to cannulate the aorta.

In two patients the ITA-pedicle was damaged. In these two cases, the pedicle was not covered with pericardium and the proximal part of the pedicle was located between the lung and the thoracic wall. Because the patients were already placed on bypass, and cardioplegia was already infused this damage of the ITA-pedicle did not result in major ischemia of the jeopardized myocardium.

Three patients showed postoperative sings of a perioperative myocardial infarction, defined as new postoperative Q-wave or T-wave changes accompanied by elevated cardiac enzyme levels. Only in one patient the infarction was located in the area of the conserved ITA-graft. One patient died, a 74 years old man, with a severely impaired left ventricular function (ejection fraction < 30%), and undergoing a combined coronary and aortic valve reoperation. He could not be weaned from extracorporeal circulation be-
cause of a low cardiac output syndrome, despite use of medication and intraaortic balloon pump. Two patients underwent resternotomy for bleeding. Four patients needed ventilatory support for more than 3 days.

Discussion

Cardiac reoperation with a patent ITA graft embraces two challenges: the dissection of the ITA-graft and perioperative myocardial protection.

The two ITA-pedicles, who were damaged during dissection, were located under the thoracic (sternal) wall. Surgical experience is of course important, however the placement of the ITA-pedicle at the initial operation is essential. Independently of the pleura is opened or left intact during harvesting the ITA, the pedicle must be covered. For a left ITA-pedicle, it is important that the pedicle is lying lateral from the pulmonary artery and enters posteriorly the pericardium. Even for a right ITA placed retroaortic the entrance in the pericardium is an essential point in the dissection of the used pedicle at the reoperation. In cases where the right ITA is placed anteraoartic it is essential that the pedicle is covered by mediastinal tissue or a synthetic patch, in order to avoid adherences between the pedicle and the sternum or thoracic wall.

Preoperatively the ITA-pedicle can be located on the chest X-ray (profile and lateral), and on the coronary angiography with additional images of the ITA-grafts, by means of the used haemoclips.

The installation of cardiopulmonary bypass before dissection of the ITA pedicle seems as recommended. Damaging the ITA-graft can happen to everyone, but the ischemia of the jeopardized myocardium due to interruption of the ITA-graft can be minimized when cardioplegia can be infused immediately. In patients where the dissection of the ITA-pedicle is difficult, we advise to clamp the aorta and infuse cardioplegia before the ITA-pedicle is dissected and clamped. This requires of course more cardioplegia but is mostly efficient, otherwise systemic hypothermia can be used.

The importance of retrograde delivery of cardioplegia, independently of coronary artery or graft pathology is well known. In patients with a patent ITA-graft, antegrade delivery of cardioplegia results in inhomogeneous distribution in the myocardium, due to the coronary artery pathology, but also because of the impossibility of distribution in the myocardial area dependent of the ITA-graft. As long as the ITA-graft is not clamped, this results in a rewarming and suboptimal protection of the myocardium.

With retrograde cardioplegia, the distribution in the myocardium is homogeneous. Even in case of unclamped ITA, the cardioplegic solution reach this myocardial area, however, more cardioplegia will be needed, just until the pedicle is clamped. An other benefit of the retrograde delivery, is that the distribution of cardioplegic solution is independent of the position of the heart. This makes it possible to infuse cardioplegia during the dissection of the heart. Besides, in our experience asystolic hearts are easier to free out the adhesions. That five of our patients received antegrade cardioplegia has to do with the limited experience with retrograde cardioplegia at that time, momently retrograde delivery of cardioplegia is common in reoperation with a patent ITA-graft.

In conclusion, our limited, experience with reoperations in patients with a patent ITA-graft, shows that a patent ITA-graft is not increasing the risk of the reoperation, and thus not a reason to keep off the reoperation. We recommend however, preoperative careful analysis of the ITA-graft course installation of cardiopulmonary bypass before dissection of the ITA-graft, and use of retrograde delivered cardioplegia.

References