REPEAT CORONARY ARTERY BYPASS GRAFT

A Thesis
Submitted for the partial fulfilment of
MD Degree in Cardiothoracic Surgery

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Faculty of Medicine
Ain Shams University
1995

الله

بسم الله الرحمن الرحيم

قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ.

صدق الله العظيم

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Acknowledgment

I would like to express my deep gratitude and heartful appreciation to Professor Dr. Ismail Sallam, Professor and Chairman of Cardiothoracic Surgery Department, Ain Shams University, who taught me how to strive for perfection. It's a great honor to work under his supervision.

Also, many thanks and gratitude go to Professor Dr.Ali Seif El-Din Maklad, Professor of Cardiothoracic Surgery Department, Ain Shams University. The credit of bringing this work to light goes to him. No other words could be said as a compensation for his time and effort he spent in supervising this work. I am in great debt.

I would like also to express my thanks to Dr. Mohammed ABdel-Aziz Ali, Assistant Professor of Cardiothoracic Surgery Department, Ain Shams University, for his general help and guidance. his friendly support and encouragement have always been there.

Finally, I would like to extend my deep gratitude and appreciation for Dr. George Reul. Senior Surgical Associate, Texas heart Institute, USA, for teaching me some of the technical secrets and spending much effort in examining the whole study group and analyzing the results.

INTRODUCTION

Direct myocardial revascularization with coronary artery bypass grafting (CABG) has become one of the most commonly performed operations during the past 20 years and has proved to relieve angina in more than 85% to 90% of the patients (Acinapura et al., 1989). The use of saphenous vein grafts (SVGs) was initially popularized, and it was hoped that long–term patency and clinical relief could be achieved. However, it has become clear since that the initial success is jeopardized by progression of atherosclerosis in the native circulation and , more importantly, by its development in SVGs, as shown by serial angiographic studies (Bical et al., 1980 and Bourassa, 1983).

As a result, more attention has been paid to dietary and pharmacologic control of hyperlipidemia, and the internal thoracic artery (ITA) has became the conduit of choice for CABG after many studies confirmed the long–term patency of ITA compared to SVGs. Up to 5 postoperative years, there is a 10–15% difference in patency rates, with 95% of ITA grafts patent, compared with 80–85% of vein grafts. However, more than 5 years after the operation, the attrition rate of venous grafts increases such that by 10 postoperative years, only 60–65% of vein grafts remain patent, the majority of which have angiographic evidence of atherosclerotic stenosis (Campeau et al., 1983 a and b).

To estimate the incidence of this disease and the magnitude of the problem, Cosgrove et al. (1986) evaluated the first 1000 patients they operated upon each year from 1971 to 1978. The percentage of patients undergoing reoperative procedures was 2.6% at 5 years, 12% at 10 years, and 17% at 12 years (Fig. 1). The annual incidence of reoperation remained stable until 5 yeas postoperatively, when the incidence of this procedure increased sharply. By 12 years, 4% of the population at risk had undergone reoperation annually (Fig. 2). This time frame coincides closely with the known progression of vein graft atherosclerosis, which progress rapidly after 5 years and becomes increasingly clinically manifest.

Significant predictors of the need for reoperation were; young age ($p < 0.001$), no ITA ($p < 0.001$), incomplete revascularization ($p = 0.0004$), NYHA functional class III or IV symptoms ($p = 0.003$), normal left ventricular function ($p = 0.003$), and one or two vessel disease ($p = 0.005$). Many of these variables are predictive of prolonged survival after primary

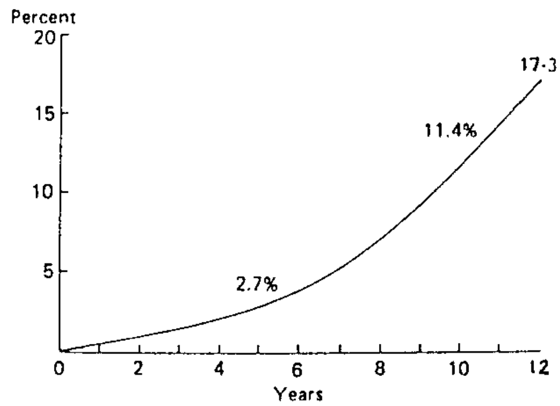

Fig. (1): Incidence of reoperations up to 12 years after revascularization
(Cosgrove et al., 1986)

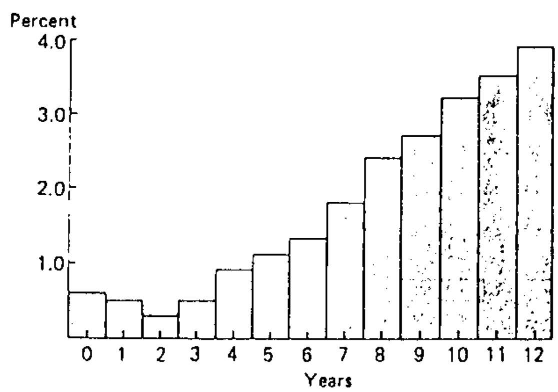

Fig. (2): Annual incidence of reoperations
(Cosgrove et al., 1986)

operation, since the longer the patient lives, the more likely a second operation becomes.

The variable that has the strongest influence on decreasing reoperation – free survival is the lack of an ITA graft, a variable that is physician dependent (Cosgrove et al., 1986).

HISTORY OF CORONARY ARTERY BYPASS SURGERY

Operative procedures for coronary artery disease and myocardial ischemia evolved gradually during a long period of false starts and disheartening stops, a great deal of experimental work, clinical trials of techniques that proved difficult to evaluate, and finally the ultimate development of a procedure which became one of the most common major operations performed in the modern world.

The clinical picture of the disease caused by coronary atherosclerosis started to become clear about two centuries ago. In 1768 the British physician William Heberden contributed the classic description he so aptly named angina pectoris. Nearly a hundred years later the first clinical diagnosis of coronary thrombosis was made by Adam Hammer in St. Louis (Shumacker, 1992).

The search for effective operative procedures for coronary disease took a meandering course. It began with indirect measures to alleviate anginal pain by severing appropriate neural pathways and by lowering the body's metabolic requirements through a reduction in thyroid function. Efforts were then directed toward bringing a new blood supply to the ischemic myocardium, a venture which generated an enormous amount of laboratory experimentation and clinical study.

Sympathetic denervation for angina was carried out fairly widely for a number of decades. Surgeons differed as to how the procedure should be performed and how extensive it should be. Practically all, however, agreed that it alleviated the pain of angina. Although there was some early hope that the operation actually improved circulation to the heart, ultimately nearly everyone concurred that its effect was achieved primarily or entirely by eliminating afferent pain fibers.

Thyroidectomy was the other indirect method for dealing with coronary sclerosis. The theory was based on the observation that some patients developed congestive failure or angina while the classic signs of exophthalmic goitre were appearing, that some patients noted angina or palpitations several months before thyroid enlargement was evident and that cardiac symptoms sometimes subsided when the enlarged thyroid decreased in size (Effler, 1991).

Like sympathectomy, thyroidectomy was virtually abandoned when the results of various operative efforts to increase myocardial circulation were judged to be promising (Shumacker, 1992).

It was Claude Beck (1894–1971) who first tackled seriously the problem of bringing a new blood supply to the myocardium, and he pursued this endeavor all his life. In 1932 he observed bleeding from both cut ends of an adhesion severed during an operation of constrictive pericarditis, and from it came the idea of promoting vascular adhesions between epicardium and pericardium through the production of generalized pericarditis, using talc powder, asbestos, phenol and also supplementing this with pedicled grafts, e.g. pectoralis muscle or omentum. He continued experimentally and by 1941 combined the intrapericardial abrasion procedures with partial occlusion of the coronary sinus. It had been suggested that partial occlusion of the coronary sinus would extract maximum amounts of the oxygen that remained in the returning venous blood. The procedure came to be known as Beck I procedure. It consisted of narrowing the sinus to a diameter of three millimeters, abrading the epicardium and the inner surface of the pericardium, and applying acid and then powdered asbestos before placing mediastinal fat and pericardium on the heart. This technique was widely utilized by Beck and many other cardiac surgeons, and with few modifications it became the most common operation for coronary disease until the era of aortic–coronary bypass surgery (Effler, 1991).

By 1948, Beck was determined to do some form of direct arterialization and decided that this would be accomplished by a graft between the descending aorta and the partially ligated coronary sinus. This operation would in effect, create an arteriovenous fistula between these two structures. The procedure proved to be more difficult than had been anticipated because the arterial graft from the descending aorta to the transverse sinus involved technical problems. Initially, the Beck II operation was performed in separate stages, with the insertion of the aortocoronary sinus graft at stage I and then, at stage II, partial ligation of the coronary sinus. Initially, the free graft entailed removal of the entire brachial artery, but this soon gave way to the use of a reversed saphenous graft. As might be expected, the clinical results, in a relatively small series of cases, were disappointing. The Beck II procedure was shelved, and the less difficult Beck I procedure continued to have clinical application (Shumacker, 1992).

Dr. Vineberg (1903–1988) may well have been the first surgeon to accomplish myocardial revascularization by introducing arterial blood to an area of myocardial perfusion deficit. He pointed out the unique properties of the ITA and proposed the idea that its small intercostal side branches were capable of proliferation after implantation, and the main ITA increased in caliber when successfully implanted in a myocardial tunnel. Vineberg relied heavily on the observation that viable myocardium contains sinusoids consisting of endothelium–lined spaces in the muscle of the left ventricular myocardium. He reasoned that functional demand would stimulate the side branches, of the implanted ITA, to proliferate and communicate directly with the comparable side branches of coronary arteries. Many qualified surgeons found this reasoning difficult to accept. The fact that experimental animals survived the operation seemed little justification for clinical application. However, a few Canadian and American surgeons were impressed with Vineberg's work, and some of them did perform operations on patients in both countries (Dobell, 1992).

Vineberg was a persistent man and was determined to establish some acceptable form of proof. Since coronary arteriography, as we know it today, did not exist, it was necessary for him to track down patients who had survived his operation and had died suddenly of unrelated causes. When he was able to salvage a postmortem heart soon after death, he injected the ITA with contrast medium (Schlessinger mass) to form a cast of the arterial implant. Obviously, this was cumbersome and difficult, but it attested to his energy and determination. To his own satisfaction, he did have specimens that radiographically demonstrated the connection between the implant and the coronary artery (Effler, 1991).

However, it was not until 1962 when doctor Vineberg sent a few patients who survived the operation and became asymptomatic, to undergo coronary and ITA arteriography to evaluate the procedure in the United States. The first three patients were found to have a patent ITA implants and visible collateral communications between the implanted artery and the anterior descending branch of the left coronary artery. This was proof positive that Vineberg's hypothesis was valid and that true myocardial revascularization had been accomplished in human patients (Vineberg, 1982).

The dramatic development had an electrifying effect upon many Canadian and US centers and between 1962 and 1968, over 2,000 patients underwent ITA implant procedure in the