Evolution of Surgical Treatment of Coronary Artery Occlusive Disease

ORIGINAL ABSTRACT

Aortocoronary Bypass With Saphenous Vein Graft: Seven-Year Follow-up

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A 42-year-old man had extensive occlusive disease of the coronary artery and angina pectoris. An autogenous saphenous vein bypass from the ascending aorta to the anterior descending coronary artery was performed on Nov 23, 1964. The patient suffered an asymptomatic anterior myocardial infarction during operation but made an uncomplicated recovery. Seven years after the operation, the graft functions with normal left ventricular hemodynamics, while the occlusive process has produced obstruction of the left main coronary artery and almost complete occlusion of the right coronary artery. To our knowledge, this is the first successful case of a saphenous vein-coronary artery bypass with the longest follow-up of a functioning coronary vein bypass graft.

See www.jama.com for full text of the original JAMA article.

Commentary by George P. Noon, MD

IN 1937, OCHSNER AND DEBAKEY1 PUBLISHED “THE SURGICAL TREATMENT OF CORONARY DISEASE” in which they reviewed indirect surgical treatment of angina pectoris consisting of 3 main approaches: the sympathetic nervous system, the thyroid, and development of collateral blood supply to the heart. Jonnesco2 initiated indirect surgical treatment of angina pectoris in patients in 1916, when he performed a sympathectomy that was later used by many surgeons with a variety of techniques and variable results. Subsequently, total thyroidectomy was found to relieve cardiac symptoms by decreasing the metabolic rate in patients with hyperthyroidism. In 1934, Weinstein et al,3 however, reported marginal results treating angina with thyroidectomy in 50 consecutive patients. In 1937, Parsons and Purks4 reported similar marginal results in 133 patients.

In 1935, Beck5 reported a number of procedures designed to promote collateral circulation. Other physician-researchers continued to develop procedures that were used experimentally and clinically to increase collateral circulation, but with questionable results.

The concept of coronary bypass grafting for occlusive disease was originally proposed by Carrel,6 who in 1910 reported his experimental coronary bypass operations in dogs and suggested the possible role of this procedure in the treatment of angina pectoris in humans. In 1961, DeBakey and Henley7 published their experimental work in dogs using knitted Dacron grafts (3-5 mm) applied to the left anterior descending artery, the circumflex artery, or both. In 1957, Bailey et al8 first reported coronary artery endarterectomy in a patient. Coronary endarterectomy was continued sporadically in selected patients.

Since the concept of direct revascularization was beginning to develop, physicians needed diagnostic testing to verify arterial coronary anatomy. In 1959, Sones et al9 reported using radiopaque contrast in the coronary arteries. At about the same time, Crawford et al10 reported successfully repairing opened coronary arteries in dogs with autologous vein patch grafts. In 1962, Sabiston11 performed the first vein graft bypass from the ascending aorta to the right coronary artery, although the patient died a few days later.

Historical Significance

The classic article by Garrett et al12 is of critical importance because 7 years after the procedure was performed, it documented the first successful coronary artery bypass graft (CABG) operation. The authors purposely waited 7 years to have a reliable follow-up outcome. Interestingly, the surgeons were not convinced that the graft was patent after the operation. The patient’s electrocardiogram showed severe reversible ST-segment depres-
sion during the operation and evidence of a perioperative myo-
cardial infarction postoperatively. One month postoperatively, a
selective coronary arteriogram and flush aortogram failed to
show graft patency. It was not until selective coronary and graft
arteriograms performed during a routine examination 7 years
later that graft patency was confirmed. The surgeons were elated
with the findings that confirmed long-term graft patency and
preservation of ventricular function, despite progression of coro-
nary artery disease. Relief of angina pectoris also continued.

This landmark article12 was monumental in the evolution of
the surgical treatment of atherosclerotic coronary artery dis-
ease. The article demonstrated a successful saphenous vein coro-
nary bypass operation with long-term graft patency, relief of
previously intractable angina, and preservation of ventricular
function. This report introduced a new era of surgical treatment
of coronary artery disease, rendering the previous indirect sur-
gical procedures obsolete. Eventually CABG surgery became
the most common cardiac surgical procedure performed. On
many occasions, DeBakey called CABG surgery an “act of provi-
dence.” This first successful procedure was not planned, but
was performed as a “rescue” and the widespread application and
positive effects of the treatment of atherosclerotic coronary
artery occlusive disease were not realized until later.

At the time of this historic surgery,12 heart disease was
the leading cause of death in the United States13 and the need
for treatment and prevention became a medical priority. The
National Institutes of Health and other sources made fund-

available for researching coronary heart disease. Exten-
sive clinical studies were initiated to evaluate medical and
surgical therapy, improve diagnosis, and elucidate patho-
genesis and prevention.

The indications for coronary artery revascularization and
medical treatment were established after review of large-
scale clinical studies. As more long-term follow-up became
available, comparison of graft patency of veins with that of
arterial conduits demonstrated the superiority of the inter-

nal mammary artery.

Coronary artery balloon angioplasty was introduced in
the 1970s by Grüntzig et al14 and followed later by the de-
velopment of coronary stents. With experience and improve-
ments, these percutaneous devices were used more exten-

tively than CABG surgery to establish blood flow in
obstructed coronary arteries. Multiple trials compared the
efficacy of balloons, stents, and bypass surgery. The suc-
cess of stents in properly selected patients decreased the num-
ber of CABG procedures performed. In general, however,
CABG procedures provided better long-term results.

To reduce surgical trauma and morbidity, surgeons be-
gan evaluating new surgical techniques. Off-pump surgery
was used to avoid such adverse effects of cardiopulmonary
bypass as hemodilution and neurologic sequelae. In prop-

erly selected patients, the off-pump operation has been suc-
cessful and widely accepted.

Minimally invasive procedures for CABG surgery and ro-
botic surgery have also been developed. These operations
require new methods of exposure, new operative tech-
niques, and new surgical instruments. Coronary artery stent-
ing is now combined with minimally invasive CABG, a hy-
brid procedure that usually involves bypass of the left internal
mammary artery to the left anterior descending coronary
artery and stenting of any other stenotic arteries.

DeBakey often spoke about the pioneering coronary by-
pass operation performed in 1964. Repeatedly, he pointed
out that it is not enough simply to perform the operation,
but also to make sure the patient does well postopera-
tively. He was quick to suggest that serendipity had played
a role in finding a surgical alternative to treat coronary ar-
tery disease. The publication of this case report in JAMA12
and the demonstration of long-term success gave high credi-
bility to the concept of coronary revascularization.

Since this landmark procedure was performed more than
4 decades ago, treatment of coronary artery occlusive disease
has undergone extensive investigation and evolution, result-
ing in improved diagnosis and more effective treatment. Since
learning of the surgeons’ successful attempt to save their pa-
tient’s life, researchers have made remarkable advances in the
diagnosis and treatment of coronary artery occlusive disease,
and as a result, countless patient lives have been extended when
disability and death might otherwise have been their fate.

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REFERENCES
2. Jonnesco T. Traitement chirurgical de l’angine de poitrine par la resection du sym-
3. Weinstein AA, Davis D, Berlin DD, Blumgart HL. The mechanism of the early
relief of pain in patients with angina pectoris and congestive failure after total ab-
5. Beck CS. The development of a new blood supply to the heart by operation.
1961;23(1):111-120.
8. Bailey CP, May A, Lemmon WM. Survival after coronary endarterectomy in
9. Sones FM Jr, Shirey EK, Proudfoot WL, Westcott RN. Cine-coronary arteriogra-
10. Crawford ES, Beall AC, Ellis PR Jr, DeBakey ME. A technique permitting op-
12. Garrett HE, Dennis EW, DeBakey ME. Aortocoronary bypass with saphenous
National Center for Health Statistics Web site. www.cdc.gov/nchs/data/dvs
14. Grüntzig AR, Senning A, Siegenthaler WE. Nonoperative dilatation of coro-
1979;301(2):61-68.
2174-2183.

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