

## Research Article

# Coronary Insufficiency: "surgery or angioplasty"

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### Abstract:

Surgery for coronary insufficiency begins with surgery to eliminate the pain of angina pectoris by cutting the sensory nerve pathways to the heart. Subsequently, surgeons attempted to revascularise the myocardium indirectly, by causing adhesions between the heart and various tissues, altering the direction of coronary circulation or creating artificial shunts in the myocardium by implanting the internal mammary artery directly into the left ventricle. But all these techniques proved insufficient, and surgeons turned to direct revascularisation of the coronary arteries. It was in 1968 that the first direct coronary revascularisation by bypass with the long saphenous vein was performed. Under the impetus of the pioneers of cardiac surgery, this type of surgery took off, helped by the development of extracorporeal circulation. Coronary surgery evolved at every level, with the development of microsurgical techniques for anastomoses, the use of arterial grafts, which are more durable than veins, and complete revascularisation. Over time, this surgery will prove to be reliable and reproducible, with excellent results and very low post-operative mortality and infarction rates. Above all, it will improve quality of life and long-term survival. Coronary surgery is still today an indispensable therapeutic tool in the treatment of ischaemic coronary disease.

**Key words: coronary insufficiency / coronary surgery / coronary bypass / ischaemic heart disease.**

### Introduction

Coronary artery disease has existed for a very long time, as demonstrated by the presence of atheromatous lesions discovered on the coronary arteries of a 50-year-old mummy belonging to the 21st dynasty of Egypt, i.e. 1000 years BC. However, the symptoms of coronary artery disease, and in particular angina attacks, were not described for the first time until 1768 by Heberden (1). At the beginning of the 20th century, while there was some confusion about the definition of angina pectoris and its pathophysiological mechanism, the therapeutic management of angina pectoris developed from the outset through a number of surgical techniques.

Later, when coronary disease was better understood surgically, coronary reconstruction developed rapidly, demonstrating its effectiveness in the treatment of coronary insufficiency. Despite medical therapeutic innovations and the emergence of interventional cardiology, surgery will continue to play a key role in the treatment of coronary artery disease.

### Technique:

#### ➤ Angina symptom surgery

Surgery for coronary insufficiency will begin with symptomatic surgery designed to eliminate angina pain. The first of these surgical interventions was based on the interruption of the heart via sensitive-motor pathways by means of a sympathectomy suggested by the Frenchman François Frank (2) in 1899. Various cervical procedures were then proposed, including

thoracic sympathectomy (3), pericoronary neurectomy (4), resection of the pre-aortic plexus (5) and paravertebral nerve block (6).

Secondly, surgeons will attempt to revascularise the myocardium indirectly, by causing adhesions between the heart and various tissues and organs such as the pericardium (7-9), pectoral muscle, stomach, liver (10), the omentum (11) or the lung (12), by altering the direction of coronary circulation (anastomosis between an artery and the coronary sinus) (13) or by creating artificial shunts in the myocardium by direct implantation of the internal mammary artery into the left ventricle (14,15). However, all these techniques proved insufficient and surgeons turned to direct coronary revascularisation.

The first approach would be surgical dilatation of the area of obstruction, or coronary endarterectomy with or without angioplasty using a venous or synthetic patch (16). Here again, however, results will be inconsistent, and in view of the published patency rates with the long saphenous vein in peripheral arterial bypass grafts (17,18), cardiac surgeons will realise the value of this vascular substitute for coronary revascularisation.

#### ➤ Coronary artery bypass reconstruction

It was in 1968 that the first direct coronary revascularisation by bypass with the long saphenous vein was successfully performed (19-21). As a suitable response to the mechanism of

myocardial ischaemia, direct revascularisation of the coronary arteries was rapidly accepted by all, and this surgery then took off, helped by the development of extracorporeal circulation, surgical techniques and anaesthesia-intensive care.

It should be noted, however, that the superiority of the results of surgical treatment compared with medical treatment was much debated, even in the early reports of randomised studies. In the 1960s and early 1970s, the patients proposed for surgery were young patients with an average age of less than 60 years, often monotruncular, with tritruncular patients representing less than 10% of indications, with good left ventricular function and no associated pathology.

However, the operative mortality rate was usually close to 5% and the post-operative infarction rate was very high, ranging from 6 to 22%. From the late 1970s onwards, the patient profile changed, with an increase in the average age, the number of coronary trunks affected, the proportion of left ventricular function impaired and associated pathologies. This change in the surgical population will become more pronounced over time.

Paradoxically, however, even though the patients are more serious, the mortality rate will gradually fall to below 3% today. This can be explained by a better understanding of ischaemic coronary pathology and the constant progress made in this field in cardiology, surgery and anaesthesia. Similarly, post-operative myocardial infarction rates will fall sharply to below 3%. This reduction in infarction rates, which helped to make coronary surgery an effective treatment for coronary insufficiency, was largely due to certain principles, such as optimal myocardial protection, the use of microsurgical anastomoses made possible by advances in instrumentation and the materials used for sutures, and the notion of "complete" revascularisation through the use of multiple bypasses.

#### ➤ **Coronary surgery and percutaneous angioplasty**

The change in patient profile was initially linked to advances in techniques, but from the 1980s onwards, the advent of percutaneous coronary angioplasty (PCI) played a major role in modifying the surgical patient population. The indisputable advantages of PCA (simple femoral puncture under local anaesthetic, short hospital stay) led cardiologists to direct patients towards this new therapeutic alternative.

As a result, mono-truncular patients will almost completely disappear from the indications for coronary surgery in favour of APC. Similarly, bi- and tri-truncular patients accessible to angioplasty will often be treated by this technique as first-line treatment. However, after a period of enthusiasm for the new techniques, the disadvantages associated with APC, and in particular the re-stenoses that occur in 20 to 30% of cases, or the impossibility of treating certain complex coronary lesions or coronary occlusions, will lead to this technique being evaluated in relation to medical treatment or surgery.

Several large randomised studies published in the 90s in mono or multitruncular patients showed that the mortality rate and the rate of postoperative infarction or mid-term surgery were identical to those of APC. However, PCA is associated with a

higher rate of patients with residual angina requiring medical treatment or further revascularisation. A large recent study will show that in patients at high risk of surgery, surgery will give the same level of quality of life at 6 months as angioplasty, thus calling into question the benefit/risk ratio which until now seemed to favour angioplasty more than surgery. Whatever the case, cardiologists and surgeons will quickly understand that these two techniques are not in opposition and that they both have their respective indications, which must be determined after a medical and surgical discussion.

This will be all the more true given that these two techniques will continue to progress, in particular with the increasingly frequent use of arterial grafts in surgery, whose superiority in terms of long-term patency will be demonstrated, and by the appearance of coronary stents which will significantly reduce the rate of re-stenosis and more recently impregnated stents which will further reduce the rate of re-stenosis.

#### ➤ **Coronary bypass with arterial substitutes**

In the early years of coronary surgery, the long saphenous vein was the optimal substitute for coronary revascularisation, allowing all sorts of technical tricks to be used to increase the number of anastomoses.

Although other venous vascular substitutes were used, such as brachial vein grafts, it was above all arterial substitutes that contributed to improving the long-term results of coronary surgery.

In fact, in several published studies, the long-term recurrence of angina in operated patients was due to an alteration in coronary venous I bypasses. As a result, the implantation of a pedicled arterial substitute rather than a venous substitute taken as a free graft from the coronary arteries appeared to be much more "physiological". The first arterial substitute to be used was the left internal mammary artery, already used by Vineberg (14,15) in his indirect myocardial revascularisations. The first long-term results in patients who had undergone internal mammary artery (IMA) bypass surgery were extremely encouraging, as this artery had a much higher patency rate than the saphenous vein. The right MIA showed comparable results to the left. The gastroepiploic artery gave excellent results, while the epigastric artery was abandoned.

The results obtained with the radial artery will vary, but a recent randomised study showed that the results obtained with this artery were comparable to those obtained with the long saphenous vein or the right internal mammary artery as a free graft. Whatever the case, the use of internal mammary arteries will help delay the onset of angina and improve patients' quality of life and survival. The concept of "all-arterial" revascularisation will therefore gradually become established in patients under 70 years of age.

#### ➤ **Complete revascularisation**

While recurrence of angina in patients undergoing coronary bypass surgery is due to the appearance of lesions on the venous grafts, incomplete revascularisation leaving certain stenotic arteries unrevascularised also contributes to the reappearance or

persistence of angina requiring the maintenance of anti-angina treatment. In the early days of coronary surgery, revascularisation was mainly performed on large-calibre arteries, but gradually, under the impetus of certain techniques using microsurgery, it became possible to perform anastomoses on increasingly smaller arteries, thereby making it possible to treat patients with severe coronary lesions and also to perform additional bypasses on smaller-calibre coronary branches. The notion of "complete" or "complete" revascularisation therefore became a necessary reality, especially in young, active patients. This concept, combined with the use of arterial grafts, still guarantees prolonged survival and a better quality of life, reducing the recurrence of angina pectoris, the number of cardiac events and hospital admissions.

### Changes in indications

Constant progress in surgical techniques and anaesthesia/resuscitation techniques, the appearance of new drug treatments, circulatory assistance systems such as the intra-aortic counterpulsation balloon, and improvements in techniques for assessing myocardial function (scintigraphy, echography, etc.) all contributed to modifying the indications for coronary surgery independently of other medical treatments and PCA.

From the 1980s onwards, coronary surgery was to be extended to very elderly patients over the age of 80, and to patients with severe impairment of left ventricular function, thereby avoiding the need for heart transplants in younger patients. It was also extended to patients in critical myocardial condition, and to patients with damage to other organs, such as renal failure patients on haemodialysis. Similarly, the excellent results obtained in coronary re-interventions will make them a growing indication for cardiac surgery services.

### Conclusion

In the 35 years since the first coronary bypass operations were performed, coronary surgery has gradually been refined in terms of both techniques and indications, becoming a therapeutic tool that still plays a major role today alongside medical treatment and percutaneous angioplasty. The results in terms of morbidity and mortality mean that today few patients are turned down for this surgery, especially as, while this surgery makes it possible to treat the effects of coronary disease, it also gives patients access to other invasive treatments for other organ diseases, thereby helping to increase life expectancy in developed countries.


### References:

1. HEBERDEN W. Some account of a disorder of the breast. M. Tr. College Physicians 1768; 2:59-61
2. FRANÇOIS-FRANK CE. Signification physiologique de la résection du sympathique dans la maladie de Basedow, l'épilepsie, l'idiotie et le glaucome. Bull Acad Nat Med 1899;41:565-8.

3. JONNESCO T. Traitement chirurgical de l'angine de poitrine par la résection du sympathique cervicothoracique. Bull Acad Nat Med 1920;84:93-5.
4. FAUTEUX M, SWENSON O. in Pericoronary neurectomy abolishing anginal pain in coronary disease. Arch Surg 1946;53:169-72.
5. ARNULF G. La résection du plexus pré-aortique dans l'angine de poitrine. Arch Mal Coeur 1948;42:1191-4.
6. MANDL F. Die Anwendungsbreite der paravertebrale Injektion bei der Angina pectoris. Klin Wschr 1925;4:2356-9.
7. BECK CS. The development of a new blood supply to the heart by operation. Ann Surg 1935;102:801-5.
8. HARKEN DE, BLACK H, DICKSON JF, WILSON HD. Deepicardialization: Simple, effective surgical treatment for angina pectoris. Circulation 1955;12:955-8.
9. THOMPSON SA, RAISBECK MJ. Cardiopericardioplexy. The surgical treatment of coronary arterial disease by the establishment of adhesive pericarditis. Ann Intern Med 1942;16:495-7.
10. BECK CS. Coronary sclerosis and angina pectoris, treatment by grafting a new blood supply upon the myocardium. Surg Gynec Obstet 1937;64:270-3. TOM SHUNG
11. O'SHAUGHNESSY L. An experimental method of providing a collateral circulation to the heart. Brit J Surg 1936;23:665-8. 34
12. CARTER BN, WADSWORTH CL. An experimental study of collateral coronary circulation produced by cardiopneumoplexy. Surgery 1949;25:489-93.
13. BECK CS, STANTON E, BATINCHOK W, LEITER E. CO<sub>2</sub> systemic revascularization of the heart by graft of 152 coronary sinus. JAMA 1948;137:436-9
14. VINEBERG AM. Development of anastomosis between coronary vessels and transplanted internal artery. Canad Med Ass J 1946;55:117-21.
15. VINEBERG AM. Experimental background by myocardial revascularization internal and mammary artery implantation supplementary techniques, with its clinical application in 125 patients: A review and critical appraisal. Ann Surg 1964;159:185-9.
16. EFFLER DB, SONES FM, FAVALORO R, GROVES LK. Coronary endarterectomy with patch graft reconstruction (clinical experience with 34 cases). Ann Surg 1965;162:590-4.
17. LINTON RR, DARLING KC. Autogenous saphenous vein bypass grafts in femoropopliteal obliterative arterial disease. Surgery 1962;51:62-5.
18. DARLING RC, LINTON RR, RAZZUK MA. Saphenous vein bypass grafts for femoropopliteal occlusive disease; a reappraisal. Surgery 1967;61:31-5.
19. FAVALORO RG. Saphenous vein graft in the surgical treatment of coronary artery disease; technique. J Thorac operative Cardiovasc Surg 1969;58:78-83.

20. JOHNSON WB, FLEMMER RJ, LEPLEY D, ELLISON EH. Extended treatment of severe coronary artery disease: A total surgical approach. *Ann Surg* 1969; 170:460-4.
21. URSCHEL HC, MILLER ER, RAZZUK MA, ALVARES JE, MCNAMARA JJ, PAULSON DL. Aorta-to-coronary artery vein bypass graft for coronary artery occlusive disease. *Ann Thorac Surg* 1969; 8:114-9.

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