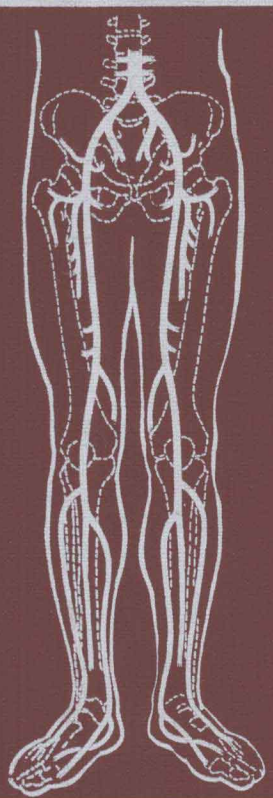
Arterial Reconstruction in the Lower Extremity

Herbert Dardik



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"DISEASES, DESPERATE GROWN, BY DESPERATE APPLIANCE ARE RELIEV'D, OR NOT AT ALL."

HAMLET Act 4, Scene 3

Foreword

One might well wonder why yet another book on arterial reconstruction is added to the ever-increasing number of vascular surgical volumes. Even a cursory examination of this excellent text quickly dispels any question of its immense value. The author has focused his extensive clinical and operative experience on the problem of arterial reconstruction in the lower extremity. For the practicing surgeon on occasion and for the neophyte more frequently this is an area fraught with difficulty both in the clinical decision making process and in the design and execution of a surgical procedure. What is conceptually simple, namely insufficient flow because of obstruction in the arterial tree, may become extremely taxing on the ingenuity and technical skills of the surgeon. Multiple obstructions in multiple vessels magnify the problem many-fold. In the extreme situation, surgical relief is impossible. With increasing experience, both in the volume of patients examined and numbers of operations performed, such surgical stalemates dwindle. Herbert Dardik is a world authority in the evaluation and surgical therapy of arterial insufficiency of the lower extremity. His many innovative contributions and his tenacious pursuit of successful revascularization have saved many legs from the consequence of ischemic necrosis and many surgeons from profound professional defeat.

The author has omitted consideration of angiography, anesthesiology, and the details of amputations, believing that they are described adequately elsewhere. He has concentrated on the essence of the problem, namely revascularization of the ischemic lower extremity. He is particularly expert and

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helpful in his discussion in those difficult cases of occlusive disease in and below the tibioperoneal trunk, sharing with us his wide experience and several original surgical maneuvers which he does do well. The text is lavishly illustrated with arteriograms of high quality and the line drawings illustrating operative procedures step by step are models of clarity. This same sequential display of the details of exposure of the arteries of the lower extremity and the detailed delineation of available procedures, not all of which will occur to the responsible surgeon, make this book especially valuable. The abstracts of selected references following each chapter are a novel and helpful bonus. Ostensibly to postpone obsolescence and thereby provide a readable and practical guide for frequent and some less frequent procedures that challenge the vascular surgeon, the author has omitted followup data. The point may indeed be well taken but there can be little doubt that the reader, especially the less experienced reader, will wish to know the results of the expert. This test is an excellent source of very practical information for the expert as well as the novice.

Allan D. Callow, M.D., Ph.D.

Preface

Vascular disorders are set off from other medical and surgical states for a variety of reasons, including the relentless progression of the degenerative process, the fact that clear-cut solutions often do not exist, and the occurrence of individual extremist attitudes based on the statistics relating to success and failure. Additionally, symptoms are based on regional or segmental patterns of the disease, while the pathologic changes in the vascular system are generalized and can surface clinically at any time. These organic problems usually coexist with other physiologic disturbances involving hemodynamic and neurogenic components.

In few fields of endeavor is experience, judgment, and technique so crucial in determining success or failure. The anatomic presence of a lesion is generally not an absolute indication for its correction. Preoperative investigations can be misleading. Furthermore, repetitive surgery for the same problem carries an exponentially higher rate of morbidity and mortality. Though oft recognized, these problems have not been sufficiently emphasized.

The challenges in vascular surgery are highlighted by the increasing human life span and the prevalence of degenerative vascular disease in the elderly. The annual economic impact is measureable in thousands of dollars per patient. Specific figures do not exist for atherosclerosis, but annual nationwide estimates of billions of dollars are truly staggering. The *1964 Report of the President's Commission on Heart Disease, Cancer and Stroke* represented the federal government's first comprehensive economic assessment of certain diseases set as program targets.

Atherosclerosis, particularly in combination with diabetes mellitus, produces a significant annual loss of both life and limb. Amelioration of this

problem has in some measure been due to developments in vascular surgery. Technical refinements, improved patient selection, and development of advanced monitoring devices for intraoperative and postoperative care have resulted in the ability to produce predictable results following surgical reconstruction. The primary challenge to the vascular surgeon in all these cases is to effect limb salvage and function with minimal morbidity and economic impact.

The raison d'être for this text is in response to the requests of both surgical residents and attending surgeons for concise, clear guidance in the surgical management of reconstructible arterial disease in the lower extremities. Efforts to span the gap in knowledge between that of the novice trainee and that of the accomplished vascular surgeon have until recently been feeble. In 1971, the Vascular Surgery Resources Subcommittee (Drs. James DeWeese, William Blaisdell, and John Foster) recognized the need for and recommended evaluation of standards for vascular surgical training. Most surgeons performing peripheral vascular surgery had emanated from general and cardiothoracic surgical programs that in fact had provided inadequate or minimal experience in peripheral vascular disorders. It was no longer appropriate to consider those who completed training in general, thoracic, or cardiac surgery to be proficient in diseases of the peripheral vascular system. Furthermore it is unlikely that one whose interest is primarily focused upon the biliary tract or cardiac valve replacement can maintain sustained interest in gangrenous states of the lower extremities. Though the technical proficiency required for cardiac and peripheral vascular surgery is comparably high, the experience and judgments in these fields are dissimilar. In 1979, the Program Evaluation and Endorsement Committee of the Society for Vascular Surgery and the North American Chapter of the International Cardiovascular Society instituted a process whereby special training programs in peripheral vascular surgery could be approved and recognized as a means leading to special certification in peripheral vascular surgery. The function of approving such programs was assumed by the Residency Review Committee in 1983, and it is hoped this move will lead to continued improvement in the education and practice of peripheral vascular surgeons.

It is my hope that this text will also help to improve the management of atherosclerotic disease in the lower extremity by focusing on the details and expertise required for performing reconstructive operations. It is not meant to represent an encyclopedic collection of all aspects of lower extremity revascularization. Subjects such as angiography, anesthesia, inflow revascularization, and amputation have been thoroughly described in recent editions of the standard textbooks of vascular surgery. The orientation of this text is to present the variations on a theme and emphasize the nuances involved in this most sophisticated subspecialty of medicine. I have purposely omitted data in order to postpone obsolescence and thereby provide a readable and practical guide for frequent, and some less-frequent, procedures that challenge the vascular surgeon.

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PART 1

Basics of Arterial Reconstruction

CHAPTER 1 Indications and Case Selection

Arterial reconstructive procedures for the lower extremities represent a significant percentage of the vascular surgeon's time and efforts. Indeed, with the growing sophistication of these procedures, the pool of patients with reconstructible arteries has expanded as the "inoperable," or "nonreconstructible," group has contracted. Nevertheless, the therapeutic directions taken for these patients continue to generate great controversy. A routine bypass for limited indications on the one hand or an extensive, complex procedure for end-stage ischemia on the other might be more appropriately treated by nonsurgical means and amputation, respectively. Analysis of growing series of patients enables us to accurately define patient selection criteria and to avoid wasteful and potentially harmful operations. The cost-benefit ratios for these expensive and time-consuming procedures must also be considered, although these calculations should also include the morbidity and mortality rates following nonsurgical treatment or primary amputation and their social and economic impacts. The goal for each individual patient, whether or not an operation is performed, must be clearly and accurately defined. Categorization for subsequent analysis will then be possible to enable better patient selection and thereby improve results.

Arterial reconstruction in the lower extremity may be required for a variety of pathologic entities. The most common is chronic occlusion secondary to atherosclerosis. Aneurysmal degeneration due to atherosclerosis is less com-

mon but nonetheless a potentially serious problem that may often require surgical attention.

Other pathologic mechanisms causing ischemia include embolism, dissection, compression, and disruption. These may be caused by a variety of conditions, which include systemic disorders (cardiac, hematologic, immunologic), congenital states (entrapment syndromes, hypoplasia), trauma, and some with still unknown mechanisms (fibromuscular hyperplasia, cystic degeneration, angiitis). Regardless of the exact etiology or mechanism, variable clinical states will exist ranging from those that are completely asymptomatic to critical ischemia and beyond to irreversible tissue loss. The diagnostic and therapeutic principles outlined in this text are applicable to all types of pathologic entities. For example, adventitial cystic disease of the popliteal artery is a localized pathologic entity for which, if needle aspiration fails, therapy consists of local interposition grafting employing techniques already standardized for the surgical treatment of atherosclerosis. Similarly, once the popliteal entrapment syndrome is diagnosed, surgery relevant to the pathology is employed, including replacement grafting where the vessel has become occluded and, in some instances, aneurysmal. Thus, although this text concentrates on the direct surgical treatment of atherosclerotic obliterative disorders of the lower limb, similar techniques, ofttimes simpler, are applicable to the management of conditions originating from trauma, congenital disorders, aneurysmal degeneration, and other states causing ischemia and potential loss of limb.

A thorough appreciation of the natural history of atherosclerosis is critical for planning therapy. Data on this subject are difficult to obtain, and those studies noted in the literature are frequently incomplete. The following represents a consensus on the natural course of atherosclerosis in the lower extremities:

- Most patients (>70%) with symptomatic atherosclerosis are claudicators. Severe ischemia occurs in 15 to 20 percent and trophic lesions and gangrene in about 10 percent.
- Few claudicators improve spontaneously, but many remain stable for long periods of time. Progression, measured in years, occurs in 25 percent and gangrene occurs in 5 percent.
- Progression of disease varies with the individual as well as with the actual location of the disease process. Relative stability or rapid progression of disease is often unpredictable in the early stages of atherosclerosis. The coexistence of diabetes mellitus appears to hasten the progress and severity of the ischemic state.
- The frequency and severity of ischemia superimposed on a claudicating limb increase as additional sites of segmental pathology develop both proximal and distal to the site of original occlusion.
- The ultimate prognosis for limb salvage becomes worse the more distal the occlusion.

- Spontaneous recovery from an episode of sudden worsening is uncommon.
- Approximately half of patients with advanced atherosclerosis expire from related causes (myocardial infarction and stroke) within 5 years. Developments in staged or synchronous peripheral vascular procedures and myocardial revascularization will favorably alter this statistic.
- Approximately one-third of patients with symptomatic atherosclerosis in one limb develop symptomatic disease in the contralateral limb within 5 years.
- Smoking, diet, exercise, and genetics are significant factors for the development, progression, or stability of the atherosclerotic process.

CLINICAL SETTING

The clinical history and physical examination are the most important means of diagnosis and evaluation for surgical therapy. Intermittent claudication is generally not considered as an indication for either surgery or angiographic evaluation. If the claudication is truly disabling, then surgical correction is warranted, but even in many of these cases, reassurance and instructions regarding exercise, cessation of smoking, and weight control lead to amelioration of symptoms. One must guard against using a potentially reversible complaint of the patient as a pretext for engaging in a major surgical undertaking. On the other hand, certain clues may be present in the history that suggest that an aggressive surgical approach be considered. Persistent numbness or tingling are, for example, indicative of an ischemic state beyond mere claudication. Patients who complain of rest or night pain are certainly potential candidates for vascular reconstruction. Nonhealing ulcers and focal gangrene are also strong indications, in the presence of pulse deficits and positive results of noninvasive hemodynamic tests, for performing angiography and vascular reconstruction. In selected cases, percutaneous transluminal dilation may be therapeutic or may be employed as an adjunct to surgery. Advanced pregangrene manifested by severe pain, coldness, petechiae, and mottling requires urgent and aggressive evaluation and, hopefully, surgery if limb salvage is to be obtained.

There is universal agreement amongst peripheral vascular surgeons that attempts to salvage a limb by vascular reconstruction are justified if the patient is suffering from advanced ischemia, if the ischemia is anatomically correctable, and if the limb can be returned to a functional existence. Each of these criteria can be enormously manipulated; therefore, readers must examine the documentation of patient information with great care before coming to conclusions, particularly when comparing different patient series and groupings.

Four major clinical categories are defined in Table 1-1.

TABLE 1-1 **CLINICAL STAGING**

1. Asymptomatic disease
   - Occlusive
   - Aneurysmal
2. Intermittent claudication
3. Rest pain sometimes with focal ulcers and/or necrosis
4. Limb-threatening disease
   - Pregangrene
   - Tissue necrosis

Surgery is generally not recommended for stage 2 and certainly not for stage 1, with the exception of major aneurysmal disease that would otherwise pose a threat to the limb by thrombosis, embolism, compression, or bleeding. Stage 2 patients that are truly disabled from their symptoms can be helped by reconstruction, but they must understand all the risk factors.

Stage 3 patients include those with rest pain, nonhealing ulcers, and/or focal gangrenous lesions but not facing imminent amputation. This group should not be confused with limb salvage patients. Selection for bypass requires experienced judgment partly based on the additional factors of anticipated patient longevity, angiographic demonstration of the pathology, and the predicted natural course of the atherosclerotic process. Major reconstruction can be avoided in mild to moderate stage 3 cases by employing sympathectomy in selected cases and, where necessary, instruction and education to lose weight, stop smoking, and undertake a monitored physical fitness program where applicable. If there is no response and certainly if there is progression to an advanced level in stage 3, then reconstruction is indicated. Timely intervention for stage 3 should prevent tissue necrosis, but ofttimes patients do not seek help until the potential for limb loss exists.

Urgent and, on occasion, emergency reconstruction is required for stage 4 cases. This category includes patients with pregangrene, established and progressing gangrene, and gangrene of such extent that in the absence of a successful bypass, limited foot amputations and debridement would fail and major limb amputation be required during that same hospitalization. These patients often require debridement or digital or forefoot amputation in addition to the bypass. The timing of these adjunctive procedures is controversial, but we believe that they should generally be performed at the same time, following the reconstructive phase of the operation. Subsequent revisions, debridements, and skin grafting may be necessary. Lesions with gross purulence and ascending cellulitis should generally be drained and treated with intravenous antibiotics prior to angiographic study and revascularization. Interestingly, this type of

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