

PERIPHERAL  
ARTERIAL  
DISEASE

*Second Edition*

by  
Wiley F. Barker, M.D.

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# PERIPHERAL ARTERIAL DISEASE

*Second Edition*

by

**Wiley F. Barker, M.D.**

Professor of Surgery,  
University of California,  
Los Angeles, School of Medicine

*Volume IV in the Series*

**MAJOR PROBLEMS IN  
CLINICAL SURGERY**

**J. ENGLEBERT DUNPHY, M.D.**

**PAUL A. EBERT, M.D.**

*Consulting Editors*

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*To the memory of*  
**JOHN HOMANS, M.D.**  
**1877-1954**

Among the many physicians whose names have become bywords in the explosive growth of medicine and medical science John Homans stands in a special position. To those who knew him least, his is the eponymic sign of pain on dorsiflexion in the presence of deep venous thrombosis, so often misstated as Homan's sign. Osler's aphorism that a man is often known best to the world by that work which he considers his least is attested by Dr. Homans' own appraisal of this sign, expressed with typical frankness, "If you wanted to name a sign after me, why didn't you pick a good one?"

To many classes of students in Boston he was a sparkling, unpredictable, and colorful teacher and author. He was above all a clinician and a teacher of clinical surgery, and his two great textbooks, *Circulatory Diseases of the Extremities* and *A Textbook of Surgery* bear clear witness to his ability to perceive basic principles and communicate them as integrated concepts to his students.

To many others he was all this as well as a tempestuous, fiery, outspoken, at times charming, at times frightening, but always stimulating mentor of clinical surgery. His barbed and keenly observant criticisms often struck with painful accuracy but their sting was always relieved by a witty and gracious dressing such that no permanent scar was left, but the goal of teaching was achieved. Such salty and irrepressible wit of course left in its wake tales galore, many apocryphal, many unrepeatable, and all told in affectionate memory. These stories share a common pattern of humor, humility, and quizzical self-appraisal. Painful honesty mixes with the quixotic support of the underdog and with thrusts at pretense and show of any kind.

It is impossible to list here all his accomplishments; many not detailed below will be met as concepts in the body of the present book. Such concepts can be recognized in the accomplishment of those in vascular surgery who worked with him. The choice of the preposition "with" is not accidental—one always had the feeling of being a partner and sharing fully in any problem with him.

The roll of names who were associated with him is a veritable honor roll in vascular surgery: Cutler, Beck, Elkin, Hufnagel, Harken, Starling, Holman, Leriche, Gross, Fontaine, Ross, Fulton, and Warren. The list goes on and on, and includes a great majority of the senior members of the Society for Vascular Surgery, who have recognized Homans' contributions by establishing a lectureship in his name.

John Homans was born in Boston. His early education at Harvard College and Harvard Medical School and his term as House Pupil in Surgery at the Massachusetts General Hospital and as Assistant to Maurice H. Richardson was an appropriate beginning for a good Bostonian. Early intimations of a pioneering and uninhibited spirit were promptly manifested by his further training in Baltimore, in London, and in New Haven before his return to Boston to participate with David Cheever under Harvey Cushing in the development of the new Peter Bent Brigham Hospital.

John Homans left an impression on the periodical literature smaller in numbers than many of his associates; almost half of his publications dealt with some form of vascular disease. His first published paper concerned the pathology and histology of the mitral and aortic valves. His later conceptual and technical contributions to the careful dissection of the region of the saphenofemoral junction, the treatment of the varicose long saphenous vein by stripping it from the thigh, and the physiologic origins of the postphlebotic syndrome in disease of the communicating veins remain as landmarks. He was the first to undertake portacaval shunt on the human in this country. His recognition of the role of the interruption of the femoral veins in the prevention of pulmonary embolism and his early espousal of lumbar

sympathectomy in the treatment of peripheral occlusive disease merely add to the list of the many areas of surgery that will always bear his imprint.

Without John Homans the field of vascular surgery would undoubtedly have developed much as it has today, but it could never have been quite the same. I am certain that the many associates of John Homans, great and small alike, support my wish to dedicate this book to a remarkable scholar, a keen observer, and a beloved man—Dr. John Homans, Surgeon.

WILEY F. BARKER

Los Angeles

# Contributors

WILEY F. BARKER, M.D.

Professor of Surgery, University of California, Los Angeles, School of Medicine, Los Angeles, California.

*Introduction; Anatomy; Physiology (With Victor E. Hall); Pathology and Pathogenesis; Diagnostic Problems; Conservative Measures, the Role of Sympathectomy; Aortoiliac Reconstruction; Femoral-Popliteal Reconstruction; Combined Aortoiliac Femoropopliteal Lesions; Results of Arterial Reconstruction for Chronic Occlusion; Arterial Trauma; Extrinsic Arterial Compression Syndromes (With J. H. Grollman, Jr.); Arterial Aneurysms; Arterial Embolisms in the Extremities; Complications of Vascular Surgery.*

WILLIAM K. EHRENFELD, M.D.

Associate Professor of Surgery, University of California School of Medicine, San Francisco; University of California Medical Center, San Francisco, California.

*Surgical Techniques for Hemodialysis Access*

JULIUS H. GROLLMAN, JR., M.D.

Associate Professor of Radiology, University of California, Los Angeles; Chief, Adult Cardiovascular Section, University of California, Los Angeles, Center for the Health Sciences, Department of Radiological Sciences, Los Angeles, California.

*Extrinsic Arterial Compression Syndromes (With Wiley F. Barker)*

VICTOR E. HALL, M.D.

Emeritus Professor of Physiology, University of California, Los Angeles, School of Medicine, Los Angeles, California.

*Physiology (With Wiley F. Barker)*

JOSEPH J. KAUFMAN, M.D.

Professor of Surgery/Urology, Chief, Division of Urology, University of California, Los Angeles, School of Medicine; Consultant, Mt. Sinai Hospital, St. John's Hospital, Santa Monica Hospital, Veterans Administration Hospital, Los Angeles, U.S. Naval Hospital, Long Beach; Attending Urologist, Veterans Administration Hospital, Sepulveda, California.

*Diseases of the Renal Vessels*



**JESSE E. THOMPSON, M.D.**

Clinical Professor of Surgery, University of Texas Southwestern Medical School, Dallas; Attending Surgeon, Baylor University Medical Center, and Parkland Memorial Hospital, Dallas, Texas.

*Cerebrovascular Insufficiency*

**FRANK C. SPARKS, M.D.**

Assistant Professor of Surgery, Division of Oncology, University of California, Los Angeles, Medical Center; Assistant Chief, Surgical Service, Veterans Administration Hospital, Sepulveda, California.

*Mesenteric Vascular Disease*



# Foreword

It is nearly ten years since the First Edition of this volume of Major Problems in Clinical Surgery appeared. In that edition a comment was made in the foreword that vascular surgery had "been coming of age and falling increasingly within the range of the broadly trained general surgeon." In the interval, vascular surgery has indeed come of age, to such an extent that it can no longer be considered the province of the general surgeon unless he has had substantial and extensive training in this field. Vascular surgery has undergone such a revolution and is so dependent upon precise judgments and careful technique that it is indeed to a considerable extent a specialty in its own right. That it should become a recognized subspecialty within general surgery is now the opinion of the majority of leading vascular surgeons.

This superb monograph by Dr. Barker will not make a vascular surgeon of the untrained general surgeon, but it will be welcomed by all general surgeons who have already had experience in vascular surgery, and will do much to keep them abreast of this very rapidly moving field. It will also have appeal in specialty areas where renovascular or cerebrovascular surgery is presently being performed. Most particularly, it will become the *vade mecum* of all young surgeons who plan to acquire and maintain broad experience and competence in this field. As did the previous monograph, Dr. Barker's contribution will rank among the classic references in vascular surgery for the next decade.

J. ENGLEBERT DUNPHY, M.D.

# Preface

The goals of this Second Edition are the same as of the First: to bring the point of view of the author and the opinions of some of his experienced colleagues into focus on common problems in the treatment of peripheral arterial disease. Particular attention has been directed to the trouble spots that are responsible for difficulties in this sphere of surgery. The First Edition encompassed a significant proportion of the bibliography on vascular disease; however, in the few years since publication of that book the literature of vascular surgery has so expanded that only a small portion of it can be included in this edition. Undoubtedly, many important contributions have been omitted. Their exclusion can be justified only because this edition is an attempt to present a book that is convenient rather than encyclopedic.

The Second Edition has been expanded to include a wide variety of arterial problems, rather than to solely concentrate on occlusive arterial disease. Particular help in this expansion was received from the contributions of Drs. William Ehrenfeld, Julius Grollman, Victor Hall, Joseph Kaufman, Frank Sparks, and Jesse Thompson. In addition, Dr. Donald Mulder made important, though untitled, contributions regarding the management of thoracic aneurysms.

Others to whom thanks are due for their special assistance include Luciano Barajas (for his special help with the work on Pathology), Jack A. Cannon, W. A. Dale, M. E. DeBakey, Edward A. Edwards, W. Sterling Edwards, J. Harold Harrison, Robert R. Linton, T. B. Massell, D. E. Szilagyi, G. W. Taylor, Richard Warren, Irving S. Wright and E. J. Wylie.

Again I want to express my particular thanks for the assistance and tolerance of Mrs. Justine Walker, Mrs. Diane Richie, and my wife, Nancy K. Barker.

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## Chapter One

# INTRODUCTION

Clinical recognition of the true patterns of peripheral arteriosclerosis occurred late in the history of medicine. Arteriosclerosis developing in the coronary arteries, the cerebral vessels, and the smaller peripheral branches was readily recognized because of the dramatic sequelae that followed upon occlusion of these vessels, but it was only in relatively recent times that study of amputation specimens led to the recognition of both diabetic and nondiabetic arteriosclerosis and Buerger's disease in the peripheral arteries.

Von Winiwarter<sup>44</sup> and Buerger<sup>4</sup> were the first to report on the condition that has since become known as Buerger's disease. Frequently, the distal arteries were found to be involved in cases of nondiabetic arteriosclerosis to the extent that gangrene developed and amputation became necessary. Isolated proximal lesions often did not become gangrenous, and the frequent occurrence of obstructive lesions in vessels of a size that could be corrected surgically was not appreciated until Leriche described surgical treatment of aortoiliac disease.<sup>30, 31</sup>

Impetus for this form of treatment was provided by dos Santos's development of arteriography of peripheral vessels.<sup>11</sup>

Embolectomy had been the first procedure to be applied with any great frequency to the larger arteries, but the presence of advanced arteriosclerosis long limited its successful application, and palliative sympathectomy remained the most useful procedure for many years.

Introduced by Leriche<sup>28, 29</sup> as periarterial sympathectomy, the procedure was modified as paravertebral ganglionectomy by Hunter<sup>19</sup> and Royle.<sup>38</sup> Adson and Brown<sup>1</sup> were the first to make wide use of

sympathectomy in peripheral vascular disease, and it remained the only useful treatment until the work of J. dos Santos.<sup>10</sup>

Although Carrel<sup>5</sup> had defined the principles of arterial repair in the early 1900's, this technique was rarely employed outside the surgical laboratory. Dos Santos utilized the line of cleavage between the diseased intima and the relatively normal media in the larger arteriosclerotic arteries to dissect free the obstructing atheromatous intima and its contained thrombus; the operation was termed thromboendarterectomy. This procedure did not meet with favor in the United States until publication of the reports of Wylie<sup>46</sup> in 1951 and Barker and Cannon<sup>2</sup> in 1953. Since then the procedure has gained increasing popularity and has been used in a variety of anatomical sites for the treatment of atherosclerosis.

Arterial replacement was also first undertaken by Carrel, but his work lay dormant until the early 1940's, when Hufnagel,<sup>20, 21</sup> Gross,<sup>18</sup> and Deterling<sup>9</sup> revived interest in it. The first arterial homografts were used by Gross in the treatment of coarctation of the aorta.<sup>18</sup> In 1950 Holden was the first to succeed with replacement of the femoral artery by a venous graft, using the autologous superficial femoral vein as a reversed end-to-end graft,<sup>19</sup> and Julian and his associates<sup>24</sup> also used venous grafts during this period. Kunlin<sup>26, 27</sup> in France and Linton<sup>32, 33</sup> in the United States applied the principle of end-to-side anastomosis to bypass arterial obstructions. Venous and arterial homografts and prostheses were commonly used. The popularity of arterial homografts waxed,<sup>9</sup> then rapidly waned as Szilagyi<sup>42</sup> and others reported marked degeneration in the transplanted segment.

The introduction and subsequent popularity of fabric prostheses followed upon an observation by Voorhees that a loose thread within the lumen of the auricle became covered with endothelium.<sup>45</sup> Ivalon, nylon, Orlon, Dacron, and Teflon prostheses have since been introduced.<sup>7, 13, 20, 21, 38</sup> Knitted or woven Dacron remains the most popular and effective fabric, but its limitations indicate that there is still need for improvement in fabric prostheses.

Although the widest experience has been in the treatment of atherosclerosis of the aorta and of the iliac and femoral arteries, disease in other areas has been successfully treated by use of combinations of the techniques just described. Freeman<sup>14</sup> was among the first to report the successful removal of a renal arterial atheroma. The bifurcation of the carotid artery soon came to be recognized as a major and correctable cause of strokes, and Eastcott,<sup>12</sup> DeBakey,<sup>8</sup> and Cooley<sup>6</sup> were among the first to attempt carotid reconstruction. Klass,<sup>25</sup> Shaw,<sup>39</sup> and Mikklesen<sup>35</sup> had successfully treated mesenteric vascular occlusions, but such occlusions occur far less frequently than those in other sites. Longmire performed endarterectomy successfully in the coronary arteries in 1958.<sup>34</sup> Endarterectomy of the coronary arterial

tree has been superseded, however, by bypass procedures which most commonly use the saphenous vein to reach from the root of the aorta to one or even three distal coronary arteries. This operation has become in some centers one of the most commonly performed cardiac operations.<sup>14, 16</sup>

The only other pathological processes causing arterial obstruction in arteries large enough to permit surgery are the lesions grouped together loosely as "fibromuscular hyperplasia," which affects the renal arteries.<sup>36, 37</sup> A similar process has been seen only infrequently in the internal carotid and mesenteric arteries, and possibly in the femoral arteries.<sup>3</sup>

In the last five years Tyson<sup>43</sup> and Garrett<sup>17</sup> have extended the distal limits of bypass procedures to the tibial vessels even at a distal level, although this type of reconstruction is not fully accepted.

The experiences of vascular surgeons in Vietnam have greatly expanded the interest in the reconstruction of the acutely injured artery.

The lesions of Buerger's disease, or thromboangiitis obliterans, develop primarily in the small peripheral vessels and are not suitable for direct surgical attack. Many misconceptions have arisen concerning Buerger's disease, and many authors doubt its existence, as a pathological entity; nevertheless it is of clinical concern, regardless of its pathological "pedigree." Much of the importance of Buerger's disease derives from use of the term to describe—incorrectly—*any* occlusive disease of the arterial tree, without verification of the presence of correctable lesions.

The most severe arterial occlusions commonly associated with diabetes mellitus develop in the smaller vessels and are thus not amenable to arterial reconstruction. Operable lesions are seen in the major arteries of diabetics, but not more frequently than in the non-diabetic population, and many of these lesions are rendered inoperable because of the multiplicity and the diffuse nature of advanced associated peripheral lesions.

The techniques of reconstructive surgery for occlusive disease have, during the period of development, become applicable with high degree of success to aneurysmal disease. The treatment of aneurysms, however, includes almost of necessity the use of materials to replace the diseased artery. Familiarity with such replacement materials and the techniques of their use has increased the popularity of bypass techniques at the expense of the popularity of thromboendarterectomy.

The only major areas of importance to the vascular surgeon that will not be included in subsequent chapters are those related primarily to the coronary arteries. The scope of this volume will therefore be considerably greater than that of the initial volume on peripheral arterial surgery in this series.



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