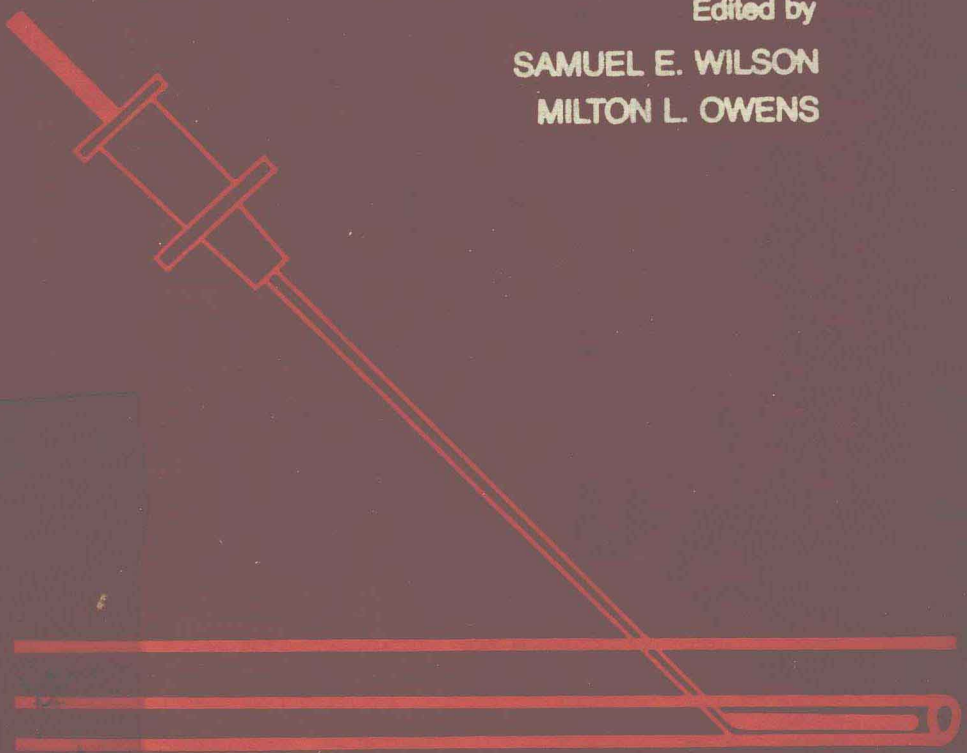
VASCULAR ACCESS SURGERY

Edited by
SAMUEL E. WILSON
MILTON L. OWENS



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Edited by

Samuel E. Wilson, M.D.
Chief, Vascular Surgery
Veterans Administration Wadsworth Medical Center
Associate Professor of Surgery
UCLA School of Medicine
Los Angeles, California

Milton L. Owens, M.D.
Chief, Dialysis and Transplantation
Veterans Administration Wasdworth Medical Center
Assistant Professor of Surgery
UCLA School of Medicine
Los Angeles, California

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VASCULAR ACCESS SURGERY

Richard Lower, M.D. (1631–1691), who obtained successful access to the circulation for blood transfusion using quills. (Courtesy of National Library of Medicine.)

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FOREWORD

TIME WAS WHEN VASCULAR access was everyone's skill. A "cutdown" at the wrist or at the ankle was in the armamentarium of virtually every physician, although some were obviously better at it than others. And that's how matters stood for some time—physicians at the periphery of problems working at the periphery of the vascular system.

The wonder of this volume (and the reason for its being) is how things have changed. Most of us scarcely realize to what degree and to what magnitude change has occurred. From a common skill, vascular access has grown into yet another surgical specialty—a field requiring special knowledge of anatomy, hemodynamics and technical skills.

Moreover, it has rapidly moved from the periphery of medical care to its very core. As this volume shows, vascular access is at the center of hemodialysis, total parenteral nutrition and regional chemotherapy, to name but a few therapeutic methods. It is an astonishingly common operation, an intricate and crucial affair made pedestrian only by its frequency. Well-done vascular access permits the marvels of total support and monitoring to the desperately ill; without it most of modern medicine is not possible.

Vascular access then is the Achilles' heel in much of what we do. By bringing together the relevant information on vascular access, the authors of this volume hope to have strengthened its value to patients and physicians alike.

EDWARD PASSARO, JR., M.D.

PREFACE

WE INTEND THIS BOOK to be a practical manual dealing with the indications, use and complications of vascular access surgery. It is directed to surgeons and surgical residents, as well as to nurses and technicians caring for patients who undergo procedures for access to the circulation.

We acknowledge and thank the Medical Media Service at Wadsworth, Nicholas Bolotine and Caroline Stabile for the illustrations, and Debi Byrnes for expert editorial assistance.

SAMUEL E. WILSON
MILTON L. OWENS

CONTRIBUTORS

CHARLES B. ANDERSON, M.D., Chief, Renal Transplantation, Barnes Hospital; Associate Professor of Surgery, Washington University School of Medicine, St. Louis

BARBARA J. BEHNKE, R.N., B.S.N., former Head Nurse, Hemodialysis Unit, VA Wadsworth Medical Center, Los Angeles

ROBERT W. BOWER, Ph.D., Physicist, Advanced Micro Devices, Inc., Sunnyvale, Calif.

RONALD W. BUSUTTIL, M.D., Ph.D., Assistant Professor of Surgery, UCLA School of Medicine, Los Angeles

CHARLENE CHENAULT, R.N., B.S.N., Head Nurse, Doctors Artificial Kidney Center, Los Angeles

ROBIN K. DAVIDSON, M.S., Research Associate, University of California, Los Angeles

O. N. FERNANDO, F.R.C.S., F.R.C.S.E., Consultant Surgeon, Royal Free Hospital, London

STEVEN GIANNOTTA, M.D., Assistant Chief, Neurosurgery, VA Wadsworth Medical Center; Assistant Professor of Neurosurgery, UCLA School of Medicine, Los Angeles

H. EARL GORDON, M.D., Chief of Staff, VA Wadsworth Medical Center; Professor of Surgery and Assistant Dean, UCLA School of Medicine, Los Angeles

JERRY GRODSTEIN, M.D., Assistant Chief, Nephrology, VA Wadsworth Medical Center, Los Angeles

JANE HARDER, M.D., Chief Resident, Neurology, VA Wadsworth Medical Center, Los Angeles

EVAN KRANTZ, M.D., Anesthesiology, VA Wadsworth Medical Center, Los Angeles

JEFFREY A. KRAUT, M.D., Chief, Home and Self-Care Dialysis, VA Wadsworth Medical Center, Los Angeles

STANLEY R. MANDEL, M.D., Professor of Surgery, University of North Carolina at Chapel Hill

MICHAEL E. MATLAK, M.D., Assistant Professor of Surgery and Assistant Professor of Pediatrics, University of Utah College of Medicine, Salt Lake City

MILTON L. OWENS, M.D., Chief, Dialysis and Transplantation, VA Wadsworth Medical Center; Assistant Professor of Surgery, UCLA School of Medicine, Los Angeles

ROBERT S. OZERAN, M.D., Associate Clinical Professor of Surgery, UCLA School of Medicine, Los Angeles

EDWARD PASSARO, JR., M.D., Chief, Surgical Service, VA Wadsworth Medical Center; Professor of Surgery, UCLA School of Medicine, Los Angeles

BRUCE E. STABILE, M.D., Section Chief, Surgical Service, VA Wadsworth Medical Center; Assistant Professor of Surgery, UCLA School of Medicine, Los Angeles

HUGH H. TROUT, III, M.D., Chief, Peripheral Vascular Surgery, Veterans Administration Medical Center, Washington, D.C.

DONALD E. WAGNER, M.D., Assistant Clinical Professor, UCLA School of Medicine, Los Angeles

RUSSELL A. WILLIAMS, M.B., F.R.C.S., Staff Surgeon, VA Wadsworth Medical Center, Los Angeles

SAMUEL E. WILSON, M.D., Chief, Vascular Surgery, VA Wadsworth Medical Center; Associate Professor of Surgery, UCLA School of Medicine, Los Angeles

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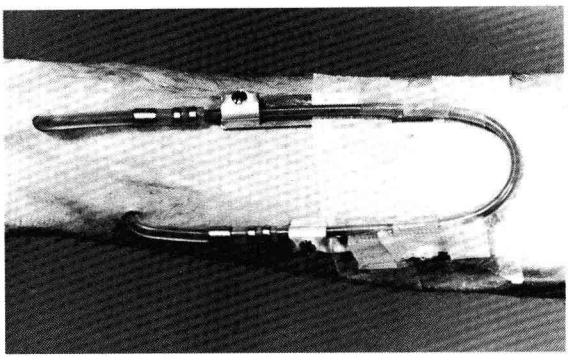

Fig 1–1.—Early external arteriovenous shunt, using metal plates on rings to secure tubing.

the carotid artery of one dog into the jugular vein of a second dog that had previously been phlebotomized. At the conclusion of the experiment, the recipient dog ". . . promptly jumped down from the table, and apparently oblivious of its hurts, soon began to fondle its master. . . ."

On June 15, 1667, Jean Denys, Professor of Philosophy and Mathematics at Montpellier, performed the first successful transfusion into man at Paris.[3] Animal blood was used in this experiment. Lower performed the first successful human transfusion in England during November of that same year. Arthur Coga, variously described as a "harmless lunatic" and an "eccentric scholar," was the subject and was given 9 or 10 ounces of blood from the artery of a sheep. Although the patient survived without any apparent physical harm, Lower's following comment reflected disappointment by the absence of expected benefits: "In order to make further experiments on him with some profit also to himself, I had decided to repeat the treatment several times in an effort to improve his mental condition, he, on the other hand, consulted his instinct rather than the interest of his health, and completely eluded our expectations."

It is not surprising that these efforts should be doomed to failure. One of the patients transfused by Denys developed all of the signs that we recognize today as a transfusion reaction. Following the death of another patient, an investigation terminated in a verdict against Denys. The infusion of animal blood into humans was rapidly abandoned, and no significant work in this area was reported for the next 150 years.

The first transfusion of human blood was performed on December 22, 1818, by James Blundell.[3] Using a syringe, he injected 12–14 ounces of blood from several donors into his patients. Considering the fact that blood typing was unknown at that time, it is not unexpected that Blundell's experiments

met with limited success. Although Karl Landsteiner discovered the A–B–O blood groups in 1901, it was another decade before his discovery led to practical application. Additional milestones were achieved in 1914 when Richard Lewisohn of New York and other investigators introduced the use of sodium citrate as an anticoagulant, and in 1937 when Landsteiner and Wiener discovered the Rh factor.

In spite of the many medical advances during this era, long-term cannulation of the circulatory system was late in evolving. It was the pioneering work of Dr. Willem Kolff and others on the artificial kidney that served as an impetus for this achievement.

Although Kolff's work in dialysis was preceded by several others, he and Berk are credited with developing the first practicable model in 1943.[4] He later left the Netherlands to continue his investigation at the Cleveland Clinic in the United States. Kolff's revised model, built in his basement in 1955, included seven beer cans, a fruit juice can and window screening to keep the cellophane in place.[5] Obvious refinements were made for commercial production, which was underway by the following year.

Early enthusiasm for the unit was dampened, however, by the technical problems associated with intermittent hemodialysis. The necessity for "cutdowns" on the artery and vein for each dialysis, and the necessity for ligating these vessels at the termination of each procedure, essentially limited hemodialysis to short-term therapy for acute renal failure. Even with the introduction of plastic cannulas, the average life of the arterial and venous lines was 7–10 days.

Chronic access to the circulation finally became a reality in 1960 through the combined talents of internist, surgeon and engineer. Scribner, Dillard and Quinton introduced the Teflon–Silastic arteriovenous (A–V) shunt (Fig 1–1), which brought new hope to the patient with end-stage renal disease.[6] Their first six consecutive patients were successfully cannulated without any clotting in the external bypass that connected artery with vein. In the seventh patient, however, repeated attempts ended in failure.[7] One can only speculate how the course of events might have been altered if the latter patient had represented their initial subject.

For the next 6 years, this ingenious device was universally adopted, and regular dialysis became a standard method of treatment. Because of interference of the external appliance with normal activity and because of the risks of infection, thrombosis and other complications, the search continued for improved techniques.

Many of these disadvantages were overcome by introduction of the subcutaneous A–V fistula by Brescia, Cimino, Appel and Hurwich in 1966. The subsequent use of the saphenous vein, as well as biologic and prosthetic grafts between artery and vein, offered alternative means for vascular access.

As these new achievements in vascular access have evolved, investigators have been alert in putting these advances to an increasing number of clinical uses. Examples of the latter include long-term parenteral administration of anticancer agents and other drugs and plasmapheresis. Although chronic access to the circulation has reached a high level of sophistication, the search will continue for further refinements and new applications.

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Chapter 2 • VASCULAR ACCESS FOR TOTAL PARENTERAL NUTRITION

BRUCE E. STABILE, M.D.

PERHAPS NO OTHER therapeutic innovation of the past decade has had the impact of intravenous hyperalimentation. The classic work of Dudrick and his associates[1,2] at the University of Pennsylvania ushered in the era of total parenteral nutrition (TPN), which has significantly reshaped our basic approach to surgical illness and injury. Thanks to these pioneers and the many more who have followed their lead, we are now able to reverse severe malnutrition through the use of intravenous solutions of concentrated glucose, amino acids and fat. Although the concept of nutritional therapy is as old as medicine itself, physicians have traditionally concentrated their therapeutic efforts on correcting specific organ dysfunctions and combating specific infectious agents rather than bolstering the body's inherent capacities for repair and defense through effective nutritional replenishment. With intravenous TPN now available, the body can be encouraged to thrive in a way that markedly augments these capacities for defense and repair. Since malnutrition is estimated to be present in up to 50% of all hospitalized patients in this country, the importance of a reliable and efficient method for dealing with this problem is obvious.[3,4] Indeed, if malnutrition were routinely listed as a diagnosis unto itself, it would undoubtedly be the most common one carried by hospitalized patients.

Clinical experience with intravenous nutritional support over the past decade suggests another important conclusion, i.e., that prevention of severe malnutrition in the starved or stressed patient is immensely more effective than treatment of the condition once developed. This appears to be true in terms of mortality, morbidity and cost-effectiveness. In the hypercatabolic patient, for example, one week of preoperative TPN probably lessens the chances of death or serious complication and shortens the in-hospital recovery period in a manner equivalent to perhaps 3 weeks of the same regimen given postoperatively. Certainly in cases of severe multiple trauma, extensive burns, generalized sepsis or major surgical procedures that will

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