A History of Vascular Surgery

SECOND EDITION

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Blackwell Futura

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Contents

Foreword to first edition (abridged)

Steven Friedman approached me approximately three years ago and asked if I thought there was a need for a book devoted to the history of vascular surgery. My response, I believe, was that there is always a need for a *good* book on any subject. Before responding further, I searched my memory for any books devoted to the broad topic of vascular surgery. There was not an overwhelming number. There were some books devoted to specific areas within vascular surgery such as varicose veins, cerebrovascular disease, and peripheral arterial disease. There was only a small number of textbooks of vascular surgery. To attest to the youth of the specialty and the rapid technical changes occurring within it, there were more atlases of vascular operations than there were textbooks. The few books devoted to the history of vascular surgery were short biographies of some of its more illustrious pioneers. A few condensed histories appeared in surgical journals, usually written as a Presidential Address by one of the modern pioneers. With those thoughts in mind, I could truthfully respond to the aspiring author that there was a need for a book devoted to "A History of Vascular Surgery."

The plan for the book was to follow the progress of vascular surgery from antiquity to the present. The emphasis was to be on the accomplishments of individuals. The question of who the individual was, what he did, and the importance of his contribution was, for the most part, to be learned in the library. Whenever possible, surgeons responsible for the recent developments were to be interviewed. To accomplish this, the author read over 90 percent of the original or translated articles in his bibliography and interviewed over twenty-five contemporary vascular surgeons.

I have had the opportunity of reading the entirety of the author's contribution on two occasions. The first draft of each chapter has arrived in my office regularly every few months during a period when the author was completing his residency and establishing a practice. As residents with whom I have written papers can attest, my technique for reviewing papers is simple. I rewrite what I don't like and add some suggestions for minor changes. I next saw these chapters in the final manuscript submitted for publication. I was very impressed. I found a finished product that embodied thought-provoking quotations preceding each chapter, accurate reporting, interesting excerpts from the lives of the pioneers, and the sources of many familiar quotations. The book was of reasonable length and more than covered the highlights of the history of vascular surgery. The flavor of the author's style appeared throughout the book and none of my rewritten paragraphs were to be found.

One of the most pertinent quotations appears at the beginning of the chapter

on Recent Advances. Henry L. Ellsworth, Commissioner of Patents in 1843, stated: "The advancement of the arts from year to year taxes our credulity and seems to presage the arrival of that period when human improvement must end." The incorrectness of that statement has been emphasized by the continual advances which have occurred in vascular surgery since 1843 and the realization that the Fogarty catheter, balloon angioplasty, and laser surgery are just the beginning of many more improved techniques available to the vascular surgeons of the future.

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1989

Foreword

Students of medical history and practitioners should take delight in reading this new edition of Steven Friedman's *A History of Vascular Surgery*. If the author was considered to be an aspiring writer with the publication of his original text in 1989, he must now be recognized as an accomplished contributor to our understanding of the historical underpinnings of one of medicine's newest disciplines – vascular surgery. A few tidbits reflect the breadth of this book.

Sushruta, a talented and productive surgeon from the subcontinent of India who lived more than 2500 years ago, is described as the first to discuss the control of bleeding vessels in a systematic manner (Chapter 1). He was also clear in his condemning those who performed the wrong operation because of mistakes or a lack of skill, as well as for greed. His statement on incompetent surgeons has become increasingly relevant in our contemporary times of greater physician accountability. The simple control of bleeding by Celsus, Antyllus, and Galen characterized vascular surgery during antiquity. More complex interventions were heralded by Richard Lambert, who was among the first to describe an actual vascular reconstruction when he reported Hallowell's 1759 approximation of the margins in an arterial wound, an observation that changed the practice of organ- and limb-threatening ligation to a reconstructive mode (Chapter 2). Nearly a century later, John Murphy performed the first successful arterial reanastomosis in 1897.

Contributions of the Scottish brothers William Hunter and the younger John, born in the early 1700s, and the Englishman Astley Cooper, born in the mid-1700s, directed the attention of clinicians to the treatment of vascular diseases other than bleeding associated with trauma (Chapters 3 and 4). All three contributed important insights into the recognition of aneurysmal disease and its treatment, albeit by simple ligature. If there was ever a story of redemption, Astley Cooper, who self-proclaimed that he "had a way with the girls," certainly would be in the forefront (Chapter 5). He was considered to be a sad rogue as a medical student and even characterized himself as an "idle rollicking, ne'er-do-well." Obviously, he redeemed himself in his later days, having been recognized as a Baron by the King of England for his contributions to the surgical sciences.

Use of autologous vein to replace or bypass diseased and injured arteries signaled the beginning of modern vascular surgery nearly 100 years ago in the publications of Alexis Carrel and Charles Guthrie (Chapter 6). Although Jose Goyanes interposed a popliteal vein in place of a popliteal aneurysm in 1906, it was four decades before the success of using reversed vein for arterial reconstructions became established, and another two decades before *in situ* reconstructions became popular in clinical practice.

Nearly two centuries passed from the days of treating aortic aneurysms by ligation to the present-day era of successful endovascular graft placement (Chapter 7). During the interim period, many vascular surgeons successfully treated aortic disease with homografts. Although the history of these last conduits was short-lived, their use led to improved operative techniques that soon thereafter made the insertion of synthetic aortic prostheses an attractive and seminal event in the evolution of vascular surgery.

The history of carotid artery surgery is remarkable if only for the centuries of overlooking the extracranial portion of this vessel as a source of emboli causing stroke (Chapter 8). It was only with the development of imaging by Egas Moniz and with Miller Fisher's autopsy study recognizing that most strokes had an embolic cause that carotid revascularization became a clinical reality. Michael DeBakey's performance of the first successful carotid endarterectomy in 1953 was not reported at that time. Instead, clinical interest in carotid artery reconstructive surgery actually evolved after the 1954 report of Felix Eastcott, George Pickering, and Charles Rob, who resected a carotid bifurcation and performed a primary reanastomosis for an obstructing arteriosclerotic lesion. Four decades passed before the efficacy of carotid endarterectomy was firmly established by the North American Symptomatic Carotid Endarterectomy Trial (NASCET) and the Asymptomatic Carotid Atherosclerosis Study (ACAS) prospective clinical trial. Similar studies will be required to define the value of catheter-based carotid artery angioplasty and stenting.

Valentine Mott was one of America's first vascular surgeons (Chapter 9). He trained for 6 months with Astley Cooper in England and then returned to New York, where, at the age of 28, he became the first Chairman of Surgery of the merged Columbia College and College of Physicians and Surgeons in 1813. Mott's legacy was in treating vessels arising from the aortic arch and terminal abdominal aorta. Just as remarkable was his death at 80, when his overall health precluded amputation of a gangrenous leg.

Successful treatment of many aneurysms became more commonplace under the aegis of Rudolph Matas (Chapter 10). This American surgeon, born in Louisiana, had lived in France and Spain before returning to his home state, where he obtained his medical degree at the age of 19 in 1880. His early work at the Charity Hospital in New Orleans provided ample opportunity to treat traumatic aneurysms. It was in this environment that he perfected the technique of aneurysmorrhaphy, which allowed maintenance of distal flow in the affected artery. Shortly after the turn of the 20th century, Matas underwent an eye enucleation for infection. Loss of binocular vision certainly did not encumber his surgical prowess. Toward the end of his career, he reported more than 600 operations for aneurysms, of which 101 were variations on aneurysmorrhaphy. It was most unfortunate that he lost his remaining eye from complications of cataract surgery, rendering him blind for the last 5 years of his life until he died at the age of 97 in 1957.

Arthur Voorhees was an example of one of vascular surgery's most important innovators. Although it is reported that he struggled in undergraduate

school and medical school, he made up for his travails by recognizing the importance of an error in an experiment that he had been responsible for during his residency (Chapter 11). The appearance of a misplaced ventricular silk suture in a dog's heart suggested that implantable devices could develop nonthrombogenic surfaces, and his subsequent insertion of vinyon-N prosthetic aortic grafts followed this observation. His laboratory work and the results of grafts inserted in humans were presented in 1953, 8 years after he had graduated from medical school. This work represented a singular triumph of surgical science.

Lessons learned from the battlefield regarding vascular surgery were slow in coming (Chapter 12). Like many other marks of progress, serendipity and luck played an important role. In 1536, Ambroise Paré, having exhausted his oil supply for cauterization in the battlefield, used what he thought was a poor substitute, only to recognize a day later that this was a much more effective manner of treating vascular wounds. His use of ligatures followed. This approach continued until World War II, when the high amputation rate accompanying vascular injuries was considered to be unacceptable. This caused the Walter Reed Army Hospital Group in 1949 to consider battlefield vascular repairs. Speedy transport of patients to mobile army surgical hospital (MASH) units and the expertise of surgeons during the Korean conflict overseeing this rather radical departure from the dogma of earlier centuries allowed reconstructive surgery to replace earlier nihilistic therapies.

The history of treating venous disease is remarkable for the lack of change (Chapter 13). Socrates was the first to recommend compression bandages, and Galen suggested the excision of varicosities. All of this occurred over 15 centuries ago. The mainstay of treatment remained compression. It was not until the importance of communicating veins was recognized by John Holmans in 1916, and their interruption by Robert Linton in 1938, that treatment of venous insufficiency changed. Bypass reconstructions within the venous system were undertaken sporadically during the past 50 years, being first reported in 1952 by Palma. Under appropriate circumstances, venous reconstructive surgery, including implantation of autologous valves removed from other locations, benefits properly selected patients.

Extra-anatomic or nonanatomic reconstructions represented a major redirection in the practice of vascular surgery, being first described by Norman Freeman in 1952 and subsequently popularized by many others (Chapter 14). The first axillary femoral bypass was undertaken by William Blaisdell in 1962 as an urgent alternative to a more major procedure in a patient experiencing a myocardial infarction in the operating theater. For a brief time, an axillary femoral bypass was thought to be advantageous over direct aortic surgery. This has not proven to be the case, but clearly these alternative procedures have provided life and limb salvage in patients who could not tolerate more direct arterial reconstructive procedures.

Two groups of French vascular surgeons have made many contributions to vascular surgery. The first group includes Drs. Jaboulay, Villard, Carrel, and Leriche. These individuals, born between 1860 and 1879, made many sentinel

observations that advanced vascular surgery into the next century. Mathieu Jaboulay was one of the first to evert the edges of an artery anastomosis, eliminating the thromboses that compromised earlier closures (Chapter 15). Eugène Villard, like Jaboulay, carried out many experimental canine studies and was one of the first to describe characteristic changes of veins interposed into the arterial circulation (Chapter 16). Alexis Carrel clearly defined perfection in vascular anastomoses (Chapter 17). His work with Charles Guthrie at the University of Chicago represented one of the most prolific times in the history of vessel wall replacements and was, in part, the basis for his receiving the Nobel Prize in 1912. The latter part of his life was one of bitterness, beginning with his forced retirement from the Rockefeller Institute at age 65 and insinuations that he collaborated with the Germans during World War II. Both robbed science and medicine of a brilliant mind, which would have likely continued to benefit mankind had these distractions not occurred. Lastly, René Leriche, who was a medical student when Carrel was a chief resident and who was taught by Jaboulay, wrote over 1000 papers involving surgery and physiology (Chapter 18). Although his observations, which began as early as 1923, on thrombotic occlusion of the terminal aorta carry his name, he was very reticent about supporting reconstructive arterial surgery.

The second group of French vascular surgeons included Drs. Kunlin, Dubost, and Oudot. These three individuals undertook the first successful lower extremity bypass and reconstructions of the aortoiliac segment for both aneurysmal and occlusive disease. In 1948, Jean Kunlin, who was a trainee and then an assistant to Leriche, undertook a femoral popliteal bypass with saphenous vein when Leriche was traveling outside France (Chapter 19). Kunlin subsequently presented eight similar cases that same year, and changed forever the surgical approach to profound lower extremity ischemia. Charles Dubost was the first to resect an aortic aneurysm and replace it with a homograft in 1951 (Chapter 20). The patient survived for 8 years following surgery. This accomplishment radically changed the perception of vascular surgery's potential. Dubost was an exceedingly talented surgeon who also made many contributions to the surgical treatment of heart disease, having been involved with more than 15 000 cardiac procedures and with the first in Europe to use the heart–lung machine. Jacques Oudot made important observations in the experimental laboratory regarding aortic occlusive disease and the physiologic effects of aortic clamping. He rapidly applied his knowledge to the management of aortoiliac occlusive disease by successfully treating such a patient with a bypass in 1950. This was a triumph of intellect and courage. These three French surgeons had a major impact on stimulating later advances in vascular surgery that were to emanate from the western hemisphere.

Catheter-based treatment of vascular disease has caused near cataclysmic changes in clinical practice. Three individuals, Drs. Dotter, Fogarty, and Parodi, have made seminal contributions to the new discipline of endovascular surgery. Charles Dotter deserves the title of the father of interventional radiology (Chapter 22). He completed his training and had an early academic appointment in

New York at Cornell University, before becoming Chairman of Radiology at the University of Oregon at age 32, a position he held for a further 32 years. An inadvertent recanalization of an occluded iliac artery led to the concept of percutaneous transluminal angioplasty, which he successfully performed for the first time in 1964 in a patient with lower extremity occlusive disease. Dotter was also the first to undertake intra-arterial fibrinolysis, and he was the first to describe intravascular stents. He was often characterized as a cantankerous individual who changed the practice of medicine. Thomas Fogarty is best known for the development of the balloon catheter for extracting emboli and thrombi from acutely occluded vessels (Chapter 23). It is interesting that as a resident in cardiothoracic surgery at the University of Oregon he created the first balloon catheter used for iliac artery dilation by Dotter. As an entrepreneur in bringing surgical instrumentation to the patient, Fogarty has more than 100 patents and has founded more than 40 medical companies. He has no peer in this regard. The last of the three innovators in intravascular interventions is Juan Parodi (Chapter 24). After completing a surgical residency in his home country of Argentina, he embarked on further training at the University of Illinois and at the Cleveland Clinic. Dr. Parodi conceived the idea of endovascular graft placement for the treatment of aortic aneurysms. He undertook the placement of these grafts in 53 dogs with excellent results. This achievement led to the first clinical application of the technology, when in 1990 he performed the first successful endovascular repair of an abdominal aortic aneurysm in a human. This seminal work was a direct result of Dr. Parodi's creativity and early persistence in bringing this technology to clinical practice. His accomplishment transformed the practice of vascular surgery.

This gem of a book, with its many illustrations, bibliographic references, and unique organization, details the accomplishments of many well-known individuals who have practiced vascular surgery from the times of antiquity to the present, and it offers tantalizing insights into others not readily recognized in discussions of this specialty's heritage.

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2004

Preface

Since the publication of the first edition of *A History of Vascular Surgery* in 1989, vascular surgery has been transformed. Technical innovations, beginning with Parodi's seminal endovascular aneurysmorrhaphy, have rapidly accelerated the evolution of our young specialty. The major vascular societies are merging to better serve our specialty and our patients, and we are grappling with profound changes in the way we train vascular surgeons. As these events unfold, it is an opportune time to update this history of vascular surgery. To chronicle the cascading advances of the past 15 years, 6 of the 13 chapters from the first edition have been revised and 11 new chapters added. Amalgamation of these two eras revealed a common thread: the continuous presence of dauntless innovators. Whether you "caught the fever" from the first edition or missed it completely, here is your second chance.

Steven G. Friedman, M.D.
2004

PART 1

Origins

CHAPTER 1

Vascular surgeons of antiquity

It [surgery] is eternal and a source of infinite piety, imparts fame and opens the gates of Heaven to its votaries, prolongs the durations of human existence on earth, and helps men in successfully fulfilling their missions, and earning a decent competence, in life.

(Sushruta)

Man has always had to face the problem of hemorrhage. Vascular surgery began with the first attempt to control a bleeding vessel. A compelling body of evidence indicates that Sushruta (Figure 1.1), the great surgeon of ancient India, first practiced ligation of blood vessels. Although Sushruta's place in historical time is debated among medical historians, most scholars of ancient Indology place it between 800 and 600 BC. Sushruta was the first great surgeon of antiquity, and his monumental treatise, *Sushruta Samhita*, was the first surgical textbook. Although the original manuscript has been lost, several translations from the Sanskrit have survived.

Sushruta divided his Samhita into six parts covering all branches of medicine, but considered surgery the first and foremost. His contributions to vascular surgery included the use of hemp fibers to tie blood vessels, application of the cautery and boiling oil to check hemorrhage, and precise instruction for the performance of amputations. Sushruta also pioneered phlebotomy as a medical treatment and described four ways of arresting hemorrhage after its use: application of astringents made from tree barks (sandhana), thickening the blood by application of severe cold (skandana), drying the wound with ashes (pachana), and cauterizing veins to make them shrink (dahana). Although it is uncertain whether Sushruta specifically used catgut ligatures, they were employed by several of the prominent Hindu surgeons who succeeded him.

Sushruta's brilliance was evidenced by his contributions to nearly every present-day field of surgery. He performed rhinoplasty, laparotomy, tonsillectomy, hernia repairs, vesicolithotomy, and anal fistulotomies, in addition to many other procedures (Figure 1.2). Sushruta may have also unwittingly inspired the first malpractice attorney with his chapter from *Samhita* concerning "defective surgical operations":

> A physician (surgeon) making a wrong operation on the body of his patient either through a mistake, or through the want of necessary skill or knowledge, or out of greed, fear, nervousness, or haste, or in consequence of being spurned or abused, should be condemned as the direct cause of many new and unforeseen maladies. A patient, with any instinct of self-preservation, would do well to keep aloof from such a physician, or from one who makes a wrong or injudicious application of the cautery,

Figure 1.1 *Sushruta, Surgeon of Old India* (from Parke, Davis & Co. *A History of Medicine in Pictures*, 1958).

> and should shun his presence just as he would shun a conflagration or a cup of fatal poison.

The surgeons of Ancient Greece did not use the ligature for control of hemorrhage. They did, however, apply various mixtures of verdigris, antimony, and lead sulfate directly to bleeding wounds. A "hemostatic button," or circular wad of copper sulfate, was also used in this manner. In the fourth century BC, Hippocrates instructed that amputations be performed through the gangrenous part to avoid bleeding. When hemorrhage was encountered, however, he counseled: "Cold must be applied . . . not however to the part itself, but to the parts adjoining."

One of the earliest attempts at compiling a complete history of medicine was made by Celsus during the first century AD. Concerning the treatment of hemorrhage, Celsus advised the use of linen pledgets soaked in cold water and compressed into the wound. If this failed, vinegar was to be applied. In the worst situation, Celsus instructed that the cautery be used or that:

> . . . the bleeding vessel should be take up, and ligatures having been applied above and below the wounded part, the vessels are to be divided in the interspace that thus they may retract while their orifices remain closed.

During the second century AD, Rufus of Ephesus wrote five books of medicine. In addition to describing the importance of palpation of the pulses for

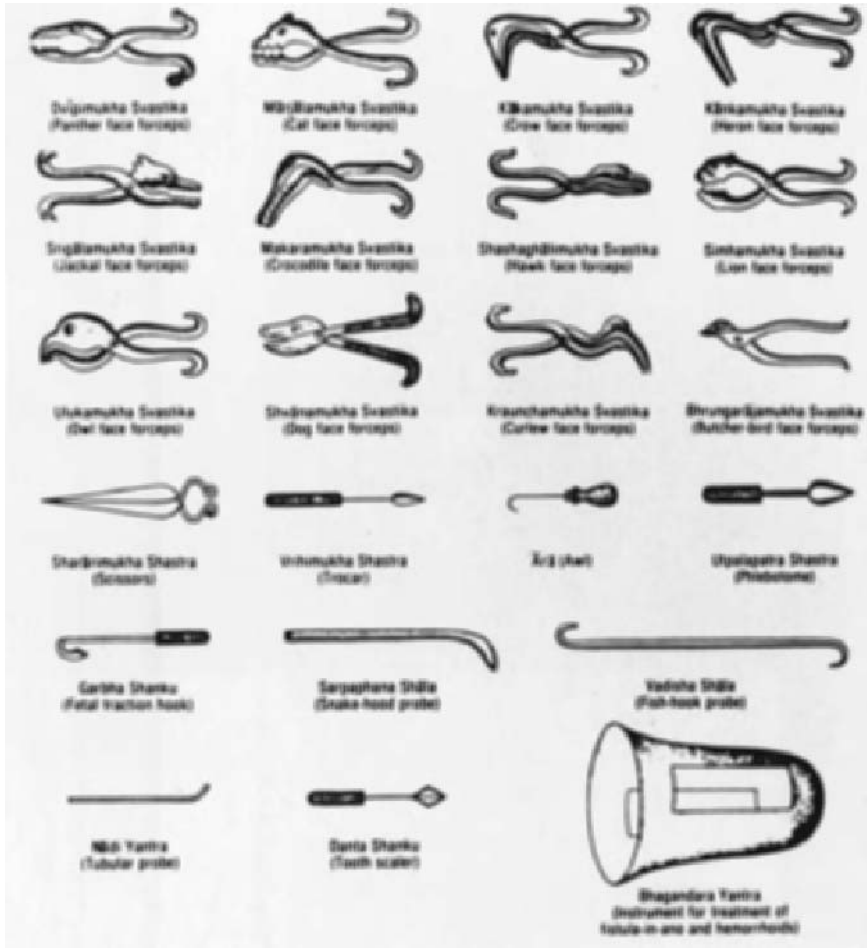

Figure 1.2 Surgical instruments of Sushruta (from Prakash UBS. Sushruta of ancient India. *Surg Gynecol Obstet* 1978; 146: 263).

diagnosis, he detailed several ways to treat hemorrhage. These included compression, styptics, cautery, and twisting the arteries to occlude them. Rufus also used the ligature.

Antyllus was also a second-century physician esteemed by his contemporaries. Osler described him as one of the most daring and accomplished surgeons in history, chiefly because of his descriptions and treatment of aneurysms. Antyllus described two forms of these lesions: those originating from a local dilation in an artery, which were cylindrical, and those resulting from trauma, which were rounded. He accurately described proximal and distal ligation of aneurysms, as well as evacuation of the sac. Antyllus was ahead of his

time and his treatment of aneurysms was largely forgotten until Rudolph Matas resurrected it 17 centuries later.

The most eminent surgeon of ancient Rome was Claudius Galen "the Clarissimus" (Figures 1.3 and 1.4). During the second century, he studied philosophy and medicine in Pergamon. Galen recognized the differences between arteries and veins, and devised specific techniques for achieving hemostasis in each. As surgeon to the gladiators for 3 years, Galen obtained much experience treating bleeding. For venous hemorrhage he used a variety of styptics; for arterial hemorrhage he used the ligature. Galen was a prolific writer and eventually authored more than 300 books. Among his more familiar observations was that "common sense" was a misnomer, since it was far from common.

Two aggressive surgeons of the third century were the twin brothers Cosmas and Damian (Figure 1.5). They were born in Cilicia, Asia Minor, and became famous physicians who performed great deeds of charity, never accepted a fee, and always defended Christ's teachings. Legend has it that Cosmas and Damian were the first to attempt anastomosis of blood vessels. An elderly servant of the church was afflicted with cancer of one of his legs. Following a long prayer to one of his patrons, the servant fell asleep and Cosmas and Damian appeared before him with their surgical instruments. The brothers amputated his diseased leg and remembered that a Moor slave had been buried that same day at St. Peter's cemetery. Cosmas and Damian rushed to the slave's grave,

Figure 1.3 *Galen: Influence for 45 Generations* (from Parke, Davis & Co. *A History of Medicine in Pictures*, 1958).

Figure 1.4 Surgical instruments of Galen's time (from Major RA. *A History of Medicine.* Springfield, IL: Charles C Thomas, 1954).

exhumed the body, amputated the dead man's leg, and attached it to their patient's stump. The church servant awoke with one black and one white leg. Unsure of whether or not he had been dreaming, the servant went to the cemetery where the Moor's body was surrounded by a crowd of curious onlookers. Next to the slave lay the servant's diseased white leg. As a result of this and other mira-

Figure 1.5 *Miracle of S.S. Damian and Cosmas* by Fernando Gallego (from Major RA. *A History of Medicine.* Springfield, IL: Charles C Thomas, 1954).

cles, Cosmas and Damian became the Christian saints of surgery. Although there are several accounts of their deaths, the most widely accepted is that they were executed by the sword in AD 287 by the governor of Lycia, when they refused to submit to idolatry. Cosmas and Damian died martyrs and are commemorated in numerous Renaissance paintings and frescos (Figures 1.6 and 1.7).

Among the great Byzantine medical writers was Aetius, who lived in the sixth century in Amida, along the Tigris River. His works consisted of 16 books,

Figure 1.6 *The Miracle of St. Cosmas and Damian* (from the School of Bellini. Courtesy of the Bettman Archive).

and in one he described the treatment of brachial artery aneurysms by proximal ligation. Aetius also was the first to ligate varicose veins.

Paulus Aegineta employed the ligature for treatment of varicose veins in a manner similar to Aetius's in the seventh century.

Albucasis of Cordova was a 10th-century Arabian surgeon who described four methods of stopping the discharge of blood from an artery: cautery, division of the artery across, use of the ligature, and styptics and bandage (Figure 1.8).

In the 11th century, Roger of Palermo employed styptics and the ligature to obtain hemostasis. He also described the "mediate ligature," a threaded needle used to suture and ligate blood vessels.