A five-decade odyssey in vascular surgery: reflections and optimism for the future

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When I look back over my personal involvement of five and a half decades in vascular surgery, I become overwhelmed by the exponential growth and changes that have occurred in our field. The birth of modern vascular surgery occurred more than half a century ago, with recognition of the concepts of arterial disobliteration and bypass, appreciation of precise anatomic exposures, invention and deployment of critical tools that included safe X-ray machines, contrast media, graft materials, sutures, intravenous solutions, blood banking, and the ingenious array of paraphernalia we deploy in surgery. The description of vascular surgery, as "the surgery of relics" is no longer apt or appropriate. Vascular surgery now encompasses the young and the old, those with established disease and others with the potential for infirmity. Improving the quality of life is now essential in deciding therapeutic efficacy. How did this come about? The basis for all these developments is *technology*. *Vascular technology* has a number of components that have individually and collectively enabled us to treat our patients with the most advanced knowledge and tools. For example, biotechnology will take us to the pills and drugs that are safer than what we have today. Vaccines will be more effective against neoplastic disease as well as infections. Therapy employing DNA microarrays will be commonplace. Clearly, the crossroads where biology and technology intersect will critically impact on how we think and how we act in treating vascular disorders. *Information technology* will have the highest impact on how we communicate, plan and conduct information. Sophisticated computerization of the future such as self-configuring wireless sensor networks and universal translation systems will inevitably relate to treatments and outcome documentation. When computerization enters the next domain at the molecular level, we will see undreamt of speed at millions of times faster than today's PCs. *Nanotechnology* will take us even further into the realm of subatomic particles and quantum computing. As difficult as it may be to envision, tools that work at the very smallest scale, for example, one billionth of a meter, will enable us to target and transform molecules and atoms. There is an implication here for the latter in treating vascular disorders, but our thinking processes will require a paradigm shift in order to enable us to develop these new treatments and potential cures.

The astounding development of minimally invasive procedures has created an entirely new dimension for us as vascular surgeons. We understand the disease process much better, continue to change the indications for intervention, and enable our patients to return to functional lives and livelihoods. Endovascular procedures currently dominate the scene but we must remain vigilant and recognize the continued value of time-honored and reliable open procedures which may still be the operation of choice for a particular case. As an example, aortic aneurysm combined with extensive obliterative disease of both hypogastric arteries may still be best served by an open approach combined with implantation of the inferior mesenteric artery. This would prevent the potentially lethal complication of colonic ischemia and gangrene.

We are also seeing a shift from open to endo for reversing critical limb ischemia. Simple segmental occlusions are now favorably managed by endovascular technology but I have concerns in that many of the patients might have been better served by a supervised exercise program combined with nutritional and lifestyle guidance. The patients who truly need us are in fact the most challenging ones and those most likely to fail. Endovascular technology employing the adjuncts of drug-elution and retrograde crural cannulation may be helpful, but there is no solid evidence to date for durability. The standard remote bypass still has enormous value, and even in the absence of a suitable vein, can be created with prosthetics in conjunction with a distal arteriovenous fistula[1,2].

The management of venous disorders is also a timely example, having transitioned from excision to ablation using various types of energies to effect minimally invasive procedures. I can envision further technological developments that will enable repair and restoration so that venous flow dynamics and

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valvular function can be maintained. As a young resident in surgery, I participated (often unhappily!) in the standard varicose vein operation that consisted of stripping the system from the ankle to the groin. This was followed by multiple incisions throughout the entire limb to extract the branching varicosities and to ligate the perforator veins. These were bloody procedures and took many hours. The patients were hospitalized for many days and instructed to limit activities, which today would truly be preposterous. Technology has changed all this so that we can now accomplish procedures that are physiologic and tailored to the individual patient. Pathologic veins can be ablated with radiofrequency energy or laser and even morselated with devices that are miniaturized and deployed through tiny incisions or punctures. Blood loss is inconsequential, pain and discomfort minimized, and hospitalization reduced to hours. Imagine the next leap in technology applied to venous disorders. Transcutaneous ablation without any incisions and blood loss, total absence of pain, and all performed as an outpatient scheduled to be discharged home straight from the operating room. Effective thrombolysis for deep and superficial venous thrombosis and placement of temporary filters are being performed today, but the efficacy and ease of use awaits technologic refinements. Fast and safe local or regional thrombolysis will also be routine once the process is controlled step-by-step, including cessation of all lytic activity beyond the area of interest. Not only will ectopic hemorrhage be avoided (e.g., intracranial) but patients currently excluded for thrombolysis (e.g., recent surgery) could be considered for such treatments.

Is there a dark side to evolving technology? Change is occurring faster than ever before and it can be argued that, on this account, we become vulnerable to misadventure and even disaster. Technological advances are sometimes unpredictable, often costly, and occasionally dangerous. Society needs to maintain vigilance and control through moral and ethical guidelines and constant examination of outcomes. Out-of-control technology is always a concern, but established and evolving guidelines and standards can serve to set the proper focus, extract the good, and eliminate the bad and dangerous. My own development of a vascular prosthesis in the early 70s is an example where initial excellent results were soon overshadowed by biodegradation and aneurysm formation of the graft. It took a decade of further efforts involving chemistry and technology to create a predictably durable vascular graft[3,4]. Nonetheless, the history of the graft persists, and it will take years to enlighten the surgical community through information technology on the changes and positive advances in using modified biologic grafts based on evolving biotechnology.

Application of technology to science and medicine will create the process of evolution in these fields. By partnering with biologic advances, future lives will be qualitatively improved, suffering and pain abolished, and access to these achievements will be possible by all. If we do not partner with research, "the medicine and surgery of tomorrow will be the medicine and surgery of today[5]." We will also need to be vigilant against unfounded repetitive activity that masquerades as scholarship and recognize that the greatest "obstacle to discovery is the illusion of knowledge[6]." All of us live through our personal golden eras of achievement and gratification. Each generation is responsible for passing the baton to the next. I am personally proud to have participated in this wondrous profession for more than five decades.

REFERENCES

1. Dardik H, Sussman B, Ibrahim IM, et al. Distal Arteriovenous Fistula as an Adjunct to Maintaining Arterial and Graft Patency for Limb Salvage. Surgery. 1983;94:478-486. PMid:6612582.
2. Dardik H, Silvestri F, Alasio T, et al. Improved Method to Create the Common Ostium Variant of the Distal Arteriovenous Fistula for Enhancing Crural Prosthetic Graft Patency. J. Vas Surg. 1996;23:240-248. http://dx.doi.org/10.1016/S0741-5214(96)70099-X
3. Dardik H, Miller N, Dardik A, et al. A Decade of Experience with the Glutaraldehyde-Tanned Human Umbilical Cord Vein Graft for Revascularization of the Lower Limb. J Vasc Surg. 1988;7:336-346. PMid:3123718.
4. Dardik H. The Second Decade of Experience with the Umbilical Vein Graft for Lower-Limb Revascularization. Cardiovascular Surg. 1995;3:265-69. http://dx.doi.org/10.1016/0967-2109(95)93874-O
5. Thompson JC. The role of research in the surgery of tomorrow. Am J Surg. 1984;147:2-8. http://dx.doi.org/10.1016/0002-9610(84)90026-6
6. Boorstin D. The Discoverers. New York: Random House; 1983. p. 15.