Research and Surgical Education

It is a most gratifying sign of the rapid progress of our time that our best text-books become antiquated so quickly.

Theodore Billroth (1829-1894)

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These wise words of one of the founding fathers of modern surgery still ring true more than a century after his death. Today's surgical literature is expanding at an exponential rate, with thousands of studies published monthly and new journal titles added continuously. The technological leap in biomedical sciences as well as the "publish or perish" culture of academic medicine has fueled this escalation in published medical literature. Cardiothoracic surgery as a specialty is no exception to this trend. As such, a surgeon should not only be able to contribute to surgical science but also be skilled at evaluating the quality, relevance, and importance of the work of others. In the era of "evidence based medicine" how well are we qualified to examine "the evidence"? With limitations on work-hours, increasing complexity of procedures, rising demands for clinical productivity, and a complex reimbursement environment, the landscape of cardiothoracic training is changing rapidly. With these changes, there is increasing concern that one of the foundations of surgical training, research experience, is being eroded and may compromise the caliber of surgical expertise in the future. It is perhaps timely to review the value of research not only for advancement of surgery, but also for its paramount role in surgical training.

American medical education at the turn of the twentieth century was arguably the worst in the industrialized world, with medical degrees being granted in as short as two sixteen-week terms. The turning point came in 1910 with the publication of the Flexner Report, which brought revolutionary reform to medical education, requiring medical schools to be affiliated with universities, have laboratory facilities, and pursue research. This was not a novel concept, but an aggressive adaptation of the European system that was already in existence. The model for this reform was the Johns Hopkins School of Medicine, which was at the forefront of embracing and evolving these ideals. William Halstead was a professor of surgery at Johns Hopkins during this time and established the first surgical residency in the United States as American medical education was undergoing a major transition. Halstead emphasized mentorship in surgical training and the importance of laboratory investigation. This model has survived to this day across virtually all surgical specialty training in the United States, and the legacy has contributed to Halsted being hailed as the father of American surgery.

Until very recently, completion of general surgical residency was a prerequisite for further training in cardiothoracic surgery in the United States. Five years of general surgery was a time for the trainee to become well versed in surgical anatomy and physiology and be comfortable in pre- and post-operative care of complex patients. The last year, Chief Resident year, was a particular time of surgical maturation and refinement of decision-making skills. The solid technical skill acquired during these years permitted completion of cardiothoracic training in 2-3 years. During general surgery residency, most quality training programs required the trainees to dedicate 2 years strictly to research, thus, in effect, lengthening general training from five to seven years and compounding the length of cardiothoracic training to 10 years. A heated debate over the last several years has brought about a sweeping change in cardiothoracic training. Full general surgery training is no longer required and more programs are accepting trainees directly out of medical school into a cardiothoracic residency. In essence, this emulates the European and Canadian systems that have been in place for a number of years. More time dedicated to cardiothoracic surgery is a welcome change as the complexity of the field is increasing with technological advancements, but simultaneous demands have been made to shorten the time of training. With these competing forces at work, it is foreseeable that the research

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requirement will slowly be phased out of the training of future cardiothoracic surgeons.

I believe that dedicated research experience is an integral and paramount component of a quality surgical training program. It is debatable what is the best juncture to break away from clinical training, but it should optimally be done before advancing into the senior years of residency so that the technical progression of the young surgeon is not interrupted. The time in the laboratory is a unique opportunity to explore the science of cardiothoracic surgery and investigate that which constitutes the basis of later clinical practice. Under a senior mentor, the young trainee has an opportunity to develop his ideas and see them to fruition. It is a time of intellectual curiosity, frequent failures, numerous frustrations but also a period of great growth, problem solving, and satisfaction. The particular area of investigation is less important than the process of discovery that shapes the surgical scientist. This process of maturation comes later to fruition as sound scientific principles are applied to clinical practice for improved patient care and innovation in the field. The length of dedicated research is also debated, but it should be at least 2 years and perhaps even three. The key to this model is that the trainee should be "immersed" in his research endeavors, which means no clinical responsibility as it is exceedingly difficult for a young resident to do both concurrently and in the end both are treated superficially. It is important that the research experience has well-defined structure and supervision so that this valuable time is not wasted or unfulfilling. Strong mentorship is crucial to the success of these endeavors, and senior surgical leaders must provide laboratory space, guidance, and financial support. There must be institutional and personal commitment to research support from faculty and administration as it is an investment that reaps great rewards for surgical centers and trainees alike. The two to three year hiatus from clinical work is also an important time of personal growth. Many choose to start families or pursue hobbies and outside interests that are difficult to reconcile with the demands of clinical training. For most who have undertaken it, laboratory experience is a welcome "breather" from the machinery of surgical residency.

Those focused on the practical may criticize this enthusiasm for research as it is only a minority of surgical trainees who enter academic practice while most concentrate on clinical work in private practice. Would a research requirement be inefficient use of their training time? Having practiced in both environments, I think nothing could be further from the truth. It is obvious that those who pursue an academic career need a strong research background as contribution to scientific literature is a requirement for professional advancement and career path development. Yet all surgeons, regardless of practice setting, need an analytical approach to their work that is based in scientific evidence. The ability to critically review the written literature and separate the "wheat from the chaff" is greatly aided by prior research experience. The scientific tools acquired in the process allow the mature surgeon to better guide his practice by applying these principles in a critical and analytical manner. As the science of surgery becomes increasing complex and art technically demanding, these skills will be important to avoid being slotted into the role of a surgical "technician". I remember the words of a surgical professor during my medical school training: "I can teach a monkey to be an operator in a year, but I can never teach it to be a surgeon". I believe these words, although exaggerated for effect, are to remind us that cardiothoracic surgery is much more than the technical act of operating. Indeed, that is perhaps the easy part. Although surgical training focuses on the technical, it is judgment, maturity, and clinical decision making that separate the great from the good. Research experience enriches the armamentarium of the surgeon regardless of practice setting and has tangible benefits even if it does not become a career path. Furthermore, as private hospitals are increasingly creating "heart institutes" and "cardiovascular centers" there is a rising need for research expertise outside of the traditional academic model. Surgeons focused on clinical practice but able to coordinate and execute research protocols are a valuable asset to many such hospitals, and ironically, a research background can be a strong bargaining chip in acquiring leadership positions in this practice environment.

Although there is not one formula for designing a successful and enriching research experience, James Watson, the 1962 Nobel Prize in Medicine recipient for the discovery of DNA, offers sage advice: "Formula for breakthroughs in research: Take young researchers, put them together in virtual seclusion, give them an unprecedented degree of freedom and turn up the pressure by fostering competitiveness". This is a time-tested recipe that has fostered innovation and advancement in cardiothoracic surgery and should not be abandoned. Surgical research experience should be maintained as an integral part of a training program as it will equip generations of surgeons not only to meet the challenges of the future but also to shape it.