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Presidential Address

Is there a renaissance in thoracic surgery?

Marvin Pomerantz, MD, *Denver, Colo.*

The Renaissance was the period that encompassed the fourteenth, fifteenth, and sixteenth centuries. The Renaissance began in Florence, Italy, and gradually spread through Europe. The greatest achievements of the Renaissance came in scholarship and art. It was a period in history when the great feudal estates began to be broken up and people began to judge others on the basis of merit and not birth. The Renaissance lasted over 300 years, and its achievements gradually became a part of everyday European life.

In present day language, the term *renaissance* denotes a rebirth or revival. In the same way that the Renaissance gradually altered European society, the field of thoracic surgery has created evolutionary changes in medicine. As I look at the renaissance in thoracic surgery, the first era extended from 1918 to 1953. During this period thoracotomies were first

begun, pulmonary resections became routine, and tuberculosis became a surgically "curable" disease. Cardiac surgery remained an infant in the life of treatment for congenital heart disease and rheumatic mitral stenosis.

In my opinion, the founding of The American Association for Thoracic Surgery (AATS) in 1918 historically marks the beginning of the renaissance in thoracic surgery. This renaissance began in New York City under the leadership of Dr. Willy Meyer, who practiced at the German Hospital which was renamed the Lennox Hill Hospital at the time of World War I. At the 1913 American Medical Association Meeting in Minneapolis, Dr. Meyer presented a paper on esophageal resection as performed by his associate, Dr. Franz Torek. It was the first successful resection of the esophagus for cancer. The manuscript received no discussion. The lack of interest prompted Dr. Meyer and his associates to organize two societies, the New York Society for Thoracic Surgery and the AATS. The word "for" thoracic surgery and not "of" thoracic surgery was chosen purposefully because of the inclusion of anatomists, anesthetists, internists, tuberculosis specialists, radiologists, and endoscopists, as well as surgeons, who were invited to join the Association.

There was considerable skepticism as to the success of such organizations because, at that time, there were few topics to discuss. Empyema, aneu-

From the General Thoracic Surgery Section, Division of Cardiothoracic Surgery, University of Colorado Health Sciences Center, Denver, Colo.

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Address for reprints: Marvin Pomerantz, MD, Chief, General Thoracic Surgery Section, Division of Cardiothoracic Surgery, University of Colorado Health Sciences Center, 4200 E. 9th Ave, C310, Denver, CO 80262.

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rysm, bronchiectasis, and tumors of the chest wall were the subjects of interest. Only empyema presented possibilities of surgical "cure." Lung cancer was uncommon, esophageal surgery impractical, treatment of tuberculosis only a fad, and everyone knew that surgery on the heart could not be done.

Despite the extreme pessimism regarding the future of these organizations, they were formed. The first meeting of the AATS was held in 1918. Seventy percent of the members were from New York. In 1922, arrangements were made with the *Archives of Surgery* to publish annually a special supplement devoted to the affairs of the Association. The first issue was printed in 1923.

The renaissance spread from New York to Michigan in the early 1920s with John Alexander. Dr. Alexander went to the University of Michigan in 1920. He wrote two books on tuberculosis, the first in 1925 entitled *Surgery of Pulmonary Tuberculosis* and the second in 1937 entitled *The Collapse Therapy of Pulmonary Tuberculosis*. In 1928 he devoted his full time to thoracic surgery and started the first thoracic surgical residency program. Dr. Alexander was a strong advocate of thoracoplasty for the treatment of tuberculosis. He popularized the three-stage removal of the upper seven ribs inasmuch as he demonstrated an increase in safety with this approach. Dr. Paul Samson, in whose name The Western Thoracic Surgical Association (W TSA) was founded, was Dr. Alexander's resident from 1934 to 1936.

The field of thoracic surgery continued to enlarge, and in 1931 THE JOURNAL OF THORACIC SURGERY was founded with Evarts Graham as editor. The JOURNAL was bimonthly and the lead article in the first issue was read at the Fourteenth Annual Meeting of the AATS. The paper came from Peiping Union Medical College and was written by C. M. Van Allen and T. S. Jung.¹ It was entitled "Postoperative Atelectasis and Collateral Ventilation." The importance of collateral ventilation was compared with that of collateral circulation.

The 1930s were exciting times for the thoracic surgeon. In 1932, Dr. Deryl Hart,² the first chairman of the Department of Surgery at Duke University Medical Center, presented a paper entitled, "Treatment of Chronic Empyema by Tidal Irrigation, Suction, and Thoracoplasty." Dr. Graham's two-page discussion was critical of Dr. Hart's technique and outlined what he considered the principles of treatment of chronic empyema. Times have

not changed! In 1933, Graham³ performed the first successful pneumonectomy for cancer and Churchill⁴ reported a bilobectomy with individual vessel ligation. In 1935 Wangenstein⁵ published on the use of pedicled muscle flaps for closure of a bronchopleural fistula, a technique still used today. In the same year, Overholt⁶ emphasized the advantages of separate ligation of the hilar structures when performing pulmonary resection. Carl Eggers,⁷ in his 1936 presidential address before the AATS, discussed the still pertinent question, "Who should perform thoracic surgery?" Should the practitioner be a general surgeon with some thoracic training, or should there be a specific training program for those who want to do thoracic surgery only?

The 1930s also provided a backdrop for the novel idea that one might perform surgery on the heart. During the decade, Heinbecker⁸ experimented with thoracic sympathectomy for "cardiac pain" or angina. Blum and Gross⁹ reported on experimental coronary sinus ligation, Claude Beck¹⁰ discussed methods to improve myocardial blood supply, and Bigger¹¹ published a paper on surgery for heart wounds. In 1938, Gross became the first physician to successfully ligate a patent ductus arteriosus.¹² The operation occurred 31 years after the operation of ductus ligation was suggested by John Munro. During this period, thoracic surgery remained a component of general surgery. A committee appointed by the AATS in 1936 recommended that a separate board of thoracic surgery not be established.¹³

In 1941 Ochsner and DeBakey¹⁴ reported on the surgical aspects of carcinoma of the esophagus. They presented four cases and collected a total of 195 cases with an operative mortality of 71.8%. This article contained more than 250 references. Surgery for tuberculosis was a major topic of discussion in the 1940s. Alexander, Sommer, and Ehler¹⁵ advocated thoracoplasty as the procedure of choice for tuberculosis complicated by stenotic bronchitis, and they believed that the need for lobectomy or pneumonectomy in these cases was rare. Chamberlain¹⁶ supported thoracoplasty for upper lobe tuberculosis. Overholt and Wilson¹⁷ believed the indications for lobectomy in tuberculosis were expanding and that the operative mortality in low-risk cases was only 5.5%. In the late 1940s streptomycin was introduced as a chemotherapeutic agent for the treatment of tuberculosis. Clagett and Shepard¹⁸ in 1943 reported on the treatment of chronic empyema includ-

ing the use of muscle flaps to close a bronchopleural fistula and to fill the empyema cavity. Pneumonectomy for carcinoma of the lung was considered the procedure of choice but carried an operative mortality of about 25%.¹⁹

It is important to recognize that thoracic surgery until the mid-1940s consisted of what we now call general thoracic surgery. Interest in cardiac surgery was only minimal. In 1944, repair of coarctation of the aorta by Gross²⁰ in Boston and Crafoord and Nylin²¹ in Sweden was accomplished. Dwight Harken²² presented papers on experiments in intracardiac surgery, and Harken,²³ Bailey,²⁴ and their colleagues performed operations on stenosed mitral valves. Blalock²⁵ at Johns Hopkins performed his classic shunt procedures for tetralogy of Fallot. Although best remembered for his cardiac surgery and training of future surgical leaders, Blalock²⁶ also reported on the relationship of the thymus gland to myasthenia gravis.

World War II found the establishment of thoracic surgical centers. The treatment of thoracic wounds was reported by Samson, Burford, Brewer, and Burbank²⁷ and by Harken.²⁸ The principle of early decortication was advocated by Samson and associates,²⁷ and these principles remain appropriate in modern practice.

With the tremendous advances in thoracic surgery during the 1940s, the climate changed regarding whether or not a separate board of thoracic surgery should be formed. In 1948 the Board of Thoracic Surgery had its first organizational meeting as an affiliate of the American Board of Surgery.

The 1950s were exciting for the thoracic surgeon. Thoracic surgery became general thoracic and cardiac surgery. Further reports on the surgical treatment of mitral stenosis were published by Harken and Bailey. Atrial septal defects were repaired by a number of closed techniques. Henry Swan from Denver was one of the leaders in the use of hypothermia and inflow occlusion. He repaired 100 atrial septal defects with only seven deaths and none in the last 57 cases.²⁹ Cross circulation provided another method to repair these defects.

The second era in the thoracic surgery renaissance began in May of 1953, when John Gibbon first successfully closed an atrial septal defect with the use of cardiopulmonary bypass. It is little remembered that Clarence Dennis attempted the same procedure using cardiopulmonary bypass in 1951, but the patient did not survive. In 1957 Kirklin and

colleagues³⁰ reported on the surgical correction of ventricular septal defects in 36 patients with the use of cardiopulmonary bypass. Coronary insufficiency remained a topic of interest, and Arthur Vineberg³¹ from Montreal was a proponent of left internal mammary implantation into the left ventricular myocardium, a procedure he had performed in experimental animals in the 1940s.

General thoracic surgery was not without advances in the 1950s. Tuberculosis was still a frequently discussed topic, and isoniazid and para-aminosalicylic acid were added to streptomycin for medical therapy. An increasing number of patients underwent pulmonary resection for tuberculosis rather than thoracoplasty with excellent results now that antibiotic coverage was available. Viking Björk, perhaps better known for his cardiac surgery, published articles on resection and osteoplastic thoracoplasty for tuberculosis. In 1957 he³² reported on 301 lobectomies with an operative mortality of only 2.3%. Ninety-four percent of the patients had a concomitant space-diminishing procedure performed.

Samson continued to write about decortication. Robinson, Jones, and Meyer³³ reported on a series of patients and demonstrated better survival for lobectomy versus pneumonectomy in carcinoma of the lung. Meyer also surveyed surgeon members of the AATS and found that about 60% used lobectomy as the operation of choice in treating lung carcinoma. The esophagus received more attention in the 1950s. Collis³⁴ reported on an operation for hiatus hernia with short esophagus. Olsen, Schlegel, Creamer, and Ellis³⁵ wrote about achalasia, and Neville and Clowes³⁶ reported on colon replacement of the esophagus.

In 1953 a second major society, the Southern Thoracic Surgical Association (STSA), was founded. In 1950 THE JOURNAL OF THORACIC SURGERY became a monthly publication. The JOURNAL underwent a name change to become THE JOURNAL OF THORACIC AND CARDIOVASCULAR SURGERY in 1959, thus recognizing the obvious advances in cardiovascular surgery.

In the 1960s the thoracic surgeon became a cardiothoracic surgeon with emphasis on the cardiac aspect. The first heart valve was successfully replaced in its native position by Dr. Albert Starr, and, after Mason Sones developed coronary angiography, the coronary artery bypass era was begun. The first coronary artery bypass, though unsuccessful,

was performed by Dr. David Sabiston in 1962. Heart transplantation was successfully performed in 1967 and has become a routine procedure throughout the country. With the increase in cardiothoracic surgery, a second national organization, The Society of Thoracic Surgeons (STS), was formed in 1964. Shortly thereafter, *The Annals of Thoracic Surgery* began publication with John D. Steele as its first editor.

During the 1970s most thoracic training programs emphasized cardiac surgery rather than general thoracic surgery. This was the beginning of an era in which coronary artery bypass dominated the field of thoracic surgery. Improvements in valve prostheses, myocardial preservation, and cardiopulmonary bypass techniques were forthcoming. General thoracic surgery received less attention, although Samson³⁷ continued to write about decortication and gave Dave Dugan, one of the founders of the WTSA, credit for introducing the word *empyemectomy*.

The Board of Thoracic Surgery became a primary board, rather than an affiliate of the American Board of Surgery, in 1971, and it became the American Board of Thoracic Surgery (ABTS). The Samson Thoracic Surgical Association was founded in 1974 under the leadership of Dave Dugan and Art Thomas and was renamed The Western Thoracic Surgical Association (WTSA) in June 1983.

Coronary artery angioplasty was introduced in the late 1970s by Andreas Grunzig and associates.³⁸ Throughout the 1980s and into the 1990s, angioplasty mushroomed into a common procedure in most catheterization laboratories. The 1980s and 1990s have produced refinements in all areas of thoracic and cardiac surgery. Lung transplantation became a reality after Cooper and the Toronto group performed the first successful transplant in 1983, 20 years after James Hardy introduced the procedure.

During this era the once inoperable organ, the heart, ceased to be inoperable. The repair of congenital defects, valvular lesions, coronary obstructions, rhythm disturbances, and transplantation dominated the practice of thoracic surgery. Concurrently, the treatment of obstructive coronary artery disease in the catheterization laboratory exploded and the previous check and balance system where cardiologists diagnosed and surgeons operated was markedly altered. General thoracic surgery, although not ignored during this second phase of the renaissance of thoracic surgery, certainly took a back seat, and individuals who wanted to dedicate

most of their efforts to general thoracic surgery became more scarce.

The founding of the General Thoracic Surgical Club initiates the current era in the renaissance in thoracic surgery. This organization began in 1988 with its leadership coming from the Mayo Clinic and general thoracic surgeons from other institutions. Membership was for thoracic surgeons whose primary practice was general thoracic surgery. Much has happened in thoracic surgery during the past 6 years and changes in our specialty reflect some of the changes going on in medicine in this country.

As of 1994 there are 93 thoracic surgical training programs approved by the Residency Review Committee. Seventy-three percent are 2-year programs with the remainder encompassing 2½ or 3 years. Almost 150 residents finish their training annually. Separate rotations in general thoracic surgery are in 62% of the programs, 52% have separate rotations in adult cardiac surgery, and 60% have separate rotations in pediatric cardiac surgery.

It is unlikely in view of the current climate in medicine to expect an increase in training programs or an increased number of residents in existing programs soon. Regardless of which health care program eventually comes to pass, we will be fortunate to keep the same numbers of resident positions we have now, and there might be less demand for our services.

The Thoracic Surgical Directors Association (TSDA) has received its wake-up call and has become appropriately active. The TSDA now appoints two members to the ABTS. The TSDA is making an effort to revise the thoracic surgical training curriculum and has obtained 100% participation in the Thoracic Residency Match. It is of interest, however, that few members of the TSDA are full-time general thoracic surgeons. John Benfield, who is a past president of the WTSA and president-elect of the STS, and Mark Orringer, who will deliver the Lyman A. Brewer III Lecture at this year's WTSA meeting, are two of these individuals. A few programs have joint directorships—one director being a cardiac and the other a general thoracic surgeon. Some members of the TSDA consider themselves to be both cardiac and general thoracic surgeons.

The ABTS, as it is today, functions for the primary purpose of protecting the public through the establishment and maintenance of standards in thoracic surgery. These standards are measured via

written and oral certifying examinations. At present, certificates are valid for 10 years after which a recertification examination can be taken, which is valid for 10 more years. The written and oral examinations are reviewed yearly and undergo continuous revision to improve their quality and psychometric validity.

As far as pediatric cardiac surgery is concerned, corrective and palliative surgery is being performed on increasingly younger patients. The ABTS has decreased certification requirements from 25 to 20 pediatric cardiac cases. It has also changed the distribution from 15 open and 10 closed cases to simply 20 cases regardless of whether they are open or closed. Additionally, 155 index cases in other areas of cardiac surgery and general thoracic surgery are required before the applicant is permitted to take the Board examination. Through the end of 1993, 5441 certificates have been issued and more than 4700 certified thoracic surgeons are practicing in the world.

Thoracic surgeons have two national societies, the AATS and STS, and two regional societies, the WTSA and STSA. Papers presented at these meetings are published in *THE JOURNAL OF THORACIC AND CARDIOVASCULAR SURGERY*, whose editorial leadership is being passed from John Kirklin to John Waldhausen, and *The Annals of Thoracic Surgery*, edited by Tom Ferguson. Papers presented at the General Thoracic Surgical Club are not published currently because they include general reviews of major topics or data that have been recently presented or will be presented.

The STS National Database has been established and now has 10 years of adult cardiac data. As of January 1994, more than 344,000 patients have been entered in the system from approximately 600 hospitals and 1235 surgeons. For first-time elective coronary artery bypass with an internal mammary artery, mortality from 1991 to 1993 is 1.38%. During the same period, emergency operations in which the internal mammary artery was used had an operative mortality of 2.5%. Overall mortality for aortic valve replacement during a similar period was 3.12% and for mitral valve replacement, 5.27%. Similar superb results are now being obtained at most institutions for bypass procedures with concomitant valve repair or replacement, valve repair alone, or with other forms of intracardiac surgery in adults.

Despite the excellent results, debate still rages regarding cardioplegia. Meetings and symposia are

held with faculties of up to 30 distinguished physicians to discuss the merits of cold versus warm, antegrade versus retrograde, or both. When this issue is decided, we dump in various additives and substrates. There are even individuals who do not use cardioplegia and report marvelous results, which I interpret as meaning that cardioplegia is not all that important or that the perfect combination of what solution given in what manner for what clinical situation at what temperature still has not been decided. At least for the present, the cardioplegia question provides interesting literature and an excuse for another meeting.

A continuous battle is being waged between cardiac surgeons and invasive cardiologists with their angioplasty catheters, lasers, atherectomy instruments, and stents. The cardiologic or surgical procedure performed is often not determined by clear indications or data, but by the aggressiveness of the cardiologic team.

I have not made mention of electrophysiologic surgery. The pioneering work of Will Sealy while at Duke University and Jim Cox now at Barnes Hospital in St. Louis is recognized worldwide as having provided an additional tool for the cardiac surgeon. Cardiac transplantation, originally pioneered in Minnesota and at Stanford, is now performed with low operative mortality at most medical centers. Similarly, the treatment of dissecting aneurysms has become a routine operative procedure, with Craig Miller, our president-elect, a leading authority.

In general thoracic surgery, current interest is in the use of neoadjuvant therapy for treatment of carcinoma of the lung, the leading killer from neoplastic disease in the United States. Cooperative studies under the auspices of such acronyms as the LCSG, ECOG, and SWOG have been carried out with results that show an increased survival with this combined form of therapy in some stages of the disease. Likewise, with carcinoma of the esophagus, neoadjuvant therapy seems to offer some benefit. Differences in the approach to esophageal carcinoma among Drs. Orringer, DeMeester, Skinner, and others exist at present, and the ultimate answer as to what is the best form of therapy is still not clear.

Lung transplantation has continued to grow. Cooper's move to St. Louis with Patterson has made their institution an instant leader in the field. Other centers have actively joined the transplantation field. When Trinkle from San Antonio introduced

telescoping of the bronchial anastomosis, this portion of the operation was simplified.

We in Denver have played a role in the recent therapy for tuberculosis, which has seen a resurgence since 1985. Over 26,000 new cases a year now occur in the United States, about 10% of which are due to resistant organisms. Surgery is now indicated for resistant organisms and localized disease. We have operated on approximately 200 patients with pulmonary mycobacterial disease, half for resistant tuberculosis and the remainder for other mycobacterial infections, with mortality rates of 2% to 3%. Results have been better than with medical management alone. Because 3,000,000 deaths occur worldwide yearly from tuberculosis, this disease cannot be ignored despite a recent report showing a slight decline in the United States.

Discussion of general thoracic surgery would not be complete without mention of video-assisted thoracic surgery (VATS). The VATS doctors have inundated the literature and reinvented each and every thoracic operation with cameras and instruments inserted via tiny incisions. Although no great scientific discoveries have come from VATS, it adds another dimension to general thoracic surgery, reduces pain, and in some procedures reduces hospital stay.

This is the way I see thoracic surgery today. Of greater significance is what is in store for the future. It is somewhat presumptuous of me to comment on this subject, because a joint conference on graduate education in thoracic surgery was held in September of 1992.³⁹ First of all, all gross technical advances in cardiac surgery have been made. The heart has been repaired in part or in toto, new plumbing has been added, valves have been replaced, and the conduction system has been rerouted to a point far beyond what was dreamed possible 41 years ago during the first successful cardiopulmonary bypass.

Similarly, the most obvious technical advances in general thoracic surgery have occurred, and VATS will find its rightful place. A rebirth in general thoracic surgery interest has blossomed along with VATS, but not solely because of VATS. Unfortunately, approximately one third of the residency programs in the United States do not have a dedicated general thoracic surgeon, a situation that impedes progress of this portion of thoracic surgery. The treatment of malignant thoracic disease will continue to evolve through neoadjuvant, other chemotherapeutic, and still greater scientific advances.

Transplantation of cardiothoracic organs will continue to develop. Better antirejection drugs and regimens will be found, but it is more likely that manipulation of the immune system, or transgenic tolerance, will provide the answers of the future. The relationship of chimerism to tolerance, as reported from Pittsburgh, remains to be established.

The most important future direction in thoracic surgery is molecular biology. The same is true of other branches of medicine. To support this contention one simply has to look at the basic science lecture of the 1993 AATS meeting given by Dr. Andrew Wechsler, entitled, "Molecular Biology: New Common Ground for Cardiothoracic Surgery." Furthermore, the Lyman A. Brewer III Lecture to be presented at this meeting by Drs. Mark Orringer and David Beer, entitled, "Carcinoma of the Esophagus from Molecular Biology to Surgery," further supports this belief. Specific genetic mutations are noted almost daily in malignant disease and other inherited thoracic disorders. Manipulation of the genetic system will obviously play a part in the treatment of thoracic diseases in the future.

Let me address residency training in thoracic surgery. I have little to say that will be new or original. With so few thoracic surgeons, splitting cardiac from general thoracic surgery seems counterproductive. The so-called "splitters," though occasionally vocal, add little to benefit thoracic surgery. The thoracic surgeon must be well trained in all areas of thoracic surgery, and to do this in less than 3 years seems impossible. John Alexander's first thoracic surgical training program began in 1928 and was a 2-year program. Dr. Alexander believed that after being trained in general surgery, a surgeon required 2 additional years of training to become a thoracic surgeon. Although some general thoracic procedures are no longer performed frequently, others have been substituted, and with cardiac surgery and transplantation, I certainly believe 3 years of thoracic training is warranted. Many discussions are going on between the leadership in general surgery and thoracic surgery as to how this can be accomplished without increasing the length of residency. Furthermore, to have a resident in a 2-year thoracic program spend a portion of the first year studying for general surgery boards diminishes the value of that year, and this problem needs to be resolved.

It is the responsibility of the TSDA in these rapidly changing times of thoracic surgery to contin-

uously update the thoracic surgery curriculum. It is unacceptable to have a resident spend most of his time doing coronary artery bypass surgery when he should have a broader view of the ever changing field of thoracic surgery. It is also the joint responsibility of the TSDA and the ABTS to be in constant communication so that the certifying examination is truly reflective of the contemporary curriculum. Fortunately, many of the members of the TSDA also serve on the ABTS. Lastly, residency programs must become more flexible. Each resident should be exposed to broad basic training in thoracic surgery. The trainee may want to be a transplant surgeon, pediatric cardiac surgeon, adult cardiac surgeon, general thoracic surgeon, or a combination of these disciplines. We must be flexible enough to accommodate these wishes and possibly use the third year of thoracic training to accomplish this goal.

The TSDA must have a broader representation in general thoracic surgery and must continue to support the principle of having a dedicated general thoracic surgeon in each program. The problem of numbers in thoracic surgery must be mentioned again. It is doubtful that residency programs will enlarge. Whether we have too many thoracic surgeons cannot be answered, because we do not know if rationing of health care will be a factor or if new technology will increase or decrease the need for our collective services. It is certain, however, that there are not enough general thoracic surgeons. Too much of general thoracic surgery done in the community is performed by noncertified, inadequately trained physicians. Greater use of physician extenders, be they nurse practitioners or physician assistants, should be anticipated in academic and private practice.

The spirit of cooperation in our societies appears to be better than when I began my practice 27 years ago. This cooperation includes research interests, practice guidelines, and dealing with the federal government, which is so anxious to regulate us. The work in this latter area by George Miller and now Jack Matloff should be appreciated by all thoracic surgeons.

Is there a renaissance? I believe there is. It began in 1918 and continues today. Whereas the classical Renaissance was in scholarship and art, the renaissance in thoracic surgery involves technical innovation and science. In the early thoracic renaissance, surgeons dared to operate on the lung or esophagus with mortalities of 50% or greater. Mortality grad-

ually decreased to under 5% for most general thoracic surgical procedures. Then came cardiac surgery. From 1953 to 1988 more emphasis was placed on cardiac surgery than general thoracic surgery. At present, cardiac surgery can be performed with mortalities at or below 5% for most elective procedures. For the renaissance to continue, we must move forward in all areas of thoracic surgery. General thoracic surgery should receive appropriate emphasis in all training programs, and since 1988 this fact appears to be appreciated by the leadership in thoracic surgery.

Many enigmatic problems in general thoracic surgery remain. Postpneumonectomy pulmonary edema, described and published extensively by Dick Peters,⁴⁰ remains almost uniformly fatal. Why patients with blood group type A have a better likelihood of survival when treated for carcinoma of the lung remains a puzzlement. Findings such as a *K-ras* mutation predicting a worse prognosis and mutations in the *p53* gene predicting lower survival are interesting but are not yet of clinical benefit.

Future directions of research will be in the area of molecular biology. Finding genetic and molecular biologic alterations in disease must be translated into clinical relevance. Much is left to be done by the next generations of thoracic surgeons. They will have to be knowledgeable in basic science, as well as in the techniques of thoracic surgery.

General thoracic surgery has been understandably ignored in many thoracic training programs because of the rapid and exciting advances in cardiac surgery. In many programs, esophageal work is done by the general surgeons and traumatic chest injuries are managed by the "trauma surgeon." These areas must be brought back into thoracic surgical training programs. As pointed out by Benfield,⁴¹ to render the best care, thoracic surgeons must be available and be involved in the management of thoracic trauma. The cardiac portion of thoracic surgery faces similar problems. Genetic manipulation and changes at the molecular biologic level offer the next frontier to conquer. The perfect algorithm for cardioplegia will be written.

Historically the Renaissance was an ongoing phenomenon that lasted more than 300 years. Thoracic surgery likewise has been evolutionary, with dramatic changes and developments since 1918. Dr. John Alexander in Michigan is the person most responsible for the orderly development of thoracic surgery. He trained 80 surgeons who disseminated

thoracic surgical knowledge throughout the country. With the development of cardiovascular surgery, there were significant alterations in thoracic surgery. Cardiac surgery dominated most training programs, as well as the clinical practice of thoracic surgery, during the past 40 years. In a literal sense, there has been a revival or renaissance in general thoracic surgery over the past 5 to 6 years. This will have to continue for a balance in our residency programs to be maintained.

The thoracic surgery renaissance will and should continue. Molecular biology and genetic manipulations are the next frontier. Thoracic surgeons will play a significant role in these disciplines of the future.

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