

Mayo Clinic and Mayo Foundation

Sait Tarhan* M. D

Historical Background

The Mayo Clinic was established in 1864. In that year, William Worrall Mayo initiated a solo medical practice in Rochester, Minnesota. He had two sons, William James Mayo, who was born in 1861, and Charles Horace Mayo, who was born in 1865. Both became physicians (Fig. I). In 1883, a tornado struck Rochester,

causing extensive damage, shortly after which, the Sisters of St. Francis established a hospital, which later was named St. Marys Hospital. The hospital was completed and opened in 1889, with a total of 27 beds. During that time, the sons of Dr. William Worrall Mayo joined him in his medical practice. Thus, the Mayo group medical practice was established more than a century ago. The practice has had a

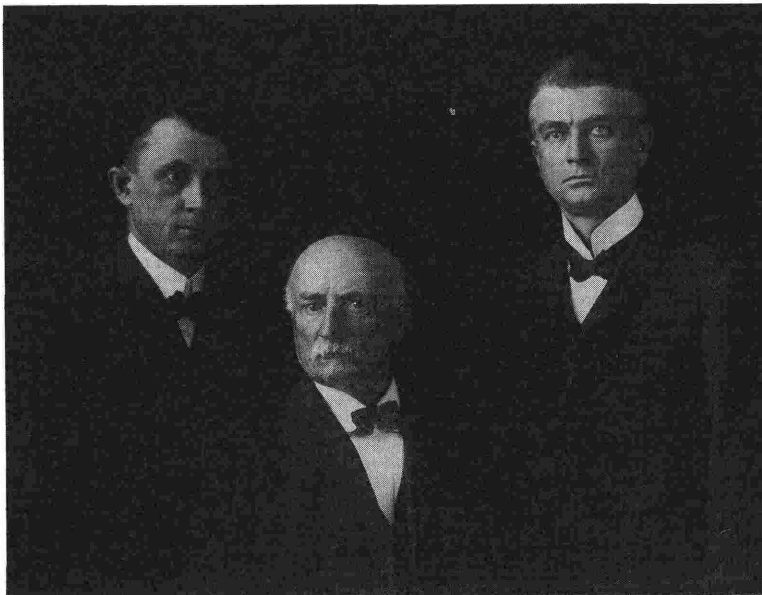


Fig. I Mayo Founders:
 Dr. Charles H. Mayo
 Dr. William Worrall Mayo
 Dr. William J. Mayo

*Professor Department of Anesthesiology Mayo Clinic
 Rochester, Minnesota 55905 USA

phenomenal growth from a horse-and-buggy medical practice to medicine that touches every corner of the United States and every corner of the world.

Certain qualities of the practice have made its past success and current growth possible: total commitment of providing compassionate care to every patient and a medical practice that draws on the combined skills of many specialists and is integrated with medical education and research programs that ensure a high standard of care. The spirit of teamwork, a quality that is woven into the very fabric of the institution, inspires the ongoing communication among physicians, scientists, administrators, paramedical staff, and students. Currently, the institution—the Mayo Foundation (Fig. II)—operates several separate entities: Mayo Clinic Rochester, Mayo Clinic Jacksonville, and Mayo Clinic Scottsdale, all of which are patient facilities, and St. Marys, Rochester Methodist, and St. Luke's hospitals, all of which admit Mayo patients.

The Mayo Foundation

Mayo Clinic Rochester (Minnesota)

The Mayo Clinic is a private group practice of medicine based on a teamwork approach to health care. It is an outpatient clinic currently staffed by more than 900 physicians and scientists. St. Marys and Rochester Methodist hospitals share with the Mayo Clinic a common heritage and common governing structure. Mayo Clinic and the two hospitals combine to form the Mayo Medical Center, the world's largest private medical center, offering patients virtually every kind of medical expertise, treatment, and diagnostic tool. Currently, more than 100 medical specialties and subspecialties are represented at Mayo. Each working day, the medical center community of approximately 16,000 persons cares for more than 4,000 patients. Mayo's patient care is entwined with and supported by extensive programs in medical education and research.

During 1988, 286, 144 patients were regis-



Fig. II Mayo Campus
Front: St. Marys Hospital

tered at the Mayo Clinic and between 1 and 1.5 million patient visits (interaction with physicians) were recorded. More than 4 million patients from all 50 states and more than 150 foreign countries have been seen since 1907, when the record system was started. About 20% of the patients require hospitalization in Rochester and the other 80% are outpatients.

St. Marys Hospital

St. Marys Hospital is one of the largest private, not-for-profit hospitals in the world with more than 1,100 licensed beds and approximately 4,000 employees. Medical services at St. Marys Hospital encompass many fields, representing some of the most sophisticated procedures in medical science. These include computer-assisted laser neurosurgery, kidney and gallstone dissolution without surgery, and cardiac transplantation. In 1988, at St. Marys Hospital, there were 31,261 admissions and 31,916 surgical procedures.

Rochester Methodist Hospital

Rochester Methodist Hospital has approximately 800 beds and a staff of more than 2,200 nursing and support personnel in both full-time and part-time positions. Rochester Methodist Hospital, with newly developed programs in areas such as liver and pancreas transplantation, serves the needs of Mayo patients and family members. In 1988 and 1989, the hospital built additional space for surgery, dietetics, pharmacy, and central supply. At Rochester Methodist Hospital, in 1988, there were 23,453 admissions and 22,872 surgical procedures.

Mayo Clinic Jacksonville (Florida)

Mayo Clinic Jacksonville was Mayo's first group practice to be established outside of Minnesota. It opened in October 1986, with 35 physicians and 160 support personnel. By the end of 1988, the staff consisted of 75 physicians and 439 support personnel and served almost 16,000 patients.

St. Luke's Hospital (Florida)

St. Luke's, a 289-bed community hospital in Jacksonville, Florida, became a Mayo-affiliated hospital in 1987. St. Luke's Hospital has approximately 1,200 employees, and about 600 physicians from Mayo and the community of Jacksonville have admitting privileges. Most patients in the Jacksonville area who require hospitalization are admitted to St. Luke's Hospital. There were 8,300 admissions to St. Luke's in 1988, 31% being Mayo patients.

Mayo Clinic Scottsdale (Arizona)

Mayo Clinic Scottsdale celebrated its first anniversary in June 1988.

During its first year, the outpatient specialty clinic provided medical care to approximately 16,600 patients, and by the end of 1988, more than 25,000 patients had registered. By the end of 1988, the clinic's initial staff of 47 physicians and 225 support personnel had increased to 74 physicians and 415 support personnel. A higher-than-expected patient demand has accelerated expansion plans, and 125,800 square feet will be added to the Scottsdale facility.

Medical Education

Medical education has had an important role at Mayo Clinic since the days of Drs. William J. and Charles H. Mayo. In 1915, they established the Mayo Foundation for Education and Research, endowing it with the bulk of their personal fortunes. The Division of Education includes Mayo Graduate School of Medicine, Mayo Medical School, Mayo School of Health-Related Sciences, and Mayo Continuing Medical Education. These entities are supported by educational services and publications appropriate for their needs.

Mayo Graduate School of Medicine

Mayo Graduate School of Medicine has been the largest part of Mayo Foundation's educational effort since 1915. More than 9,000 alumni practice, teach, and do research throughout the United States, Canada, and more than 60 other countries.

Each year, approximately 200 men and women choose Mayo for their graduate medical education. With more than 850 residents and fellows, the graduate school trains physicians in approximately 90 specialties and subspecialties. Graduate education also is available in research and fields applied to medicine.

Mayo Medical School

Mayo Medical School accepts only 40 students for each graduating class. The medical school, which began in 1972, is fully accredited. Because the size of each class is small, each student can receive personal attention from his or her instructors.

Mayo School of Health-Related Sciences

The Mayo School of Health-Related Sciences trains students in 12 allied health programs, including physical therapy, laboratory technology, and nurse anesthesia. In 1988, 313 students were enrolled in the program. Many other programs of medical education also have been either instituted or enlarged.

Mayo Continuing Medical Education

The Mayo Clinic established an International Education and Visiting Physician Program, which hosted more than 1,200 visiting physicians and administrators during 1988. As continuing education efforts, 52 courses have been organized, and in 1988, more than 6,000 persons have attended these courses.

Mayo Clinic Proceedings

The *Mayo Clinic Proceedings* (Fig. III) remains the flagship of the Mayo Clinic publications, and at the present time, the *Proceedings* has the third largest circulation of the general journals in the United States.

Medical Research

The Mayo brothers and their early colleagues believed that medical investigations could contribute greatly to the diagnosis and treatment of their patients. They took this premise one step

further by suggesting that the research investigator be a full partner of the surgeon and the internist. This philosophy opened the way for a dynamic and free exchange of ideas among colleagues. The result was an efficient flow of findings from the research laboratory to the patient's bedside.

Currently, this tradition is maintained by more than 1,000 full-time scientists, clinical investigators, research fellows, and support staff engaged in research projects in virtually every area of clinical and laboratory sciences. Of these, more than 250 practicing physicians devote part of their time to research.

A tradition of sustained support, both philosophical and financial, is the framework of the Mayo Clinic's international presence in research. This support has made possible a steady stream of contributions to scientific literature and ultimately to the care of Mayo patients.

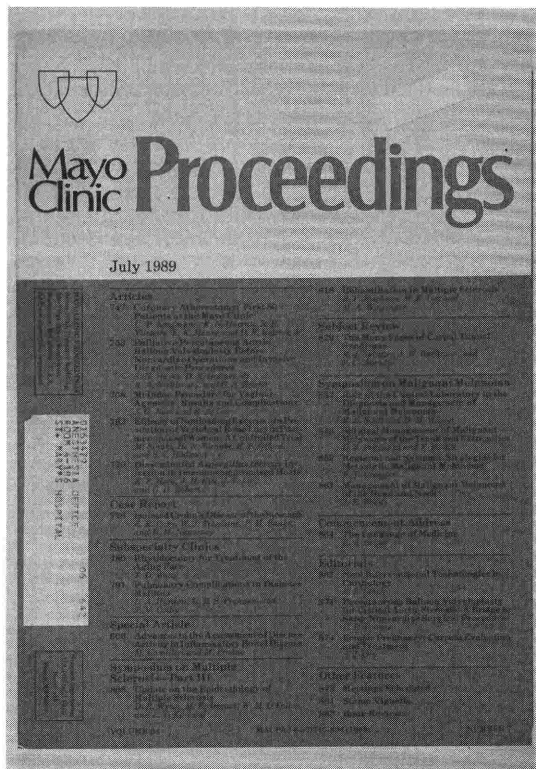


Fig. III The Mayo Clinic's Medical Journal has a circulation of 128,000

In 1988, Mayo's research budget exceeded \$76 million. Of that total, approximately \$50 million was awarded to the institution from sources outside Mayo.

Anesthesiology at Mayo Clinic

As is commonly known, surgery before the advent of anesthesia was a truly terrible experience for patients and for the surgeons who witnessed the suffering of their patients. Perhaps the best that can be said about surgery in those days was that it was limited to procedures that could be performed quickly, usually being confined to amputations, the setting of fractures, and the repairing of superficial wounds.

Anesthesiology did not immediately burst forth as a specialty (Fig. IV, V, VI, VII, VIII). Earlier anesthetics were typically administered by assistants, students, or physicians who happened to be present, observing a surgeon's skill. The introduction of anesthesia to the Mayo practice was much the same. The story is told that a young Charlie Mayo became an anesthetist by chance one day as he observed one of his father's surgical procedures. Dr. W. W. Mayo was removing an ovarian tumor, and a well-known Rochester physician was administering the anesthesia. Evidently unaccustomed to the sight of a major operation, the assisting physician fainted, and taking his place, the young Charlie Mayo continued to apply the anesthesia. The Mayo brothers were quick to recognize the value of experienced anesthetists. They first recruited Dinah Graham and then her sister Edith to be their anesthetists. A number of other helpers were also hired to administer anesthesia.

In 1924, Dr. Will recruited Dr. John S. Lundy to start a section of anesthesiology. At that time, there were 18 nurse anesthetists at the Mayo Clinic. Dr. Lundy developed the theory and practice of balanced anesthesia and introduced new combinations of anesthetic agents

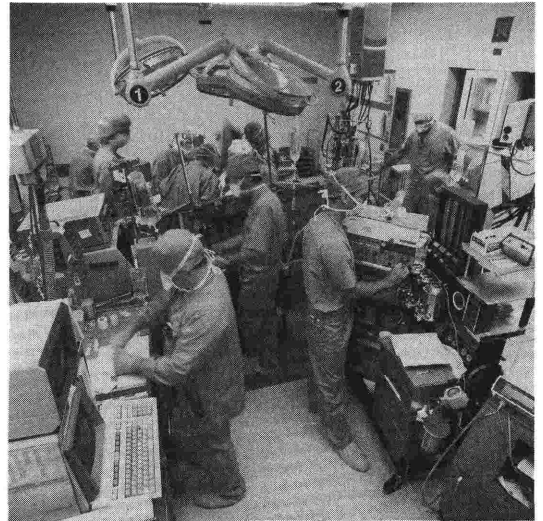


Fig. IV A general view of the cardiac surgical operating room. At right, a resident in training works with anesthesia equipment. At left, a nurse anesthetist works among computer terminals which present information about various aspects of the patient's condition.

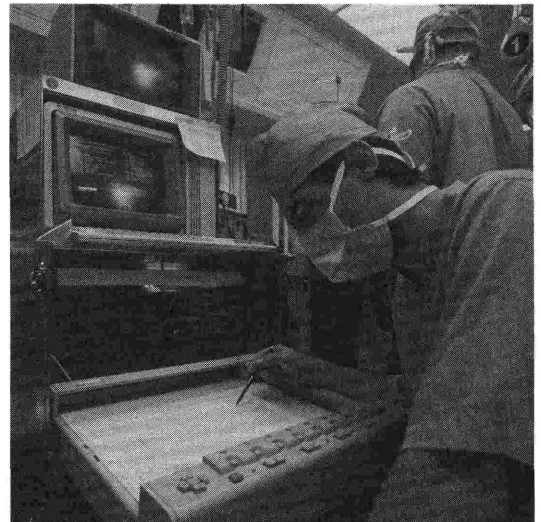


Fig. V Computerized anesthesia record. Entries are being made in the record during surgery.

and methods. He became a prominent force behind the development of anesthesiology as a



Fig. VI Information about the moment-by moment changes in the patient's respiratory status by a mass spectrometer. Also includes oxygen, carbon dioxide, nitrogen and volatile anesthetics.

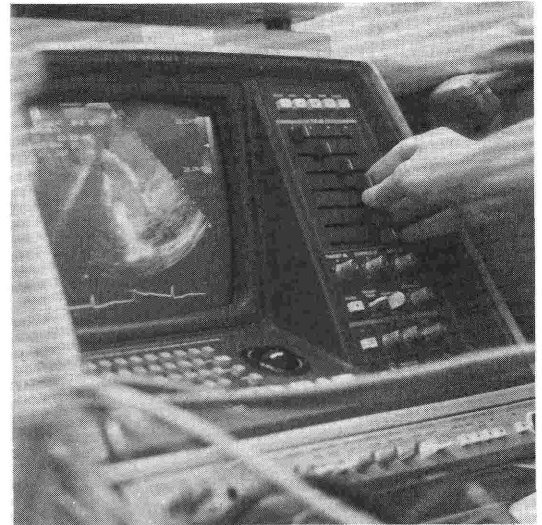


Fig. VIII Throughout the bypass operation, a two dimensional transesophageal echocardiogram shows the status of the heart.



Fig. VII A monitor displays a menu of options that relate to a patient's vital signs.

medical specialty. In 1934, he directed the first clinical trials of Pentothal (thiopental sodium, a short-acting barbiturate), which he found to have a more potent, relaxing effect than other barbiturates. Although others had

used the agent, it was largely through Dr. Lundy's efforts that its intravenous introduction become universal. Pentothal is still one of the most commonly and widely used anesthetics in the world.

In order to monitor patients closely after surgery, Dr. Lundy opened one of the first postanesthesia recovery rooms in the world at St. Marys Hospital in 1942. In 1936, Dr. T. Harry Seldon had established the world's first blood bank at the Mayo Clinic. About 1958, Dr. Albert Faulkner, with his finger pulse monitor, was the first to use the Doppler principle in medicine. He was also a pioneer in gas analysis, using the mass spectrometer and automated administration of Pentothal and muscle relaxants, and he introduced the esophageal stethoscope into medical anesthesia. It was only logical that anesthesiologists would assume the lead in the next step in caring for patients with life-threatening illnesses—critical care.

Critical Care

Other than the care delivered in the postanesthesia recovery room, there was no

system for attending to the needs of many critically ill surgical and medical patients until 1966. At that time, to answer this crucial need, The Section of Respiratory and Intensive Care Services was established at the Mayo Clinic. Eventually, this activity brought together consultants and residents from anesthesiology and internal medicine in the Critical Care Service.

The Critical Care Service provides the newest technology and the personal care to help patients recover from life-threatening events. At the medical intensive care unit of St. Marys Hospital, the critical care team is responsible for the complete care of the patient. In the surgical intensive care units, patients at both St. Marys and Rochester Methodist hospitals, including those in whom complications have developed, those with advanced disease, or victims of trauma, are cared for in the Critical Care Service on a round-the-clock basis.

The Critical Care Service cooperates with the Anesthesiology Department and the Thoracic Diseases Division of the Department of Internal Medicine. Although physicians from the two latter specialties bring different backgrounds to the service, they perform essentially similar tasks.

Research

In the early 1970s, Mayo established its own Section of Anesthesia Research, and Mayo researchers have been especially interested in the effects of anesthesia on respiration, the biotransformation of anesthetic agents, the damaging effects of anesthesia on organ systems such as the kidney and liver, an understanding of the effects of anesthetic drugs on the brain (especially on cerebral blood flow and metabolism), and a better understanding of brain damage causes and of drugs that can be developed for preventional brain damage.

While substantial progress has been made in the delivery and effectiveness of anesthetic

drugs and in the understanding of what combinations of drugs to use or avoid, the ultimate question remains: "How does anesthesia work?" The answer will come through observations at the bedside as well as from research in the laboratory. For researchers, the promising areas of investigation include the study of combinations of drugs and the measurement of their effects on specific organs.

Managing Pain

The methods for relieving pain are as old as pain itself. Despite the collective efforts over centuries to relieve pain, pain management is relatively new. Mayo Clinic opened its outpatient Pain Clinic, one of the first such clinics in the United States, in 1974. Together with the Pain Consulting Service offered at St. Marys and Rochester Methodist hospitals and with the Pain Management Center in the Department of Psychiatry, the Pain Clinic offers hope of relief from the temporary or permanent debilitation of pain.

Before a patient is referred to the Pain Clinic, he or she is thoroughly examined by Mayo specialists who provide specific findings to the

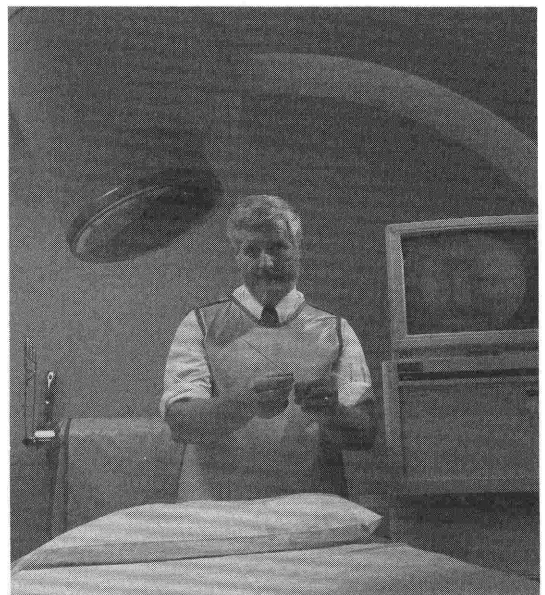


Fig. IX Use of image intensifying fluoroscopy in the precise placement of needles and nerve blocks used in pain management.

Pain Clinic team. The Pain Clinic team approach brings together anesthesiologists, psychiatrists, and physiatrists. For example, if a patient has intractable back pain, specialists from internal medicine, neurology, orthopedics, physical medicine, and possibly psychiatry and social work may have already seen the patient. The Pain Clinic consultants attempt to define the problem more precisely (Fig. IX).

Three types of pain—acute, terminal, and chronic—can be identified. Each type has a different cause, or different psychologic effect, and a different treatment. Postoperative pain or pain caused by trauma is classified as acute pain. Treatments such as nerve blocks and use of narcotics usually offer substantial relief from acute pain. During the last 5 years, acute pain has become reasonably well understood. It has been said that acute pain is the forerunner of chronic pain and that if acute pain can be prevented, chronic pain may not develop.

Terminal pain, often associated with advanced cancer, may develop in patients with terminal ischemia, autoimmune deficiency syndrome (AIDS), and heart conditions. Although many of the postoperative pain techniques apply, the treatment of terminal pain is more complex than the treatment of other types of pain because of the psychologic implications of the dying process.

The third type of pain—chronic pain—is now

recognized as a major international problem. Worldwide, a billion work days are lost annually because of backache. In 99% of cases of backache, evidence of pain cannot be seen on a roentgenogram or a computed tomogram because soft tissue is involved. In the management of chronic pain, an anesthesiologist works with a physiatrist to help the patient reach the best possible physical condition. A strong, healthy body is important to tolerate discomfort that cannot be avoided. Therefore, months of relief can be obtained with a nerve block or an epidural injection, and the patient can be given an opportunity to eliminate drugs and improve his or her physical and psychologic functioning.

At Mayo Medical Center, anesthesia care is provided annually for 54,000 surgical patients. Mayo anesthesiologists also provide anesthesia services for many other areas of diagnostic and radiologic evaluation. They attend to critically ill patients in intensive care units and provide management for patients with acute or chronic pain. Each day at the Mayo Clinic Rochester, a team of more than 500 consultant physicians, resident physicians, nurse anesthetists, respiratory therapists, laboratory specialists, and technicians support approximately 80 major operating rooms and 120 anesthetizing areas. These 500 individuals work for one common goal at the Mayo Clinic—to make modern surgery possible for all who need it.