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## Special Article

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### Harvey Cushing: His Contribution to Anesthesia

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Please put this [collection of Ether charts] in a corner of the Treadwell Library, where someday some young fellow may brush the dust from it and say, "Who were these fellows anyhow, and what is this 'ether' they are talking about? Do you mean that people used to be put to sleep by the inhalation of drugs in the 19th century?"

*Harvey Cushing, 1920*

Cushing's earliest experience with anesthesia prompted an interest in it and led to many important contributions to the specialty, including the introduction of the first anesthetic charts and routine blood pressure measurement. In addition, he reintroduced the use of local anesthetics into clinical practice, coined the term "regional anaesthesia," and recognized that improvements in anesthetic standards could lead to better operating conditions.

On January 10, 1893, Dr. Frank Lynam offered Cushing, then a Harvard medical student, the opportunity to administer ether to a woman with a strangulated hernia. Lynam recalls that Cushing "was not as anxious for the position as I had expected. . . ." (1,p69). It is recorded in Cushing's "line-a-day" diary, and in a letter to his father, that he had given ether on several occasions before this date, and it appears that his reluctance on this day may have arisen from a previous unpleasant experience. Despite Cushing's reservations, the patient was anesthetized. The surgeon, Dr. C. B. Porter, found "a sack filled with gan-

grenous black intestines floating in pus. The patient failed rapidly and, though stimulation was given, died on the operating table a few minutes later" (1,p70).

In the early days of anesthesia, death under ether was not uncommon, and it is probable that the woman's death was not the first that Cushing had witnessed. This is substantiated by a letter written by him in February 1920 in which he describes his first experience administering ether (2). He recalls that he was called down from his seat in the surgical amphitheater and sent into a side-room, where, under the direction of an orderly, he proceeded to "etherize" the patient, an elderly man, as best he could. After repeated urgent calls from the surgeon, the patient was wheeled into the amphitheater. As the operation started, "there was a sudden great gush of fluid from the patient's mouth most of which was inhaled. . . ." The patient died. Cushing writes:

I supposed that I had killed the patient. The operation was completed in spite of the episode, as a demonstration to the class. I slunk out of the hospital, walked the streets of North Boston the rest of the afternoon, and in the evening went to the surgeon's house to ask if there was any possible way I could atone for the calamity to the man's family before I left the Medical School and went into some other business.

To my perfect amazement I was told it was nothing at all, that I had nothing to do with the man's death, that he had a strangulated hernia, and had been vomiting all night anyway, and that sort of thing happened frequently and I had better forget about it and go on with the Medical School. I went on with the Medical School but have never forgotten about it.

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It is evident that these episodes had a profound effect on Cushing and probably contributed to his interest in making anesthesia a safer specialty.

Harvey Williams Cushing was born in Cleveland, Ohio, on April 8, 1869, the son of a doctor. After graduation from the Central High School in 1887, he entered Yale College and distinguished himself in both academia and athletics, obtaining his BA degree in June 1891. Despite several pleas by Russell Chittenden, Professor of Physiological Chemistry, for Cushing to remain at Yale, he decided to follow in his brother's footsteps and enter Harvard Medical School; he took up his place in September 1891. On June 26, 1895, he received the degrees of MD and AM cum laude.

It was during his second year as a medical student that Cushing gave that first fateful anesthetic. After this unfortunate episode, he and Ernest Amory Codman, a classmate, resolved that they would improve their technique of administering ether. Cushing suggested (2) that "in order to make a game of the task

before us we made a wager of a dinner as to who could learn to give the best anaesthesia."

Codman, writing later (2), recalled nothing of the dinner of which Cushing spoke but remembers the "determination to train ourselves to be good etherizers." To this end they devised the first anesthetic records. These "ether charts" were introduced in 1894 and allowed both the anesthetist and the surgeon to follow the condition of the patient by recording pulse, respiration, and temperature during the operation (Fig. 1). There was no doubt in Cushing's mind (2) that "we both became very much more skillful in our jobs . . . particularly due, I think, to the detailed attention which we had to put upon the patient by the careful recording of the pulse rate throughout the operation." He also states (2) that careful anesthesia and record taking "was undoubtedly a step toward improvement in what had been a very casual administration of a dangerous drug. We do much better with ether these days, but even so there remains much to learn."

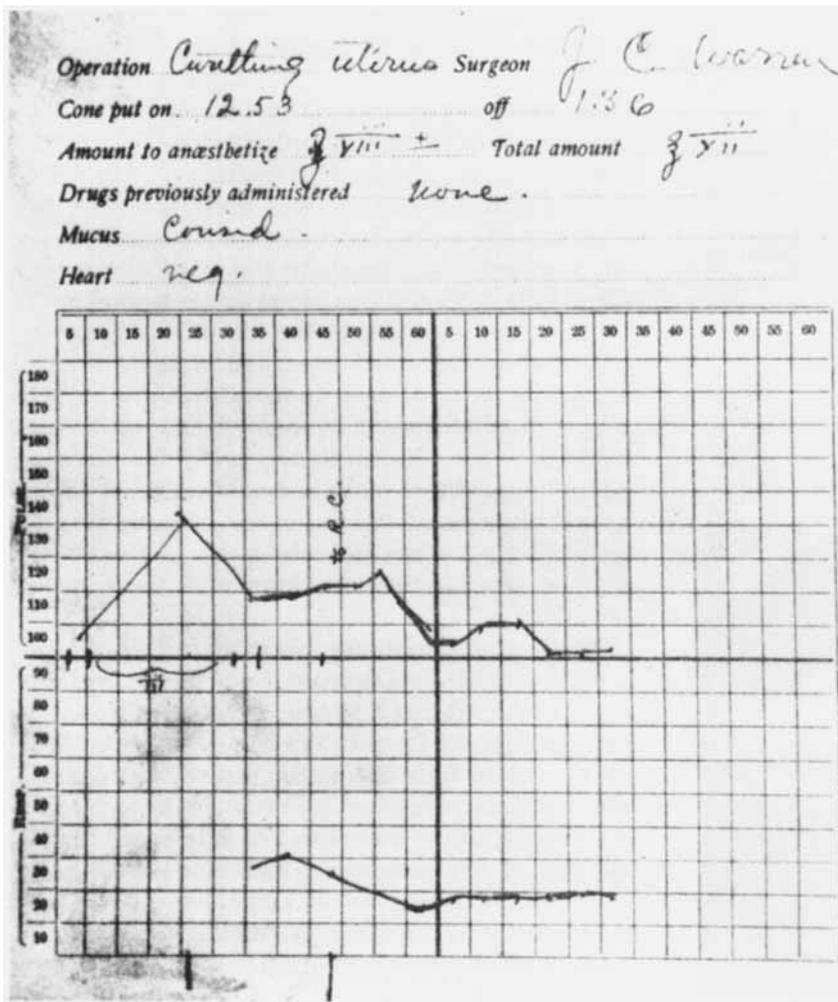


Figure 1. One of Codman's early ether charts, dated November 30, 1894. (By permission of *Surgery, Gynecology and Obstetrics*.)

In April 1895, Cushing took a locum tenens position at the Massachusetts General Hospital and for two months worked with the surgeon John Wheelock Elliot. During this time Cushing assisted at two operations for brain tumor, and it appears that his enthusiasm for neurosurgery stems from this experience. His internship, at the same hospital, began on August 1 of that year, after which he moved to Baltimore to become assistant resident to William S. Halsted at the Johns Hopkins Hospital (Fig. 2). Halsted, who had also attended Yale, had moved to Baltimore from New York in 1886 and had become Professor of Surgery in 1890.

Anesthetic practice in Baltimore was similar to that in Boston where medical students were called upon to administer anesthesia using ether cones made from newspaper. Cushing found it impossible to change this practice, and after a number of anesthetic deaths at the hospital in the autumn of 1897, he began to investigate the use of cocaine as a local anesthetic. He

Figure 2. Harvey Cushing, age 29; photographed during his time at Johns Hopkins Hospital (Yale Medical Library).



became adept at performing nerve blocks for a number of surgical procedures, and later published his observations concerning "Cocaine Anaesthesia in the Treatment of Certain Cases of Hernia and in Operations for Thyroid Tumors"; this article appeared in the Johns Hopkins Hospital Bulletin in 1898 (3). It is obvious from this article that Cushing recognized the dangers of administering ether to those patients with "full stomachs" or to the elderly with respiratory or cardiovascular disease. Several other publications dealing with local anesthesia followed (4,5). These reports contain details of his technique of supplementing cocaine anesthesia with "a few inhalations of chloroform—not enough, however, to make the patient lose consciousness. . . ." Cushing continues, "We may justly speak, therefore, of the method of anaesthesia which is employed as a morphia-cocaine-chloroform combination, the first and last drugs being merely adjuvants of the local anaesthetic. . . ." He further describes the role of an assistant in place of the anesthetist who offers "timely encouragement" to the patient. Cushing was almost certainly the originator of the term "regional anesthesia" (6). Although there is little doubt that Cushing rekindled interest in the use of cocaine anesthesia, it is interesting to note that Halsted had experimented extensively with the drug shortly after its introduction in 1884, and had published his findings (7). However, Cushing claims (8) that he "was utterly unaware that his chief had ever made studies with cocaine of any sort, so reticent was he about this particular matter and so little did questions of priority interest him."

During his residency at the Johns Hopkins Hospital, Cushing remained interested in neurosurgery, and in July 1900 he began 14 months of travelling in Europe visiting many eminent neurologists and neurosurgeons. While in Berne, under the direction of Theodore Kocher, his experiments led to the finding that an increase in intracranial pressure was associated with a reflex increase in the arterial blood pressure; this later became known as the Cushing reflex (9).

Shortly after concluding his work in Switzerland, Cushing visited the Ospedale di St. Matteo in Pavia where he found that a simple, "home-made" adaptation of Scipione Riva-Rocci's blood pressure device was in routine daily use by the bedside of every patient. He quickly sketched a diagram of the apparatus; this drawing can be found in his diary dated May 5, 1901 (Fig. 3). On his return to Baltimore in September of that year, Cushing almost immediately developed a new anesthesia chart (Fig. 4), and insisted that blood pressure should be recorded during all major operations. His first publications relating to the subject of

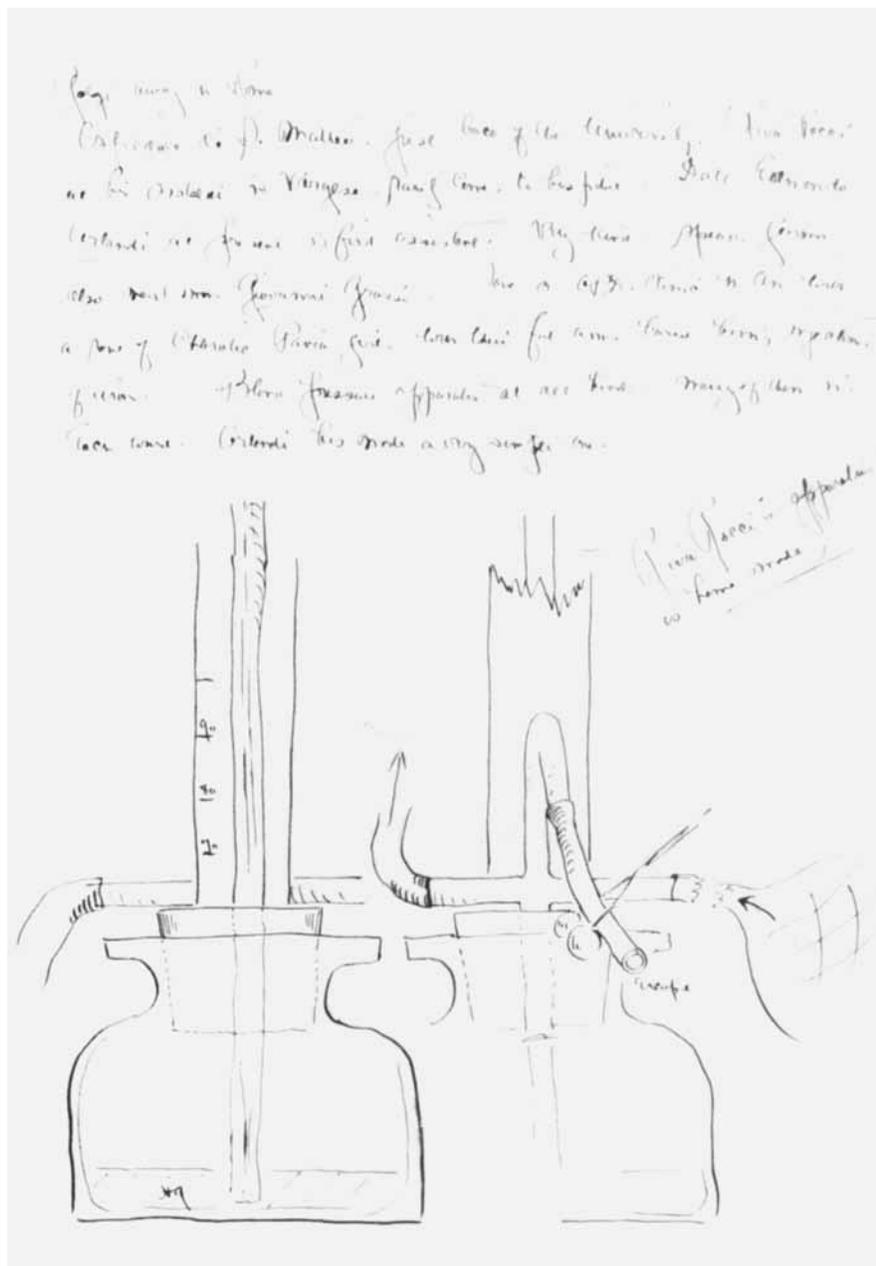


Figure 3. Sketch of Riva-Rocci's blood pressure apparatus from an entry in Cushing's diary dated May 6, 1901 (Yale Medical Library).

blood pressure appeared in September 1902 (10) and March 1903 (11). In the former article, Cushing presented data to show that cocaine applied to major nerve trunks could prevent the shock often associated with limb amputation. Cushing, therefore, shared similar views with George Crile, whose experiments had stimulated Cushing's work on the subject. On January 19, 1903, he presented a paper to a special meeting at the Boston Medical Library. The talk was titled "The Clinical Value of Blood Pressure Observation," and, as a result of this reading, the Harvard Medical School distributed a circular to all members of the Department of Surgery requesting that a committee be formed to consider the "importance of blood

pressure determinations." After many meetings of this committee and a great deal of deliberation, it was eventually decided that "the skilled finger was of much greater value clinically for determination of the state of the circulation than any pneumatic instrument" (1,p214). Despite this decision, and possibly due, in part, to the publication of George Crile's monograph "Blood Pressure in Surgery" (12), clinicians throughout the country began to record blood pressure during surgical procedures. Cushing, therefore, must be given a great deal of credit for the introduction and acceptance of blood pressure determinations into America. An amusing anecdote from this period appears in Fulton's biography of Cushing (1,p216). During a

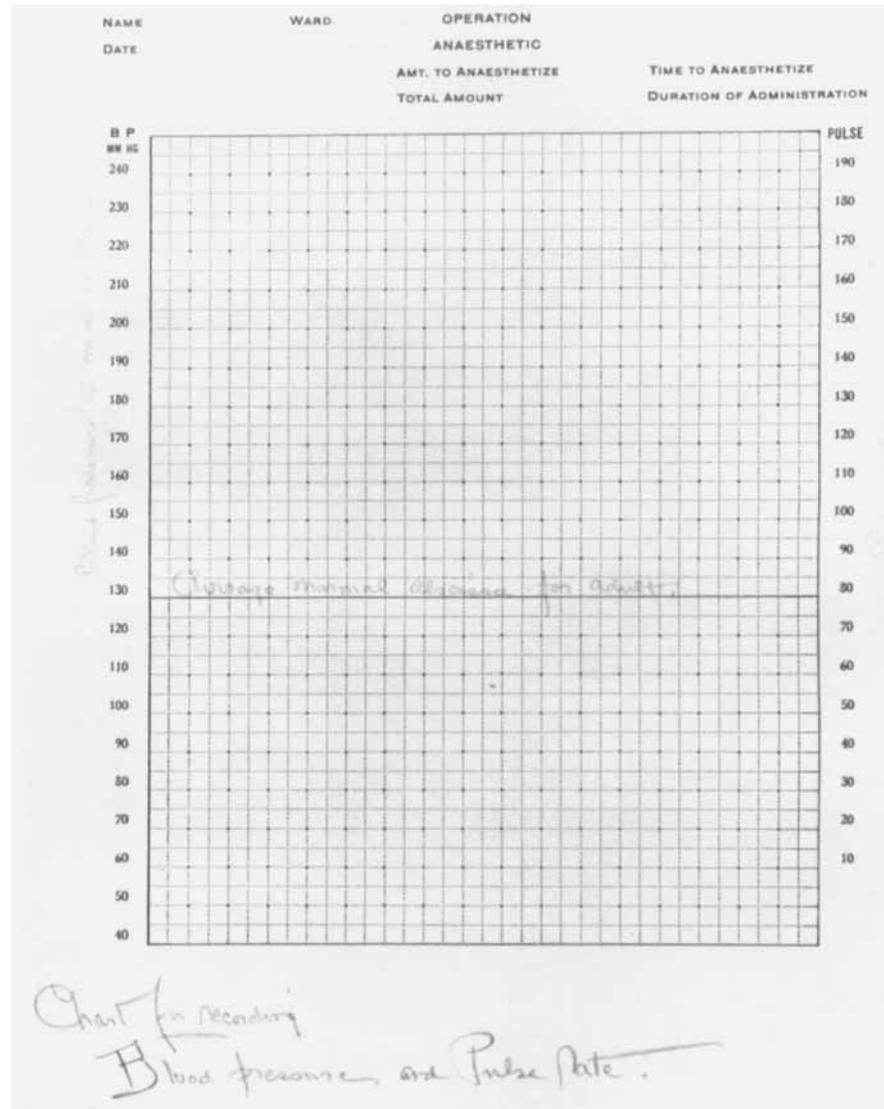


Figure 4. Cushing's original blood pressure chart with comments by its designer. It was introduced into practice in 1902 (Yale Medical Library).

tense moment in an operation, an inexperienced student nurse, who was substituting as an anesthetist, was suddenly told to take a pressure reading. A few minutes later, Cushing felt something tugging at his trouser leg only to find that the nurse was putting the cuff on him!

Cushing's reservation concerning the administration of ether by medical students was still apparent at this time; this is illustrated by his adoption of a full-time physician anesthetist. Halsted believed that the administering of ether was an essential part of an intern's training, but Cushing felt that anesthesia by the "cone and struggle" method was inappropriate for neurosurgical operations. He therefore employed

the services of Dr. S. Griffith Davis to administer anesthesia for him. Private patients paid for the service; for public patients Cushing paid Davis out of his own pocket (13). This is one of the first recorded instances in America of a surgeon employing another physician exclusively for the provision of anesthesia.

In 1912, Harvery Cushing was appointed Surgeon-in-Chief to the newly opened Peter Bent Brigham Hospital in Boston and as Professor of Surgery at Harvard. He continued to employ the services of a regular anesthetist, Dr. Walter Boothby. Boothby was replaced in 1916 by Gertrude Gerrard, the first nurse anesthetist at that hospital. In May 1917, Harvey Cushing was Surgeon-in-Chief of the American Ex-

peditionary Base Hospital Number 5 in Boulogne, with Gerrard as anesthetist. She was also a member of his surgical team at an advance hospital in Belgium and, for her services there, she was decorated with the British Royal Red Cross.

On Cushing's return to private practice at Harvard, he continued to excel in the practice of neurosurgery, performing over 2000 craniotomies. On November 5, 1932, he performed his last operation—the removal of a highly vascular meningioma from a physician's daughter—and shortly after retired from Harvard. In 1933 he accepted the nonclinical post of Sterling Professor of Neurology at Yale, a position that he occupied until his death on October 7, 1939.

Harvey Williams Cushing will always be remembered for his pioneering work in the field of neurosurgery, but his contribution to the early days of anesthesia should not be forgotten.

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