



THE COLLABORATIVE RELATIONSHIP BETWEEN THE SURGEON AND THE NURSE AND THE ANESTHESIA OVER THE PAST CENTURY.

Meshari Dekhilallah Jabbar Almutairi^{1*}, Majed Sannat Aziz Alotaibi², Salman Mutaq Mohsen Alghadhbani³, Musaad Saeed Sinhat Alotaibi⁴, Meshari Abdulrhman Saude Alotaibi⁵, Majed Bander Sunhat Alotaibi⁶, Ahmad Ghuwayzi Sumran Alharbi⁷, Ahmed Faraj Samel Alawfi⁸, Hamad Lafi Mazyed Almutairi⁹, Sami Shubat Hawwaf Alotaibi¹⁰

Abstract

To meet the need for qualified anesthetists, American surgeons recruited nurses to practice anesthesia during the Civil War and in the latter half of the 19th century. The success of this decision led them to collaborate with nurses more formally at the Mayo Clinic in Minnesota. During the 1890s, Alice Magaw refined the safe administration of ether. Florence Henderson continued her work improving the safety of ether administration during the first decade of the 20th century. Safe anesthesia enabled the Mayo surgeons to turn the St. Mary's Hospital into a surgical powerhouse. The prominent surgeon George Crile collaborated with Agatha Hodgins at the Lakeside Hospital in Cleveland to introduce nitrous oxide/oxygen anesthesia. Nitrous oxide/oxygen caused less cardiovascular depression than ether and thus saved the lives of countless trauma victims during World War I. Crile devised "anoci-association," an outgrowth of nitrous oxide/oxygen anesthesia. Hodgins' use of anoci-association made Crile's thyroid operations safer. Pioneering East Coast surgeons followed the lead of the surgeons at Mayo. William Halsted worked closely with Margaret Boise, and Harvey Cushing worked closely with Gertrude Gerard. As medicine became more complex, collaboration between surgeons and nurse anesthetists became routine and necessary. Teams of surgeons and nurse anesthetists advanced thoracic, cardiovascular, and pediatric surgery. The team of Evarts Graham and Helen Lamb performed the world's first pneumonectomy. Surgeon-nurse anesthetist collaboration seems to have been a uniquely American phenomenon. This collaboration facilitated both the "Golden Age of Surgery" and the profession we know today as nurse anesthesia.

^{1*}Technician Anesthesia Afif Hospital, Saudi Arabia

²Technician Anesthesia Afif Hospital, Saudi Arabia

³Technician Anesthesia Afif Hospital, Saudi Arabia

⁴Technician Anesthesia Afif Hospital, Saudi Arabia

⁵ Technician Anesthesia Afif Hospital, Saudi Arabia

⁶Technician Anesthesia Afif Hospital, Saudi Arabia

⁷Technician Operation Afif Hospital, Saudi Arabia

⁸Technician Operation Afif Hospital, Saudi Arabia

⁹ Technician Operation Afif Hospital, Saudi Arabia

¹⁰ Technician Operation Afif Hospital, Saudi Arabia

***Corresponding Author:** Meshari Dekhilallah Jabbar Almutairi

*Technician Anesthesia Afif Hospital, Saudi Arabia

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Because of the frequent mortality associated with both anesthesia and surgery, the 50 years after Morton's demonstration of ether anesthesia in 1846 were sometimes called the "period of the failed promise."¹ "With surgery, the main culprit was infection... With anesthesia, problems arose from unskilled administration by 'occasional anesthetists.'"¹

Nurses collaborated with surgeons to solve both these problems. First, surgeons depended on nurses to minimize the transmission of infection.² Before the acceptance of aseptic practice in the late 1890s, nurses followed Joseph Lister's prescription to spray carbolic acid over the operating room. At Johns Hopkins Hospital in Baltimore, surgeons and nurses dipped their hands in permanganate, oxalic acid, and mercuric acid in a multistep cleansing process. Mercuric acid so irritated the hands of the scrub nurse for Chief Surgeon William Halsted (1852–1922), Caroline Hampton, that he commissioned the production of high-quality gloves from the Goodyear Rubber Company, thereby protecting Hampton's hands and incidentally further decreasing the incidence of infection. "The introduction of rubber gloves to surgery began as simply and unremarkably as protecting a nurse's skin from irritation."³

With infections reduced, surgeons turned their attention to the need for quality anesthesia. In 1953, Virginia Thatcher, the first historian of nurses as anesthetists wrote: "Finally, operations could be performed without fear of fatal surgical infection, and ...no longer could surgeons afford to tolerate the consequences of hit-or-miss anesthesia when the whole human body lured them to new adventures in surgical therapeutics."⁴

The Civil War greatly increased the number of surgeries and thus anesthetics. The demand for anesthesia was filled, at least in part, by recruiting nurses. Thatcher quotes a report from an 1866 publication. "On July 4, 1863, after the Battle of Gettysburg, a Mrs. John Harris 'taking some chloroform and stimulants...left Baltimore...and penetrated as near as possible to the scene of the conflict, administering as much as in her power to the stream of wounded...'"⁵ We do not know if Mrs. Harris was a trained nurse. A second report is of an unnamed "nurse in attendance" who also administered chloroform to a wounded soldier.⁶ A third report is specific. Catherine S. Lawrence, a native of Skaneateles, New York, had undergone nurse training under Dorothea Dix (of mental health fame) and administered chloroform at the Kalorama Hospital in Washington, DC, around the time of the Second Battle of Bull Run (1862). It is

not known who the surgeon was, and Lawrence mentioned only once in her autobiography that she "tied arteries and administered chloroform."^{7,8} Thus, it is unlikely that anesthesia formed more than a small part of her duties, but Lawrence was the earliest known nurse who practiced anesthesia. After the Civil War, nurse anesthesia was born out of the need, as Thatcher aptly put it, for anesthetists who would: "1. be satisfied with the subordinate role that the work required; 2. make anesthesia their one absorbing interest, 3. not look on the situation of anesthetist as one that put them in a position to watch and learn from the surgeon's technique, 4. accept comparatively low pay, and 5. have the natural aptitude and intelligence to develop a high level of skill in providing the smooth anesthesia and relaxation that the surgeon required."⁹

Catholic nuns, who worked for free in frontier hospitals, were drafted and formed the first group of identifiable nurse anesthetists. The earliest known example was Sister Mary Bernard who entered St. Vincent's Hospital in Erie, Pennsylvania, in 1877 to take up nursing and "within the year was called upon to assume the duties of anesthetist."¹⁰ One Sister, Secundina Mindrup (1868–1951), lived long enough to tell her story directly to Thatcher. "The doctors would come with their assistants to give the anesthesia, but then they would need the assistant for something else and would teach the Sister how to give the anesthesia."¹⁰

A booming economy and gender bias drove this development as well. Westward expansion of the 1870s and 1880s led to the establishment of many small hospitals, an absence of physician anesthetists led surgeons to rely on just about anyone as an anesthetist, and they tended to favor women. Marianne Bankert, whose book *Watchful Care: A History of America's Nurse Anesthetists*, expanded Virginia Thatcher's work, made these points convincingly: "early discussion on the need for professional (medical) anesthetists returned again and again to the economic factor...talented physicians and interns had no (financial) incentive to concentrate on the giving of anesthetics."¹¹ Bankert found that bedside manner mattered too: "what was fundamentally an economic issue was resolved by utilizing talented, trained women, frequently was veiled, unconsciously and/or consciously, in a romantic aura praising the 'natural' appropriateness of women as anesthetists, labeling their expertise and concern for patients as uniquely 'feminine.'"¹¹

THE FIRST SURGEON-NURSE ANESTHETIST PAIRS

In 1889, the Sisters of St. Francis opened St. Mary's hospital in Rochester Minnesota. There the Mayo brothers (Dr. William W. Mayo [1819–1911], Dr. William J. Mayo [1861–1939], and Dr. Charles H. Mayo [1865–1939]) distinguished themselves as surgeons. From the outset, “the Drs. Mayo saw no reason why an intelligent nurse could not be an able anesthetist, and Dr. W.W. Mayo undertook to teach Miss (Edith) Graham how to administer chloroform.”¹² Edith and her sister Dinah Graham were graduate nurses (not nuns). “(F)rom the beginning, (they) administered the anesthesia, in addition to acting as the Mayos' office nurse, general book-keeper and secretary.”¹²

Then in 1893, Alice Magaw came to St. Mary's. She replaced Edith Graham who left nursing to marry Charles Mayo. Magaw had trained at the Women's Hospital of Chicago under Mary Thompson, a physician. It is not known if anesthesia formed a part of Magaw's nursing education. Two researchers Jeff Nelson and Steve Wilstead speculated that Thompson, who was said to have “opened many doors for the future medical training of women,” inspired Magaw to “make a mark in her role as a nurse anesthetist through commitment to details, expert clinical practices, and a pioneering spirit.”¹³ Magaw would indeed make a mark on anesthesia.

Two surgeons, Albert Ochsner of Chicago and James Moore of Minneapolis, had brought to the United States the German practice of inducing anesthesia by gradually increasing the dripping of ether onto a gauze-covered mask. Magaw adopted this technique. Dripping ether was a significant advance over the popular custom of pouring ether onto a sponge wedged inside a paper cone. Patients breathed from the cone and often became hypoxic. In 1 of her 6 publications, Magaw argued that ether should “not be combined with asphyxia, as has been recommended and is now practiced in many hospitals, the so-called ‘choking or smothering method’.”¹⁴

Magaw induced anesthesia by gradually increasing the application of ether onto the gauze while slowly bringing the mask to the patient's face. She complimented this technique by speaking to her patients, continually reassuring them throughout the induction of anesthesia. Because a patient's inhibitions might disappear before they lost consciousness, they might become fearful and struggle. But because the patient could still hear, Magaw used verbal reassurance to “do away with

their fear.”¹⁵ Magaw elaborated: “Suggestion is a great aid in producing a comfortable narcosis. The anaesthetist (sic) must be able to inspire confidence in the patient, and a great deal depends on the manner of approach.... The subconscious or secondary self is particularly susceptible to suggestive influence; therefore, during the administration, the anaesthetist should make those suggestions that will be most pleasing to this particular subject. Patients should be prepared for each stage of the anaesthesia with an explanation of just how the anaesthetic is expected to affect him: ‘talk him to sleep,’ with the addition of as little ether as possible.”¹⁵ With this method, Magaw reduced the amount of ether given for a typical operation and decreased the incidence of struggling to nearly zero. Her exemplary work prompted Charles H. Mayo to name Magaw “The Mother of Anesthesia.”¹⁶ Magaw listed and described many of these principles in articles she published between 1899 and 1904. She amassed a remarkable record of more than 14,000 anesthetics without a fatality. Nelson and Wilstead asserted that Magaw developed sound anesthesia principles that remain true today.¹⁴

Nurse anesthesia had not yet become formalized, but Magaw's adept and innovative practice and Henderson's training and practice set them apart. They were examples of what Thatcher identified as “the beginning of a new type of nurse, whose function was not restricted to providing food, cleanliness and comfort, but encompassed scientific skills that required knowledge of physics, chemistry and bacteriology.” Thatcher concluded that “it was inevitable that into her hands should fall more and more functions for which the physician, occupied with the application of new scientific learning in his practice, found he had no time.”²⁰

Another factor contributing to the hiring of nurses as anesthetists was physician neglect of anesthesia. The Mayos recruited Miss Graham and then Miss Magaw “in the first place through necessity; they had no interns. And when the interns came, the brothers decided that a nurse was better suited to the task because she was more likely to keep her mind on it, whereas the intern was naturally more interested in what the surgeon was doing.”²¹ Between 1889 and 1910, the Mayos employed a complement of “anesthetizers.” Jean Pougiales listed 8 ([Table 1](#)).²² Only 2 were not nurses: Drs. Isabella Herb and Leda Stacy. Each anesthetist was associated with a specific surgeon in a specific operating room.

Anesthetists	Years	Operating rooms	Surgeons
Edith Graham	1889–1893	2	Drs. W.J. Mayo and C.H. Mayo
Alice Magaw	1893–1918	2	Drs. W.J. Mayo and C.H. Mayo
Dr. Isabella Herb	1899–1904	2	Dr. C.H. Mayo
Florence Henderson	1904–1917	2	Dr. C.H. Mayo
Mary Hines	1905–1936	3	Dr. E. Starr Judd
Dr. Leda J. Stacy	1908–1910	4	Dr. Emil Beckman
Mary Shortner	1909–1949	4	Dr. Emil Beckman
Ann Powderly	1909–1950	4	Dr. C.H. Mayo

With consistent and safe anesthesia, the Mayos prospered as surgeons. William Mayo Sr. wrote that throughout history, “Surgeons like (Ambrose) Pare could amputate a leg or could take off an arm at the shoulder joint in the twinkling of an eye, because the bulk of the anesthesia was provided by strong men and ropes.”²³ But his sons, the younger Mayos did not have to be speedy. They learned what they could by watching their father and visited clinics on

the East Coast to observe other surgeons. They became respected for “sureness, soundness, and thoroughness,” not for speed.²⁴

As their confidence grew, so did the number of operations they performed. The trend is unmistakable (Fig. 1). From 655 in 1893 to 23,622 in 1919, the numbers then decreased slightly, perhaps due to World War I before leveling off until 1924.²⁵

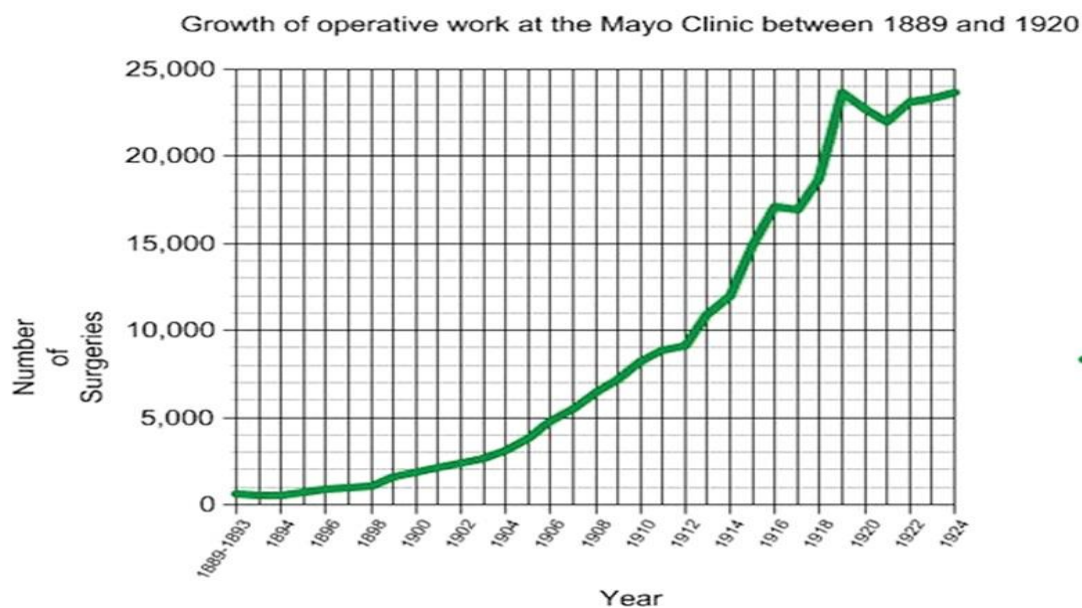


Figure 1

Growth of operative work at the Mayo Clinic between 1889 and 1920, from Mayo Clinic Division of Publications. Adapted from: Sketch of the History of the Mayo Clinic and the Mayo Foundation. Philadelphia, WB Saunders, 1926.²⁵ Their operations also grew more complex. Once proficient with gynecologic operations, the Mayos learned about appendectomies. “One of the bitter classic battles of medical history” concerned whether to treat appendicitis medically or surgically. Drs. Will Mayo and Charlie Mayo adopted Albert Ochser’s “starvation treatment” of patients with a ruptured organ. “Put the patient at rest and give him absolutely nothing to eat or drink,

above all no cathartics. In a few days the acutely dangerous phase will pass and appendectomy will be safe.” And it worked. “Probably nowhere in the nation did the number of operations for appendicitis mount so quickly or so high as in Rochester. In 1900 the number for the year was one hundred eighty-six. In 1905 it passed the thousand mark.”²⁶ This was revolutionary.

The Mayos were not averse to risk taking. In their era, thyroid operations were thought of as dangerously “foolhardy performances” due to the risk of uncontrollable blood loss. Charles Mayo reported in 1912 that he had performed 278 successfully.²⁷ This prompted one British author to

write: "All in all, in his time, Mayo remained unmatched in his continent for the highest number of thyroidectomies and the lowest operative mortality, hence his other title, the 'Father of American Thyroid Surgery'."²⁸ The Mayos even performed some neurosurgical procedures, the first in 1891. "The cases mainly involved trauma to the head, spine, and peripheral nerves, although abscesses and tumors were also described."²⁹

The advent of safe anesthesia during this era lessened the public's fear of hospitals. When St. Mary's opened its doors in 1889, "Miss (Edith) Graham remembered that: We almost had to lock some of the first patients in their rooms; they were so sure they were going to die if they came to a hospital."⁴¹ But, in tracing the evolution of rural community hospitals, Charles Rosenberg, an eminent Professor of History and Sociology at the University of Pennsylvania, found that safe surgery renewed people's faith in hospitals, making "institutional treatment seem both necessary and proper—a sign of family devotion and not neglect...Minnesota's Mayo Clinic was only the most famous and atypically successful of small-town enterprises."⁴² Although some people remained skeptical of "surgeons and their willingness to solve diagnostic problems with their scalpels," they were in the minority. "Most communities looked on their local hospitals with pride and hope."⁴² The nurses who practiced anesthesia during this era contributed to this success.

Collaboration Between Nurse Anesthetists and Surgeons Spreads Across the Country

Nurse anesthesia was born in the Midwest in the latter decades of the 19th century. But Thatcher provides examples to show that by the second decade of the 20th century even "conservative" surgeons in Massachusetts, Rhode Island, Philadelphia, and New York "had capitulated to nurse anesthesia."⁴³ William Halsted's adoption of nurse-administered anesthesia at Johns Hopkins Hospital is a specific example. Halsted developed techniques to repair hernias, anastomose bowel, and treat breast cancer. His radical mastectomy became the treatment of choice for decades. And Halsted's model of teaching formed the basis of modern surgical residency training.

But Halsted resisted nurse anesthesia. According to Thatcher as late as 1908, "interns were giving ether by the cone and struggle method" because William Halsted believed that all interns should learn how to give ether. "To Harvey Cushing (1869–1939), the father of neurosurgery, this kind of anesthesia had nothing to recommend it in operations for brain

tumors, and Cushing employed (physician) S. Griffith Davis to administer anesthesia for him. Private patients paid for this service; for public (charity) patients Cushing paid Davis out of his own pocket."⁴³ In 1912, Cushing left Hopkins for Harvard University and Samuel Crowe was placed in charge of the otolaryngology service. "Crowe did not want house officers to administer anesthesia to his patients, nor could he afford to pay Davis, as had Cushing. He found the answer to his problem in Margaret Boise, (a nurse) whom he employed in 1913 as a private anesthetist with the reluctant consent of Halsted. When Hugh H. Young (1870–1945), with whom Crowe shared an operating room on alternate days, saw how well the anesthesia was managed on Crowe's service, he asked to get in on the deal, and an arrangement was made whereby each would pay half Margaret Boise's salary... Halsted could not help but observe how the problems of anesthesia were being handled on the services of Crowe and Young, and when Margaret Boise had been at Hopkins for only a few months, he asked to borrow her for the administration of anesthesia for a difficult thyroid operation. The upshot was that she was soon employed by the Johns Hopkins Hospital as the head anesthetist for the surgical department, and she gave anesthetics to most of Halsted's patients until his death in 1922."⁴³ By 1913, Halsted was 61 years old. He "operated only a day or two each week, and rarely did more than a single case each day."⁴⁴ Yet, during this period, when Boise administered Halsted's anesthetics, he reported "650 cases of exophthalmic goiter,"⁴⁴ and he "devised a method for draining the common bile duct through the stump of the cystic duct."⁴⁴ Then in 1918, when members of Johns Hopkins Hospital deployed as Base Hospital 18 to France, Halsted "resumed a more arduous teaching and surgical schedule."⁴⁴ The arrangement with Boise paid off for Halsted and his patients. Furthermore, "while working for Crowe and Young, (Margaret Boise) devised a simple machine for the administration of anesthesia to patients undergoing tonsillectomy and, in collaboration with Young, invented a gas-ether machine later known as the Boise-Young apparatus."⁴⁵ Whether Boise enjoyed any proceeds from the sale of her anesthesia machinery is not known.

Harvey Cushing (1869–1939) expressed great interest in and concern for the quality of anesthesia. Cushing, together with the Boston surgeon Amory Codman (1869–1940), developed and implemented the first anesthetic record, to "focus the anesthetizers attention" on the patient rather than the surgery.⁴⁶ A harrowing anesthetic death that Cushing contributed to as a third year medical

student at Harvard and his experiences using a nurse anesthetist in Europe during World War I may have influenced his thinking.^{47,48} In 1912, Cushing employed the physician Walter Boothby as his anesthetist in Boston. The appointment proved to be temporary. Gertrude Gerard was a 1915 graduate of Peter Bent Brigham Hospital School of Nursing. She told historian Thatcher that “Walter Boothby, the hospital’s chief anesthetist at the time, trained her (to administer anesthesia), and when he became head of the section on metabolism at the Mayo Clinic in 1916 she took his place as anesthetist for Harvey Cushing.”⁴⁹

The working lives of Cushing and Gerard together have not been extensively investigated. It is known that, during World War I they deployed to France with the Harvard University medical unit as Base Hospital 5. Base Hospital 5 replaced a British medical team in Camiers, just south of Ypres where the fighting was intense. According to Cushing’s biographer Michael Bliss, the “Canadians and Australians told Cushing that the British had given the Americans the worst site for a hospital in all of France and warned him to expect indolence and indifference when he suggested reforms or innovations.”⁵⁰ Nevertheless, Cushing, with Gerard, performed hundreds of operations on patients with “the most serious” head injuries.⁴⁶ His debridements “were so effective that his mortality rate for wounds that penetrated the dura fell from 54.5 percent in the first month of the battle to 28.8 percent in the third.”⁴⁶

In the American South, Another Category of Anesthesia Provider Is Born

The Midwest and East Coast were relatively well off financially and could afford to build hospitals with state-of-the-art operating rooms. “In the South, which was making a slow recovery from the ravages of the Civil War, there was neither incentive nor funds to provide the hospital accouterments necessary to the new (aseptic) surgery. A concomitant lack of house officers and interns required surgeons to depend on one another to administer anesthesia and incidentally brought into existence a new category of administrator, the private nurse anesthetist.”⁵¹ One example was Ethel Baxter who described to Thatcher her work between 1901 and 1913 for the surgeon Eugene J. Johnson. “Johnson’s practice took him throughout the impoverished sections of rural Mississippi, and with him went Ethel Baxter, traveling by any available means of conveyance, even ox cart, sterilizing instruments in the kitchen oven, scrubbing floors and dousing the furniture in the operating room with antiseptic solution, and on one

occasion constructing an operating table from two planks pulled off a barn and laid across two casks, the operation being performed on the porch since the flies swarmed less viciously there than in the house.”⁵¹ Thatcher asserted that “such arrangements originated independently throughout other parts of the South and became so well established that the private nurse anesthetist attending her surgeon and acting as an independent agent in providing her equipment and obtaining fees, is a familiar figure in Southern hospitals today.”⁵¹ Surgery was thus extended by nurse anesthetist-surgeon pairs to those who might not otherwise receive it.

A NEW ANESTHETIC METHOD FOR THYROID SURGERY

Hodgins work with Crile did not end with the 1918 armistice. After the war, Crile, like his contemporaries Charles Mayo and William Halsted, pursued thyroid surgery. Crile had observed how patients with hyperthyroidism become excessively frightened when faced with the stress of surgery. “The importance of the emotions in this disease was impressed upon me over and over again.”⁶³ From those impressions, Crile inferred that to “conquer exophthalmic goiter, fear itself must be eliminated.”⁶³ He theorized that a total blockade of peripheral noxious stimuli would prevent the brain from ever generating fearful symptoms. Crile devised an anesthetic method that he termed “anoci-association”⁶⁴ to completely block noxious stimuli from reaching the brain.

Anoci (no injurious) association (stimulus or memory) was produced by the inhalation of nitrous oxide and/or ether along with oxygen, plus the injection of intramuscular morphine and scopolamine, and local anesthetics at the surgical site. In certain instances, brief inhalations of nitrous oxide were begun days before the surgery to condition the patient to wearing a mask. Some contemporary historians of anesthesia and pain therapy think of anoci-association as a premodern version of pre-emptive analgesia.^{65,66}

The nurse-patient relationship was integral to the success of anoci-association. Patients with exophthalmic goiter Hodgins wrote: “are hypersensitive to any external stimuli, their sense of fear is exaggerated, and they make a marked response to even slight physical injury. These patients, therefore, must be approached with great caution.”⁶⁷ For “several consecutive days before the day of operation the nurse anesthetist would administer inhalations of oxygen, with perhaps a very small amount of nitrous oxide.”⁶⁷

On the day of surgery, the most severely anxious patients would be anesthetized in bed using “analgesia plus local anesthesia.”⁶⁷ Stable patients were given nitrous oxide to the point of analgesia and then transported to the operating room on a wheeled stretcher. Some patients were even kept partially awake throughout an operation. Hodgins wrote “it devolves upon the anesthetist to guide the patient through the analgesic stage and to interpret to him comfortably the happenings of the operation.”⁶⁷ During periods of increased surgical stress, “it may be necessary for the anesthetist to explain to the patient that she knows he is not comfortable, and that she is going to let him have a little sleep for a few minutes.”⁶⁷ Anoci-association could be manipulated to produce a less than a complete anesthetic, but it worked. “We have found that, unless there is an utter lack of self-control, patients respond very well indeed to the suggestion that they can co-operate with the anesthetist.”⁶⁷ Because anoci-association sometimes produced less than a complete anesthesia, Crile felt like we “stole the glands of hundreds of patients.”⁶³

COLLABORATION BECOMES A NECESSITY

An initial shortage of physician anesthetists forced surgeons to collaborate with nurses who practiced anesthesia. Collaboration enabled or facilitated surgery. But Thatcher makes the case that as medicine grew more complex during the middle decades of the 20th century, collaboration (she called it interdependence) became a requisite part of progress, and no longer just an innovative stopgap. “Neither medical nor surgical practice could prosper without the host of attendants and tons of apparatus that the hospital provided...”⁶⁸ Inevitably, large institutions and highly organized provider groups evolved to support this type of practice. And medicine became “a graphic illustration of science as a co-operative pursuit in which an accepted interdependence of many classes of workers (dentists, surgeons, obstetricians pharmacologists, physiologists, engineers, anesthesiologists, and nurse anesthetists) was a vital necessity.”⁶⁸ Dentists, surgeons, obstetricians, pharmacologists, physiologists, engineers, anesthesiologists, and nurse anesthetists led to advancements in medications, equipment, and clinical techniques, which were then turned over to commercial enterprises and marketed. Inevitably some excellent pairs emerged. Other pairs deserve our attention. Further investigation would surely advance our understanding of history. It might also enhance our appreciation of collaboration.

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