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A history of Colombian neurosurgery: events, persons, and outcomes that have shaped the specialty in the country

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The history of Colombian neurosurgery is a collective legacy of neurosurgeon-scientists, scholars, teachers, innovators, and researchers. Anchored in the country's foundational values of self-determination and adaptability, these pioneers emerged from the Spanish colonial medical tradition and forged surgical alliances abroad. From the time of Colombian independence until the end of World War I, exchanges with the French medical tradition produced an emphasis on anatomical and systematic approaches to the emerging field of neurosurgery. The onset of American neurosurgical expertise in the 1930s led to a new period of exchange, wherein technological innovations were added to the Colombian neurosurgical repertoire. This diversity of influences culminated in the 1950s with the establishment of Colombia's first in-country neurosurgery residency program. A select group of avant-garde neurosurgeons from this period expanded the domestic opportunities for patients and practitioners alike. Today, the system counts 10 recognized neurosurgery residency programs and over 500 neurosurgeons within Colombia. Although the successes of specific individuals and innovations were considered, the primary purpose of this historical survey was to glean relevant lessons from the past that can inform present challenges, inspire new opportunities, and identify professional and societal goals for the future of neurosurgical practice and specialization.

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The history of neurosurgery in Colombia is part of a gradual process tied to the very fabric of the sociocultural development of the nation itself. It mirrors the country's self-actualization to a republican identity after colonial rule. The history of surgical systematization is also a tapestry of pioneering personalities, exchanges, and innovations. The road to establishing neurosurgery in Colombia had significant milestones that can serve to enlighten neurosurgeons about medical specialization in our own time.

French Influences in the Early Republic: 1822–1848

Neurosurgery's entrance onto the world stage as a specific discipline occurred during the transition from the 19th to 20th century. In countries such as the United Kingdom, France, and Spain, experimental physiology had occurred for much of the 19th century.[1–3] Colombian independence was achieved in 1819, and the new ruling class sought to either reform or revitalize useful Spanish institutions such

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FIG. 1. An oil painting of Dr. Pompilio Martínez by Inés Acevedo Biester, Bogotá, Colombia, August 1938. Courtesy of The National Academy of Medicine of Colombia. Figure is available in color online only.

as the medical establishment. In 1822, just 3 years into its statehood, the new government invited two prominent French physicians, Pierre Paul Broc and Bernardo Daste, to teach at Hospital San Juan de Dios.[4] Broc taught anatomy, and Daste taught surgery. Their adherence to the methods of Broussais (a practical, systematic approach to the body) left a lasting impact on Colombian surgery, such that the Universidad Central de Bogotá's first textbooks were all translations from existing French medical books.[5] Soon, medical students who wanted to further their educations utilized these French connections and thereafter returned to Colombia to train in French anatomoclinical practices.

Surgeons' Roles Redefined: 1849–1892

The second half of the 19th century saw a steady increase in the overall number of physicians and a new role for surgeons. Until this point, most of the so-called "Latin surgeons" who operated across the country lacked formal educations and had merely trained as barbers, "sangradores" (phlebotomists), and apothecarists.[6] By then, a second generation of physicians had returned from their educations in France and found themselves dealing with a significant cholera outbreak in the 1850s and 1860s. Dr. Antonio Vargas Reyes, an internationally trained pathology professor, launched his career in public health in the midst of that epidemic.[7] He made one of the first recorded neurosurgical interventions in Colombia by undertaking "the first esquirlectomy [squirlectomy] in a patient with an open comminuted and subsidence fracture."[8] Although the prominent physicians of this era, such as Samuel Fajardo-Camero and Julio Z. Torres, diagnosed various cranial pathologies and made advancements in treatment, their expertise, like that of Vargas Reyes, was not specialized in surgery alone.

Additionally, the Colombian Liberal Party's dominance of politics in this period promoted policies of greater access to education and licensing for ordinary people. The result was that many physicians felt that practitioners without proper training would soon emerge. They closed ranks and worked toward keeping medical licensing selective.[9] Thus, this period is marked by more staggered progress toward surgical innovation due to generalization and protectionist trends in the medical community.

The Advent of Modern Neurosurgery: 1893–1914

In 1893, Dr. Tomas Quevedo Restrepo, representing the third generation of Franco-Colombian cooperation, diagnosed a tumor in the left hemisphere of the brain of a 35-year-old patient, thereby demonstrating how the anatomical and physiopathological approach had been embedded in the Colombian surgical system. Dr. Quevedo performed the first operation on a patient with a cerebral tumor in Latin America, marking a definitive threshold for specialized neurosurgery in the country's medical history.[10] This surgery also indicated the spread of the neurosurgical specialty beyond the capital of Bogotá, as it took place in the emerging medical system of Medellín. Although Dr. Quevedo's patient died days after the successful surgery, another year would yield more progress. In 1894, Dr. Julio Torres contributed to the momentum of the nascent neurosurgical movement in Colombia by successfully removing a brain tumor, resulting in long-term postoperative survival.[11] Although the success of such craniotomies is significant, the fact that they were performed at all is perhaps even more noteworthy. Craniotomies were mainly considered experimental, even among experienced practitioners such as Sir Victor Horsley in the United Kingdom, who had performed upward of 44 procedures.[12] The Colombian forays into the field were not common occurrences in the postcolonial societies of the time.

At the turn of the 20th century, the bonds between the Colombian and French medical education systems had solidified through nearly 75 years of cooperation. The relationship flowed both ways, as French physicians often spent time teaching and researching in Colombia. This atmosphere afforded even deeper ties to other European countries. Dr. Pompilio Martínez (Fig. 1) typified the experience that a Colombian medical student could attain. After graduating from Universidad Nacional in Bogotá, he pursued advanced surgery studies in Paris, Berlin, and Vienna. Returning to Colombia in 1900, Dr. Martínez advanced the role of the specialized neurosurgeon by performing 12 craniotomies in 6 years with a 90% success rate.[11] His eclectic training was again on full display in 1914 when he performed the first heart surgery in Colombia, when he sutured a traumatic wound to the heart. During this time frame, Drs. R. Posada and J. V. Maldonado conducted successful surgical operations in patients with Jacksonian epilepsy.[13]

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Changes in International Exchange: 1915–1940

Historically, World War I was a driving force in the early growth of modern neurosurgery as a specialty. Throughout history, cranial and spinal war wounds have been the subject of much research, thus resulting in neurosurgical advancements.[14,15] A significant outcome of this global conflict on neurosurgery was a set of basic management principles for intracranial projectile wounds and the development of a training system for time-sensitive cranial interventions. Colombia remained neutral for the duration of the conflict, but the devastated European landscape meant that opportunities for continued collaboration would not be forthcoming. The United States emerged from the war effort, having led the final victorious push without sustaining damage to its infrastructure and with its allies and enemies financially indebted to it. In October 1919, at a meeting of the American College of Surgeons, Dr. Harvey Cushing and a group of surgeons proposed the formation of neurosurgery as a surgical specialty. It was ratified 5 months later in 1920 with the foundation of the Society of Neurological Surgeons.[16] This event shifted the dynamic significantly for Colombian surgeons desirous of furthering their studies abroad. However, enrollment into the United States was by no means immediate. The policies of the United States government in the 1920s were increasingly isolationist and anti-immigrant.[17] As such, some of the first Colombian surgeons to bridge the gap did not start arriving until the early 1930s.

Despite interrupted international exchanges, neurosurgical innovation did not cease in Colombia during this time. In 1925, Dr. Juan Bautista Montoya performed the first arterial sympathectomy in the city of Bogotá. As an echo of the European collaborations of the recent past, Dr. Montoya had the opportunity to be trained by Louis Pasteur and Eugène-Louis Doyen in Paris. After returning to Colombia, he performed several trigeminal rhizotomies that were reported in Dr. Bonilla Naar's 1941 thesis.[18,19] Dr. Montoya was also instrumental in establishing a tradition of technological innovation in the theater of Colombian neurosurgery. He brought the first radiography machine to Colombia only 6 years after its invention by Roentgen.[20] Consequently, the first radiograph ever taken in Colombia was performed as early as 1901. Dr. Montoya also insisted that operating rooms be constructed according to the European standards of the day. He implemented this first at Hospital San Juan de Dios in Bogotá and later at the San Vicente de Paul Hospital in Medellín, of which he was a cofounder. Due to his ubiquitous role as a teacher, practitioner, and innovator, he is widely regarded as one of the pioneers of neurosurgery in Medellín.[21]

Establishing Neurosurgery as a Specialty in Colombia: 1941–1965

The interwar years provided a window across the Americas that allowed for collaboration and training in neurosurgery that had not occurred previously. Not only did Colombian neurosurgeons train in the United States, but also in Chile, Canada, Brazil, and Mexico. Like the first generation of French-trained Colombian physicians who returned to their homeland in the 1840s, these physicians brought the knowledge, techniques, and confidence needed to implement neurosurgical advancements. The leaders of this generation took neurosurgery to new horizons in their respective areas of research, leadership, technical innovation, teaching, and organization of associations.

Dr. Alvaro Fajardo Pinzón became the first Colombian neurosurgeon trained at the Neurological Institute of New York under Drs. Stokey and Scarf. He likewise spent time working with Drs. Adson and Craye at Mayo Clinic in Rochester, Minnesota. He was following in the footsteps of the father of Chile's neurosurgery specialty, Dr. Alfonso Asenjo. The latter would play a role in shaping another neurosurgical innovator in this generation, Dr. Ernesto Bustamante (Fig. 2). Dr. Fajardo returned to Colombia as the first formally trained neurosurgeon from a country that recognized it as a specialty. His arrival in Bogotá signaled the era when neurosurgery would be implemented in Colombia as a specific medical discipline. In 1942, he demonstrated the possibilities of this new chapter by performing the first pneumoencephalography procedure in the country.[8]

Soon after the arrival of Dr. Fajardo in 1945, Dr. Mario Camacho Pinto took his place among the foundational neurosurgeons of the contemporary period. He likewise had trained exclusively in neurosurgery in the United States, pursuing his specialty by working as a traveling "volunteer assistant" to Drs. Walter Dandy and Freeman Watts across the United States.[22] Upon arrival to Bogotá in 1945, he was the first doctor in the country to be officially appointed as a neurosurgeon at Hospital San Juan de Dios. He performed the country's first prefrontal lobotomy by following the technique developed by Egas Moniz that he had practiced under Freeman Watts.[22] In 1943, he published a case series of all the prefrontal lobotomy procedures he had performed with Dr. Luis Jaime Sanchez.[23] In 1951, he became the first professor of neurosurgery at the Universidad Nacional Medical School. That same year, he performed the first cerebral angiogram in Colombia.[24] In addition, his achievements included publishing the first cases related to interventions for subdural hematomas in childhood and the treatment of craniosynostosis.[25] He was a founding member and the first president of the Colombian Neurological Society in 1961.

Bogotá's first neurosurgery service began in earnest in 1952 at Hospital San Juan de Dios with the appointment of Dr. Alejandro J. Jiménez Arango as director. He benefitted from a wide range of international exchanges, starting in Paris and later relocating to Chile to study under the aforementioned Dr. Asenjo. He followed this with a tutorship under Dr. Wilder Penfield in Montreal and a fellowship in neurology at Massachusetts General Hospital in Boston.[8] Dr. Alejandro Jiménez stepped down as chair of the neurosurgery department at Universidad Nacional in 1961 and was replaced by Dr. José Mora Rubio. Dr. Mora Rubio's legacy is far-reaching, and his talent as a physician came from his ability to work in medicine,

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FIG. 2. Dr. Ernesto Bustamante accompanied by his wife and some of his children. Courtesy of the personal archive of Dr. Enrique Osorio Fonseca. Figure is available in color online only.

politics, and academics as he simultaneously managed several public health ministries and institutions during his career.

Another trailblazing figure in the development of Colombian neurosurgery at this juncture was Dr. Salomón Hakim. The son of Lebanese immigrants, Dr. Hakim graduated from Universidad Nacional and further advanced his medical education at Harvard University. He is regarded as a surgeon-scientist because he integrated medical physics, electronics, electricity, and chemistry into his neurosurgical practice.[26] He joined the neurosurgery department at Hospital San Juan de Dios as a teaching faculty member in 1954. In 1957, he came across a rare case of "symptomatic occult hydrocephalus." Using his knowledge and love of physics, he termed the phenomenon "normal pressure hydrocephalus syndrome (NPH)."[27] In 1965, he flew to the United States, accompanying a second patient who was manifesting symptoms because he was convinced that no one would treat her as he indicated. That patient underwent a successful operation at Massachusetts General Hospital, and his results were published in association with attending physician Dr. Raymond Adams in the *Journal of Neurological Sciences*.[28] Ever the scientist, Dr. Hakim developed a pressure-regulating shunt to drain excessive CSF from the brain's ventricular system. He continued to perfect the model over his lifetime and in coordination with his son, Carlos. The Hakim programmable valve (Fig. 3) continues to be one of the best CSF shunts worldwide for the treatment of hydrocephalus.

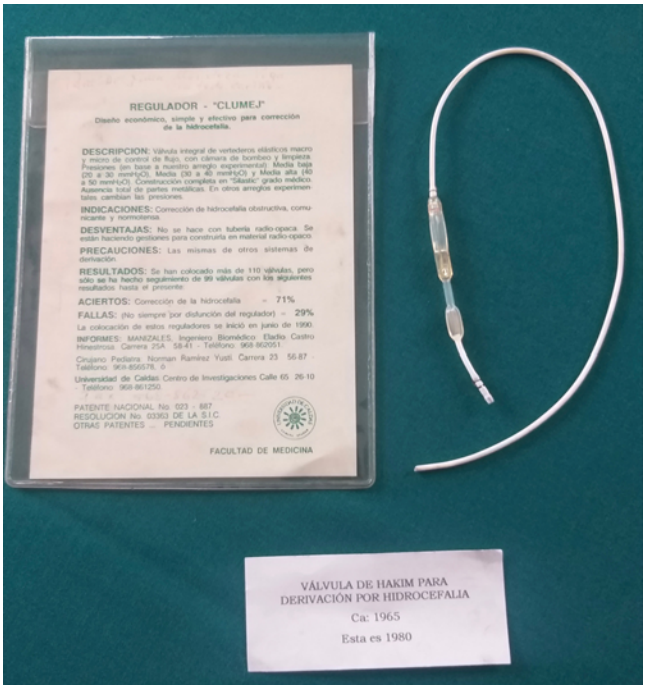


FIG. 3. The valve patented by Dr. Salomón Hakim, on display in the Museum of the History of Medicine. Courtesy of The National Academy of Medicine of Colombia. Figure is available in color online only.

Dr. Bustamante's contributions to Colombian neurosurgery were related to his solid fundamentals and effectiveness as a multigenerational teacher. As a medical student coming up at the University of Antioquia in the 1940s, Dr. Bustamante demonstrated a passion for neurosciences. While still a medical student, he coauthored the first published case of precoronal multiform espongioblastoma.[29] Desiring to deepen his practice, he traveled to

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Chile after graduation. There he trained as a neurosurgeon under the direction of Dr. Asenjo, who had already mentored Drs. Arango and Pinto a few years earlier. Upon Dr. Bustamante's return to Colombia in 1950, he appealed to the dean of the University of Antioquia, Dr. Velez, and the director of Hospital San Vicente de Paul, Dr. Isaza, to found a neurology and neurosurgery service. In 1955, this service accepted its first neurosurgery resident.[30] He enacted a series of "firsts" in a surgical practice rooted in his semiological approach to medicine. Dr. Bustamante performed the first aneurysm clipping in Colombia in 1949, followed by the first temporal lobectomy in 1953, the first hemispherectomy in 1954, and the first commissurotomy in 1966.[31] His lifelong commitment to teaching meant that he exemplified the role of the surgeon-scholar to several generations of Colombian neurosurgeons. His published work was both pervasive and novel, as evidenced by his 1952 seminal analysis of aneurysms coauthored with Dr. Luis Carlos Posada that covered the topic for the first time in Colombia.[32]

A prime example of how these luminaries provided efficacious mentoring can be seen in the contributions of the first-ever neurosurgery resident to graduate in Colombia. In 1958, Dr. Saul Castaño became the program's first success story. Alongside Dr. Bustamante, Dr. Castaño performed the first stereotactic surgery (pallidotomy) in Colombia to treat a patient with Parkinson's disease. The surgery performed on the patient with Parkinsonian symptoms was described as a "chemical lesion to the palladium."[33] This is considered the first stereotactic procedure in the country and shows how functional medicine laid the foundations for future best practices. In 1960, just a couple of years after that famous surgery, Dr. Fernando Rosas Peña built upon this foundational knowledge by creating one of the first pieces of equipment for stereotactic surgery.

Associations, Technical Innovations, and Accomplishments: 1966–Present

As the late 1960s and early 1970s came around, a sufficient number of neurosurgery graduates were available to start organizing themselves into national associations and organizations in order to orchestrate their collective efforts. Dr. Pinto established the Colombian Neurological Society in 1961, and this was soon complemented by the Neurological Institute of Colombia in 1966. Dr. Jaime Gómez González was both its founder and director, representing Bogotá and Universidad Javeriana's commitment to collective efficacy in the field. The most visible indication of the Neurological Institute of Colombia's contributions to neurosciences would be its facilitation of the country's first CT and first MRI scans, which took place in 1977 and 1989, respectively.[34] Neuropathology also became a specific focus in this time frame due to the specialized interest of Drs. Gabriel Toro Gonzalez and Federico Lopez Gaviria.

In this period, the drive for modernization included neurosurgeons who embraced a "tinkering" style to find more effective ways to operate. In 1976, for instance, Dr. Bustamante used a microscope for the first time in Colombian neurosurgery to manage a brain aneurysm.[22] The data attest to the benefits of aneurysm treatment. Dr. Bustamante had intervened in 808 patients in Medellín by 1979, reducing the operatory mortality rate from 25% in 1949 to 8% in 1979. Furthermore, in his prospective work on aneurysms published in 1983, he reported a mortality rate of 2% with a morbidity rate of 6%.[22] In 1987, Dr. Bustamante set another milestone in Colombian neurosurgery when he performed the first central nervous system transplant at San Ignacio University Hospital, implanting a fragment of adrenal medulla into the caudate nucleus of a patient with Parkinson's disease.

In 1981, another technical alteration was added to the earlier work of Dr. Rosas. Upon returning to Medellín from his fellowship in stereotactic surgery, Dr. Luis Carlos Cadavid found difficulties putting everything he learned into practice due to the lack of specialized equipment. Thus, Dr. Cadavid, along with Dr. Gabriel Jaramillo, set about creating the first stereotactic frame made in Colombia.[35] Over the years, significant improvements to the techniques, approaches, and recommendations have impacted neurosurgical practice, not only nationally but internationally.

Another challenge many Colombian neurosurgeons faced in this period was bone reinstitution. Dr. Jaime Fandiño and his group from Universidad de Cartagena proposed using "totumo," a medicinal plant with wound-healing and anti-inflammatory properties that many local physicians use as the primary source for medicines.[36] According to some of the earliest pamphlets available on public health, Colombian medicine has maintained a tradition of putting care "within the common people's grasp."[37] This is reflected in some of the devices and drug patents of the contemporary neurosurgical industry. For instance, Hospital San Vicente de Paul in Medellín patented the cheapest ventriculoperitoneal valve ever made, which costs a mere $30.[38]

Conclusions

The Current Landscape of Neurosurgery in Colombia

Emerging from a small group of thoughtful, committed surgeons, Colombian neurosurgeons now number approximately 500 and serve the medical needs of its 45.5 million inhabitants (Fig. 4). These professionals come from 10 neurosurgery programs that graduate upwards of 20 neurosurgeons each year.[39] Training in all programs requires 5 years of postgraduate education. Of the 10 universities offering neurosurgery training programs, 5 are private institutions and 5 are public. These programs are concentrated in the major metropolitan areas of Bogotá, Medellín, Cali, and Cartagena. The programs offer placement to 1–3 residents annually. There are no community programs in Colombia because the Ministry of Health only recognizes University Hospital–affiliated residencies.

The role of women in Colombian Neurosurgery is steadily growing. At present, 40 women practice neurosurgery in the country, and the Colombian Neurosurgery Association counts 30 women among its members. Currently, 17 female residents are enrolled in all 10 residency programs, each of which has at least 1 or 2 female resi-

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FIG. 4. A photograph of several notable Colombian neurosurgeons taken on the occasion of the 50th anniversary of the founding of Universidad del Valle Neurosurgery (August 15, 2008). Courtesy of the personal archive of Dr. Enrique Osorio Fonseca. Figure is available in color online only.

dents (Table 1). The programs enjoy both national and international prestige thanks to the confluence of various schools of medicine, both past and present, that have shaped their theory and praxis. Overall, the history of 20th century neurosurgery cannot be reduced to any singular legacy or innovation but the willingness of its practitioners to seek out change, stimulate curiosity, and selflessly and compellingly build upon each other's successes. These are powerful lessons from the past that can inform present challenges, inspire new opportunities, and identify professional and societal goals for the future of neurosurgical practice and specialization.

TABLE 1. Five-year neurosurgery residency programs in Colombia run by university medical schools

University	City	No. of Residents Admitted Annually
Universidad de Cartagena	Cartagena	1
Fundación Universitaria de Ciencias de la Salud (FUCS)	Bogotá	2
Universidad Nacional	Bogotá	2
Universidad Javeriana	Bogotá	2
Universidad El Bosque	Bogotá	2
Universidad Rosario	Bogotá	3–4
Universidad Militar Nueva Granada	Bogotá	2
Universidad del Valle	Cali	1
Universidad de Antioquia	Medellín	3
Universidad ICESI	Cali	1–2

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Alvernia, Osorio Fonseca, Cadavid, Cespedes. Acquisition of data: Osorio Fonseca, Cadavid, Cespedes, Vargas, Berbeo, Ordóñez-Mora. Analysis and interpretation of data: Cespedes, Gonzalez, Ordóñez-Rubiano. Drafting the article: Osorio Fonseca, Cespedes, Vargas, Grady, Gonzalez, Berbeo, Ordóñez-Mora. Critically revising the article: Alvernia, Grady, Ordóñez-Rubiano. Approved the final version of the manuscript on behalf of all authors: Alvernia.

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