

## Historical Review

# Reflections on a career in neurosurgery

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## Abstract

Robert Heimbürger recounts his career in neurosurgery, including some of the early years of modern neurosurgery and some of the contributions he made, particularly in the areas of early repair of myelomeningocele and spinal cord tethering, high-intensity focused ultrasound for the brain, stereotactic surgery, washing hair and scalps instead of shaving for cranial surgery, and neurosurgical consultation in Asian countries. Now aged 96, he continues to have a keen mind and thorough commitment to the profession that offered him a lifetime of inspiration and service.

**Key Words:** High-intensity focused ultrasound, history of neurosurgery, myelomeningocele, spinal cord tethering, stereotactic surgery

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## INTRODUCTION

Robert F. “Bob” Heimbürger, M.D., FACS was born in China in 1917, and his home was on the campus of Shantung Christian University (now Shandong University) in Tsinan (now Jinan), Shandong Province until his family returned to the US in 1934. He graduated from Drury College in Springfield, Missouri in 1939 and from the Vanderbilt University School of Medicine in March, 1943 (the first wartime accelerated medical school class). After completing 2 years of general surgery residency at Duke University, he was drafted to report for duty with the US Army. When the officer in charge of assigning newly arriving MDs learned that Bob had spent his last 6 months at Duke on the Neurosurgical Service, he said, “you are a neurosurgeon!” and confirmed a decision Bob was already making. Stationed at Mayo General Hospital in Galesburg, Illinois, Bob learned many neurosurgical procedures on the job, performing laminectomies for spinal cord decompression, cordotomies for pain, spinal nerve sections for spasticity, peripheral nerve repair procedures, and pressure sore repairs. He spent many

days splicing nerves severed during World War II service, sometimes an arm in the morning and a leg in the afternoon, or vice versa. He frequently wished he could examine these brave men months or years later to see if there had been any return of function from the hours he had spent patiently getting their severed nerves’ ends back together.

Upon completing his Army duty, in 1946 Bob entered neurosurgery residency at Chicago Memorial Hospital, under Drs. Paul C. Bucy and Percival Bailey. Recognizing the value of his experience in the Army, the American Board of Neurological Surgery gave him a year’s credit toward neurosurgical board eligibility. In fact, he got far more hands-on surgical experience in the Army than he did during his 2 years of neurosurgery residency. Except for an emergency evacuation of a subdural hematoma while Dr. Bucy was out of town (Dr. Bailey told him on the phone “go ahead”) and an elective release of an ulnar nerve entrapment in which he was already quite experienced, Bob only assisted Bucy with surgeries. His 2 years of residency never afforded him the opportunity to perform surgeries himself. He had plans, and an

impending National Institutes of Health grant, to conduct histopathology and neuropsychology research with Dr. Percival Bailey on patients undergoing brain surgery at **Illinois Neuropsychiatric Institute**. However, this changed when he was invited in 1948 to spend a few months at Indiana University Medical Center (IUMC) in Indianapolis, Indiana while the university sought a neurosurgeon to establish their Neurological Surgery Service and Residency Program. A few months turned into 40 years, as he was asked after a time to serve as the first director of the Division of Neurosurgery, a position he held until 1961. Although he spent the last years of his career, 1983-1988, at Chang Gung Memorial Hospital in Taipei, Taiwan, building additional neurosurgical capacity near the land of his birth, he maintained his faculty appointment at the Indiana University School of Medicine until he retired in 1988.

In this article, Bob Heimburger attempts to recount some of the early years of modern neurosurgery and some of the contributions he made. Now aged 96, he continues to have a keen mind and thorough commitment to the profession that offered him a lifetime of inspiration and service.

The suggestion from Dr. James Ausman, Editor of *Surgical Neurology International*, that I submit a paper for publication caused me to wonder. What could a 96-year-old, 25-year retired neurosurgeon add to a scientific journal like *Surgical Neurology International*? It would take me completing a full 4-6 year neurosurgery residency to learn procedures done regularly by neurosurgeons these days. After considerable contemplation, I decided that younger neurosurgeons might be encouraged to be innovative if they read some recollections of the early days of modern neurosurgery, including some ways in which I might have been innovative. The first could be my accepting Ruth Kerr Jacobi, M.D., to the Neurological Surgery Residency at IUMC. She was possibly the first woman to become a neurosurgery resident. This memory reminds me of other ways in which I may have been innovative.

I was welcomed to IUMC in July 1949 by Drs. Bill Freeman, Chief of Experimental Surgery, and Harris B. Shumacker, Chief of Surgery; I had made friendships with both of them at Mayo General Army Hospital, in Galesburg, IL.<sup>[6-9]</sup> At IUMC I was assigned a desk in the Surgery Department, and given directions to a convenient boarding house where one of the surgery residents lived. As soon as I reached Indianapolis, I started to perform many different surgeries at a busy pace, while waiting to be told that I could return to my planned career at Chicago Memorial Hospital, working with patients thought to require prefrontal lobotomies, under the guidance of neurosurgeon and neuropathologist Dr. Percival Bailey.

It is hard to remember which of the IUMC Administrators, Harry Shumacker, or the Dean of the Medical School, or someone else, casually asked me if I could stay on the faculty of Indiana University School of Medicine. Drs. Bailey and Bucy said that sounded like a good opportunity, and I agreed, as I enjoyed being very busy performing numerous neurosurgical operations (none of which I had done myself previously; I had only assisted Dr. Bucy during my 2 years of residency under him, but he prepared me to do virtually any neurosurgery operation myself).<sup>[1]</sup>

## EARLY REPAIR OF MYELOMENINGOCELE AND SPINAL CORD TETHERING

One of these procedures was the closure of spina bifida or myelomeningocele in newborn babies. Some of the babies had a long portion of their spinal cord exposed in a cyst, but the cysts in others were much less extensive. In some babies the cyst ruptured during birth while in others they were less extensive and did not rupture during delivery. Advice in textbooks and medical journals at the time was to treat these unfortunate babies with tender care but leave the defects in their backs alone until they were 6 months or older before trying to close the tissue over the exposed spinal cord. Most of the babies succumbed to meningitis in spite of extensive care provided by mothers, families, and experts. The normal faces and intelligent eyes of the babies who were brought for my examination caused me to think that they deserved better than to wait 6 months for surgery.

A paper in a medical journal written by a young neurosurgeon, William R. Chambers, reported better results if these babies had their spinal canals closed surgically soon after birth, so I began performing early surgical closure of their spinal defects.<sup>[3]</sup> Family physicians hearing of my willingness to do so would occasionally phone in the middle of the night to say, “get the OR ready; I’m bringing one to you!” The babies arrived held gently in the arms of a nurse or relative, often in the family physician’s car. The family physicians liked to scrub in with me and a surgical resident for these operations. All of the babies survived.

I gave a talk about these operations to a surgical society in London, England. After my presentation, a young surgeon asked, “Why bother with these poor defective babies?” Now, with decades of hindsight and thousands of persons with congenital spinal defects leading normal lives, the answer is obvious.<sup>[24]</sup> Was this the beginning of progressively early repair of congenital spinal defects, even to closing the babies’ spinal defects while they are still *in utero*?

Another defect was tethering of the spinal cord by a *filum terminale* that failed to grow, stretching the spinal

cord and nerve roots as the child's body grew longer. Severing the *filum terminale* surgically relaxed the stretched spinal cord to relieve urinary dysfunction, and eventually serious pain and neurological dysfunction, and allow their nerve roots and muscle connections to function more normally.<sup>[36]</sup> In spite of this, it has been hard for many surgeons, particularly orthopedic surgeons, to recognize *filum terminale* tethering of the spinal cord, as an effective and relatively easy surgical procedure.

## HIGH-INTENSITY FOCUSED ULTRASOUND FOR THE BRAIN

During a neurosurgical meeting in Philadelphia, engineers William and Frank Fry presented a paper about very selective, localized destruction of small brain nuclei or tracts in cats. The idea of using the technique and other stereotactic surgery procedures to treat Parkinsonism and other conditions intrigued me. I contacted the Fry brothers at the University of Illinois in Champaign-Urbana, Illinois. They had already made arrangements with my neurosurgeon friend Dr. Russell Myers to build an apparatus to use high-intensity focused ultrasound (HIFU) to make very discrete brain lesions in patients at the University of Iowa, in Iowa City. I made several trips to Iowa to watch Russell Myers and his team use the huge stereotactic unit the Fry's had built to produce discrete HIFU lesions in the brains of patients with a variety of movement disorders. None of the patients I saw in Iowa seemed to have received much benefit from their HIFU therapy. Each of Russell Myers' patients had had a large segment of skull removed to allow the HIFU to reach the desired target in the patient's brain structure, for example, a part of the thalamic nuclei, near the center of the brain. Soon after my visits, the Iowa team stopped performing their HIFU procedures to allow careful evaluation of their results, because they had not produced the benefits they hoped for in their first 100 patients.

My 120-mile drives to Champaign-Urbana to visit the Fry brothers' ultrasound laboratory became almost monthly. With the help of relatives, I brought several patients with malignant brain tumors to the University of Illinois to receive HIFU in an attempt to diminish the spread of their malignant brain tumors. We found that chemotherapy and radiation treatments seemed to be enhanced by the HIFU treatments so that the patients had considerably longer than expected survivals. One young man lived a normal life for 17 years after his glioblastoma multiforme was diagnosed and partially removed; the remaining tumor was treated with HIFU in the Fry's ultrasound laboratory, prolonging his life many times over the usual 12 months of survival. The young man seemed normal cognitively, neurologically, and physically for his 17 years of survival.

A young woman with a malignant right temporal lobe glioblastoma multiforme tumor was sent from a well-respected east coast hospital back to her parents' home in Indianapolis to die. Her parents brought a vivacious young woman to see me, carrying films showing a sinister-appearing mass in the right temporal lobe of her brain. I persuaded her and her parents to see what we could do with HIFU. At the Fry's ultrasound lab, she and her parents were impressed by the ultrasound equipment we used to see her tumor more precisely. She recovered quickly from my removal of her right temporal lobe, which contained all we could identify of her glioblastoma multiforme. We took her back to Champaign-Urbana several times for HIFU therapy while her parents became increasingly impressed by the Fry brothers and their innovation. We found that HIFU significantly improved the treatment results of the few malignant brain tumors we treated with ultrasound in addition to chemotherapy and radiation.<sup>[30]</sup>

This young woman survived five good years instead of the expected one to one and a half years. Her parents provided a sizeable grant to help move the Fry's ultrasound laboratory from the University of Illinois to IUMC. Indiana University administrators were also impressed enough with what they saw at the Fry Laboratory to welcome its move to IUMC. With great ingenuity the Fry brothers transported their stereotactic HIFU instrument on trucks and brought it to IUMC. Because the instrument weighed more than a ton, the IUMC Maintenance Department strengthened the floor of a second floor operating room in the James Whitcomb Riley Memorial Children's Hospital, with large steel beams. Moving the Fry Laboratory to IUMC enabled years of fruitful service and research on ultrasound uses in the brain, including imaging research, which was eclipsed by the invention of the computed tomography (CT) scan in the 1970s.<sup>[13-15,34]</sup>

## STEREOTACTIC SURGERY

The Fry brothers' stereotactic HIFU instrument was unique in being usable for very precise stereotactic surgery, with the patient's head in several different positions. None of the stereotactic surgery instruments in use by others at the time could be used to enter the posterior skull to create lesions in cerebellar nuclei, but at my request, the Fry instrument included that possibility. We practiced with the new instrument by fixing a human cadaver head (not just a skull!) into the instrument's head-holding device, with the face to either side, as well as the face up and face down positions. Doing so gave us good experience, as we got ready to do stereotactic surgery on living patients.<sup>[22]</sup>

The moveable X-rays units used to identify the desired target in a patient's brain were unreliable until two

small X-ray units were permanently attached to the head-holding device. The films made with the firmly fixed X-ray units provided measurements that were extremely precise. Positive contrast ventriculograms, which IUMC neurosurgical staff had introduced at about the same time, were put to good use to guide electrodes precisely to the desired targets in the patients' brains. It was thrilling to watch awake, lateral-lying patients hold up a tremulous Parkinsonian arm and see the tremor stop the moment the electrode was advanced the last millimeter to the target. Delighted patients would move their arms, watching as their hand and arm came under their own conscious and complete control. The instrument was used with increasing confidence and accuracy for almost 1000 stereotactic surgeries, mainly for Parkinson's Disease.

Excess blood loss from the 2 cm scalp incisions needed for making burr holes in patients' skulls was corrected by making the skull opening part of the electrode guidance system. Our IUMC machinist, Mr. Bob Leckrone, made guides for long 3/8 inch drill bits placed against the patient's skull through a 1/2 cm scalp incision. Only a few mm of the drill bit was allowed through the guide, to prevent the twist drill from penetrating the dura mater. The 3/8 inch hole in the skull became part of the guidance of the electrode going through the pierced skull and dura mater to the brain target chosen on the ventriculograms during stereotactic surgeries. At first we were concerned about the possibility of bleeding from the pierced dura mater, but bleeding never has become a problem in the several thousand skull holes made. Each patient had at least two 3/8 inch skull holes made, one for the ventriculogram and the other for the minimally destructive electrode.

### Spasticity

Our first stereotactic approach to the cerebellar nuclei was in an alert 10-year-old boy with cerebral palsy who constantly squirmed around, while he was awake, in his padded crib. Under general anesthesia to keep him from being frightened, he was placed in the face down position in the Fry's stereotactic surgery instrument. As with all the patients, a positive contrast ventriculogram provided an excellent view of the fourth ventricle, from which accurate measurements could be made to the child's cerebellar nuclei, which were targeted and partially destroyed. The boy woke up with less of his "squirming" movements, but as alert as he had been preoperatively. On a visit about 2 years later, I found him much bigger and kneeling in his high-sided bed making noises in what seemed to be an attempt to speak, but with no evidence of the squirming he showed before his cerebellar nucleus surgeries. Stereotactic dentatectomies, putamenotomies, and posterior rhizotomies in other cerebral palsied children and adults had similar but not as pronounced improvements in their involuntary movements, as observed in the first boy.<sup>[10,17,21,23,26,28,29,31]</sup>

Fortunately, IUMC's entire neurosurgical staff had been working on adapting a positive contrast liquid for use in myelography and ventriculography.<sup>[2,11,12,16]</sup> Neurosurgery resident Charles Goodell used methylglucamine iothalamate, and found it very suitable for visualizing both the spinal canal and cerebral ventricles in animals. When injected into the spinal canal or ventricular system of dogs, there was no difficulty or abnormal reaction. This was the same with humans, but other positive contrast materials caused unpleasant reactions in animals, and consequently were not used in humans.

### Convulsive and behavioral disorders

Stereotactic amygdalotomy seemed a worthy procedure for helping people with difficulty controlling their violent outbursts of anger, leading to injury to other people and property damage.<sup>[18-20,27,35]</sup> One of the first amygdalotomies we did was on a generally very pleasant man who periodically flew into a rage, hurting people and damaging things. He was confined to a secure psychiatric hospital, whose staff asked if I could help him. He remained pleasant while his head was being fixed in the stereotactic head holder, as well as during the stereotactic surgery itself. As soon as his head was released from the head holder, he stood up before he could be moved to his secure room, and anxiously started feeling about his clothing, asking "where is my pipe", which of course he had not brought into the operating room. He calmed down very quickly and remained pleasant. The hospital where he was confined allowed him to leave and seek a job away from psychiatric care. He married, and seemed to have a normal psyche, but after several years he started having heated arguments with a neighbor, and was again confined in the psychiatric hospital. He was brought to me again, and I performed an amygdalotomy on the opposite side. He got along well, fully awake, during and after the second stereotactic amygdalotomy, and was again released from the psychiatric hospital, but after a number of years he was again confined to a secure psychiatric hospital. No clinical report became available on him, and I was unable to visit him as the psychiatric hospital was a long distance from IUMC.

A middle-aged woman had been evicted from several nursing homes because of angry destructive behavior, and her daughter could not manage her in her daughter's home. We performed an amygdalotomy, and the patient was very pleasant, talking and laughing while her head was fixed in the stereotactic head holder. She maintained cheerful conversation as the electrode approached the chosen amygdala target. The moment the electrode moved the final millimeter to the target, she started to sob, remembering her deceased husband. As the surgery finished, she became cheerful again. After several years her daughter reported that she was able to care for her mother in the daughter's home, with only occasional brief times of "grumpiness".

## WASHING HAIR AND SCALPS INSTEAD OF SHAVING FOR CRANIAL SURGERY

Shaving patients' heads, especially women's, for the small incisions used in stereotactic surgeries seemed excessive, so we started washing patients' hair and scalps with the soap used for preparing surgeons' and nurses' hands for surgery. This washing was done twice in the evening before surgery and once again on the day of surgery. One centimeter of hair was shaved at the time of surgery, to keep hair from being dragged into the operative incision. This procedure worked so well for stereotactic surgery that it was also used for craniotomies, thus requiring shaving of only about a cm around the curve of a craniotomy incision. This preparation was satisfactory without a single infection in numerous cranial surgeries.

## NEUROSURGICAL CONSULTATION IN ASIAN COUNTRIES

Indiana University Chancellor Herman B. Wells became concerned that only one medical school was left in Pakistan when it was partitioned from India in the 1940s, so Dr. Wells offered to help Pakistan establish additional medical schools. Several Pakistani medical school faculty members came to IUMC to observe changes that had been made in preclinical medical education. After they returned to Pakistan, they asked for assistance with clinical medical education as well. I was asked to go to Pakistan to learn what I could about the need for residency-level training there. For 3 months at the end of 1962, I visited the 10 new medical schools that had been started in Pakistan. I reported to the IUMC administrators that it would be very good to help establish residencies in surgery, medicine, pediatrics, and obstetrics and gynecology in Pakistan. Soon we learned that US government funds would no longer be available, so my 3 months in Pakistan were very pleasant, but unfortunately not immediately helpful for Pakistan medical education.

In the late 1970s an invitation to spend 6 months in Jesus Hospital in South Korea intrigued me because it brought me close to China where I grew up. My wife was eager to accompany me, so we had 8 very pleasant months in South Korea. Jesus Hospital was an attractive modern building with a large very competent staff of Korean and American physicians and surgeons. There were two young Korean neurosurgeons who had completed their training in Korea, and four resident neurosurgeons. It was not long before they learned that I had been doing stereotactic surgery, so I was sent back to IUMC to bring my stereotactic instrument (which was now quite portable), to use and teach in Jesus Hospital. This was the first stereotactic surgery done in Korea. We completed a number of stereotactic procedures,

mainly for Parkinsonism, and the Korean neurosurgeons persuaded me to leave my stereotactic instrument in Jesus Hospital, where it was used for several years after I left. I also carried out some of my duties as National Civilian Consultant for Neurosurgery to the Surgeon General, US Air Force, by making several official visits to US air bases in South Korea.

A few years after we returned from South Korea, still with a desire to connect with the Asia of my boyhood, it was suggested that I apply for a position at the 3000-bed tertiary care Chang Gung Memorial Hospital outside Taipei, Taiwan. My first letter of inquiry was returned, saying "you're too old," so I dropped the idea, but later I received an official invitation to serve at Chang Gung. I decided to go even though my wife decided not to join me. I found there a well-established neurosurgery service with two Taiwanese neurosurgeons, each of whom had completed very good residencies in Taiwan, in addition to four Taiwanese neurosurgery residents. I was provided a nice office and apartment, and after a short wait, a car. I became involved in multiple surgeries with residents, including several percutaneous coagulations of thoracic sympathetic nuclei for hyperhidrosis (sweat dripping from the hands), a condition that is a great deal more common in Taiwan than in the USA. My Taiwanese colleagues also requested that I bring a stereotactic instrument, so machinist Bob Leckrone obliged by building another instrument. I used the new instrument for a number of procedures, but none of the Taiwanese neurosurgeons or residents desired to use it, possibly because it did not look as sophisticated as the commercial stereotactic instruments they had seen. I served in Taiwan for 5 years, returning to the US for a couple of weeks in the summer and again for the Christmas/New Year holidays. I enjoyed returning to the land and culture of my childhood, contributing teaching and mentoring to neurosurgeons in training, and refreshing and using my Mandarin language skills.<sup>[4,5,25,32,33]</sup>

## RETIREMENT

Upon returning from Taiwan in 1988, I retired from IUMC and donated my personal medical library to the Chang Gung Memorial Hospital Library. My wife was glad to get the books and bound journals out of our garage! The next I saw them, when I visited Taiwan a couple of years later, they were neatly arranged on shelves of the Chang Gung Hospital Library, to be used by the residents and staff. I am thankful to God for a lengthy and satisfying career during a time when the ranks of neurosurgeons and the surgical procedures they performed were growing rapidly. Many people throughout the world have been helped to achieve lives of better health and fulfillment, and neurosurgery has played a prominent role in that improvement.

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## Commentary

Somerset Maugham (1874–1965), physician, British playwright, and novelist contemplated his life in the fourth quarter and summarized his thoughts in a little book, *The Summing Up*. Looking back over a lifetime of accomplishments, he summarized it all in one sentence: “The meaning of life lies in what one wills to create.”

With the humility exemplified throughout his career as a teacher, experimental scientist, neurosurgeon, and father, Dr. Heimbürger, in his “reflections,” all too briefly touches on the areas in which he also demonstrated incredible creativity. His boldness and creativity undoubtedly was enhanced by his mentors during his residency in Chicago. Dr. Paul Bucy, a major force in neurosurgery at the time; Dr. Percival Bailey, a world renowned neurosurgeon and

neuropathologist; and Dr. Ward Halsted, a pioneer neuropsychologist in evaluating behavior of people with known frontal lobe damage all were his mentors. Having just finished his residency, he was recruited to be the first Chairman of Neurosurgery at Indiana University.

As the only medical school in the state, the James Whitcomb Riley Pediatric Hospital became the center for virtually all of the myelomeningocele children and thousands of children born with spasticity. His pioneering of new techniques for closure of spina bifida and his empathetic approach saved the lives of thousands of “defective” babies. He also pioneered posterior cervical rhizotomies for reducing spasticity in children with cerebral palsy.<sup>[1]</sup>

It was his frustration with the current treatment, or better, lack thereof of involuntary movement disorders and major behavioral problems that prompted his most significant and innovative contributions. His interests in stereotactic surgery led to visits to multiple centers and leaders in the field at that time. These included Doctors Ernst Spiegel and Henry Wycis in Philadelphia where he learned of the rationale for choices in deep brain targets for stereotactic treatment of various diseases. Irving Cooper in New York showed him his stereotactic instrumentation for the treatment of dystonia and Parkinson's disease. Then in 1953–1954 while serving in the air force in Germany he visited Cecile and Oskar Vogt and witnessed exacting studies of human basal ganglion anatomy and pathology. In the early 1960s he collaborated with William J. Fry of the University of Illinois and constructed a one ton stereotactic instrument for the treatment of Parkinsonism that was called “the monster.”<sup>[3]</sup>

After hearing of the work of Hirotaro Narabayashi from Japan who successfully performed amygdalotomies in patients with violent behavior disorders, he directed his attention to these patients. As a resident at Indiana University at the time, I vividly recall doing histories and physical examinations on patients from maximum security prisons with violent and at times uncontrollable tempers. Restrained with hand and ankle cuffs and sometimes in strait jackets, they were referred for stereotactic amygdalotomy.<sup>[2]</sup> Many of these patients

subsequently became calm enough to mingle with other inmates in the stressful prison environment and were able to leave their cages in solitary confinement.

In the words of Patrick J. Kelly of New York, “Heimburger was a pioneer who developed an interest in stereotactic procedures at the dawn of human stereotaxis.” Permeating his entire career was a deep spirituality and faith that no doubt derived from his missionary parents in China where he was raised. No doubt this subsequently influenced his decision to go to South Korea and Taiwan to teach and to continue to sow the seeds of creativity that so characterized his life and the neurosurgical residents and faculty whom he taught there.

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