Historical vignette


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Theodore Brown Rasmussen succeeded Wilder Penfield as director of the Montreal Neurological Institute (MNI) and held this post from 1960 to 1972. His meticulous follow-up analyses of the MNI seizure series provided substantial evidence for the success of surgery in the treatment of focal epilepsy. In addition, he made significant contributions to surgery of the pituitary gland for control of cancer, treatment of cerebral and spinal tumors, application of the intracarotid Amytal test for lateralization of speech and memory function, and characterization and treatment of epilepsy accompanied by chronic encephalitis, now referred to as Rasmussen syndrome. His painstaking attention to surgical details as well as his insistence on close monitoring of patient care and critical scrutiny of clinical results marked him as an outstanding teacher and role model for young neurosurgeons and neuroscientists.

KEY WORDS • intracarotid Amytal test • epilepsy surgery • Montreal Neurological Institute • Wilder Penfield • Rasmussen syndrome

Theodore Brown Rasmussen became the second director of the MNI and held this post from 1960 to 1972; he succeeded Wilder Penfield, who had founded and directed the Institute since 1934. Rasmussen was born on April 28, 1910, in Provo, Utah, the son of Gertrude Brown and Andrew Theodore Rasmussen. His father was a professor of neuroanatomy at the University of Minnesota, and many students benefited from the elder Rasmussen’s compact but comprehensive Outlines of Neuro-Anatomy. Theodore Rasmussen attended and graduated from the University of Minnesota (B.S., M.B., 1934; M.D., 1935; and M.Sci. in neurology, 1939). He supported himself while attending medical school by playing the clarinet and saxophone in a jazz band. Because of his keen interest in track and field sports, in 1935 he arranged a rotating surgical internship for a year and a half at King’s County Hospital in Brooklyn, New York, so he could attend these events at Madison Square Garden. At King’s County Hospital, Rasmussen came under the influence of Dr. Jefferson Browder, a trainee of Harvey Cushing, who had developed one of the best centers for the treatment of head injuries in the world. Young Rasmussen decided on a career in neurosurgery. Dr. Owen Wangensteen, whom Rasmussen had come to know at the University of Minnesota, advised the young physician to do his neurosurgical training with Wilder Penfield at the MNI. Rasmussen contacted Dr. Penfield, who immediately offered the younger man a temporary internship in Montreal for 4 months. Regarding this opportunity, Ted later commented, “I wasn’t sure, because it meant giving up a marvelous job as admitting physician at King’s County Hospital with one hundred dollars a month plus room, board and laundry.” Then he recalled with a chuckle, “I mentioned my doubts to a friend who reacted with: ‘My God, a chance to work with Wilder Penfield ... take the next bus to Montreal.” Thus Rasmussen spent 5 months at the MNI and then, following Penfield’s suggestion, studied for 3 years as a fellow in neurology at the Mayo Foundation.

In the Laboratory for Experimental Surgery and Pathology at the Mayo Foundation, Rasmussen demonstrated that clipping the middle cerebral artery in the dog produced a gross infarct with pronounced hemiparesis, whereas attaching a clip to either the anterior or posterior cerebral artery did not produce significant brain damage. This experimental work gained him a master’s degree in science and became the basis for later investigations on cerebral ischemia. He also reviewed a series of 557 intraspinal tumors with Kernohan and Adson, cataloguing the differential diagnosis, pathological classification, and distribution of these lesions along the spinal axis. In their 1940 report the authors also referred to 350 cases of protruded intravertebral disc, a condition described only a few years earlier by Mixter and Barr in Boston and by Love and Camp at the Mayo Clinic. During this period Rasmussen began his longstanding

Abbreviation used in this paper: MNI = Montreal Neurological Institute.
interest in the pituitary gland; he participated in a study with several colleagues including his father, which demonstrated that cutting the pituitary stalk in dogs produced persistent hyperthermia. These researchers subsequently showed that local heating of the anterior hypothalamus suppressed shivering and produced peripheral vasodilation. On the clinical service, the younger Rasmussen was exposed to many experienced teachers, including the senior neurologists Henry Woltman and Fred Moersch, and the ophthalmologist Henry Wagener. During this time at the Mayo Foundation, Rasmussen developed a solid background in experimental and clinical neurology, which would prove invaluable in his future neurosurgical career.

Ted Rasmussen returned to the MNI from 1939 to 1942 for his neurosurgical training under the tutelage of Wilder Penfield, William Cone, and Arthur Elvidge. Despite the war, these were good years at the Institute, with a group of trainees including Boldrey, Erickson, Pudenz, Odom, and others, who would become leaders of neurosurgery in America (Fig. 2).

**Military Service**

Eight months before completing his senior residency, Rasmussen was called on by the US Army. He spent the next 4 years as chief of the neurosurgical section, first at the 14th Evacuation Hospital and later at the 20th General Hospital, in the India–Burma theater of operations. He was discharged with the rank of lieutenant colonel. During his time in the military he treated a series of 100 patients with caus-
algia by applying a procaine block or performing sympathectomy, a series that he later reported on with a colleague and that was published in the *Journal of Neurosurgery*.41

**Return to McGill University**

Following the war, Rasmussen spent 2 years as an assistant neurosurgeon and a lecturer in neurology and neurosurgery at McGill University. During this time he worked with Wilder Penfield on detailed analyses of the cortical localization of sensory, motor, and speech function in 400 patients in whom brain mapping had been conducted as part of the surgical treatment of epilepsy. This extensive review spawned a flurry of reports on eye movements, vocalization and speech arrest, and sensorimotor representation as defined by cortical stimulation,39 culminating in a monograph by Penfield and Rasmussen entitled *The Cerebral Cortex of Man*19 (published in 1950), which is now considered classic reference in this field. It included detailed maps of the sensory and motor cortex and from these were derived new versions of the now-familiar homunculus representing the topographic pattern of the motor and sensory cortex (Fig. 3).

**Professorship at the University of Chicago**

In 1947 Rasmussen became professor of neurological surgery at the University of Chicago. Here he initiated a novel project with a team of radiation physicists to use radioactive yttrium, which delivers $\beta$ radiation, to ablate the pituitary gland in the treatment of patients with metastatic cancer.56 The clinical application of this technique followed detailed experiments on the reaction of brain and pituitary tissue to $\beta$ radiation.49 Rasmussen and his father also published a noteworthy report on the histological characteristics of the pituitary gland of Bushman, a 500-lb gorilla from the Lincoln Park Zoo who had succumbed to a strange peripheral neuropathy related to a deficiency of dietary factors.21,44

Rasmussen again took up the problem of cerebral ischemia in a definitive series of experiments with Harvey. They determined that temporary clipping of the middle cerebral artery for 50 minutes in monkeys produced an infarct approximately as large as that following permanent occlusion, but no gross cortical changes were observed after occlusions lasting less than 30 minutes.11 They noted an alteration in the electrocorticogram within a few seconds after clipping and observed the reversibility or permanence of slow waves on electroencephalograms postoperatively.10 They also described vasospasm following surgical manipulation of the artery. These findings represented the first available data on changes in the primate brain associated with controlled temporary occlusion of a single important cerebral artery.

**Second Return to McGill University and the MNI**

After 7 years in Chicago, Dr. Rasmussen returned to McGill University in 1954 to become professor and chairman of neurology and neurosurgery, in charge of the teaching, research, and residency programs. When Wilder Penfield retired in 1960, Rasmussen succeeded him as director of the MNI, taking over the additional responsibilities of the clinical activities of the hospital as well as the Institute’s separate research budget. During his term, he also served as neurologist and neurosurgeon-in-chief at the Royal Victoria Hospital (Fig. 4). In 1963 in response to provincial legislation, the Montreal Neurological Hospital was constituted, legally separating the 135-bed hospital from the teaching and research institute, and Rasmussen assumed the title of the first director-general. He efficiently administered this trinity of the MNI, the Montreal Neurological Hospital, and the Department of Neurology and Neurosurgery in a well-
ordered and evenhanded manner, while he continued to engage in active surgical practice and clinical research. By 1972 when he turned over the reins to the third director, the administrative affairs of the Institute and the Hospital were smoothly organized and financially viable, providing a firm matrix for building expansion and the developments in brain imaging that occurred in the 1970s and 1980s.

Further Contributions to Neurosurgery

At the MNI, Theodore Rasmussen continued his contributions to important aspects of neurosurgery, some of which may be mentioned as examples of his varied but persistent interests. Among his most widely cited studies was his substantiation of the application of the intracarotid Amytal test introduced by Juhn Wada of Japan. At the MNI Rasmussen engaged Wada to determine in monkeys the effective dosages of the drug so that the test could be safely used in patients for defining cerebral lateralization of speech function. Rasmussen greatly extended the value of this test by suggesting that it be modified as well for assessment of memory and electroencephalographic localization of epileptogenic areas. This wider application of the test resulted in many refinements of the technique, improved its value as a diagnostic method, and cast new light on cerebral dominance and handedness.

In these clinical research projects, Theodore Rasmussen worked closely and effectively with Herbert Jasper, Francis McNaughton, Preston Robb, Peter Gloor, Brenda Milner, Fred and Eva Andermann, Luis Felipe Quesney, and a continuing roster of keen young neurosurgical fellows. His main interest, however, centered on the surgical treatment of epilepsy and on the meticulous documentation of postoperative results. He consolidated and extended the pioneer work of Wilder Penfield and associates by an assiduous focus on long-term outcome. He firmly established the evidence-based role of surgery in the amelioration and, frequently, the cure of focal seizures.

On the basis of the sometimes dramatic response to cortisone in patients with large pituitary adenomas or gliomas, Rasmussen and Gulati set up a controlled protocol with three consecutive series of patients undergoing temporal lobectomy for epilepsy. They observed significant reductions in postoperative hemiparesis and dysphasia with increasing perioperative dosages of cortisone. These researchers noted no detrimental effect on electrolytes or wound healing, and no occurrence of infections or gastric hemorrhage.

In another study, the dossiers of two series of patients treated for seizures by performing temporal lobectomy were extracted from the long-term follow-up series: 100 patients in whom there was minimal removal of the hippocampus and another 100 patients in whom a large portion of the structure had been removed. In both series, 63% of patients proved to have satisfactory postoperative results, being either free from seizures or enjoying a marked reduction in seizure frequency. The substantial advantage of radical removal of the amygdala with sparing of the hippocampus and hippocampal gyrus lay in the protection of memory function, as detailed in postoperative studies by the neuropsychology group at the MNI.

In his 25 years (1955–1980) of active surgery at the MNI, Rasmussen probably performed more operations for epilepsy than any other surgeon of his time and became the foremost authority in this field. For example, in the 1980s, when publications from most centers interested in the neurosurgical treatment of epilepsy were describing series of 50 to 100 cases in which excision was used to treat temporal lobe seizures, Rasmussen detailed follow-up analyses of approximately 1200 cases treated at the MNI between 1928 and 1980.

The MNI records for epilepsy surgery, which had been begun by Wilder Penfield and William Cone in 1928, and are now an unmatched world series of approximately 3000 cases, continue to serve as a standard of reference for other
neurosurgical centers in which the systematic surgical treatment of epilepsy eventually became adopted.

Rasmussen Syndrome

In 1958, together with Jerzy Olszewski and Donald Lloyd-Smith, Theodore Rasmussen published the clinical and pathological features of three patients with focal seizures due to chronic localized encephalitis.38 This newly defined entity, later recognized as “Rasmussen syndrome,” provoked much discussion and research on causative factors and possible treatment. The condition, the description of which has been refined in successive updates, was the topic of an international symposium in 1991.1,2,17

The role of surgical treatment in selective examples of this syndrome was established. This often involved major interventions such as hemispherectomy, which had already offered relief of seizures in other young patients with hemiparesis.3 This procedure later led Rasmussen and others to recognize postoperative hemosiderosis and hydrocephalus, a sometimes fatal complication of hemispherectomy.26 Rasmussen pioneered the modification of the excision technique to a “functional disconnection,” leaving in situ most abnormal brain tissue, a maneuver that greatly reduced this hazard.24,45

Career Achievements

In 1972, after retiring from his administrative positions at the MNI and McGill University, Rasmussen actively continued his surgical practice and follow-up analyses of seizure surgery. During his career he authored 175 articles on neurosurgical topics and served effectively as a teacher and role model to many young neurosurgeons and neuroscientists. After he stopped performing surgery in 1980, he continued for the next decade to work on the rich lode of data in the MNI seizure series, publishing a canon of more than 50 analytic reviews on all aspects of the surgical treatment of focal epilepsy, only some of which are referenced here.22,23,33,40 He represented the MNI at national and international meetings, being widely sought after as a visiting professor and lecturer (Fig. 5). As one of the outstanding leaders in neurosurgery, he was president of the Association of Neurosurgeons of Quebec, the Canadian Neurosurgical Society, the American Association of Neurological Surgeons, and the American Epilepsy Society. He received the Outstanding Achievement Award from both the University of Minnesota and the University of Chicago and held honorary degrees from Edinburgh and Umeå Universities. He served on the American Board of Neurological Surgery (1970–1976) and on the Epilepsy Advisory Committee of the National Institute for Neurological Diseases and Stroke (1972–1976). He was appointed professor emeritus at McGill University in 1980. Rasmussen was particularly pleased to be selected for the Distinguished Service Award of the Society of Neurological Surgeons in 1989; the first such award, established by that Society in 1969, had honored Wilder Penfield (Fig. 6).

Envoi

In 1947 Theodore Rasmussen married Catherine Archibald of Truro, Nova Scotia. With a son and three daughters they enjoyed a full family life. They devoted much of their time to entertaining current fellows and visiting former fellows of the MNI. Both Ted and Catherine were keen on sports, enjoying skiing, scuba diving, and boating. Ted maintained his enthusiastic interest in jazz and was able to recall names of famous Basin Street instrumentalists (Fig. 7). His succinct sense of humor often brightened the day. Once, a neurosurgical colleague earnestly queried, “Ted, how come you were born in such an out-of-the-way place as Provo, Utah?” Ted replied, “I wanted to be near my
mother.” In one of his rare forays into neurosurgical philosophy, at the opening of the Barrow Neurological Institute, he made a plea not to make specialty training programs too rigid or too lengthy; he opined, “All sacred cows need to be gently prodded from time to time to check whether their mantles of divinity are still intact.”

Rasmussen’s former student and friend, Bryce Weir, the fourth successive MNI graduate to hold the chair of Neurological Surgery at the University of Chicago, recently wrote:

Theodore Rasmussen did not wear his heart on his sleeve. He was always precise and deliberate; rounds were conducted at a half-trot. His aphorisms became part of the mental fabric of all his trainees. “Mustn’t do that. Don’t jiggle the brain,” and “Put up the side rails; the bed is high and the floor is hard,” spring to mind. While not effusive in manner, he was never unkind or sarcastic. He had a quiet sense of humor; as osteoporosis took hold in late life, he told me he was turning into a capital “C.” Unlike many in the early generations of neurosurgeons, he was no megalomaniac and never sought to increase his own status by belittling others. There was no overt senti- mentality in his interactions with patients but they all sensed his intense commitment to their well-being and his desire to ease their suffering.47

When Catherine predeceased him in 1998, Ted moved to Calgary to be with his three daughters and their families, who provided him with comfort and love in his retirement years. Relying on an address list of his many colleagues and students living in all parts of the world, he kept in touch by methodical daily correspondence. He took great satisfaction in the establishment of the Theodore Rasmussen Reading Room in the library at the MNI and in the annual Theodore Rasmussen Lecture on Neurosurgery, both sponsored by his former residents. He died on January 23, 2002, 3 months before his 92nd birthday, from complications of prostatic cancer. Ted Rasmussen will be warmly remembered by his family, friends, colleagues, and students for his wisdom, modesty, and gentleness, and by many hundreds of patients with relentless epilepsy to whom he gave relief from seizures by his surgical care.

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References

Theodore Brown Rasmussen


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