

Modern psychosurgery before Egas Moniz: a tribute to Gottlieb Burckhardt

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The history of modern psychosurgery has been written in several ways, weaving around many pioneers in the field during the 19th century. Often neglected in this history is Gottlieb Burckhardt (1836–1907), who performed the first psychosurgical procedures as early as 1888, several decades before the work of Egas Moniz (1874–1955). The unconventional and original case series of Burckhardt, who claimed success in 50% of patients (3 of 6), had met with overt criticism from his contemporary medical colleagues. The authors describe 2 illustrative cases of cortical extirpation performed by Burckhardt and review his pioneering case series for surgical outcome, despite the ambiguity in postoperative evaluation criteria. Although Burckhardt discontinued the project after publication of his surgical results in 1891, neurosurgeons around the world continued to investigate psychosurgery and revitalized his ideas in 1910; psychosurgery subsequently developed into a full-fledged neurosurgical specialty. (DOI: 10.3171/FOC/2008/25/7/E9)

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GOTTLIEB Burckhardt (1836–1907; Fig. 1), a Swiss psychiatrist, was the first physician to perform modern psychosurgery, in which the contemporary theories about brain–behavior and brain–language relationships were amalgamated and practically applied to patient care. Interestingly, however, that landmark text was dedicated to Egas Moniz (1874–1955), the Portuguese neurologist whom the authors credited as the “first who conceived and executed a valid operation for mental disorder.”^{4,5,8,9} Thus both names are often associated with the origins of psychosurgery, but Burckhardt’s is often forgotten or omitted in discussions of the history of modern psychosurgery.¹³

Born into a famous family in Basle on December 24, 1836, and the son of a physician, Burckhardt studied at Basle, Gottingen, and Berlin. After graduating with a thesis on the epithelium of the urinary tract, he started practicing as a general practitioner in his hometown. In 1873, he moved to the Waldau Psychiatric Clinic at the University of Berne; soon afterwards, he published a book on the physiological diagnosis of nervous diseases.² At Waldau, he worked under Professor Scharer and became a regular reviewer for the *Korrespondenzblatt für Schweizer Ärzte*, and researched the relationship between brain temperature and mental illness.² Burckhardt left the clinic next year to take a position as Director of Prefargier Psychiatry Clinic near the Lake Neuchatel, where he performed the first landmark topectomy in 1888 (Fig. 2). After publishing his groundbreaking work in 1891 (Table 1), he ended his research and practice of psychosurgery due to heavy criticism from his contemporaries; he turned his attention to the daily

operations of the Prefargier asylum for 5 years before retiring in 1896.^{3,4} Burckhardt died of pneumonia in 1907.²

Contemporary Research Influences

The neuroscience environment that prevailed in the late 1880s influenced Burckhardt’s decision to perform experimental topectomies in human patients. In 1870, Fritsch and Hitzig provided invaluable proof of the neurophysiological reality of functional specialization in brain using electrical stimulation, followed by ablation methods. They observed the entire cortical surface in dogs and found that stimulations in some areas elicited motor responses—extension, flexion and rotation of limbs—while others did not.¹¹ Burckhardt was also impressed by the work of Friedrich Goltz. Goltz found that total removal of the neocortex made dogs easily provoked to rage, while removal of the temporal cortex resulted in more calm and tame animals.^{7,11} Burckhardt was also strongly influenced by the neuro-pathological studies of Jules Bernard Luys in the brains of patients with dementia, recorded in *Traité des maladies mentales*. He understood that the paracentral lobule, according to Luys, appeared to be a bridge from which hallucinatory excitations flew off to motor areas.¹¹

Burckhardt also referred to the autopsy studies of Broca and Wernicke with respect to localization of language functions and hallucinations. He decided that it did not matter whether the first activation of a verbal hallucination originated in cortical areas as expressed by Tamburini and Wernicke, or in subcortical areas, as expressed by Hagen or



FIG. 1. Gottlieb Burckhardt, an oft-forgotten father of psychosurgery. Taken from: **Psychosurgery: A Historical Overview**, 2001.

Meynert.¹¹ Burckhardt believed that patients with auditory hallucinations could be helped by the removal of a particular pathologically functioning area and made several interesting speculations about the possibility of the acoustic word–memory cortex, implicated in the “chain of processes” that cause auditory hallucinations. He seems to have drawn ideas from the work of French author Mairét, who demonstrated hypertrophic temporal gyri in patients with schizophrenia in 1883.¹⁴ Mairét had also proposed that the “megalomaniac” type of dementia was located in the convex region of frontal and temporal lobes and that the “melancholic” form was found in the first temporal gyrus, the anterior third of the sphenoid gyrus and hippocampus.¹¹ Three central conceptual neurophysiological ideas influenced the views of Burckhardt: 1) all mental disorders have a physical basis; 2) associationism and connectionism were the predominant models for understanding nervous system functioning; that is, the nervous system was believed to include 3 systems: an input or afferent sensory system, a linking or connecting system for information processing, and an efferent motor or output system; 3) and each mental module (or faculty) was considered to be related to a specific brain site.²

This model was in accordance with Wernicke’s wiring diagram for language function and helped Burckhardt explain the symptom clusters related to specific anatomical sites after each surgery. It was according to this model that Burckhardt predicted that lesions in certain association areas might alter behavior in specific ways. He thought that affect was a cortical event that was transformed into motion, not through subcortical, but through the cortical re-



FIG. 2. Fig. 2. The Prefargier Asylum where Burckhardt performed his pioneering surgeries. Reprinted from *Brain Language*, 45, Joannette Y, Stemmer B, Assal G, Whitaker H, From theory to practice, the unconventional contribution of Gottlieb Burckhardt to psychosurgery, p 16, 1993, with permission from Elsevier.

gions—this was the reason that validated the use of topectomies in psychiatric diseases.^{11,16} He believed that severing certain connections would alleviate symptoms without hampering the input or output neurons. He also thought that the operation would not only prevent the expression of symptoms, but also the patient’s experience of them.¹¹ He wrote:

If excitation and impulsive behavior are due to the fact that from the sensory surfaces excitations abnormal in quality, quantity and intensity do arise, and do act on the motor surfaces, then an improvement could be obtained by creating an obstacle between the two surfaces. The extirpation of the motor or sensory zone would expose it to the risk of grave functional disturbances and to technical difficulties. It would be more advantageous to practice the excision of a strip of cortex behind and on both sides of the motor zone creating thus a kind of ditch in the temporal lobe.²

Burckhardt at Prefargier Clinic

Shortly after Burckhardt’s arrival as director at Prefargier, a 3-room laboratory was constructed to enable him to pursue his research activities in the areas of anatomy and psychophysiology. His first work, presented on February 4, 1884 at Prefargier, was a study on the role of heredity in the surface configuration of brain.¹¹ His interest in clinical research started to blossom in 1888. Burckhardt wrote in the annual report:

The Committee, having funded me, and the installations and necessary preparations having been done, and the patient’s family having consented, we performed the first operation on December 29th. This is not the place to provide all the details. Let me simply state that, to my knowledge, Prefargier is the first institution where cranial trephination and the removal of small portions of cerebral cortex have been performed, not just to satisfy surgical indications, but rather for psychiatric purposes.

Starting on December 29, 1888, Burckhardt performed operations in 2 women and 4 men, with the first patient undergoing 4 procedures. Five of these patients suffered from “primare Verrucktheit,” a clinical category that should be considered as equivalent to schizophrenia. This clinical category was reintroduced by Sander (1868), and popularized as “originare paranoia” by Krafft Ebing, by which he meant a hereditary delusional/hallucinatory psychosis with an onset at puberty.¹ The patients included in Burckhardt’s case series had intractable mental illnesses and were deluded, aggressive, and having auditory hallucinations. He had little surgical experience, and the surgeries were all performed in a small room on the grounds of Prefargier.¹ The patients received bilateral localized topectomies (selective removal of the cerebral cortex), in the areas now known as the Wernicke and Broca centers, as well as in the temporal and parietal lobes. However, there is no detailed description of postoperative evaluation of aphasias or the extent of weakness of contralateral extremities. Of the 6 patients, 3 had partial improvement in symptoms and 1 died after status epilepticus developed.

Illustrative Cases

We have chosen 2 illustrative cases from Burckhardt’s surgical series, based on the previous descriptions made in the original German text (1891), as well as the accounts of Joannette et al.¹¹, Moutier (1908),² and Freeman and Watts.⁵ These cases reflect 2 cardinal neurophysiological aspects of

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Burckhardt's approach to psychosurgery: 1) acting on a psychic center (the localizationist tradition) and 2) controlling the influence of a given psychic center on another center (the associationist tradition).¹¹

Case 1

This French-speaking, 51-year-old right-handed woman had been hospitalized at Prefargier for 15 years due to manic agitation. She had, according to Burckhardt:

...irritability and changes in her mood. As fast as lightning, from the smallest cerebral event, be it of sensorial or intellectual in origin, there develops an increase or a change likewise quickly to violent events.

Burckhardt decided to try a surgical cure for her impulsiveness and sudden mood changes. Because he believed that Broca area resection would cause weakness and that the Wernicke area greatly influenced the motor areas, he decided to remove a small strip of tissue between the posterior and anterior components of the language system—the associations between sensory and motor areas.

On December 29, 1888, Burckhardt removed 5 g of cortex from 2 cm of the lateral part of the superior parietal lobe and the medial part of the left supramarginal gyrus in a 4-hour procedure. Ten days later, fever and transient hemiplegia developed but resolved quickly, and the patient was less violent and still had florid mood changes. She underwent a second operation on March 8, 1889, in which 2.5-g of cortex from the posterior part of the first and second temporal convolution was removed during a 2.5-hour procedure. Afterwards the patient was happier and less agitated than before surgery, but her mood swings persisted. Burckhardt performed a third surgery on May 29, 1889, in which he removed an additional 2.5 g of cortex in a 4.5-hour operation. A strip of parietal cortex from the interparietal fissure, the lateral border of the superior temporal lobe, more of the supramarginal gyrus, and some of the angular gyrus were removed. Postoperatively, the patient continued to hallucinate and experience mood changes; 8 months later, she had no visual or auditory hallucinations and the impulsiveness and agitation had also improved as well. She had become “word-deaf” and logorrheic, however, and continued to threaten the asylum staff. Burckhardt decided to resect the pars triangularis as the next step, and did so in a 2.5-hour procedure on February 12, 1890, over a year after the first surgery. He removed 1.5 g of cortex corresponding to the pars triangularis of the third frontal convolution. The patient had no weakness or aphasia postoperatively, and her mental state was reported to have improved. She remained calm most of the time, which according to Burckhardt was a state of “quiet dementia,” wherein the continuous flow of speech was disrupted and she had become quiet.¹¹

Case 2

This 26-year-old, right-handed man who made a living as a painter began to experience symptoms at the age of 17 years. At 21, he developed restlessness, ataxia, and the delusion that he was the son of a prince. In February of 1887 he developed auditory hallucinations, mood swings from agitation to depression, and suicidal ideations. He continued painting, but in each of his paintings he added a nose and a mosquito to each corner. In July 1887, he was admitted to Prefargier with worsening symptoms, visual hallucinations, disturbances of smell and sensations, and short-

term memory loss. He also had frontotemporal headaches, heat-spells, red-inflamed eyes, an irregular sleep pattern, and masturbatory tendencies. He showed initial signs of improvement with hospitalization and was sent home, only to be readmitted with worsening symptoms including weight loss, a pale appearance, and asymmetrical pupils.¹¹

On June 5, 1889, Burckhardt resected part of the patient's Wernicke center during a 3.75-hour surgical procedure. A total of 4.6 g of cortical tissue was removed from the posterior half of the first and the second temporal convolution of the left hemisphere. In the initial days after surgery, the patient was calm and spoke very little. His pronunciation was intact, and no word-deafness or comprehension defects were noted. After another week, there was mild worsening of aphasia (wrong words with nonfluent speech), which spontaneously improved; his visual and auditory hallucinations remained the same. Considering this poor outcome, Burckhardt performed a second operation, this time in the Broca area. He excised both the pars opercularis and pars triangularis of the third frontal convolution in the left hemisphere; 2.5 g of cortex was removed during a 2.5-hour long procedure. Surprisingly, the patient was once again nonaphasic and nonapraxic. His pronunciation was intact, but his speech was more formulaic and reduced in vocabulary. His hallucinations were decreased, and he became calmer. He began to draw again, play cards and billiards, and started looking at magazines, explaining the paintings and personalities. Burckhardt rejected the possibility of a worsening dementia after surgery in this patient, remarking that the patient was “mentally free and more unrestrained.” The patient's mother affirmed that the patient became quieter, better behaved, and more manageable postoperatively.¹¹

Berlin Congress and Aftermath

Burckhardt presented his operative findings and outcomes at the Berlin Medical Congress of 1889, attended by the greatest alienists of the time.²⁰ Those in attendance included academic luminaries like Victor Horsley (1857–1916), Valentin Magnan (1835–1916), and Emil Kraepelin (1856–1926). Horsley presented the results of his first 44 neurosurgical operations (10 deaths) at the same meeting.¹ Burckhardt's paper, according to a report by Meuron,⁶ had made everyone feel ill at ease and encountered harsh comments from colleagues. However, his unconventional work was subsequently discussed in a number of countries. Worcester (1891) presented a summary to his American colleagues, emphasizing the side effects and brevity of the follow-up.^{1,20} Kraepelin (1893) referred to Burckhardt's interventions with disrespect: “he suggested that restless patients could be pacified by scratching away the cerebral cortex.”¹ Giuseppe Seppilli (1891) wrote for an Italian audience, stating that Burckhardt's modular view did not “fit in well with the view held by most [experts] that the psychoses reflect a diffuse pathology of the cerebral cortex and [ran counter to] the conception of the psyche as a unitary entity.” Due to his theoretical weakness, Seppilli concluded, it would be most unlikely that anyone would follow Burckhardt's ideas and procedures and concluded that “an absence of treatment was better than a bad treatment.”^{22,18}

After the Berlin meeting, Burckhardt went on to publish his case series in a masterful paper that is often quoted but

TABLE 1
Burckhardt's surgeries documented in his 1891 paper

Case No.	Age (yrs), Sex	Original Diagnosis	Primary Symptom(s)	Year of Op	Site of Op	Complication(s)	Outcome of Op
1	51, F	chronic mania	aggression	1888	right temporoparietal	motor weakness	no change
2	31, M	primary dementia	excitement	1889	left frontal	epilepsy	quieter
3	35, M	original paranoia	violence	1889	left temporal	none	quieter
4	37, F	original paranoia	delusions & auditory hallucinations	1889	left temporal	word deafness	no change
5	26, M	original paranoia	paranoid delusions	1889	left frontotemporal	none	improvement
6	33, M	original paranoia	violence & auditory hallucinations	1889	left temporal	sensory aphasia & epilepsy	death 5 days postop

rarely read. It is 88 pages long and includes 6 case histories, repeated mental state assessments, a complete review of clinical and experimental literature on brain localization, and a sound theoretical argument.¹ In Britain, William Ireland summarized Burckhardt's views well:

Dr. Burckhardt has a firm faith in the view that the mind is made up of small faculties, holding their seats in distinct parts of the brain. Where excess or irregularity of function occurs, he seeks to check it by ablation of a portion of the irritated centers. He defends himself from the criticisms which are sure to be directed against his bold treatment by showing the desperate character of the prognosis of the patients upon whom the operations were performed...

Ireland also wondered "whether any English physician would have the hardihood to imitate Burckhardt."¹⁰ Psychosurgery was not publicly attempted again until 1910, when Estonian neurosurgeon Lodovicus Puusepp severed the "association fibers" between the frontal and parietal cortex in 3 patients who were described as manic depressive or "epileptic equivalents."^{2,17} Later successors, such as Moniz, Freeman, and Watts, performed several leukotomies or lobotomies, while others like Mettler followed the techniques of Burckhardt in using topectomy procedures for affected patients.^{5,15,19} Controversies over the history and origins of modern psychosurgery continue today, but the impact of Burckhardt's personal surgical series had clearly spurred the research in neurophysiology and psychosurgery that followed. Near the end of his 1891 paper, he makes the following comment:

Doctors are different by nature. One kind adheres to the old principle: first, do no harm (*primum non nocere*); the other one says: it is better to do something than do nothing (*melius anceps remedium quam nullum*). I certainly belong to the second category.^{3,12}

Conclusions

The transition to the modern era of psychosurgery starts with the series of topectomy operations performed by Gottlieb Burckhardt, the Swiss surgeon whose pioneering work paved the way for later surgeons, including Egas Moniz. His psychosurgical techniques posed a bold challenge and opposition to the fundamental practice of treating the mentally ill, leading to his being ostracized from the medical community. His work has remained obscure, but is nonetheless noteworthy for the neurosurgical community.

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