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Surgical Leader *The Evolution of Cauterization: From the Hot Iron to the Bovie*

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THE BOVIE ELECTROCAUTERY has become a fundamental tool of modern-day surgery, particularly for its integral role in hemostasis, yet despite this landmark invention and its widespread use, there is very little said about the man behind the machine: William T. Bovie. It would be thousands of years from the inception of cautery in medicine until the birth of Dr. Bovie and his device. However, his work in biophysics and collaboration with Dr. Harvey Cushing would revolutionize surgical practice in the early 20th century and forever ingrain his name into the field of surgery.

An ancient aphorism describing the power of cautery proclaimed, “Those diseases which medicine does not cure, iron cures; those which iron cannot cure, fire cures; those which fire cannot cure, are to be reckoned incurable.”¹ Such a bold statement speaks to the importance and use of cauterization even during ancient times. Its use has been described as early as 3000 B.C., when Egyptians treated tumors and ulcers of the breast with the “fire-stick.”¹ Twenty-six hundred years later, it would be advocated by Hippocrates as a treatment for joint problems and hemorrhoids. By the 7th century A.D., cautery would be identified not only as a therapy, but also as a hemostatic agent, and it would subsequently be used most commonly for that purpose. Although the popularity of the cautery as a surgical instrument fluctuated over the centuries, the evolution of electrosurgery established an unwavering role for cautery in the field of surgery.¹

The first cited use of electricity in surgery dates back to 1900, when a Parisian physician, Dr. Joseph Rivière, was using electrical currents to treat a patient for insomnia. During one of these sessions, a spark from an electrode generating his currents landed on Dr. Rivière’s hand, and he immediately noted its coagulating effects. He subsequently used this same current to successfully remove a carcinomatous ulcer off the

hand of his insomniac patient. During the next decade, electricity was used and modified to treat minor lesions of the skin, oral cavity, bladder, and rectum. Dr. Simon Pozzi used higher frequency and voltage along with lower amperage currents to treat skin cancers and coined the term fulguration. Dr. Eugène-Louis Doyen improved this modification by attaching a grounding plate to the generator and placing the plate underneath the patient. He found this helped the current to penetrate deeper into tissues and called his method electrocoagulation. Approximately 1910, Dr. William L. Clark, medical director of Clark Hospital in Philadelphia, Pennsylvania, made a major breakthrough in electrosurgery. He altered the design of his predecessors by increasing the amperage and decreasing the voltage generated by the electrical device. This produced a hotter spark that was capable of penetrating even deeper into tissues. He also created a smoother current by substituting a multiple spark gap for the more commonly used single one. He coined the term desiccation, because his new design was found to shrink tissues from dehydration. Dr. Clark’s improvements on the electrosurgical apparatus set the stage for the work of William T. Bovie (Fig. 1).²

While Dr. Clark was experimenting with electrotherapy, William T. Bovie had just received his bachelor’s degree from the University of Michigan in 1905. He then went on to attain a Masters in botany and a Doctorate in plant physiology from Harvard University. He stayed at Harvard to work at the Harvard Cancer Commission from 1920 to 1927, and it was here that he began his work in electrotherapeutics and fortuitously partnered with Dr. Harvey W. Cushing, the “father of neurosurgery.”³

Although electrosurgery was shown to be beneficial in the treatment of some surgical diseases during the early 1900s, it was not uniformly welcomed by the medical community. Dr. Bovie’s initial attempts to study and use electrical currents were hindered by the growing popularity of radium therapy for cancer and the reluctance of his superiors to support his work. Despite the opposition, Dr. Bovie managed to continue his research.² With a precocious sense of biophysics,

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FIG. 1. William T. Bovie working at his alternating-current switchboard in his laboratory at the Colis P. Huntington Memorial Hospital at Harvard Medical School. Reproduced from Goldwyn, 1979.

his initial work revolved around elucidating the fundamental principles behind electrotherapy rather than its clinical applications. By investigating the effects of different alternating currents, he eventually constructed what would become the prototype for all future electrical devices. This new apparatus produced a high-frequency current delivered by a “cutting loop” that could either cut or coagulate depending on the type of current delivered. His “new electrosurgical unit” had both hand and foot controls as well as a number of operating electrodes that were interchangeable in the pistol grip (Fig. 2).³ The practice of electrosurgery slowly grew but was still limited to minor procedures because of an underlying skepticism within the surgical community. However, in 1926 when renowned neurosurgeon, Dr. Harvey Cushing, expressed interest in Dr. Bovie and his work, the two established a well-respected role for electrotherapeutics in surgery and their partnership became pivotal in advancing the field.

Dr. Bovie’s unit was put to the test on October 1, 1926, at the Peter Bent Brigham Hospital in Boston, Massachusetts. The patient was a 64-year-old paper maker who had a painless, slowly enlarging mass on the right side of his head. Four days earlier, Dr. Cushing had attempted but failed to remove it because of the tumor’s high vascularity. Believing that the mass was a malignant meningioma, he sought the aid of Dr. Bovie and his

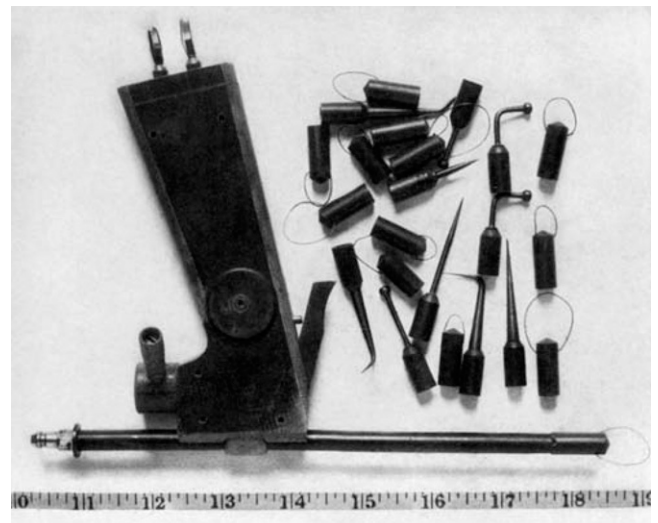


FIG. 2. Photograph depicting the original model of the electrosurgical pistol grip and a collection of various terminal electrodes. Reproduced from Cushing, 1928.

electrical apparatus. Although the patient’s hemoglobin had dropped to 2.8 after the initial surgery, Dr. Cushing was able to resect the tumor without incident during the second attempt using Dr. Bovie’s unit. The pathology revealed a vascular myeloma.² Dr. Cushing was pleased with the results of Dr. Bovie’s electrical device, and the pair continued to work on refining it. After several months of further experimental work, they called Mr. G. H. Liebel, President of the Liebel-Flarsheim Company of Cincinnati, to develop a commercial form of the electrical apparatus. To make it widely available, Dr. Bovie sold his patent rights for just \$1.⁴

Dr. Bovie’s device allowed for minimal blood loss, little tissue damage, and low infection rates. Although not a surgeon himself, his work revolutionized surgical practice and the role of electrosurgery in medicine. His perseverance despite adversity and his thirst for knowledge propelled the field of surgery into a new era, allowing for the eradication of many tumors once thought “inoperable.” Although he died a poor man, his work has had an enormous impact on generations of patients, surgeons, students, and researchers as his name continues to resonate throughout operating rooms around the world: “Bovie please!”

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