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Neurosurgeons and electrocautery

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NEUROSURGEONS AND ELECTROCAUTERY

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Electrocautery is an indispensable surgical tool. Many surgeons do not even use a knife to cut the skin or dissect the tissues. They use electrocautery to do all the cutting and hemostasis. Little is it known that the credit for introducing this tool into modern surgery, popularizing it, and refining it, goes to neurosurgeons.

Electrocautery is a process of controlled heating and burning of tissues to dissect and obtain hemostasis. This is based on the principle demonstrated by Morton and d'Arsonval in the late 19th century that alternating current at high frequency (above 100 kHz; household electricity runs at 50-60 Hz.) does not affect the electrophysiology of excitable cells of the body but does heat up the tissue.

(From left to right) William T. Bovie, Harvey Cushing and Leonard Malis

To a neurosurgeon, a knife is not of unit use in the brain; the tip of a metallic suction tube does all the dissection, while the electrocautery controls the bleeding from brain parenchyma or tumor. In fact, electrocautery, along with an adequate lighting system to look into the depth of dissection, were the main factors that brought the field of neurosurgery into a safe zone. Prior to these facilities, neurosurgical procedures had a very high mortality, to the extent that it was sometimes ridiculed that a neurosurgeon on a typical day would operate on the brain in the morning and do an autopsy in the afternoon - on the same patient.

Two kinds of electrocautery systems exist: the monopolar and the bipolar. Monopolar systems use a metallic tip connected to the current generator; a grounding pad attached to the body somewhere away from the surgical site completes the circuit. Since the intensity of the electrical field is highest at the tip of the monopolar metal, the heat generated is highest close to it. Bipolar systems have two wires leading to a pair of forceps with metallic tips, and the circuit is completed by current flowing from one tip of the forceps to the other with the tissue in between the tips. The bipolar system can provide a much more controlled coagulation of tissues as compared with the monopolar system.

Use of electrocautery tremendously improved the ability of neurosurgeons to perform brain operations safely. Electrocautery was used in a very crude form on skin lesions as early as 1910. It was further developed by William T Bovie (1882-1958; a biophysicist at Harvard and later at Northwestern University) at the behest of the neurosurgeon Harvey Cushing (1869-1939), and then used by the latter at Peter Bent Brigham Hospital in Boston, in a brain tumor patient in 1927.

The problem with monopolar electrocautery is that although the maximum point of electrocautery is right next to the tip of the monopolar electrode, the electrical field that radiates out from that point of contact can heat up tissues in the surrounding area as well. To achieve even more limited and controlled electrocoagulation, Leonard Malis (1919-2005) designed and introduced bipolar electrocautery in 1953 while at Yale. Malis later spent four decades as a neurosurgeon specializing in microsurgery at Mount Sinai School of Medicine. Although the history of both monopolar and bipolar electrocautery is deeply embedded in the history of neurosurgery, both (particularly monopolar) were quickly adopted by other surgical specialties.

A bipolar forcep and monopolar probe with generator.