Electrosurgery

Part II. Technology, applications, and safety of electrosurgical devices

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Learning objectives

After completing this learning activity, participants should be able to compare and contrast electrosurgery with other surgical methods; describe the different technologies used in different electrosurgical units for controlling the output power, tissue effect, and patient and operator safety; and delineate the contraindications and limitations of electrosurgery.

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Electrosurgical currents can be delivered to tissue in monopolar or bipolar and monoterminal or biterminal modes, with the primary difference between these modes being their safety profiles. A monopolar electrosurgical circuit includes an active electrode and a dispersive (return) electrode, while there are 2 active electrodes in bipolar mode. In monoterminal mode, there is an active electrode, but there is no dispersive electrode connected to the patient's body and instead the earth acts as the return electrode. Biterminal mode uses a dispersive electrode connected to the patient's body, has a higher maximum power, and can be safer than monoterminal mode in certain situations. Electrosurgical units have different technologies for controlling the output power and for providing safety. A thorough understanding of these technologies helps with a better selection of the appropriate surgical generator and modes. (J Am Acad Dermatol 2014;70:607.e1-12.)

Key words: bipolar; biterminal; electrosurgery; high frequency; monopolar; monoterminal; power; radiofrequency.

INTRODUCTION

The term electrosurgery (radiofrequency surgery) refers to the passage of high-frequency electrical current through the tissue in order to achieve a specific surgical effect. Previous generations of electrosurgical generators used a spark gap and/or a vacuum tube to make the desired high-frequency electrosurgical currents. However, modern units use transistors to make high-frequency currents with a variety of waveforms. The shape of an electrosurgical current waveform does not have any direct effect on the final tissue results of the current. The only variables that determine the final tissue effects of a current are the rate and depth at which heat is produced.[1-3] In electrosection, the ratio of peak to average voltage of a current affects the depth of coagulation on the incision walls; with higher-peaked voltages there is deeper coagulation.[2,4-6]

Electrosurgical currents can be delivered to the tissue in monopolar or bipolar and monoterminal or biterminal modes, with the primary difference between these modes being their safety profiles. Different electrosurgical generators may have different current waveforms, different technologies for the control of output power, and different safety technologies. A better understanding of these technologies and their applications and an awareness of potential complications of electrosurgery helps to improve efficacy and safety of surgical procedures.

BIPOLAR VERSUS MONOPOLAR ELECTROSURGERY

Key points

- **In monopolar electrosurgery, there is an active electrode and a dispersive electrode, while in bipolar mode there are 2 active electrodes**
- **In bipolar mode, electrical current passes only through the tissue grasped between the tips of the bipolar forceps**

In electrosurgery, the prefixes mono- and bipolar refer to the number of active electrodes. In monopolar electrosurgery, an active electrode carries current to the tissue (Fig 1). Current then spreads through the body to be collected and returned to the electrosurgery unit by a large-surface dispersive electrode. The dispersive electrode is also known as the return, neutral, passive, or patient plate electrode.

Two types of dispersive electrodes are in common use today: conductive and capacitive. With the conductive type, a metallic foil or conductive polymer is attached to the patient's skin. With the capacitive type, the conductive foil has an insulating

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