

Surgical Diathermy

Dia-thermy is a Greek word which means through heat. The use of heat in medicine dates back to 3000 BC when Egyptians used heat to remove tumours. High frequency currents can also be used in operating rooms for surgical purposes involving cutting and coagulation. The frequency of currents used in surgical diathermy units is in the range of 1–3 MHz in contrast with much higher frequencies employed in short-wave therapeutic diathermy machines. This frequency is quite high in comparison with that of the 50 Hz mains supply. This is necessary to avoid the intense muscle activity and the electrocution hazards which occur if lower frequencies are employed. The power levels required for electro-surgery are below the threshold of neural stimulation provided that the diathermy frequency is in the radio-frequency range. When the frequency is at least 300 kHz, both the faradic and the electrolytic effects are largely eliminated during the flow of current through the human tissue. This then allows the exclusive utilization of the thermal effect in high frequency surgery providing both the applications for cutting and coagulation.

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Electro Surgical Cutting & Coagulation

Cutting: When a high frequency current passes through the needle or a wire, it heats up the pointed surface and the heat generated tears the tissues underneath. The other electrode is called the indifferent electrode, on which the patient lies, distributes the heat over its wide surface and hence very little heat is felt.

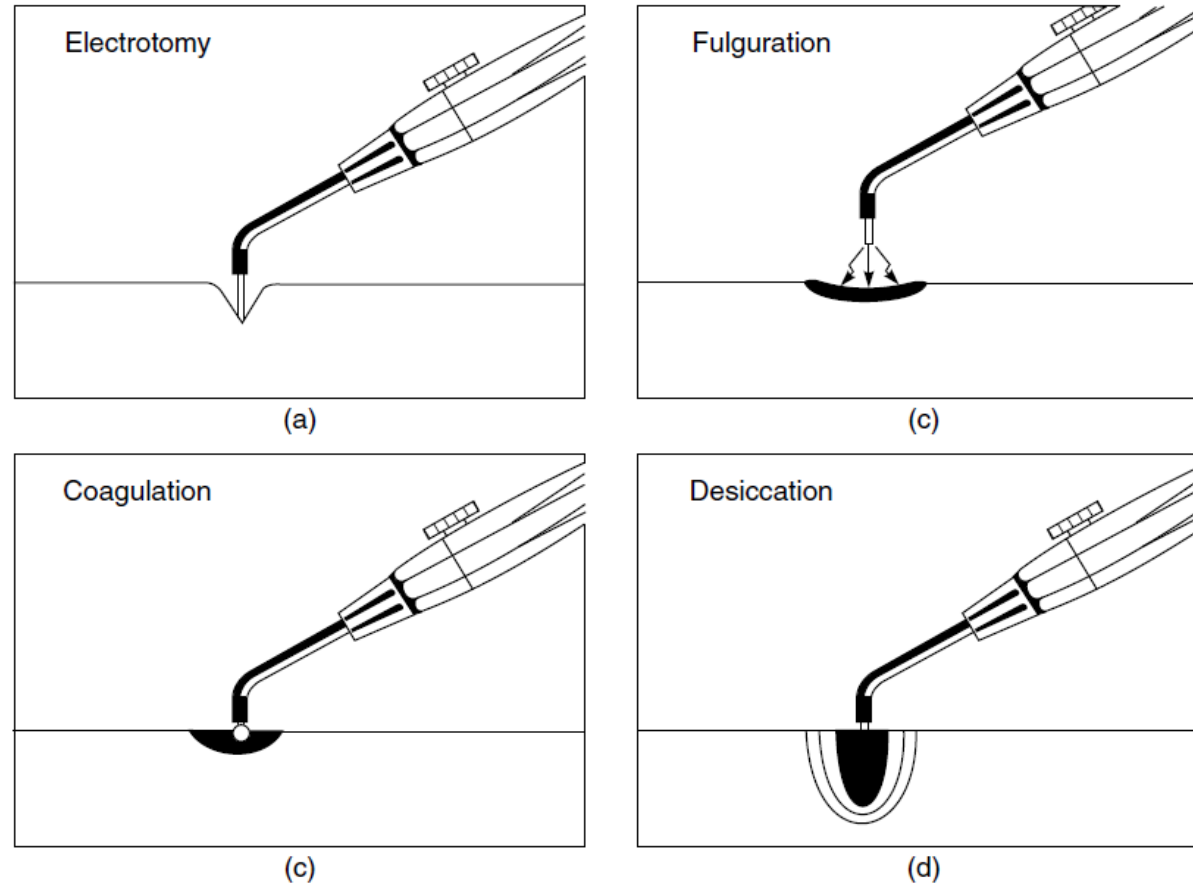
Coagulation: The heat generated is used to coagulate the tissue, at the tip of the electrode

Fulguration: The superficial tissues are destroyed without affecting the deep seated tissues. This is done by passing the electric current through the needle or ball electrode which generates an arc. Fulguration is done without touching the tissues. This is used to remove fistulas or cysts.

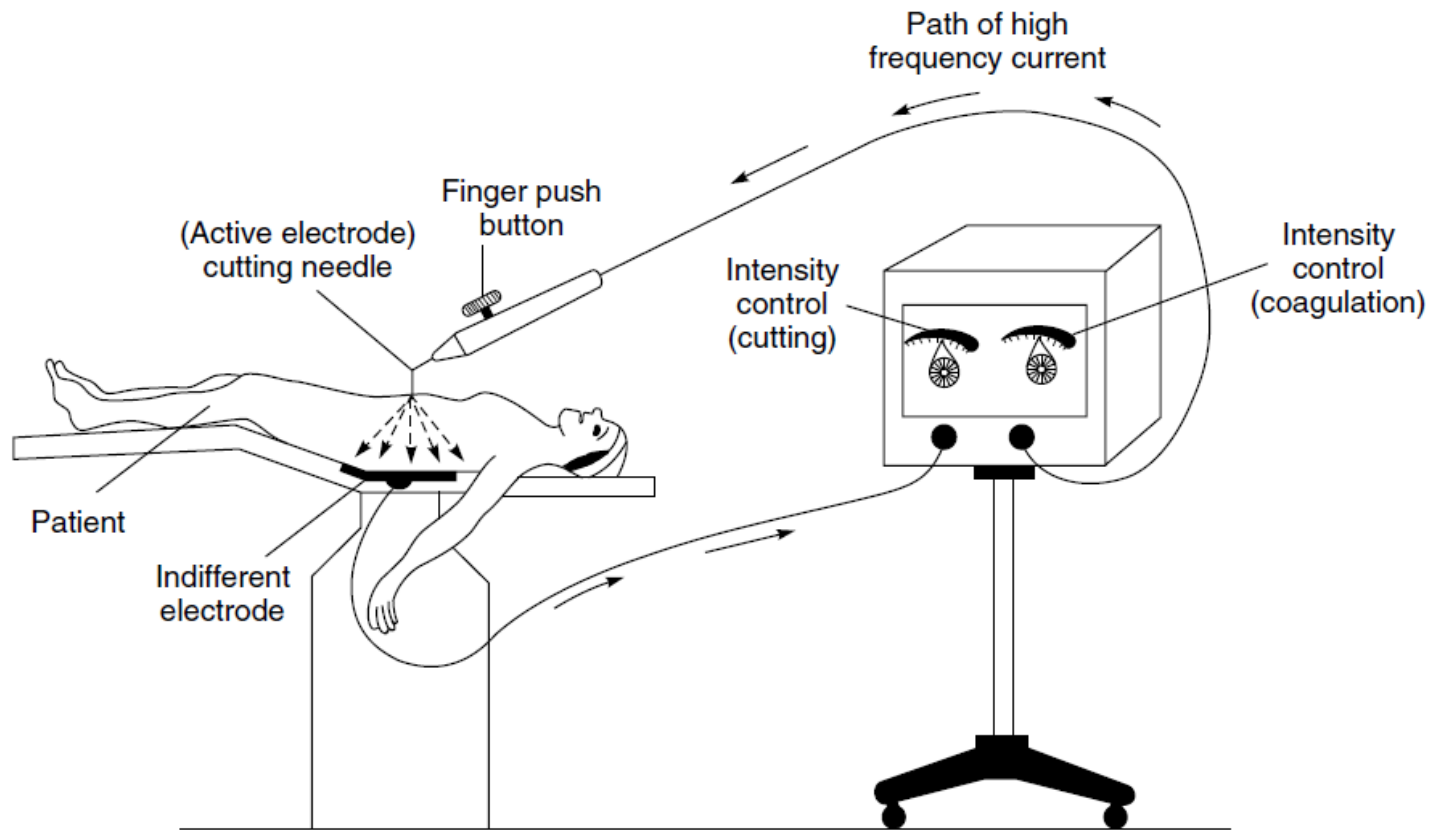
Desiccation

The electrode is struck and kept steady in the tissue and depending on the intensity of the current a high local heat is generated which dries up the tissues and causes coagulation.

Different Types of Electro-Surgery



➤ **Fig. 27.2** *Various types of electro-surgery techniques commonly employed in practice*

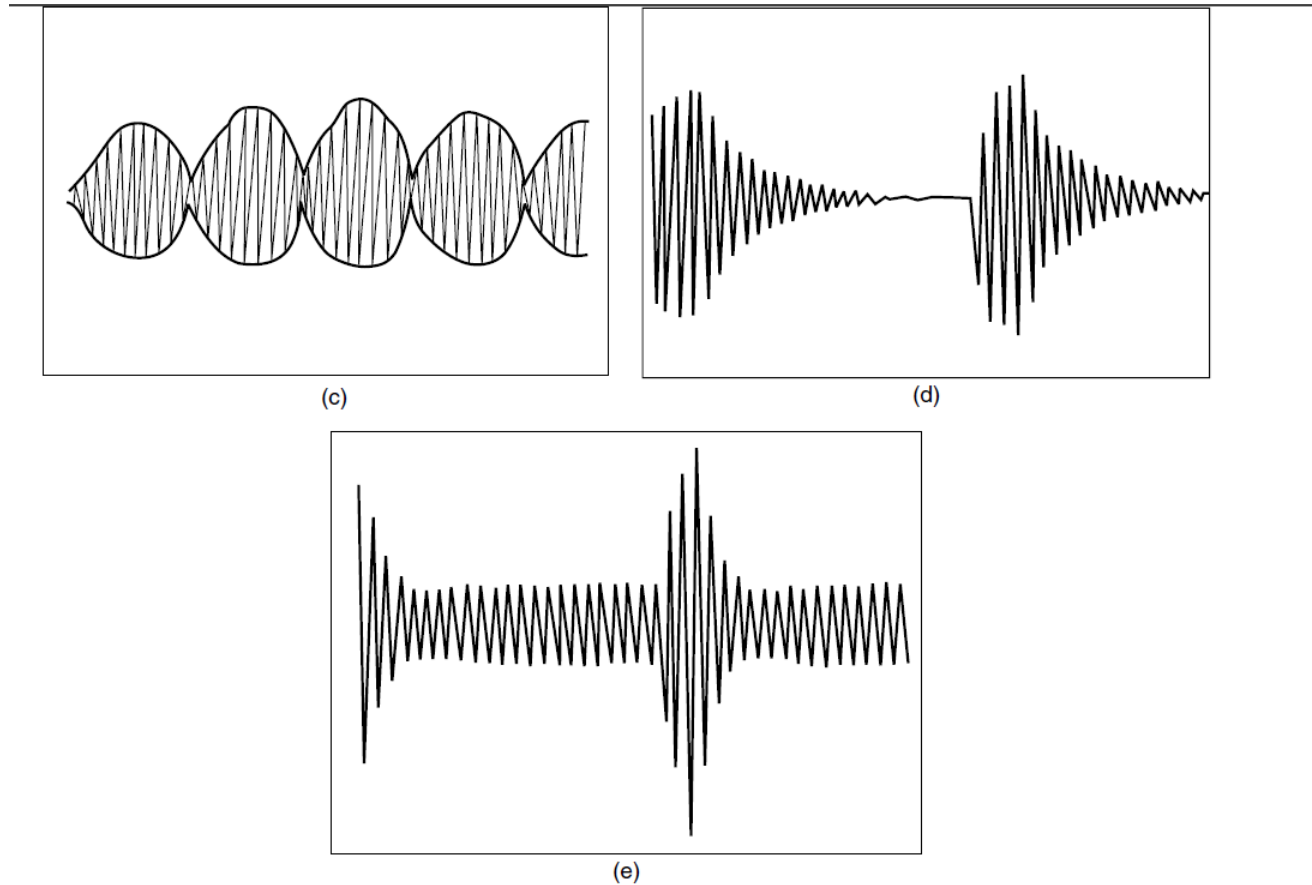


➤ **Fig. 27.1** *Principle of surgical diathermy machine*

Haemostasis

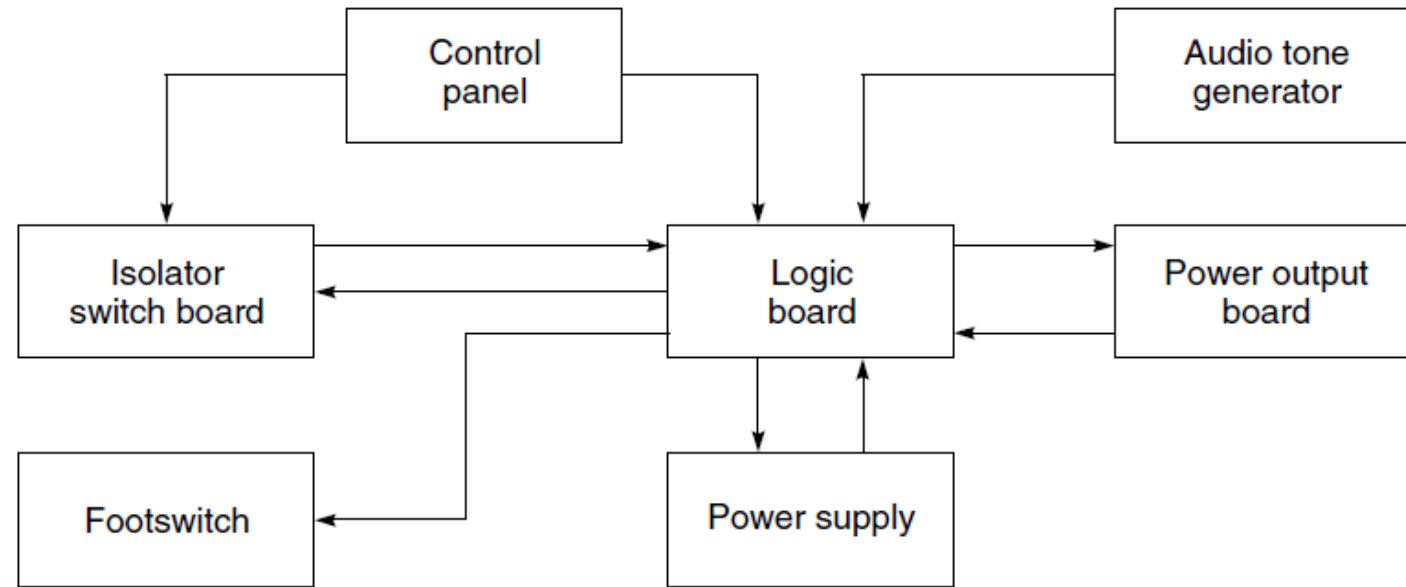
The process of using current simultaneously for cutting and coagulation through the electrodes is called Haemostasis. The use of high current in surgery results in effortless cutting as it requires no force to be applied and the tissue just melts in front of the cutting edge. A high voltage of 200 Vp is required to produce an arc between the metallic plate and the body tissue. The suitable voltage is between 200V-500 V. If the voltage exceeds 500 V the tissue gets charred and the electrode will be carbonised. The arcs are small & microscopic in nature. Coagulation happens at a voltage of 70V.

Types of Waveforms



➤ **Fig. 27.3** *Types of waveforms generated by surgical diathermy machines:*
(c) *Coagulate waveform generated by spark gap generator*
(d) *Coagulate waveform generated in a solid state diathermy machine*
(e) *Blend waveform generated in a solid state diathermy machine*

Surgical Diathermy Machine



➤ **Fig.27.4** *Block diagram of solid state electro-surgical unit*

Working of a Diathermy Machine

The machine uses a RF generator & a spark gap generator. The RF generator produces an undamped oscillation suitable for cutting, whereas the spark gap oscillator produces an undamped oscillations suitable for coagulation. The mixing and using of both these oscillations is very important and results in many possibilities in cutting and coagulation.

The solid state oscillators deliver 250 KHz-1 MHz with a power of 400 W delivered to 500 ohms at 2000V in the cutting mode and a power of 150 W in coagulation mode. The burst duration is 10-15 Secs. With a repetition frequency of 15 KHz.

Different frequencies and operation

The logic control unit provides the different timing pulses and an astable multivibrator generates a 500 KHz signal which is divided by binary counters into different frequencies. A frequency of 250 kHz is given to the power output stage, which has a series of darlington pair to boost the power output. An isolation circuit separates the machine from the electrode for safety consideration. And for coagulation purposes a 15 KHz signal provides gating for three cycles of 250 KHz for coagulation. The pulse width of this output is set at 12 microseconds.

The tone generator provides different tones for each mode 1KHz for, coagulation 500Hz for cutting and 250 Hz for haemostasis.

Monitoring signals

The logic circuits are used to receive external control signals and to operate the isolating relays, give visual indications and determine the alarm conditions.

The logic circuits receive information from the foot-switch, finger switch and alarm sensing points.

A thermostat is sometimes mounted on the power amplifier heat sink. In case of over temperature it becomes open-circuited, signalling an alarm and interrupting the output.

Safety Issues

Isolation is provided between the low frequency primary and the secondary. The low frequency should be prevented from appearing at the diathermy machine, it will lead to accidental burns. Other safety issues are rectification of high frequency current will happen at the point of contact of surgery resulting in muscle contraction, this happens when the surgery is near the point of some sensitive nerve tissue. However this is not dangerous to the patient or to the doctor. But personnel standing closer to the RF carrying cables will have induced current in his body and if he touches any metallic surface or the body of the surgical unit sparks will fly at the point of contact. So care should be taken not to touch any metallic surface.

Safety Issues Contd....

Anaesthesia gases tend to settle near the floor and operating the foot switch near such surfaces might result in explosion. Care should be taken such that no such explosion occurs in the atmosphere near the foot switch where electrical contacts are operated.