SAQ-14A8 Describe the principles of surgical diathermy.

1. **Definition:**
   
   Surgical diathermy = equipment that converts electricity to heat, which is used to cut, destroy or coagulate tissues during surgery

2. **Principles:**
   
   a. When voltage is applied across a conductor \( \rightarrow \) current flows
   
   b. When voltage is applied across body \( \rightarrow \) current flows through body \( \rightarrow \) either produces heat or other physiological effects depending on the current and frequency applied
   
   c. At low frequencies (e.g. 50 Hz) \( \rightarrow \) low currents cause heat, high currents cause muscle contraction, cardiac arrhythmias and electrocution
   
   d. At high frequencies (e.g. > 100 kHz) \( \rightarrow \) heat is produced with both high and low currents \( \rightarrow \) this is the principle of diathermy
   
   e. Surgical diathermy usually uses very high frequencies between 0.5 – 1.5 MHz \( \rightarrow \) heating with minimal stimulation of myocardium, muscles and nerves

   f. Amount of heat generated when current passes through body depends on current density
      
      - **Current density** = current per unit area
      - Current flows through small area (e.g. active electrode) \( \rightarrow \) high current density \( \rightarrow \) significant heat produced
      - Current flows through large area (e.g. patient plate) \( \rightarrow \) low current density \( \rightarrow \) minimal heat produced
      - Heating Power = \( V \times I \) (\( \therefore \) for given current, larger resistance \( \rightarrow \) more heating power \( \rightarrow \) more heat produced)

3. **Surgical Effects of Diathermy:**
   
   a. Cutting
      
      - Waveform = continuous high frequency sine wave
      - Fine arc between tissues and active electrode
      - Rapid heating of tissue over small area \( \rightarrow \) cut
      - Voltage 250 – 3,000V, 0.5MHZ
   
   b. Coagulation (2 types: spray and contact)
      
      - Spray coagulation \( \rightarrow \) arc b/w tissue and blunt electrode tip
      - Waveform = bursts of damped sine waves with high peak amplitude
      - Higher voltages required (up to 9,000V, 1 – 1.5MHz)
      - Contact coagulation involves direct contact of active electrode with tissue
      - Evaporation of intracellular water \( \rightarrow \) desiccates tissues \( \rightarrow \) coagulation
      - Lower voltages required than spray coagulation
   
   c. Blended
      
      - Waveform = mixture of continuous and damped sine waves
      - More %continuous \( \rightarrow \) more cutting
      - More %damped \( \rightarrow \) more coagulation

4. **Types of Electrodes:**
   
   a. Monopolar:
      
      i. 2 connections to patient \( \rightarrow \) active electrode and neutral patient plate
      
      ii. Current passes from active electrode (high current density \( \rightarrow \) heating) to patient plate (low current density \( \rightarrow \) minimal heating)
      
      iii. Patient forms a major part of the circuit
   
   b. Bipolar:
      
      - 2 small electrodes with high current densities
      - Patient not a major part of the circuit
      - Electrodes normally incorporated in a pair of forceps
      - Good coagulation properties but poor cutting ability
      - Not earthed

5. **Potential Hazards:**
   
   a. **Electrical burns:**
      
      - Diathermy burn \( \rightarrow \) Accidental activation of diathermy, break in cables/circuit \( \rightarrow \) Prevent by storing diathermy electrode in insulated quiver when not in use & using an audible alarm when the diathermy is active
      
      - Poor contact with neutral patient plate \( \rightarrow \) stray capacitance \( \rightarrow \) allows electrical circuit to be completed via other pathways (operating table, floor, equipment) \( \rightarrow \) burn
      
      - Alcoholic skin prep + other flammable agents \( \rightarrow \) ignition/explosion with diathermy
      
      - Channeling effect \( \rightarrow \) organ being diathermied has attachment or pedicle \( \rightarrow \) concentrates current \( \rightarrow \) current density in pedicle \( \rightarrow \) potential damage to blood vessels (e.g. penis, digits, etc)

   b. **Electrical interference:**
      
      - Diathermy frequencies can interfere with monitors e.g. ECG (overcome by low pass electrical filters)
      
      - May interfere with PPM/AICD function \( \rightarrow \) inappropriate firing/pacing (overcome by appropriate positioning of neutral patient plate; bipolar safer than monopolar)

   c. **Tissue damage:**
      
      - Excessive diathermy may form excessive necrotic tissue \( \rightarrow \) poor wound healing
      
      - Diathermy of delicate end arteries \( \rightarrow \) ischaemia
      
      - Difficult to control depth of tissue necrosis from diathermy \( \rightarrow \) may cause perforation of hollow viscera

   d. **Diathermy smoke:**
      
      - Plume is toxic to eyes and lung
      
      - Plume may contain live cells \( \rightarrow \) dissemination of disease

Sources: Dr Podcast, waveforms from www.GLOWM.com

**Examiner’s comments** – pass rate 31%