

اسم المادة و الكورس —

Sawa University

جامعة ساوة الاهلية

College of health and medical techniques

كلية التقنيات الصحية والطبية

Department of Anesthesia

قسم تقنيات التخدير

Fourth Stage

المرحلة الرابعة

Lecture No.
5.....

أستاذ المادة :د.انمار رحمن كاظم

Overview

- ▶ Radiofrequency (RF) ablation is a minimally invasive technique using heat generated by high-frequency alternating current to destroy pain-conducting nerve fibers.
- ▶ It is primarily used for chronic pain syndromes when conservative management fails.

Mechanism of Action

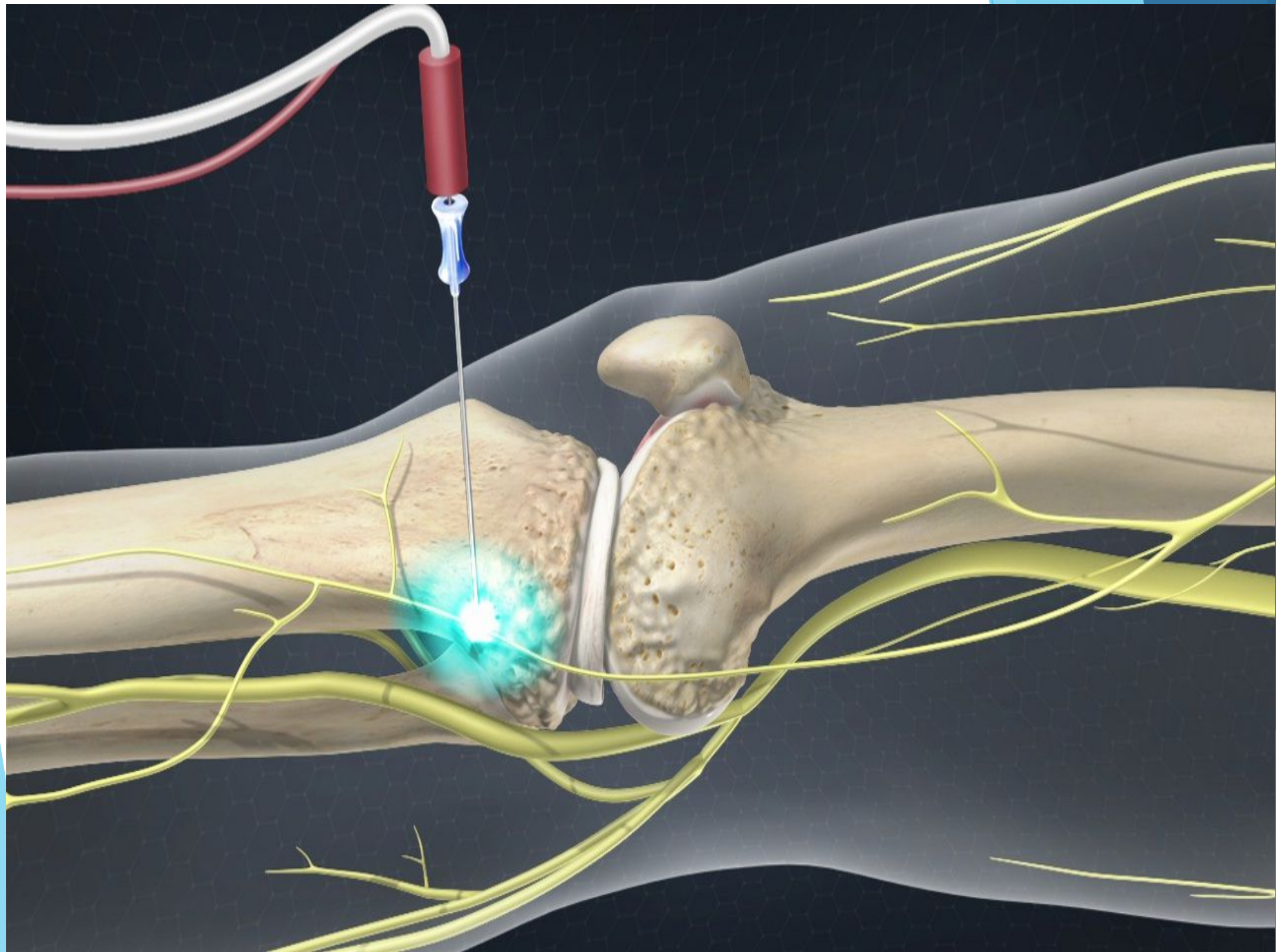
- ▶ RF current causes ionic agitation producing heat (60-90°C).
- ▶ This leads to coagulative necrosis of targeted nociceptive fibers while preserving adjacent structures.
- ▶ Two types: Conventional RF (thermal lesion) and Pulsed RF (neuromodulatory **effect without tissue destruction**).

step by step mechanism

- ▶ Step-by-step mechanism Application of current: An electrode is placed near the targeted nerve that is sending pain signals. Ion vibration and heat generation: Radiofrequency current is passed through the electrode. This current causes the water molecules in the surrounding tissue to vibrate rapidly, creating frictional energy and heat—a process known as the Joule effect. Protein denaturation: Once the temperature reaches a critical point (typically around $(60-80^{\circ}\text{C})$), the heat causes proteins within the nerve cells to denature and their cell membranes to melt. Tissue destruction: This damage prevents the nerve from functioning and transmitting pain signals to the brain. Pain signal interruption: By destroying the nerve tissue, the RFA procedure interrupts the pain pathway, providing pain relief

step by step mechanism

- ▶ Different techniques
- ▶ Conventional RFA: This involves creating a permanent lesion through thermal damage.
- ▶ Pulsed radiofrequency (PRF): This technique uses a different, lower temperature to influence nerve function without causing permanent tissue destruction. It is thought to help modulate pain signaling pathways in the spinal cord, though its precise mechanism is still being researched



Equipment and Setup

- ▶ 1. RF generator producing alternating current.
- ▶ 2. Needle electrode (insulated shaft with active tip).
- ▶ 3. Grounding pad.
- ▶ 4. Fluoroscopic or ultrasound guidance.
- ▶ 5. Temperature and impedance monitoring system.



Indications

- ▶ • Chronic facet joint pain (lumbar, cervical)
- ▶ • Sacroiliac joint pain
- ▶ • Trigeminal neuralgia
- ▶ • Post-amputation pain (stump or phantom)
- ▶ • Chronic discogenic pain
- ▶ • Peripheral neuralgias (occipital, intercostal, etc.)



Contraindications

- ▶ • Local infection
- ▶ • Coagulopathy
- ▶ • Uncontrolled systemic illness
- ▶ • Allergy to local anesthetic or electrode materials
- ▶ • Pacemaker dependency (relative)

Procedure Steps

- ▶ 1. Patient positioned and prepped under sterile technique.
- ▶ 2. Local anesthetic infiltration.
- ▶ 3. Needle placement under fluoroscopy or ultrasound.
- ▶ 4. Sensory and motor stimulation testing.
- ▶ 5. Lesioning at 80° C for 60-90 seconds (conventional RF).
- ▶ 6. Post-procedure analgesia and monitoring.

Complications

- ▶ • Neuropathic pain or dysesthesia
- ▶ • Local bleeding or hematoma
- ▶ • Infection or neuritis
- ▶ • Motor deficit (rare)
- ▶ • Pain recurrence due to nerve regeneration

Pulsed Radiofrequency

- ▶ Delivers short bursts of current with low temperature ($\leq 42^{\circ}\text{C}$).
- ▶ Modifies pain transmission without nerve destruction.
- ▶ Useful for neuropathic pain and sensitive areas (e.g., dorsal root ganglion).

Role of Physiotherapy

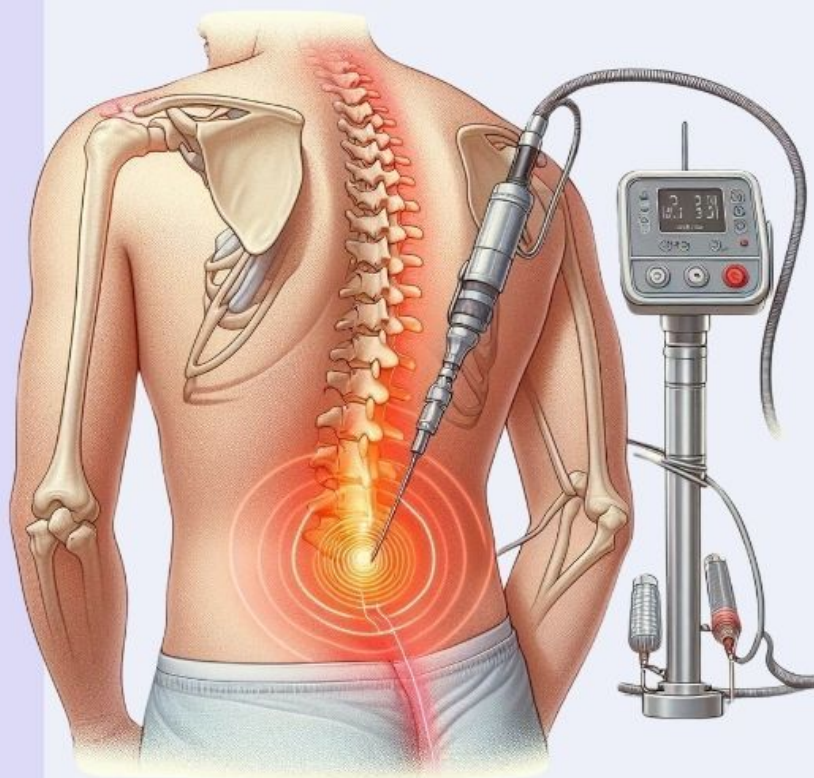
- ▶ Physiotherapy complements RF by restoring function and preventing recurrence.
- ▶ Includes:
 - ▶ • Post-procedure range-of-motion exercises
 - ▶ • Core strengthening and posture training
 - ▶ • Pain education and behavioral therapy integration
 - ▶ • Prevention of deconditioning and chronicity

Advantages Over Other Techniques

- ▶ • Precise lesioning of target nerves
- ▶ • Long-lasting relief (6-18 months)
- ▶ • Minimal tissue damage
- ▶ • Repeatable and safe under imaging guidance

BENEFITS OF RADIOFREQUENCY ABLATION FOR CHRONIC BACK PAIN

- **Effective Pain Reduction:** Up to 70-80% of patients report significant relief.
- **Minimally Invasive:** Uses needle electrode, minimal downtime, and lower risk than surgery.
- **Safety Profile:** Low risk of infection, bleeding, significant nerve damage.
- **Long-term Relief:** Benefits last from six months to over two years.
- **Improved Functionality and Quality of Life:** Enhances mobility, decreases anxiety and depression, improves sleep.
- **Reduced Need for Pain Medication:** Decreases reliance on oral painkillers, including opioids.
- **Addresses Opioid Crisis:** Offers an alternative pain management strategy, reducing opioid use and dependence.



side effects and management

- **Common Side Effects:** Temporary discomfort, swelling, bruising, transient nerve pain post-procedure.
- **Rare Complications:** Infection, bleeding, nerve damage, allergic reactions to anesthesia.
- **Managing Side Effects:** Ice packs for swelling/discomfort, OTC pain relievers, rest, avoiding strenuous activities.
- **When to Seek Medical Help:** Fever, increased redness/swelling, severe pain, sudden weakness/numbness, loss of bladder/bowel control.
- **Risk Profile Comparison:** RFA has fewer risks compared to surgical options, offering a lower risk of infection, shorter recovery times, and avoiding the potential for failed back surgery syndrome. It's a minimally invasive option with quicker recovery, making it preferable for many.

Recent Advances (2023-2025)

- ▶ • Cooled RF for larger lesion size and deeper nerve coverage
- ▶ • Bipolar RF technology for increased precision
- ▶ • Real-time ultrasound-guided RF
- ▶ • AI-assisted target mapping and pain prediction algorithms

References

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