

Permanent Pacemaker -Implantation Techniques-

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History

- Initial epicardial implants

Senning: Thorac Cardiovasc Surg 38:639, 1959.

- Intracardiac pacemaker for Stokes-Adams seizure

Furman and Schwedel: N Engl Med 261:948, 1959.

- Transvenous approach

- Cephalic vein access by cutdown technique

Furman: Ann Thorac Surg 41:438, 1986.

- Subclavian vein access by Seldinger technique; introduction of peel-away sheath

Feiesen, et al: Can J Surg 10:131, 1977.

Littleford and Spector Ann Thorac Surg 27:265, 1979.

- Dramatic size reduction of pacemaker

1980 ~ present

Personnel

- Operator
 - physician or cardiac surgeon
perform a minimum of 12 procedures per year
- Supporting personnel
 - scrub nurse or technician or trainee
 - circulating nurse
 - individual responsible for the performance of electrical testing

Implantation Room & Equipment

- Implantation room
 - cardiac catheterization laboratory or operating room
 - intermediate-sterile area, ventilation system, sealed from high-traffic
- Fluoroscopy with angiography capability
 - single plane or biplane
- Physiologic monitoring & recording equipment
 - pulse oximeter, ECG recorder, external defibrillator, automatic BP cuff
- Emergency cart
- Analyzing equipment
 - pacing system analyzer (PSA)
- Lighting
 - multiple high-intensity lamps, headlamp
- Electrocautery device
 - appropriately grounded

Implantation Room & Equipment



Preoperative Assessment

- Indication of pacemaker implantation
 - documentation of bradyarrhythmia
- Selection of pacemaker type
 - atrium status, AV conduction, rate response
- Medications
 - oral anticoagulant
 - oral antiplatelet drug
 - IV anticoagulant
 - hypoglycemic agent

Preoperative Orders

- Fast for at least 6 hours before the procedure
- Vital sign
- Chest X-ray
- ECG
- Blood test
 - CBC, PT/aPTT, Na/K, BUN/Cr
- Adequate hydration with IV fluid
 - IV line on the side of the planned procedure
- Prophylactic antibiotics
- Shaving of the procedure area
- Empty the bladder before coming to the room

Sterile Precaution



Plastic House over Patient's Head



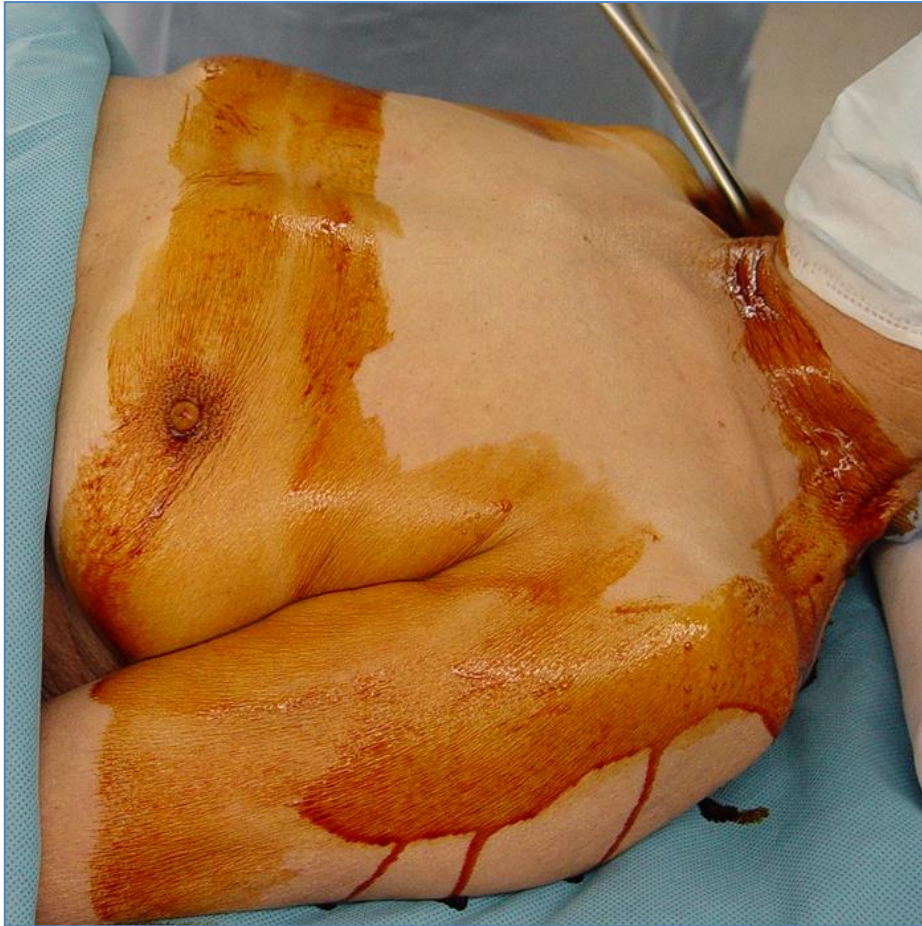
Skin Cleansing

- In general
 - povidone-iodine scrubbing
 - alcohol scrubbing
- Allergic to povidone-iodine
 - chlorhexidine or hexachlorophene scrubbing

Skin Cleansing



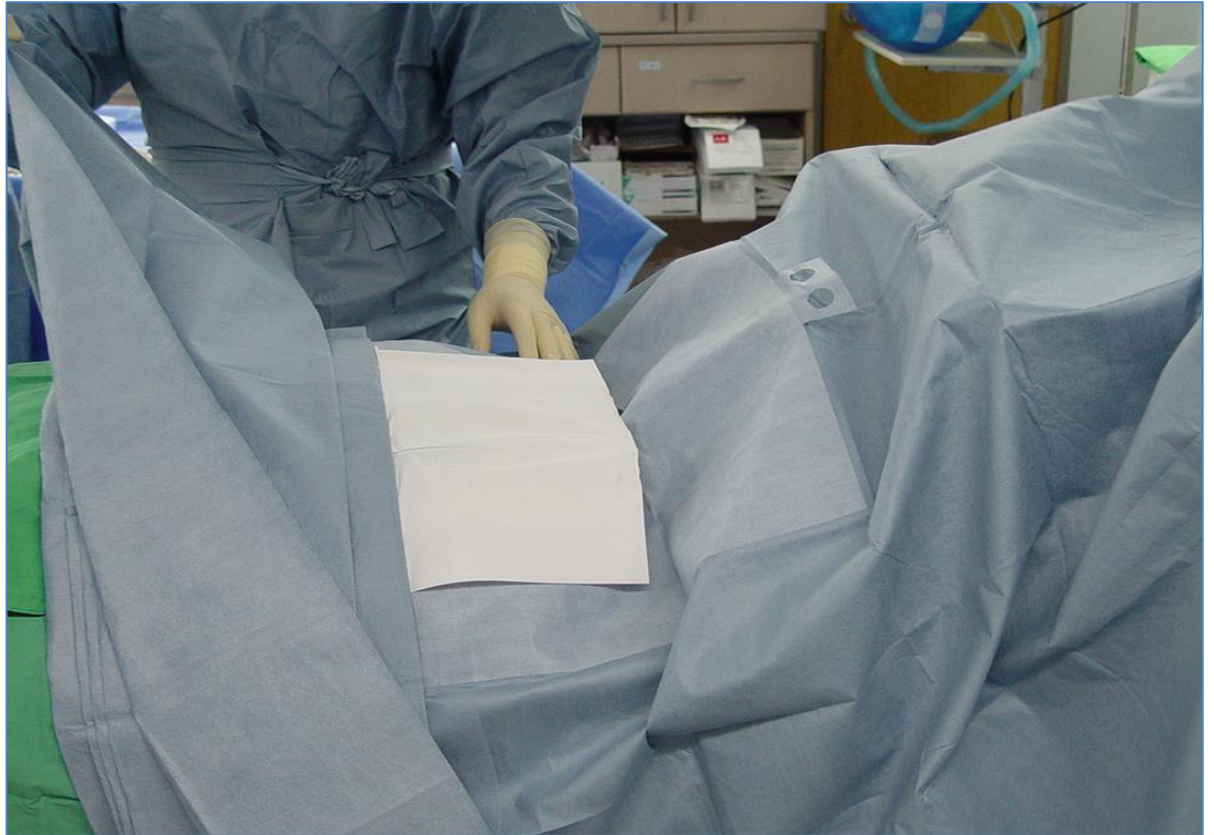
Povidone-iodine Scrubbing



Alcohol Scrubbing



Draping Process



Anesthesia, Sedation, & Pain Relief

- Local anesthesia
 - lidocaine: fast onset, max. dose 300 mg (4 mcg/kg)
 - procaine: fast onset, max. dose 800 mg (11 mcg/kg)
 - bupivacaine: moderate onset, max. dose 100 mg
- IV drugs for conscious sedation
 - midazolam; 1- 2.5 mg, max. dose 5 mg
 - fentanyl; 50-100 mcg, max. dose 100 mcg, very short-acting
- IV drugs for pain control
 - morphine; 1.5-15 mg, max. dose 20 mg, long-acting
 - meperidine; 25-100 mg, max. dose 100 mg, long-acting

Antibiotic Prophylaxis

- To reduce the incidence of pacemaker procedure-related infection
 - Controversial effect
- IV drugs
 - Cefazolin
 - 1 g preoperatively, 1 g every 8 hours postoperatively
 - Vancomycin
 - 1 g preoperatively

Surgical Tray

- Kelly clamp; large
- Scalpel blade and handle
- Forceps; nontoothed and toothed
- Scissors; Metzenbaum, suture, iris
- Retractors; Army-Navy, Senn, Weitlaner self-retaining
- Hemostats and clamps; curved, straight mosquito
- Needle holder
- Suture material
 - ETHIBOND 2-0 Polyester green coated braided non-absorbable suture material
 - VICRYL 4-0 Polyglactin 910 absorbable suture
 - DERMALON 4-0 Monofilament Nylon

Surgical Tray



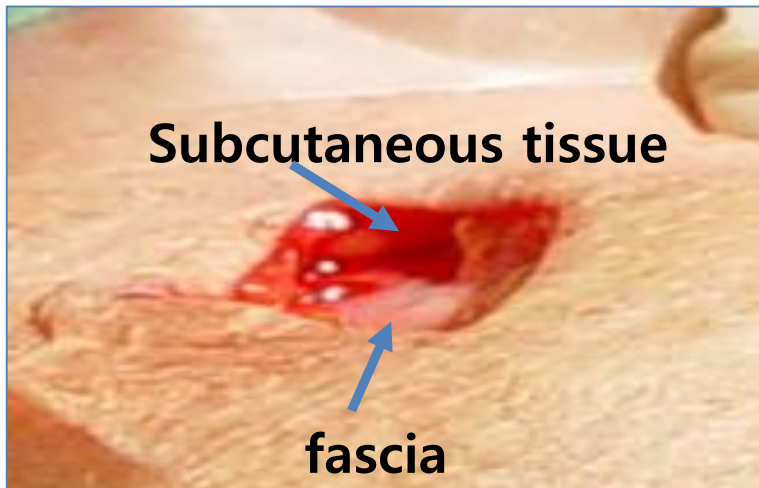
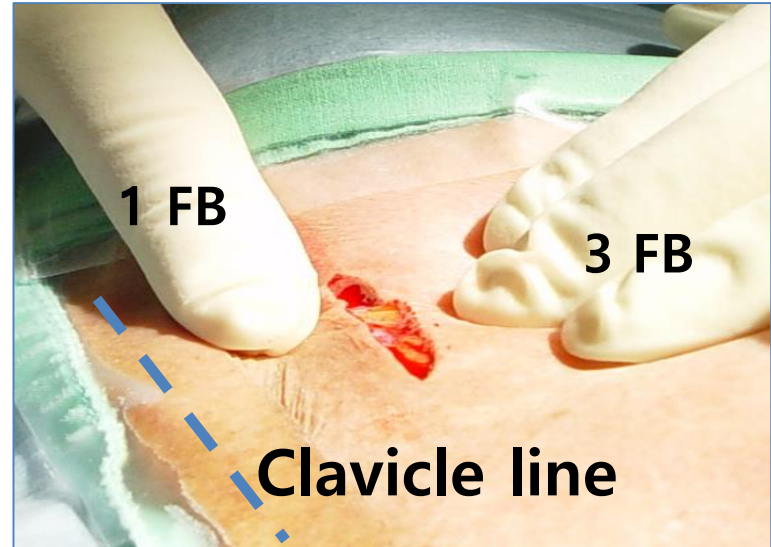
Surgical Tray



Surgical Tray



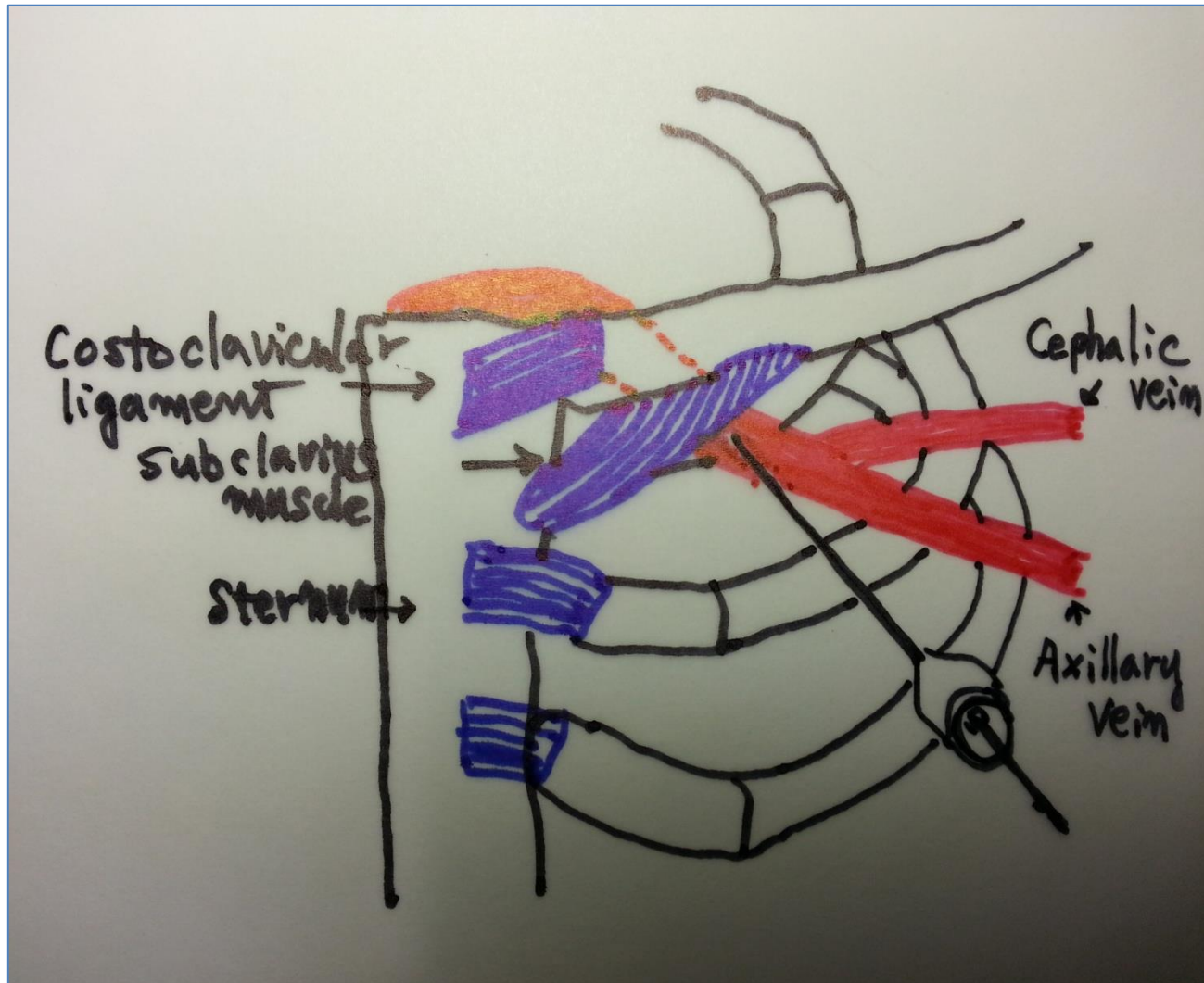
Skin Incision & Creation of Pacemaker Pocket



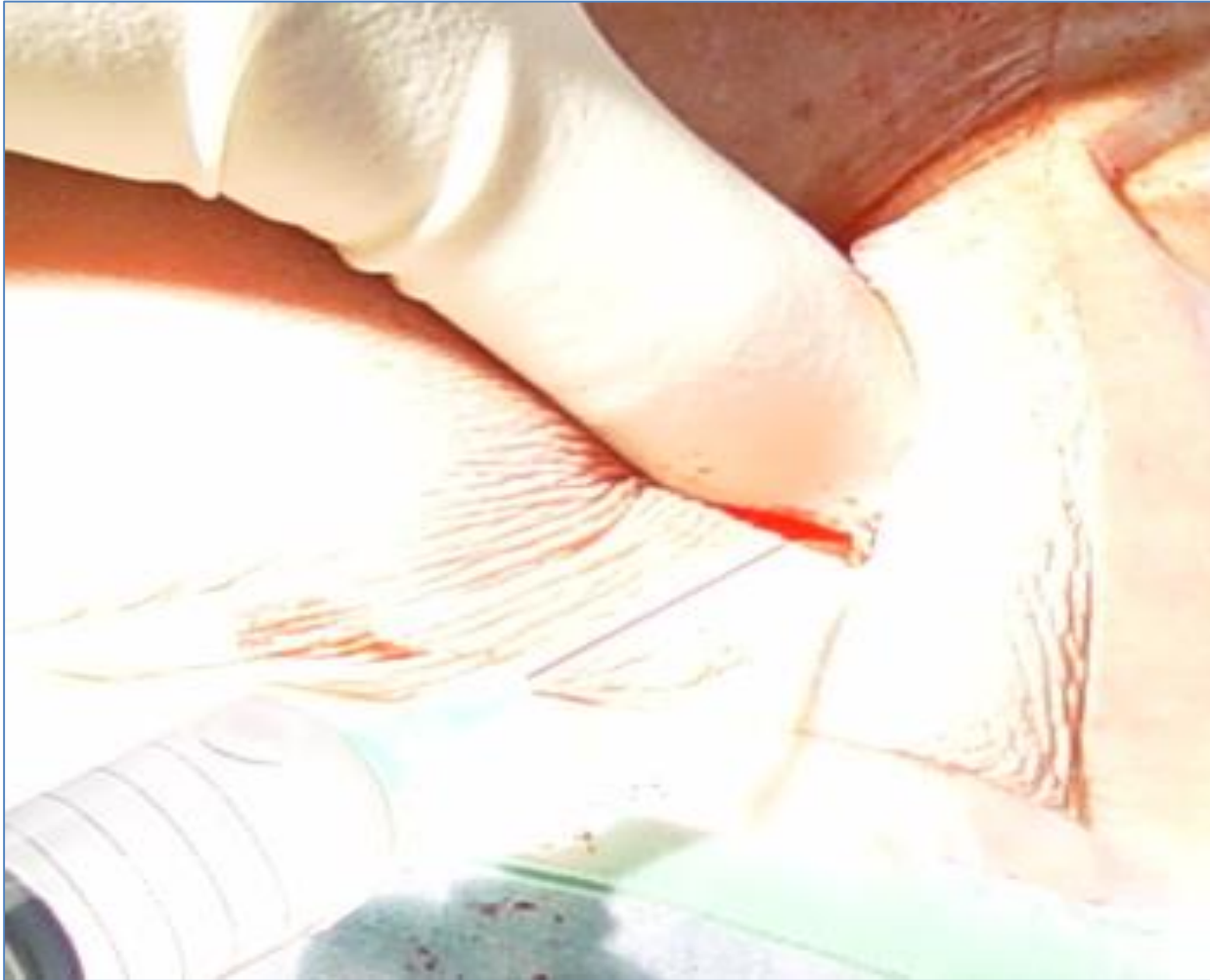
Transvenous approach

- Cephalic vein
- Subclavian vein
- Axillary vein

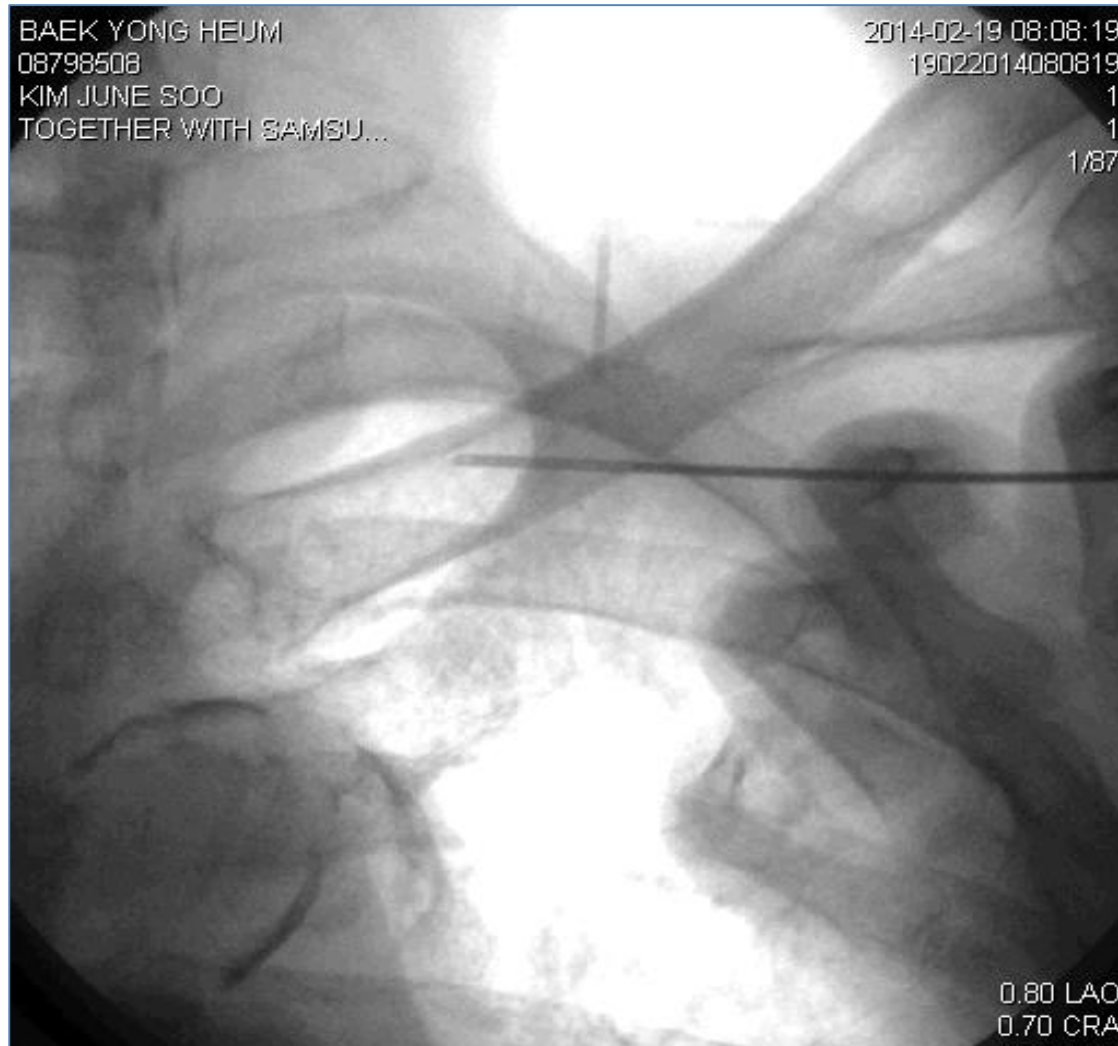
Subclavian Puncture



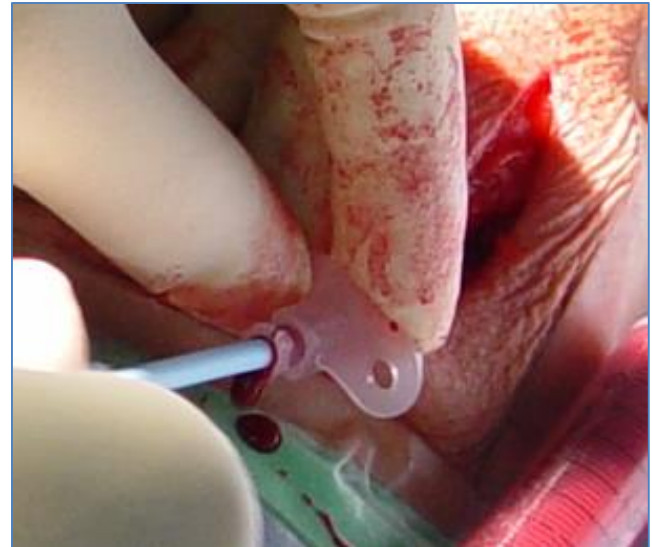
Local Anesthesia



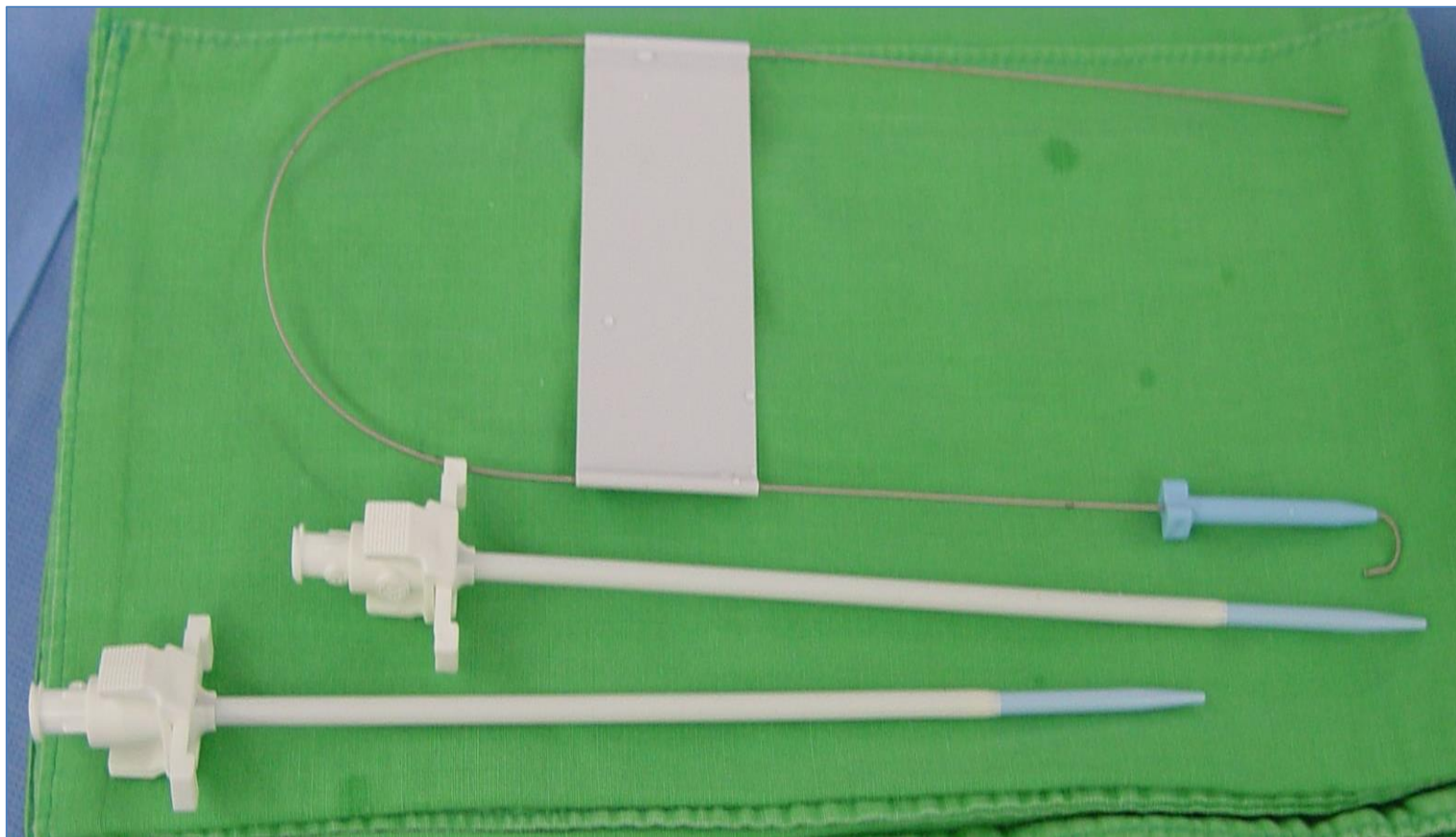
Subclavian Puncture & Guidewire Insertion



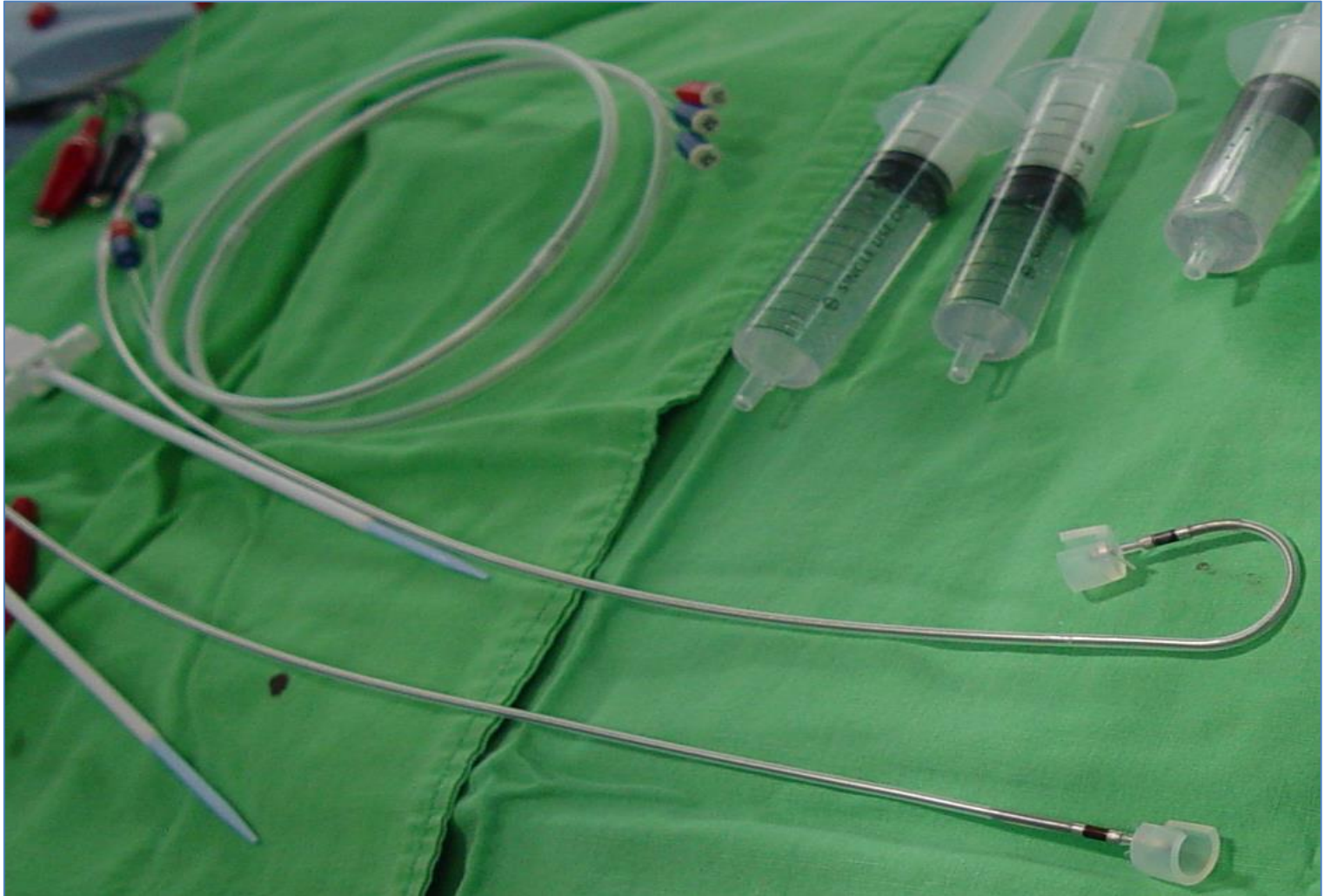
Subclavian Puncture & Guidewire Insertion



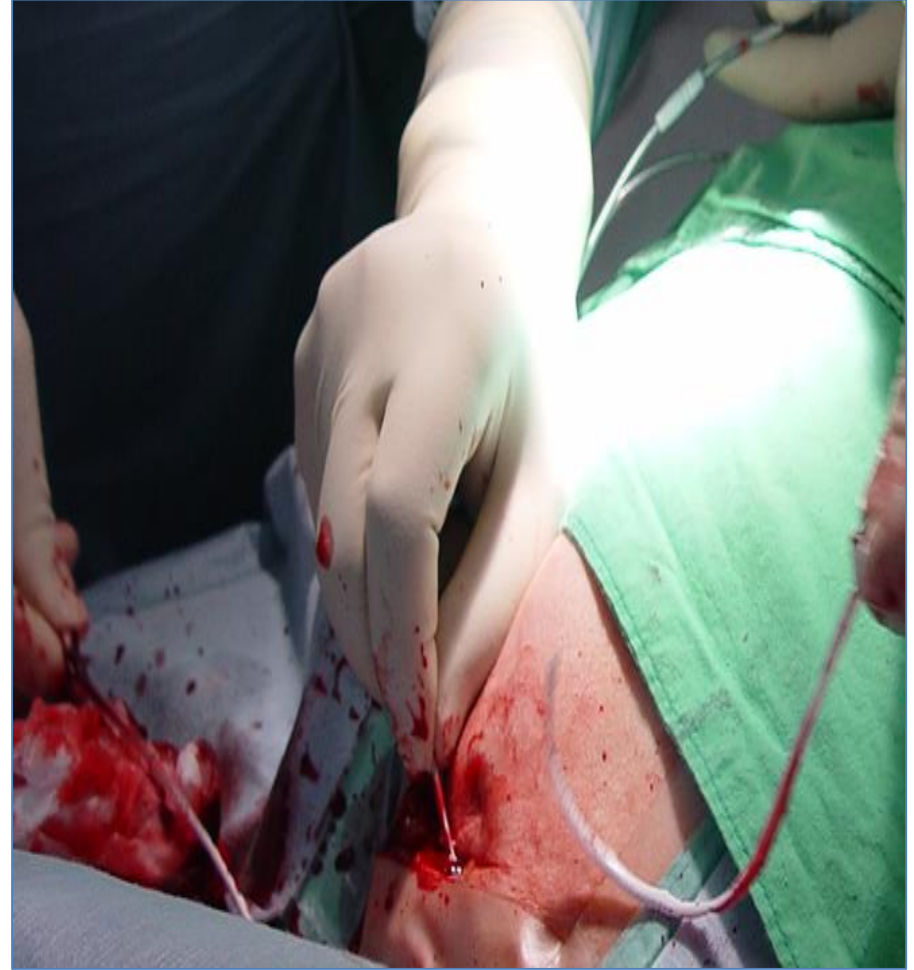
Pacemaker Introducer Kit



Sheaths & Pacemaker Leads



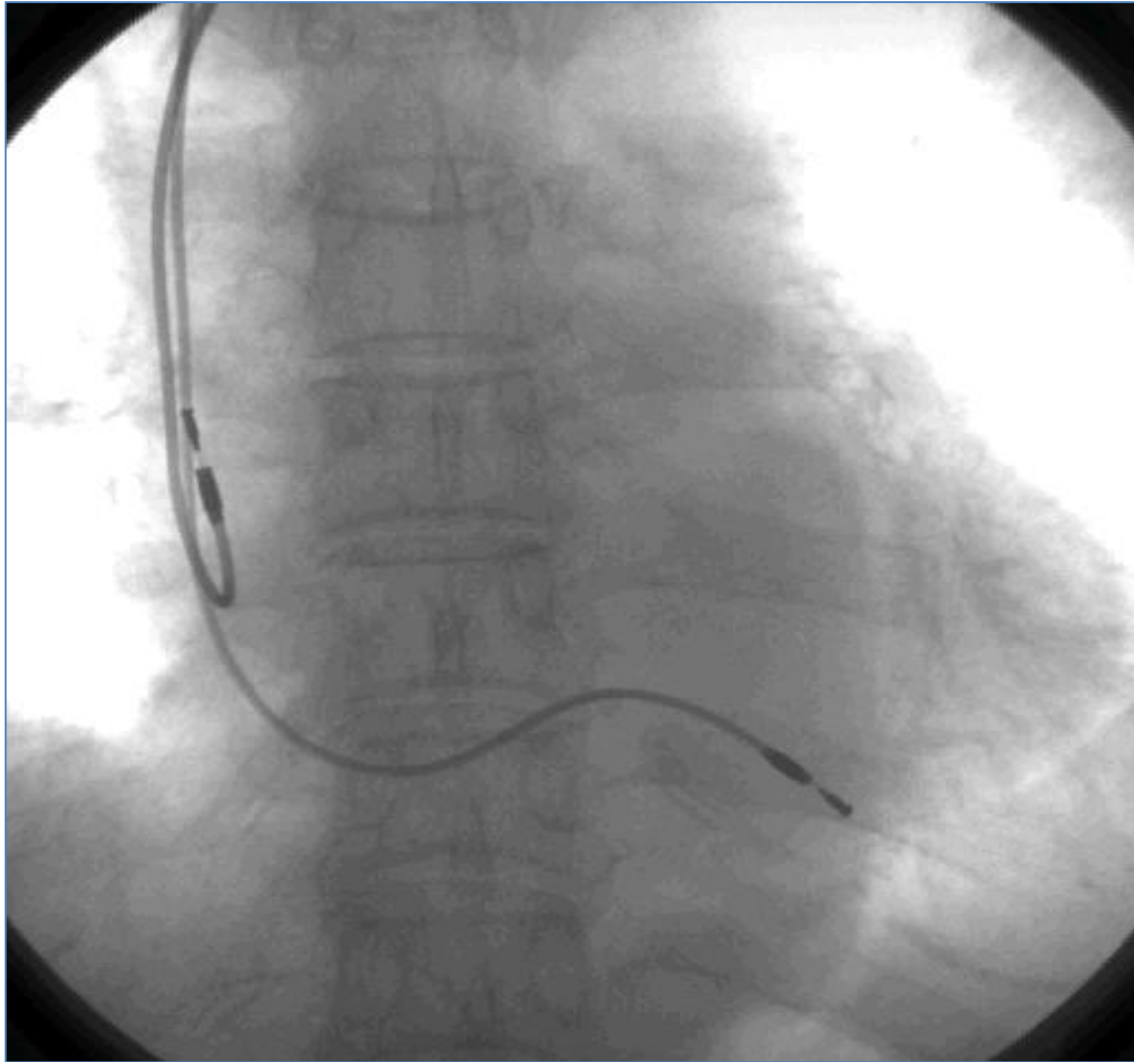
Insertion of Sheath & Pacemaker Lead



Placement of Pacemaker Leads

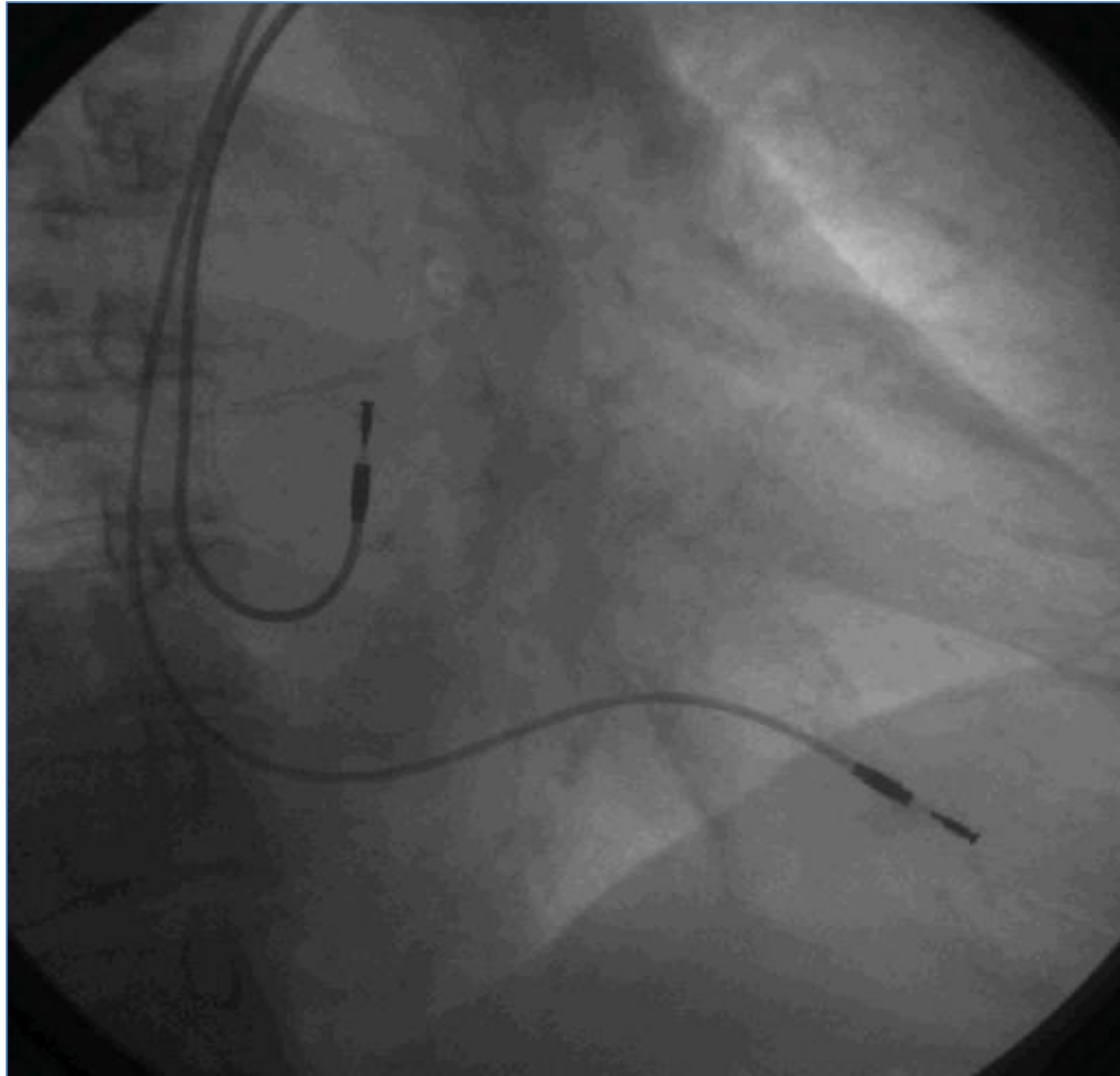


Placement of Pacemaker Leads



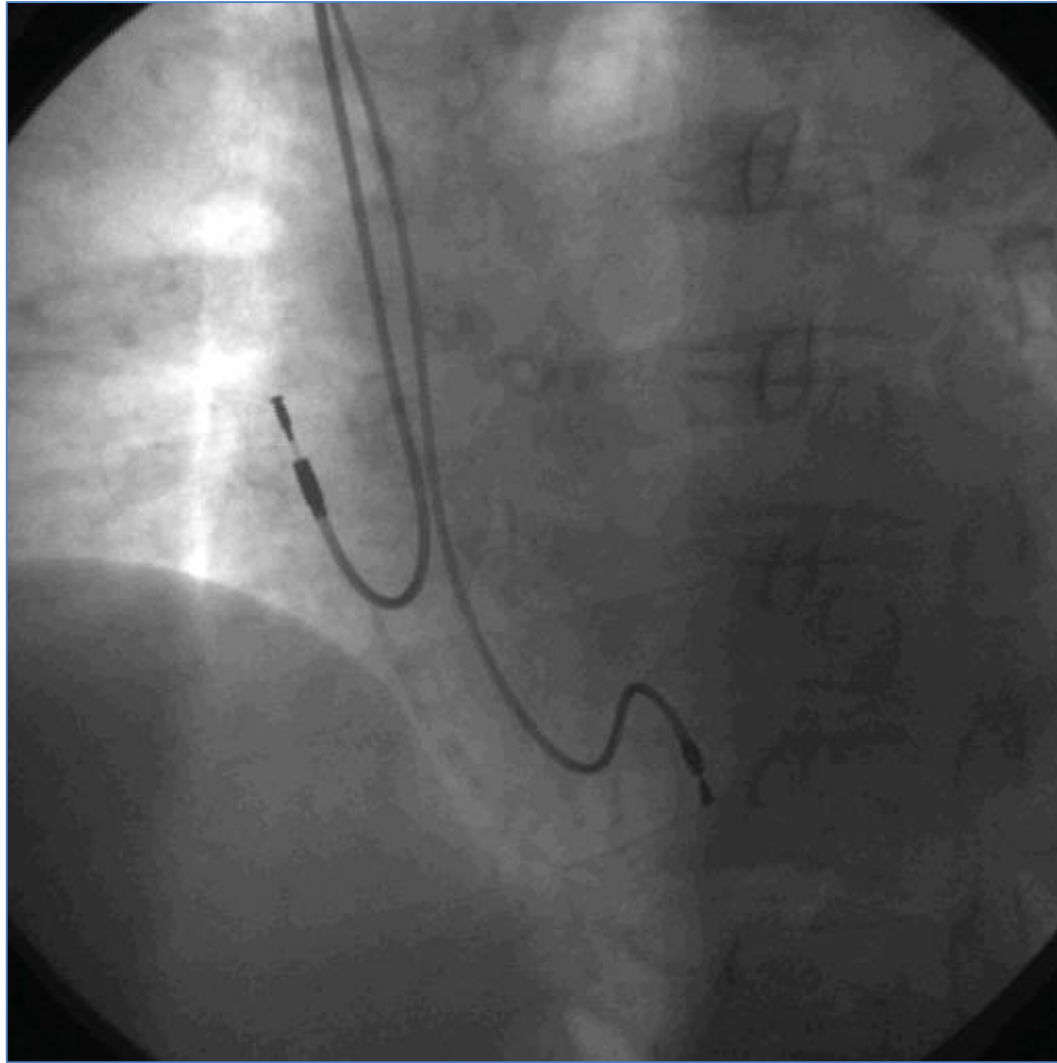
AP View

Placement of Pacemaker Leads



RAO View

Placement of Pacemaker Leads



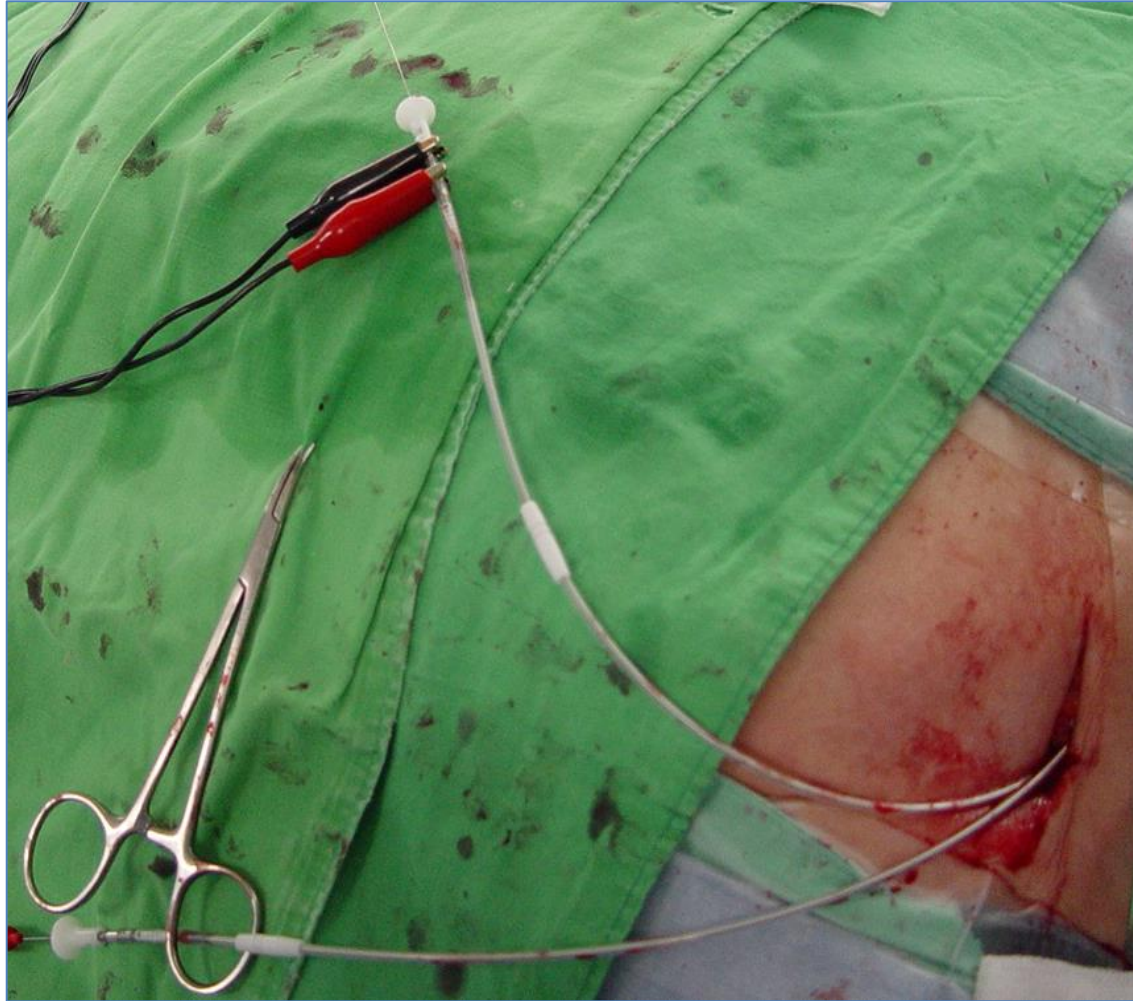
LAO View

Placement of Pacemaker Leads



LAT View

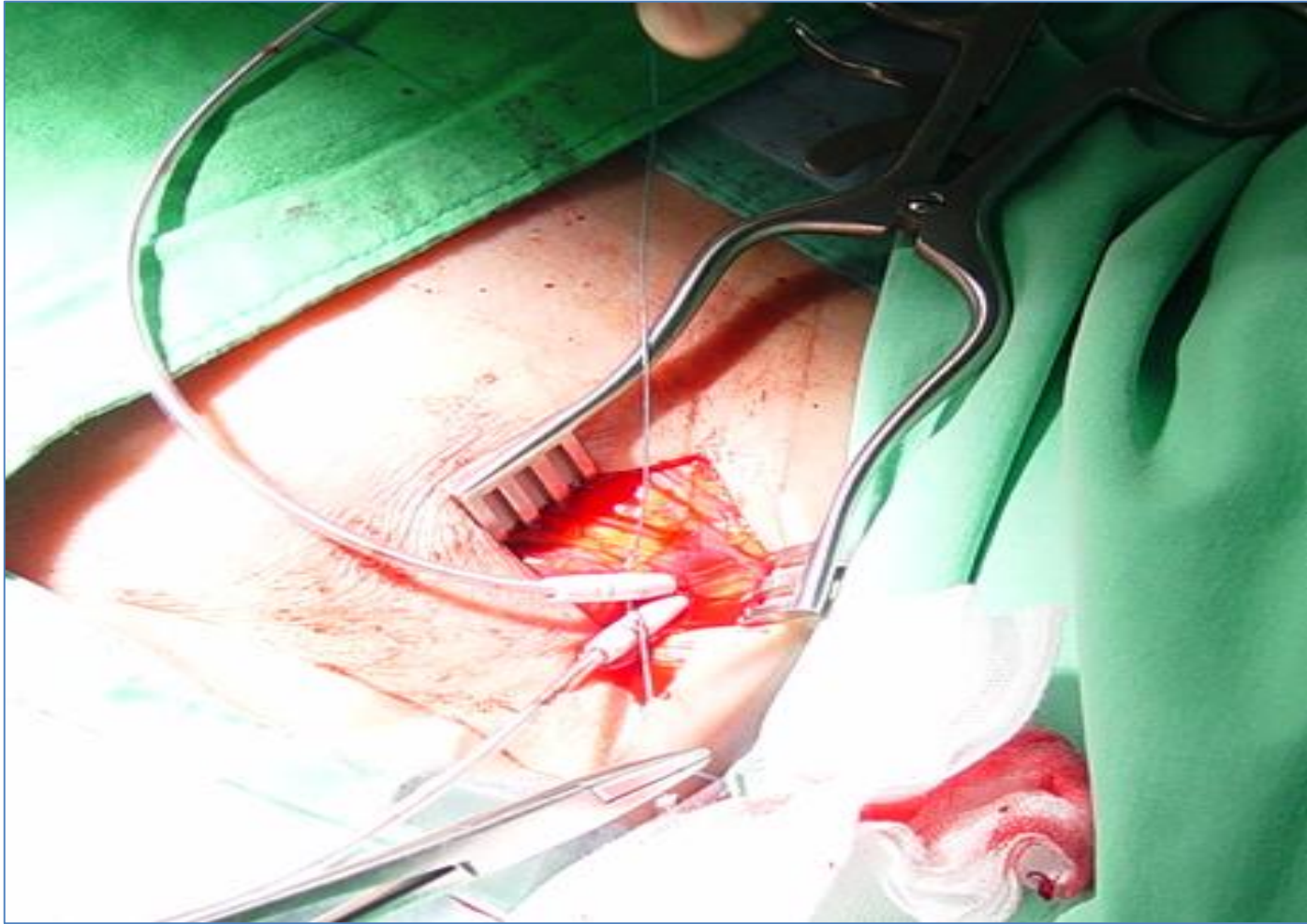
Intraoperative Measurements



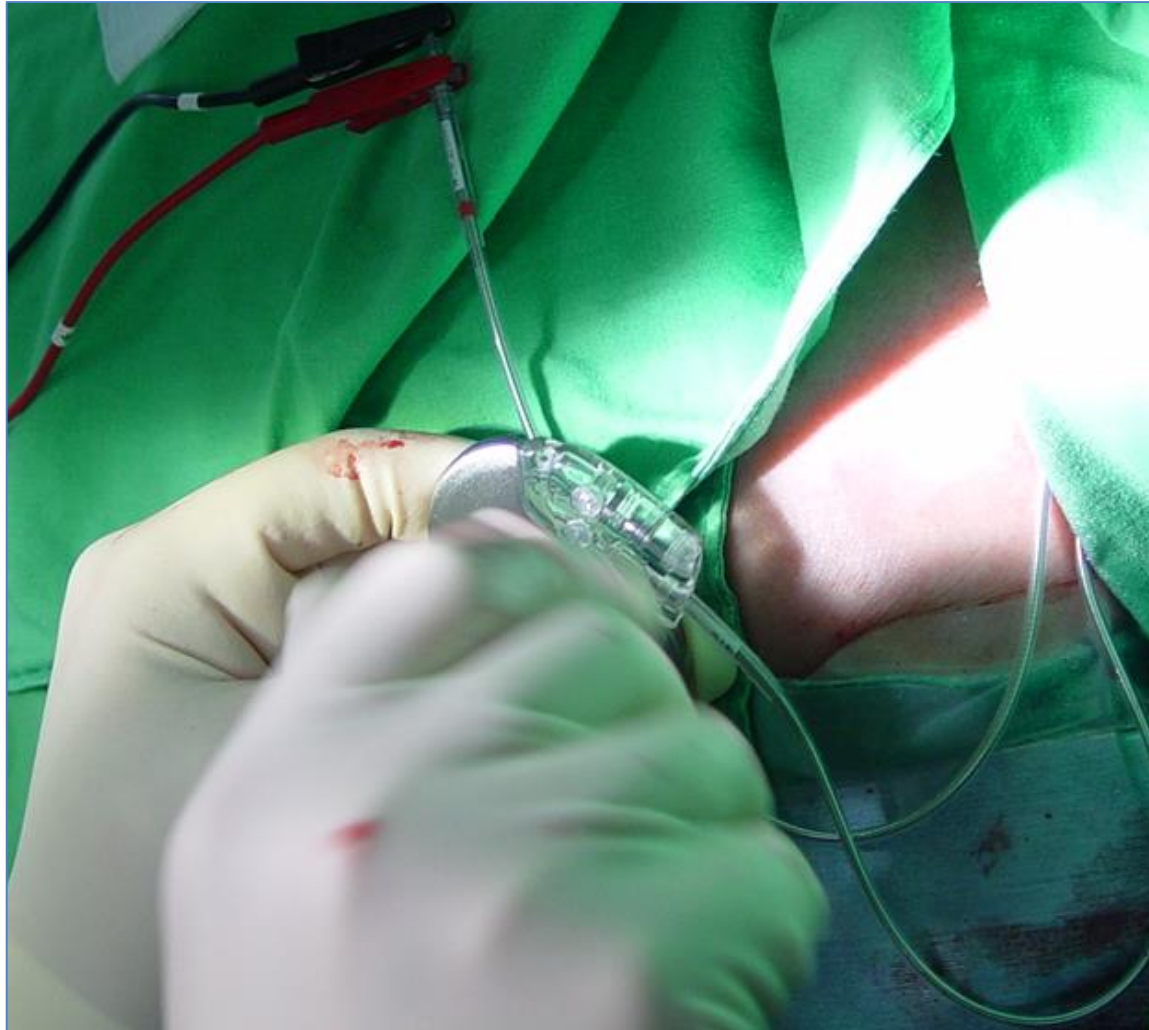
Intraoperative Measurements

- Sensing
 - Amplitude of atrial electrogram: >2 mV
 - Amplitude of ventricular electrogram: >5 mV
- Pacing
 - threshold for atrial lead: < 1.5 V at 0.5 msec pulse width
 - threshold for ventricular lead: < 1.0 V at 0.5 msec pulse width
- Impedance
 - 250-1500 ohm at output of 5 V & 0.5 msec pulse width
- Check diaphragmatic stimulation at 10 V

Securing leads



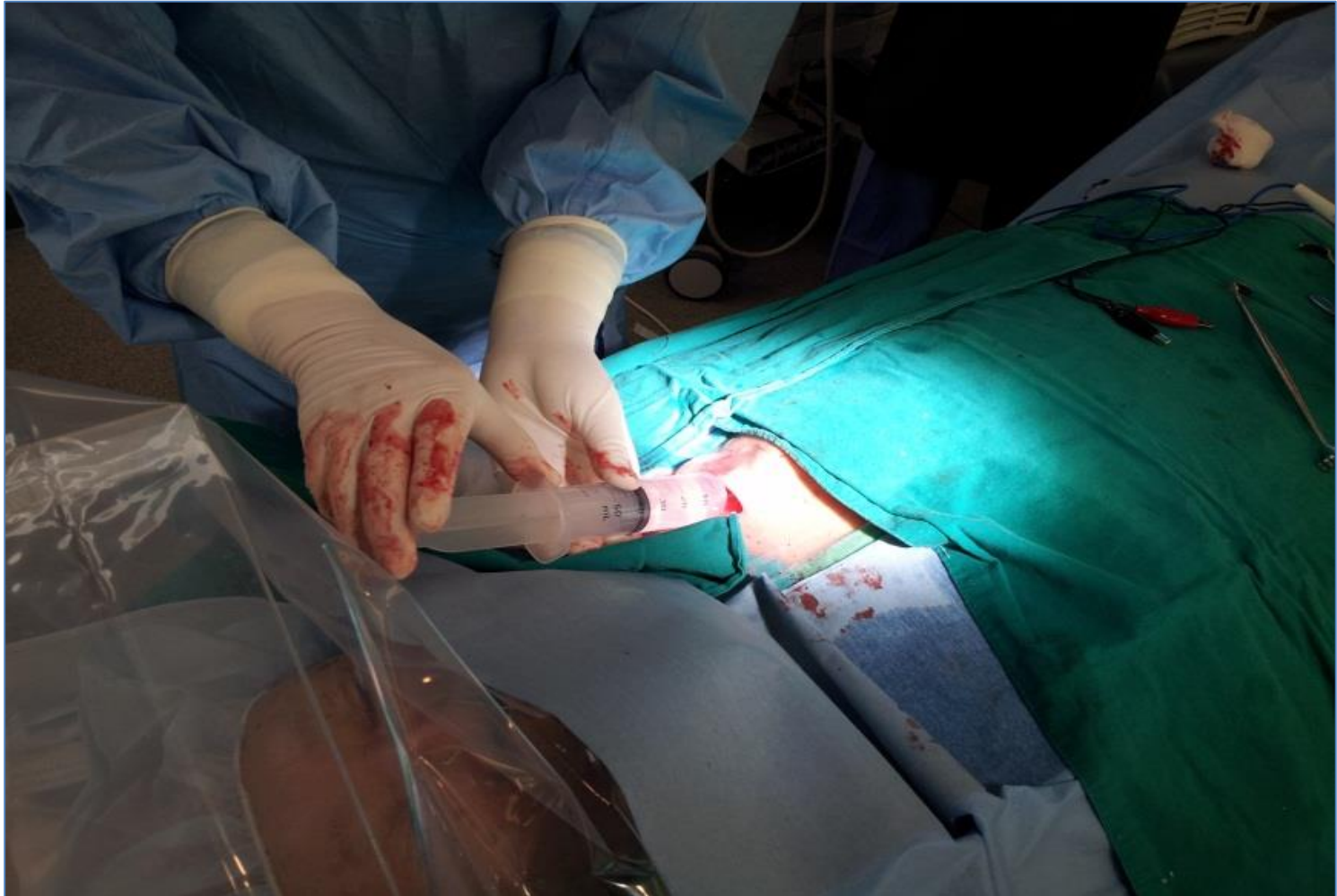
Connecting Leads with Pulse Generator



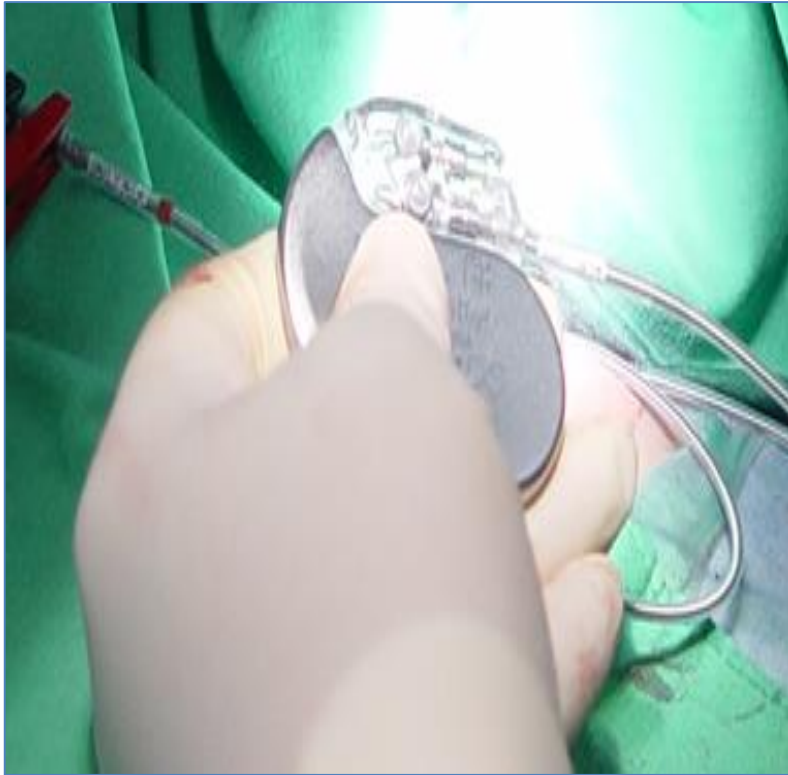
Wound Irrigation

Agent	Concentration
Bacitracin	50,000 units in 200 ml of saline
Cephalothin	1 g/L of saline
Cefazolin	1 g/L of saline
Cefuroxime	750 mg/L of saline
Gentamycin	80 mg/L of saline
Vancomycin	200-500 mg/L of saline
Povidone-iodine	Concentrated or diluted in aliquots of saline

Topical Antibiotic Irrigation



Positioning of Leads & Generator within the Pocket



Closure of Pacemaker Pocket



Complications of Pacemaker Implantation

- Pneumothrax
- Hemothorax
- Laceration of subclavian artery
- Arteriovenous fistula
- Nerve injury
- Thoracic duct injury
- Chylothorax
- Lymphatic fistula
- Air embolism
- Infection
- Pocket hematoma