Principle of Microsurgery

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Definition

- Microsurgery
  - Surgery performed on very small structures, such as blood vessels & nerves, with specialized instruments under a microscope
Purpose

- 1st microsurgery, using a microscope to repair blood vessels
  - Jules Jacobson of University of Vermont in 1960
- 1st successful replantation
  - 1964 by Harry Bunke
  - Rabbit's ear
  - Blood vessels < 0.04 in (0.1 cm)
  - ~ vessels in human digit
Numerous Techniques of Microsurgery

- Otolaryngologists (ENT)
  - Small, delicate structures of inner ear or vocal cords.
- Ophthalmologists
  - Remove cataract
  - Corneal transplants
- Urologists
  - Vasectomies (male sterilization)
- Gynecologists
  - Tubal ligations (female sterilization)
- Plastic surgeons
  - Reconstruct disfigured skin, muscles, or to transplant tissues from other parts of the body
Equipment

- MICROSCOPE
  - 5–40x
  - Lower magnification
    - Identify & expose structures
  - Higher magnification
    - Microsurgical repair

- SURGICAL LOUPES
  - 2–6x
Instruments

- Forceps
- Needle holders
- Scissors
- Vascular clamps
  - controlling bleeding
- clamp applicators
- Irrigators
  - washing structures
- Vessel dilators
  - opening up cut end of vessel
Suture

- Diameter (gauge) ranges in size & depends on procedure & tissue
  - 2-0 (0.3 mm) - 6-0 (0.07 mm)
  - 9-0 (0.03 mm) - 12-0 (0.001 mm) for MS
- Absorbable (broken down in body) vs Non-absorbable (retaining its strength)
- Natural (silk, gut, linen) / synthetic (nylon, polyester, wire)
- Needle shapes (straight/curved)
- Point types (rounded, cutting, or blunt)
- <0.15 mm for MS
Techniques

- **BLOOD VESSEL REPAIR**
  - Anastomoses
    - End-to-End (between two cut ends)
    - End-to-Side (connection of one cut end to the wall).
  - Expose the vessel
  - Irrigation
  - secured with clamps
  - Contrast material placed behind
  - 1st suture - full thickness
  - 2nd & 3rd sutures - 120°
Techniques

- End to End repair
  - Arteries 1 mm
    - between 5 & 8 stitches
  - veins 1mm
    - between 7 & 10
  - clamps are released
- End to Side repair
  - Oval-shaped hole is cut on recipient vessel
Nerve Repair

- Process of connecting two cut ends of nerve
  - Neurorrhaphy / Nerve anastomosis
- Peripheral nerves
  - Bunches of nerve fibers called fascicles
  - Enclosed by perineurium
  - Epineurium is the outer layer
- Nerve repair
  - Suturing of epineurium only
  - Perineurium only
  - Through both layers
Pre-op Preparation

- **Investigations**
  - Blood: CBP, L/RFT, Clotting profile...
  - T&S / X-match
  - X-rays, CXR
  - ECG
  - Doppler /Arteriogram

- **Advice**
  - No smoking
  - No drinking, coffee, cola...
Pre-op preparation

- **Donor Site**
  - No blood taking or IV access
  - Prevent injury
  - Marking of skin area by surgeon
  - +/- prepare the donor site of skin graft

- **Recipient Site**
  - debrides all necrotic or slough tissue.
  - +/-Ensures wound swab for culture is –ve
Replantation
Replantation

- Surgical attachment
  - Revascularization of a body part that has been completely amputated
Revascularization

- Restoration of circulation to a devascularized but not completely amputated part
Preserve the amputated parts

- Placed in a bag after being wrapped in an sterile gauze dampened with NS
- Bag placed in container & submerged in ice NS bath to maintain a temp of 4°C
- Labeling
- Never by placed in a hypotonic or hypertonic solution
Preserve amputated parts

- Don’t try to detach
- Don’t stretch
- Moistened with NS
- Loosen dressing & crepe
- Cool with ½ ice & ½ H2O in plastic bag
- Support with splint
Relevant history

- Mechanism of injury
  - Avulsion or crush
- Time of injury
  - Ischemic time
- Emergency treatment rendered, including care provided to amputated part
History

- Patient’s age
- Hand dominance
- Occupation/ vocational demands & expectations
- Previous hand injuries or disability
- Other major injuries
- Medical/ psychiatric conditions that may preclude replantation
Relevant physical examination

- Location (level) of amputation
- Single or multiple injury levels in the extremity
- Single or multiple amputated parts
- Condition of amputated part (sign or crush or avulsion)
- Condition of the amputation stump
Sequence for replantation

- Wound debridement
- Identification of arteries, veins, nerves & tendons
- Bone stabilization
- Extensor tendon repair
- Flexor tendon repair
- Vascular anastomosis
- Nerve repair
- Skin closure
Methods for bony stabilization

- K wire or intraosseous wires
  - can be placed rapidly & easily
- Lag screw fixation or miniplate & screws
- Plate fixation
  - major limb replantation
Post-op Care

- Complete bed rest
- Keep warm
  - Warm Room (~26ºC)
  - ? lamp treatment
- Bed cradle
- Support operated limb → Avoid torsion of pedicle
Post-op Care

- **Elevation**
  - Heart level
  - Above heart level
  - One pillow

- **Vital Signs**
  - BP/P
  - Body Temp.
  - I/O
Post-op Care

- IVF
  - Hydration
- Foley’s catheter
  - measure output
- NPO
- Pain control
  - (No Puncture on affected site)

- Medication
  - Dextran 40
  - Aspirin
  - Persantin
  - Analgesic
  - Antibiotics
Monitoring

- Colour
- Capillary Refill
- Tissue Turgor
- Temperature
- Doppler
- SpO₂
- Pin Prick
Monitoring

- **Colour**
  - Normal $\rightarrow$ Pink
  - Arterial fail $\rightarrow$ Pale
  - Venous fail $\rightarrow$ Cyanotic

- **Capillary Refill**
  - Normal $\rightarrow$ 1-2 sec
  - Arterial fail $\rightarrow$ Slow
  - Venous fail $\rightarrow$ Fast
Monitoring

- **Tissue Turgor**
  - Normal → Full
  - Arterial fail → Hollow, “Prune like”
  - Venous fail → Tense, Distended+ Blisters
Monitoring

- **Temperature**
  - Normal: 30-37°C
  - Replanted or flap: +/− 2-3°C
  - ? By touch
  - By Thermo Scan
  - Arterial / venous thrombosis
    - fall below 30°C, differential 2.5°C
  - Arterial thrombosis/ Venous thrombosis:
    - rapid fall 3°C/slowly fall 1-2°C
Monitoring

- Doppler
  - Vascular Doppler
  - Implantable Doppler Probe
- Laser Doppler Flow meter

- SpO₂
  - Normal: ~ >90%
  - Vascular compromise
    - Sudden fall
    - Not ↑ on 100% O₂ given

Vascular compromise: Sudden fall, not increased on 100% O₂ given.
Monitoring: Pin Prick

- **By Surgeon**
  - 25 gauge needle
  - No.11 blade
- Heparin
  - promote bleeding
- Normal: **Bright red** blood
- Slow to start bleeding
- Bleeds a short

- Arterial Occlusion: Serum
  - No bleeding
- Venous Occlusion:
  - Bleeds brisk
  - Bleeds a long time
Pressure on flap
Thank you