Burn Pathology
“While there is life, there’s hope”

- Theocritus (3rd Century B.C.)
Burn Patient Mortality
LD50

Percent Burn

1943  1995  1996

100  90  80  70  60  50  40  30  20  10  0

1943  1995  1996
Cutaneous Burn
↓
Multi-Organ System Problems
Immobilization and Bed Rest Effects
Organ System Involvement

✓ Integumentary System
Hypertrophic versus Keloid Scars
C. Healed partial thickness wound. Note the loss of the rete pegs in the healed area. Rete pegs return after time.
Heat Tolerance in Patients with Extensive Healed Burns


✓ Austin KG, et al. *J Burn Care Rehabil* 2003;24:9-14
Cutaneous Sensory Changes Following Burn Injury


Organ System Involvement

✓ Respiratory System
Burn Injury
Respiratory Pathophysiology

Lung edema
1. Burn insult
2. Fluid overload

Decreased ventilation

Hypoxemia

Shortness of breath
Excessive fatigue

Decreased ventilation/perfusion ratio

Alveolar collapse
Organ System Involvement

✓ Cardio-vascular System
Pressure Gradients

- Hydrostatic pressure
- Oncotic pressure
Vascular Response to Injury

Mural cell
Basement membrane
Endothelial cell
Mononuclear leukocyte
Polymorphonuclear leukocyte

Venule (20 to 30 μm) shows transient vasoconstriction in response to injury

Histamine

Mast cell
Complement fractions
Prostaglandins

Separation of endothelial cell junctions, leaving open gaps
Polymorphonuclear leukocytes emigrate through endothelial gaps after plasma leakage
Formation of rouleaux by red blood cells
Margination of leukocytes on endothelial surface

Histamine and other substances cause active vasodilatation of local vessels and increased permeability at level of venules
INCREASED CAPILLARY PERMEABILITY

NORMAL ARTERIOLE

ARTERIOLE AFTER BURN

Escaping fluid causes edema
Cardio-vascular Changes

- Decrease cardiac output
  - Decreased stroke volume
  - Reduced MAP
  - Increased RHR
  - Increased HR with exercise
Hematologic Effects

- Hemoconcentration
  - Decreased intravascular fluid
  - Increased hematocrit
  - Increased blood viscosity
    - Wound conversion
    - Thrombotic susceptibility
Musculo-Skeletal System

✓ Muscle protein metabolism

✓ Muscle atrophy
Strength loss from muscle disuse

✓ 3% per day
✓ 20% per week
✓ 50% in 3 – 5 weeks

Halar & Bell, 1990
Hospital Length Of Stay

Saffle, JBCR 1995, 1996
Heterotopic Ossification

✓ Etiology
  → Calcium mobilization from immobilization
  → High protein intake
  → Microtrauma
  → >20% total body burn
  → Sepsis
Heterotopic Ossification

✓ Incidence
  
  → 0.1% - 3.3% (Retrospective studies)

  → 13.6% - 23% (Prospective studies)
Heterotopic Ossification

✓ Location
  → Highest – elbow, shoulder, hip
  → Other – knee, ankle, wrist, hand,
  → TMJ, cricoarytenoid joint
  → Full-thickness injuries
  → Areas that remain unhealed for prolonged period of time
  → May appear in areas other than burn
Heterotopic Ossification

✓ Symptoms
  → Pain with range of motion
  → Quality of pain change
  → Point-specific pain
  → Limitation of motion
  → Bony end feel
Heterotopic Ossification

✓ Prognosis → good
Additional Musculo-Skeletal Problems

- Osteoporosis
- Fractures
- Joint dislocations
- Septic arthritis
- Amputations
- Bone spurs
- Bone retardation
Peripheral Neuropathy

✓ Etiology

1. Polyneuropathy
   → Uncertain
   → May be neurotoxin
   → > 20% total body burn
Peripheral Neuropathy

Etiology

2. Local neuropathy
   → Direct thermal injury rare
   → Management injury due to pressure
   → Improper position in bed or operating room
   → Compression from edema, bandages, or tourniquet
   → Entrapment secondary to HO
   → Injections
Peripheral Neuropathy

✓ Incidence

→ 15% - 29% Prospective studies
Peripheral Neuropathy

✓ Location
  → Brachial plexus
  → Ulnar nerve
  → Peroneal nerve
  → Median nerve*
Peripheral Neuropathy

✓ Symptoms

→ Muscle paralysis/Weakness
→ Paresthesias/Anesthesia

✓ Prognosis: Spontaneous recovery
Burn Pain

- Worst experience for human
- Continues until all wounds are healed
- Greatest obstacle to rehabilitation
- Non-reproducible
Pain Management

✓ Realize patient has pain
✓ Resist taking confrontations personally
✓ Allow patient to express pain/emotions
✓ Provide for rest periods
✓ Encourage patient participation
Treatment Interventions

✓ Sensory reappraisal
✓ Patient preparation/education
✓ Time pain medication with therapy treatment
Pain is temporary,
Pride is forever!
Psychologic Issues
Pain is inevitable, 

Suffering is optional!
Specialized Senses

✓ Ophthalmic

✓ Audiologic
Marjolin’s Ulcer (1828)

✔ Latent period: 20 – 30 years
✔ Etiology: Chronic local infection or irritation
   Delayed healing
✔ Predilection: Extremities & joint creases