## Burn Pathology

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#### "While there is life, there's hope"

- Theocritus (3<sup>rd</sup> Century B.C.)

## Burn Patient Mortality LD50



#### 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

 ✓ Ben-Simchon C, et al. *Plast Reconst Surg* 1981;67:499-504

 ✓ Austin KG, et al. J Burn Care Rehabil 2003;24:9-14

#### Cutaneous Sensory Changes Following Burn Injury

#### ✓ Ward RS, et al. J Burn Care Rehabil

1991;12:569 - 575

# Malenfant, et al. *Pain* 1998;77:241 - 251



#### **Organ System Involvement**

#### Respiratory System





#### **Organ System Involvement**

#### ✓ Cardio-vascular System



## Body Fluid Compartments



#### **Pressure Gradients**

#### Hydrostatic pressure

#### > Oncotic pressure











#### Cardio-vascular Changes

- Decrease cardiac output
  Decreased stroke volume
  Reduced MAP
  Increased RHR
  - ✓ ↑Increased HR with exercise

#### Hematolgic Effects

- Hemoconcentration
  - ✓ Decreased intravascular fluid
  - ✓ Increased hematocrit
  - $\checkmark$  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







## ✓ Etiology

- → Calcium mobilization from immobilization
- → High protein intake
- → Microtrauma
- → >20% total body burn
- → Sepsis

#### ✓ Incidence

→ 0.1% - 3.3% (Retrospective studies)

→ 13.6% - 23% (Prospective studies)

#### ✓ Location

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

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

#### ✓ Prognosis → good



#### Additional Musculo-Skeletal Problems

- ✓ Osteoporosis
- ✓ Fractures
- ✓ Joint dislocations
- ✓ Septic arthritis
- ✓ Amputations
- ✓ Bone spurs
- ✓ Bone retardation

#### ✓ Etiology

- 1. Polyneuropathy
  - → Uncertain
  - → May be neurotoxin
  - $\rightarrow$  > 20% total body burn

## **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

#### ✓ Incidence

# → 15% - 29% Prospective studies

#### ✓ Location

- → Brachial plexus
- → Ulnar nerve
- → Peroneal nerve
- → Median nerve\*

- ✓ 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
- $\checkmark$  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**

✓ Opthalmic

✓Audiologic

#### Marjolin's Ulcer (1828)

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