Burn and Bite/Sting

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General Aspect of Burn

- 1,200,000 burn/year in USA → 50,000 (4%) urn/year required hospitalization → 5,000 (0.4%) burn died per year → 10% mortality

- Populations:
  - Toddler: hot water (scalding burn)
  - Young adults: flame burn
  - Elderly
  - Low social economic group

- Morbidity and mortality rates associated with burns are decreased.

- 50% decline in burn-related deaths and hospital admission in the United States over 20 years
Burn Unit

- Experienced burn surgeons
- Dedicated nursing personnel
- Physical and occupational therapists
- Social workers
- Dietitians
- Pharmacist
- Respiratory therapist
- Psychiatrists and clinical psychologists
- Prosthetists
<table>
<thead>
<tr>
<th>Criteria for refer to burn center</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Partial thickness burn greater than 10% TBSA</td>
</tr>
<tr>
<td>2. Burn involving the face, hands, feet, genitalia, perineum, or major joints</td>
</tr>
<tr>
<td>3. Any full-thickness burn</td>
</tr>
<tr>
<td>4. Electrical burns, including lightning injury</td>
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<tr>
<td>5. Chemical burns</td>
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<tr>
<td>6. Inhalation injury</td>
</tr>
<tr>
<td>7. Burns in patients with pre-existing medical disorders that could complicate management, prolong recovery, or affect outcome.</td>
</tr>
<tr>
<td>8. Any patient with burns and concomitant trauma</td>
</tr>
</tbody>
</table>
Pathophysiology of Burn (I)

- Thermal injury $\rightarrow$ coagulation necrosis of the epidermis and underlying tissue
- The depth of burn: the temperature and the duration of exposure
- Classification of Burn according to the causes
  - Flame
  - Scald
  - Contact
  - Chemical
  - Electrical

Coagulation necrosis from the transfer of the heat energy

$\rightarrow$ Direct injury of cell membrane
Pathophysiology of Burn (II)

**Depth of Burn**

- **First degree**: injury localized to the epidermis
- **Superficial second degree**: injury to the epidermis and superficial dermis
- **Deep second degree**: injury through the epidermis and deep into the dermis
- **Third degree**: full-thickness injury through the epidermis and dermis into the subcutaneous fat
- **Fourth degree**: injury through the skin and subcutaneous fat into underlying muscle or bone

Normal Skin: physical barrier against bacterial invasion, important role for control of temperature, water and vitamin D production
Pathophysiology of Burn (III)

Depth of Burn

– First degree:
  painful, erythematous, and blanch to the touch, sunburn or minor scalding burn, no scarring

– Superficial second degree:
  erythematous, painful, blanch to touch, and often blister, healing within 7-14 days with some slight discoloration

– Deep second degree:
  pale and mottled, do not blanch to touch, but remain painful to pinprick, healing in 14-35 days with severe scarring

– Third degree:
  hard leathery eschar, painless and black, white, or cherry red in color, healed by reepithelialization from the wound edges, skin graft
Pathophysiology of Burn (IV)

Irreversible damage

Critical area

Zone of Coagulation

Zone of Stasis

Zone of Hyperemia

EPI DERMIS

DERMIS
Pathophysiology of Burn (V)

**Zone of Burn Area**

- **Zone of coagulation**: the necrotic area of burn where cell have been disrupted, irreversible damage

- **Zone of stasis**: the area immediately surrounding the zone of coagulation, moderate degree of insult with decreased tissue perfusion, either survive or go on to coagulation necrosis (possible reversible), associated with vascular damage and vessel leakage, thromboxane $A_2$ present in high concentration $\rightarrow$ local inhibitor: improve blood circulation

- **Zone of hyperemia**: vasodilatation from the inflammation surrounding the burn wound, clearly viable tissue, healing process, no risk for further necrosis
Pathophysiology of Burn (VI)

The Rule of Nine

Burn Size
For Example,

70 Kg male, Flame burn, Second degree
Solution

- Arm: 9%
- Anterior surface of right trunk: 9%
- Anterior surface of right lower limb: 9%

= 27%
Figure 20–4. Systemic effects of severe burn.
Treatment of Burn

- Initial first aid
- Fluid therapy
- Wound Care
- Rehabilitation
Initial Treatment

- **Prehospital**
  - Removed from the source of injury
  - Always suspect to have inhalation injury → 100% Oxygen
  - All ring, watches, jewelry and belt should be removed
  - Room temperature water can be poured on the wound within 15 minutes of injury to decrease the depth of the wound
  - Cold water should be avoided to preclude hypotherima
  - Initial assessment: primary and secondary survey
  - Initial wound care: only protection from the environment with clean dry dressing
  - Intravenous small dose of narcotic agent after full assessment
  - Transport
Fluid Resuscitation

Rapid Calculation of Initial Fluid Rate;
= (BSA X BWt/8)/ hr

80 Kg man with a 40 % of burn;
= (40 X 80)/8 = 400ml/hr

Formula Calculation for first 24 hours

<table>
<thead>
<tr>
<th>Formula</th>
<th>Crystalloid Volume</th>
<th>Colloid Volume</th>
<th>Free Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkland</td>
<td>4 ml/kg/% TBSA burn</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Brooke</td>
<td>1.5 ml/kg/% TBSA burn</td>
<td>0.5 ml/kg/% TBSA burn</td>
<td>2.0 L</td>
</tr>
<tr>
<td>Galveston (pediatric)</td>
<td>5000 ml/m² burned + 1500 ml/m² total</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

½ amount ➔ The first 8 hrs
For Example,

70 Kg male, Flame burn, Second degree
Solution = 27%

Fluid during transfer;
\[(\text{BSA} \times \text{BWt}/8)/ \text{hrs} = (27 \times 70/8)/ \text{hrs} = 236 \text{ cc/hr}\]
Solution = 27%

Fluid during first 24 hrs;  
= 4 cc/kg/BSA  
= 4 x 70 x 27  
= 7560 cc/ 24 hrs

The first 8hrs;  
= 7560/2  
= 3780/8hrs  
= 472.5 cc/hr  
The next 16 hrs  
= 3780 cc/16 hrs  
= 236 cc/hr
Escharotomy
Wound care I

<table>
<thead>
<tr>
<th>Antimicrobial Salves</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Silver sulfadiazine (Silvadine)</td>
<td>Broad-spectrum antimicrobial; painless and easy to use; does not penetrate eschar; may leave black tattoos from silver ion; mild inhibition of epithelialization</td>
</tr>
<tr>
<td>Mafenide acetate (Sulfamylon)</td>
<td>Broad-spectrum antimicrobial; penetrates eschar; may cause pain in sensate skin; wide application may cause metabolic acidosis; mild inhibition of epithelialization</td>
</tr>
<tr>
<td>Bacitracin</td>
<td>Ease of application; painless; antimicrobial spectrum not as wide as the above agents</td>
</tr>
<tr>
<td>Neomycin</td>
<td>Ease of application; painless; antimicrobial spectrum not as wide</td>
</tr>
<tr>
<td>Polymyxin B</td>
<td>Ease of application; painless; antimicrobial spectrum not as wide</td>
</tr>
<tr>
<td>Nystatin (Mycostatin)</td>
<td>Effective in inhibiting most fungal growth; cannot be used in combination with Sulfamylon</td>
</tr>
<tr>
<td>Mupirocin (Bactroban)</td>
<td>More effective staphylococcal coverage; does not inhibit epithelialization, expensive</td>
</tr>
</tbody>
</table>
# Wound care II

## Antimicrobial Soaks

<table>
<thead>
<tr>
<th>Solution</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5% silver nitrate</td>
<td>Effective against all microorganisms; stains contacted areas; leaches sodium from wounds; may cause methemoglobinemia</td>
</tr>
<tr>
<td>5% mafenide acetate</td>
<td>Wide antibacterial coverage; no fungal coverage; painful on application to sensate wound; wide application associated with metabolic acidosis</td>
</tr>
<tr>
<td>0.025% sodium hypochlorite (Dakin's solution)</td>
<td>Effective against almost all microbes, particularly gram-positive organisms; mildly inhibits epithelialization</td>
</tr>
<tr>
<td>0.25% acetic acid</td>
<td>Effective against most organisms, particularly gram-negative organisms; mildly inhibits epithelialization</td>
</tr>
</tbody>
</table>
## Wound care III

### Synthetic Coverings

<table>
<thead>
<tr>
<th>Material</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OpSite</td>
<td>Provides a moisture barrier; inexpensive; decreased wound pain; use complicated by accumulation of transudate and exudate requiring removal; no antimicrobial properties</td>
</tr>
<tr>
<td>Biobrane</td>
<td>Provides a wound barrier; associated with decreased pain; use complicated by accumulation of exudate risking invasive wound infection; no antimicrobial properties</td>
</tr>
<tr>
<td>Transcyte</td>
<td>Provides a wound barrier; decreased pain; accelerated wound healing; use complicated by accumulation of exudate; no antimicrobial properties</td>
</tr>
<tr>
<td>Integra</td>
<td>Provides complete wound closure and leaves a dermal equivalent; sporadic take rates; no antimicrobial properties</td>
</tr>
</tbody>
</table>
## Wound care IV

### Biologic Coverings

<table>
<thead>
<tr>
<th>Biologic Covering</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xenograft (pig skin)</td>
<td>Completely closes the wound; provides some immunologic benefits; must be removed or allowed to slough</td>
</tr>
<tr>
<td>Allograft (homograft, cadaver skin)</td>
<td>Provides all the normal functions of skin; can leave a dermal equivalent; epithelium must be removed or allowed to slough</td>
</tr>
</tbody>
</table>

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Excision and Skin Graft + Broad spectrum antibiotics
Snake Bite

- Snake: 3500 species in the world
- poisonous snake; 10%
- In Korea, just three snakes have poison
  - 살모사 (殺母蛇; agkistrodon blomhoffii brevicaudus)
  - 까치 살모사 (agkistrodon saxatalis)
  - 불독사 (agkistrodon calaginosus)
- 국내 사교상환자: 년간 409.6명
살모사, 살무사 (殺母蛇)
Agkistrodon blomhoffii brevicaudus
Agkistrodon saxatalis, Korean-Magpie-Viperine-Snake
불독사, 쇠살모사, 부독사

*Agkistrodon calaginosus*
Snake Bite

- **In Korea, just three snakes have poison**
  - 살모사 (殺母蛇; *agkistrodon blomhoffii brevicaudus*)
  - 까치 살모사 (agkistrodon saxatalis)
  - 불독사 (agkistrodon calaginosus)
  - 출현시기: 4월 하순 ~ 11월 중순. 녹음기
  - 골짜기풀밭, 돌무더기, 경작지

- **사독:**
  - 효소계 물질: phospholipase A, protease, endonuclease, \(L\)-aminoacid oxidase, lecithinase, ATPase, DNPase, ribonuclease, deoxyribonuclease, phosphomonoenterase, cholinesterase, hyaluronidase, glycerophosphatase, 5-nucleotidase
  - 비효소계물질: crotoxin(neurotoxin), crotamine(cytolysin), proteolytic factor(hematoxin)
Snake Bite

- **Phospholipase A**: 세포막 파괴, 용혈작용, 체장염
- **Protease**: 교상 부위의 조직괴사
- **Hyaluronidase**: 확산효소 (spreading factor)
- **Neurotoxin**: Ach 유리 억제, N-M junction 차단 → 호흡마비, 심근마비
- **Hematoxin**: 적혈구 세포막에 직접 작용하여 용혈작용, 항응고작용
- **Cytolysin**: 조직세포의 파괴 및 기능억제 (뇌간세포에도 작용), 혈관내피세포 파괴, 신세뇨관의 상피세포 파괴, 백혈구 적혈구의 파괴
Snake Bite

- Identification of poisonous snake bite:
  - 독사: 1-2개의 독아 자국, 비독사: 한두줄의 차아자국
  - 국소반응: 갑갑한 통증 및 압통, 조직괴사 및 피하 출혈, 수포형성

Snake bite
Snake Bite
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Snake Bite

전신증상:
- 발열, 오심, 구토, 호흡곤란, 복통, 시야혼탁, 의식장애, 안검하수, 설사, 현기증, 전신부종, 경부강직, 하혈, 두통, 언어장애
- 한국산 독사의 경우에는 전신증상이 심하지 않음
- 빈혈이나 황달은 오래 지속됨

국소치료:
- First aid
  - 독이 전신으로 퍼지기 전에 현장에서 실시하는 응급처치로 한 시간 이내에 시행함이 좋음
  - Fixation: 사독의 전신화를 막기 위하여 교상부위를 고정함
  - Tourniquet: 임파액의 흐름을 막을 정도로 느슨하게 장착
  - Incision and suction: 교사후 5분 내의 경우 사독의 50%가 제거됨, 30분 후에는 효과 없음, 1 cm X 5 mm
  - Excision: 교사후 2시간 이내에 정상출혈이 있는 피하조직을 광범위하게 제거시 대부분의 독을 제거할 수 있음.
  - Cryotherapy: 조직의 괴사만 일으키며 사독의 비활성화의 증거가 없음
Snake Bite

- First Aids

Apply direct pressure on external wounds with sterile cloth or your hand, maintaining pressure until bleeding stops.

If bleeding has not stopped after 15 minutes of direct pressure, apply strong pressure at one of these points between the wound and the heart.

Use a tourniquet ONLY AS A LAST RESORT, if bleeding cannot be stopped and the situation is life-threatening.
Snake Bite

- First Aids

After bleeding stops, bind wound with tight bandage and apply ice pack with direct pressure for 10 minutes.
Snake Bite First Aids (immobilization)

Based on material by Dr. S.K. Sutherland, Commonwealth Serum Laboratories
Snake Bite

전신 치료
- Anitvenin treatment:
  - Important for systemic toxicity
  - But, no cross immunity: polyvalent antivenin (?)
  - Anaphylactic shock and serum sickness due to horse serum of antivenin
  - 전신독성이 강하지 않는 한국산 독사에서는 꼭 필요한지 의문
- Steroid treatment
  - Traditional treatment, but effective?
  - Report of decreased incidence of serum sickness in antivenin treatment
- Adequate antibiotic treatment
- Tetanus toxoid
- Conservative treatment for renal failure, respiratory failure, DIC, liver failure
Human Bite

- 구강내 세균:
  Staphylococcus, Streptococcus, Anaerobic streptococcus, gonococcus, Vincent’s bacillus, fusiform bacillus, Spirochetes, Tetanus bacillus, Gas gangrene bacillus, Treponema pallidium

🩱 이러한 균으로 오염되었다고 생각하고 치료함
Human Bite

- 충분한 세척 및 변연절제술
- 광범위 항생제 치료
- Delayed wound closure: 6시간 내에 내원한 안면부의 경우에는 충분한 세척과 변연 절제술 후 봉합할 수 있다.
- 그러나 완전히 avulsion된 귀나 코의 조각은 다시 이어주는 것은 거의 성공하지 못한다.