Modern Burn Wound Care
Deaths related to burn injuries
The Challenges of Children

• Aetiology of burns  age dependant
• Burn size estimation  growing child
• When to refer and admission criteria
• Fluid resuscitation  needs glucose, maintenance
• Airway management  anatomical differences
• Nutrition  REE × 1.2-1.4
• Wound care and surgery  much the same
• Pain relief  analgesic and angiolytic
• Family involvement  family dyad
The aftermath
<table>
<thead>
<tr>
<th>Technology</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resuscitation</td>
<td>1940’s</td>
</tr>
<tr>
<td>Topical antiseptics</td>
<td>1960’s</td>
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<tr>
<td>Early excision and grafting</td>
<td>1970’s</td>
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<tr>
<td>Early enteral feeding</td>
<td>1980’s</td>
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<tr>
<td>High frequency percussive ventilation</td>
<td>1980’s</td>
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<tr>
<td>Engineered skin / tissue substitution</td>
<td>1990’s</td>
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<tr>
<td>Nano-crystalline silver</td>
<td>2000</td>
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<tr>
<td>Modulating healing / scar formation</td>
<td>2000</td>
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</table>
Minor Burns suitable for Outpatients Treatment

Partial thickness burns < 10 % TBSA
Full thickness burn < 1% TBSA
No co-morbidity
Facility able to treat

86% burns treated in this manner
Acceptable results
4244 patients in 1 year
42% children
TBSA 7.4%
satisfactory outcome

Ambulatory therapy < 71%
LOS > 53%
Infection > 40%
Cost > 45%
Critical sites and criteria for admission

*All burns less than 1 years of age*

- *All burns greater than 10% TBSA*

- Third-degree burns of any size in any age group.

- Special areas; face, hands, feet, genitalia, major joints

- Electrical burns, including lightning injury

- Chemical burns

- Inhalation injury fire or scald injury

- Circumferential burns of the limbs or chest

- Pre-existing medical conditions or concomitant trauma

- Suspected Child abuse

- Septic burn wounds  ANZBA, ABA, RK Sharma 2010
Fluid resuscitation

- They have **limited circulating volumes**
- Fluid losses are proportional larger
- Infants and children are **prone to burn shock**
- Delay as short as 30 min can be detrimental
- **IV cannulation is difficult** in small children
  Anatomical positions of major veins are different
- Body surface area formulations for calculations
- Ringers lactate 3ml/Kg/% burn
- Urine 0.5-1ml/ kg/ hour
- Infants <20Kg needs **glucose**
Enteral resuscitation and feeding

2 groups  
366 EEN and resuscitation  
322 IV resuscitation and late enteral nutrition  
No difference in age, cause, TBSA, surgery or total fluid volume over 48 hours

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Early enteral nutrition 3-6 hours</th>
<th>Late enteral Nutrition &gt;48 hours</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS</td>
<td>12±2</td>
<td>16± 3</td>
<td>P&lt; 0.05</td>
</tr>
<tr>
<td>Body weight reduction</td>
<td>3%</td>
<td>9%</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>nil</td>
<td>nil</td>
<td>-</td>
</tr>
<tr>
<td>Aspiration</td>
<td>small, infrequent</td>
<td>nil</td>
<td>-</td>
</tr>
<tr>
<td>Mortality</td>
<td>8.5%</td>
<td>12%</td>
<td>P&lt; 0.05</td>
</tr>
</tbody>
</table>

Safe and effective method
Khorasani E N, Mansouri F. Burns 2010
Pathophysiology

Central zone of necrosis

Coagulative necrosis

Zone of stasis decrease tissue perfusion

Obliteration of microcirculation

Experimental

Activated protein C anti-coagulant

Anti-inflammation

100μgKg⁻¹ IV single dose

Measure laser doppler, autoradiograph

Improved perfusion and decreased zone on skin necrosis

Nisanci M, Eski M et al. Burns 2010
Important sites for infection  75% of deaths

- invasive devices
- burn wound
- urinary tract
- cellulites
- other occult sites
- bloodstream
- pneumonia
Ventilator associated pneumonia

Common with inhalation injury
Develops within 48 hours
Mortality 33%
Many resistant organisms
Extended ICU stay

92 patients in ICU - TBSA 30%
52 VAP with 30% mortality
implemented preventative strategies
early diagnosis, early extubation
protocol driven therapy (antibiotics)
Experimental Burn Wound Sepsis Topical Ag⁰ Ag⁺

- Reduce bacterial burden
- Wounds less inflamed
- Accelerated wound healing
- Accelerated granulation tissue formation and angiogenesis
- Down regulating MMP levels thereby facilitating wound healing
Full Thickness Burn - 10 days
Inflammation inconspicuous
Bacteria are absent

Status at 19 days
30% deep dermal burn

Skin graft 2%
The ravaging effects of a severe burn “Burn illness”

- Hypermetabolic / catabolic
- Loss of muscle and bone mass
- Prolonged inactivity
- Physical limitations
- Fatigue
- Stunted linear growth
- Psychosocial displacement

Early enteral feeding within 6-12 hours
**Nutritional Support**

**Injury**
- Trauma
- Sepsis
- Burns

**Enteral feeding**

**Stress Hormone Release**

**Hypermetabolic Response**

**Catabolism**

**Multi-organ Failure**

**Death**

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<tr>
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<th>E</th>
<th>L</th>
<th>F</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortisol</td>
<td>N</td>
<td>N</td>
<td></td>
<td>Non-significant</td>
</tr>
<tr>
<td>Glucagon</td>
<td></td>
<td></td>
<td></td>
<td>Non-significant</td>
</tr>
<tr>
<td>Insulin</td>
<td></td>
<td></td>
<td></td>
<td>Anabolic response</td>
</tr>
<tr>
<td>I/g</td>
<td></td>
<td></td>
<td></td>
<td>Anabolic response</td>
</tr>
<tr>
<td>GH</td>
<td></td>
<td></td>
<td></td>
<td>Anabolic response</td>
</tr>
</tbody>
</table>

**Metabolic response:**
- low level anabolic response
Burnt child

- Day treatment
- Admission

- Conservative SPT
- Surgery DPT, FT burns

- Topical therapy
  - versajet, biobrane
  - long acting antiseptics
- Early surgery
  - autografting
  - synthetic dressings
Surgical management

Superficial partial-thickness burns
conservative treatment

Deep partial and full thickness burns
excision and autografting within first few days

Indeterminate –depth burns wait for 10-14 days, followed by regular assessments and definitive treatment
Deep partial to full thickness burns

Early excision, prompt wound closure

- decrease LOS
- fewer metabolic and septic complications
- decrease expenditure
- increase survival, improved functional and cosmetic results

Ong YS. Burns 2006
Small change – Big Difference

Clysis

Clysis  Reduce blood loss by 25-40%
Thrombo-elastograph  - hypercoagulation for 24 hours
Whole blood TX  -  coagulation normalises
Packed cells  -  remain hyper coagulable

Estimated blood loss: 2531 ml

Actual blood loss: 1619 ml
36% less blood loss

35%FTB
20% donor
Comparison of Surgical Techniques for infants < than 4 months. No 59

<table>
<thead>
<tr>
<th></th>
<th>Immediate tangential excision and grafting</th>
<th>Early excision allografts and delayed grafting</th>
<th>Delayed excision and grafting on granulation tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>25</td>
<td>27</td>
<td>7</td>
</tr>
<tr>
<td>Average TBSA%</td>
<td>14.6</td>
<td>14.2</td>
<td>15.7</td>
</tr>
<tr>
<td>Pre- op + culture</td>
<td>8 (32%)</td>
<td>11 (36)</td>
<td>7(100%)</td>
</tr>
<tr>
<td>First surgical procedure days</td>
<td>6(2-5)</td>
<td>7.6(2-25)</td>
<td>17.7( 13-50)</td>
</tr>
<tr>
<td>No of surgical procedures</td>
<td>1.6( 1-10)</td>
<td>1.3 (1-5)</td>
<td>1.791-5)</td>
</tr>
<tr>
<td>% graft take</td>
<td>84</td>
<td>64.7</td>
<td>85.7</td>
</tr>
<tr>
<td>Blood requirement ml/Kg</td>
<td>16.7(5-50)</td>
<td>14.4(15-50)</td>
<td>11.494-32)</td>
</tr>
<tr>
<td>Los days</td>
<td>30.8</td>
<td>45.2</td>
<td>40.8</td>
</tr>
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</table>
Hydrosurgery systems in Wound Debridement

- **Versajet** *hydro surgery* (Venturi effect)
  combines lavage and sharp debridement

- **Ultrasonic assisted wound debridement**
  combines mechanical vibration and irrigation

- **Value**
  dermal preservation/ bactericidal effects
  gentle removal of necrotic tissue

  Cubison Tc. Burns 2006
Hydro-debridement

Remove devitalized, necrotic, infected tissue in small increments and preserves tissue

Preserves more dermis than conventional tangential techniques

Reduces bacterial burden

Promotes a state similar to that found in acute wound healing

Minimize the need for further wound revision

May help to reduce scarring
Biobrane

Partial thickness
HWB
VBSS = 0

Day 1

Day 3

Day 6

Day 10

3 months
Conclusion

• Prevention slow progress
• Resuscitation fluid creep
• Sepsis still a major problem biofilms
• Nutrition early introduction
• Surgery early excisions and grafting
• Burn should be healed by 21 days
• Rehabilitation starts on day one