Combating Burns: Triage and Care of the Burn Patient

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Assistant Professor of Surgery
Duke University Medical Center
I Have Nothing to DISCLOSE
Most Common Questions

- Should I transfer?
- Do I Admit?
- Should we intubate?
- Antibiotics?
- Should we do an escharotomy?
- What kind of dressing should I use?
- Who can I call to ask a question?
Statistics

- 486,000 Burn Injuries Treated per year
- 40,000 Hospitalizations Related to Burns
- Fire/Smoke Deaths: 3275
- 4,000 Deaths per year
  - 75% occur at scene
- Age 5-20, LA$_{50}$ = 94.5%TBSA
- Age >70, LA$_{50}$ = 29.5%TBSA
- Survival Rate: 96.8%
- Gender: 68% Male, 32% Female
- Ethnicity: 59% Caucasian, 20% African-American, 14% Hispanic, 7% Other
- Admission Cause: 43% Fire/Flame, 34% Scald, 9% Contact, 4% Electrical, 3% Chemical, 7% Other
- Place of Occurrence: 73% Home, 8% Occupational, 5% Street/Highway, 5% Recreational/Sport, 9% Other
Burn Mortality Risk Factors

- Age >60
- >40% TBSA
- Inhalational Injury
Figure 10

ETIOLOGY

Total N = 153,646 (Excluding 29,390 Unknown/Missing)

Categories of Etiology
- Fire/Flame (43.7%)
- Scald (33.0%)
- Contact with Hot Object (8.8%)
- Electrical (3.9%)
- Chemical (3.3%)
- Other, Non Burn (2.3%)
- Burn, Unspecified (2.6%)
- Inhalation Only (1.4%)
- Skin Disease (0.3%)
- Radiation (0.3%)

ETIOLOGY

Table 5

<table>
<thead>
<tr>
<th>Etiology</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire/Flame</td>
<td>67,216</td>
</tr>
<tr>
<td>Scald</td>
<td>50,674</td>
</tr>
<tr>
<td>Contact with Hot Object</td>
<td>13,556</td>
</tr>
<tr>
<td>Electrical</td>
<td>5,999</td>
</tr>
<tr>
<td>Chemical</td>
<td>4,976</td>
</tr>
<tr>
<td>Other, Non Burn</td>
<td>4,271</td>
</tr>
<tr>
<td>Burn, Unspecified</td>
<td>4,014</td>
</tr>
<tr>
<td>Inhalation Only</td>
<td>2,126</td>
</tr>
<tr>
<td>Skin Disease</td>
<td>421</td>
</tr>
<tr>
<td>Radiation</td>
<td>393</td>
</tr>
<tr>
<td>Unknown</td>
<td>29,390</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>183,036</strong></td>
</tr>
</tbody>
</table>
PLACE OF OCCURRENCE - E849 CODE

Categories of Injury Site
- Home (69.1%)
- Industrial (9.4%)
- Street/Highway (6.7%)
- Other Specified Place (5.8%)
- Recreation and Sport (4.7%)
- Public Building (2.7%)
- Residential Institution (0.9%)
- Farm (0.8%)
- Mine/Quarry (0.1%)

Total N = 157,674 (Excluding 25,362 Unknown/Missing)

PLACE OF OCCURRENCE - E849 CODE

<table>
<thead>
<tr>
<th>Place of Occurrence</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>108,877</td>
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<td>Industrial</td>
<td>14,801</td>
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<tr>
<td>Street/Highway</td>
<td>10,539</td>
</tr>
<tr>
<td>Other Specified Place</td>
<td>9,117</td>
</tr>
<tr>
<td>Recreation and Sport</td>
<td>7,370</td>
</tr>
<tr>
<td>Public Building</td>
<td>4,207</td>
</tr>
<tr>
<td>Residential Institution</td>
<td>1,492</td>
</tr>
<tr>
<td>Farm</td>
<td>1,191</td>
</tr>
<tr>
<td>Mine/Quarry</td>
<td>80</td>
</tr>
<tr>
<td><strong>Unspecified</strong></td>
<td><strong>25,362</strong></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>183,036</strong></td>
</tr>
</tbody>
</table>
**Circumstance of Injury**

**Categories of Circumstance of Injury**
- Accident, Non-Work Related (69.4%)
- Accident, Work Related (15.1%)
- Accident, Recreation (4.2%)
- Accident, Unspecified (4.1%)
- Other (3.5%)
- Suspected Assault/Abuse (1.4%)
- Suspected Child Abuse (1.1%)
- Suspected Self Inflicted (1.1%)
- Suspected Arson (0.2%)

Total N = 150,327 (Excluding 32,709 Unknown/Missing)

**Table 7**

<table>
<thead>
<tr>
<th>Circumstance of Injury</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident, Non-Work Related</td>
<td>104,258</td>
</tr>
<tr>
<td>Accident, Work Related</td>
<td>22,685</td>
</tr>
<tr>
<td>Accident, Recreation</td>
<td>6,361</td>
</tr>
<tr>
<td>Other</td>
<td>5,227</td>
</tr>
<tr>
<td>Accident, Unspecified</td>
<td>6,233</td>
</tr>
<tr>
<td>Suspected Assault/Abuse</td>
<td>2,100</td>
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<tr>
<td>Suspected Self Inflicted</td>
<td>1,568</td>
</tr>
<tr>
<td>Suspected Child Abuse</td>
<td>1,635</td>
</tr>
<tr>
<td>Suspected Arson</td>
<td>260</td>
</tr>
<tr>
<td>Unknown</td>
<td>32,709</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>183,036</strong></td>
</tr>
</tbody>
</table>
HOSPITAL DISPOSITION

Figure 14

Total N = 183,036

Outcome
- Lived (96.3%)
- Died (3.7%)
<table>
<thead>
<tr>
<th>Age Group</th>
<th>0.1 - 9.9</th>
<th>10 - 19.9</th>
<th>20 - 29.9</th>
<th>30 - 39.9</th>
<th>40 - 49.9</th>
<th>50 - 59.9</th>
<th>60 - 69.9</th>
<th>70 - 79.9</th>
<th>80 - 89.9</th>
<th>&gt; 90</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth- .9</td>
<td>0.3</td>
<td>1.8</td>
<td>6.9</td>
<td>9.4</td>
<td>24.7</td>
<td>28.8</td>
<td>44.9</td>
<td>50.0</td>
<td>70.4</td>
<td>91.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Died/Total</td>
<td>15/5558</td>
<td>26/1456</td>
<td>30/435</td>
<td>21/224</td>
<td>24/97</td>
<td>21/73</td>
<td>22/49</td>
<td>21/42</td>
<td>19/27</td>
<td>33/36</td>
<td>232/7997</td>
</tr>
<tr>
<td>1 - 1.9</td>
<td>0.0</td>
<td>0.4</td>
<td>0.6</td>
<td>2.7</td>
<td>8.5</td>
<td>16.7</td>
<td>28.6</td>
<td>20.0</td>
<td>25.0</td>
<td>75.0</td>
<td>0.2</td>
</tr>
<tr>
<td>2 - 4.9</td>
<td>0.1</td>
<td>0.2</td>
<td>0.8</td>
<td>5.3</td>
<td>7.9</td>
<td>19.7</td>
<td>9.3</td>
<td>25.0</td>
<td>60.0</td>
<td>45.5</td>
<td>0.8</td>
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<tr>
<td>5 - 15.9</td>
<td>0.1</td>
<td>0.3</td>
<td>1.1</td>
<td>2.3</td>
<td>4.3</td>
<td>5.1</td>
<td>11.6</td>
<td>13.8</td>
<td>49.0</td>
<td>60.0</td>
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<tr>
<td>16 - 19.9</td>
<td>0.1</td>
<td>0.4</td>
<td>1.1</td>
<td>3.3</td>
<td>5.2</td>
<td>9.4</td>
<td>14.3</td>
<td>18.5</td>
<td>58.3</td>
<td>66.7</td>
<td>1.1</td>
</tr>
<tr>
<td>20 - 29.9</td>
<td>0.2</td>
<td>0.6</td>
<td>1.6</td>
<td>6.2</td>
<td>12.4</td>
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<td>25.2</td>
<td>43.5</td>
<td>60.0</td>
<td>77.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Died/Total</td>
<td>23/14854</td>
<td>19/3368</td>
<td>18/1103</td>
<td>31/503</td>
<td>31/249</td>
<td>30/154</td>
<td>32/127</td>
<td>30/69</td>
<td>48/80</td>
<td>67/87</td>
<td>329/20594</td>
</tr>
<tr>
<td>30 - 39.9</td>
<td>0.3</td>
<td>0.9</td>
<td>2.9</td>
<td>6.7</td>
<td>11.0</td>
<td>25.3</td>
<td>34.7</td>
<td>51.1</td>
<td>68.9</td>
<td>94.3</td>
<td>2.3</td>
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<tr>
<td>Died/Total</td>
<td>35/12629</td>
<td>27/3057</td>
<td>29/993</td>
<td>32/479</td>
<td>29/264</td>
<td>40/158</td>
<td>41/118</td>
<td>46/90</td>
<td>51/74</td>
<td>82/87</td>
<td>412/17949</td>
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<tr>
<td>40 - 49.9</td>
<td>0.4</td>
<td>1.5</td>
<td>4.8</td>
<td>10.9</td>
<td>23.1</td>
<td>42.3</td>
<td>37.6</td>
<td>62.9</td>
<td>74.7</td>
<td>91.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Died/Total</td>
<td>50/14033</td>
<td>51/3414</td>
<td>57/1179</td>
<td>65/596</td>
<td>74/321</td>
<td>85/201</td>
<td>53/141</td>
<td>44/70</td>
<td>65/87</td>
<td>101/111</td>
<td>645/20153</td>
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<tr>
<td>50 - 59.9</td>
<td>0.8</td>
<td>3.7</td>
<td>10.1</td>
<td>21.2</td>
<td>39.7</td>
<td>53.0</td>
<td>67.8</td>
<td>81.6</td>
<td>87.8</td>
<td>89.6</td>
<td>5.4</td>
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<tr>
<td>Died/Total</td>
<td>82/10463</td>
<td>96/2602</td>
<td>93/922</td>
<td>83/392</td>
<td>96/242</td>
<td>79/149</td>
<td>78/115</td>
<td>62/76</td>
<td>65/74</td>
<td>86/96</td>
<td>820/15131</td>
</tr>
<tr>
<td>60 - 69.9</td>
<td>2.0</td>
<td>6.5</td>
<td>19.1</td>
<td>42.9</td>
<td>52.5</td>
<td>67.0</td>
<td>85.7</td>
<td>90.2</td>
<td>100.0</td>
<td>89.6</td>
<td>8.3</td>
</tr>
<tr>
<td>Died/Total</td>
<td>115/5714</td>
<td>99/1533</td>
<td>96/502</td>
<td>100/233</td>
<td>63/120</td>
<td>61/91</td>
<td>42/49</td>
<td>46/51</td>
<td>30/30</td>
<td>43/48</td>
<td>695/8371</td>
</tr>
<tr>
<td>70 - 79.9</td>
<td>4.0</td>
<td>15.4</td>
<td>34.0</td>
<td>59.2</td>
<td>74.5</td>
<td>84.4</td>
<td>88.0</td>
<td>92.9</td>
<td>90.0</td>
<td>90.6</td>
<td>14.9</td>
</tr>
<tr>
<td>Died/Total</td>
<td>132/3268</td>
<td>138/898</td>
<td>119/350</td>
<td>109/184</td>
<td>73/98</td>
<td>54/64</td>
<td>44/50</td>
<td>26/28</td>
<td>18/20</td>
<td>29/32</td>
<td>742/4992</td>
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<tr>
<td>80 or Greater</td>
<td>6.9</td>
<td>28.7</td>
<td>63.9</td>
<td>77.2</td>
<td>89.0</td>
<td>96.7</td>
<td>86.7</td>
<td>93.5</td>
<td>97.1</td>
<td>100.0</td>
<td>24.9</td>
</tr>
<tr>
<td>Died/Total</td>
<td>154/2225</td>
<td>210/731</td>
<td>179/280</td>
<td>105/136</td>
<td>73/82</td>
<td>58/60</td>
<td>39/45</td>
<td>29/31</td>
<td>34/35</td>
<td>27/27</td>
<td>908/3652</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>0.6</strong></td>
<td><strong>2.9</strong></td>
<td><strong>8.5</strong></td>
<td><strong>16.3</strong></td>
<td><strong>25.4</strong></td>
<td><strong>37.5</strong></td>
<td><strong>42.6</strong></td>
<td><strong>56.2</strong></td>
<td><strong>72.5</strong></td>
<td><strong>84.8</strong></td>
<td><strong>3.6</strong></td>
</tr>
<tr>
<td><strong>Died/Total</strong></td>
<td><strong>630/102495</strong></td>
<td><strong>687/23956</strong></td>
<td><strong>637/7491</strong></td>
<td><strong>571/3502</strong></td>
<td><strong>489/1922</strong></td>
<td><strong>456/1215</strong></td>
<td><strong>377/886</strong></td>
<td><strong>326/580</strong></td>
<td><strong>387/534</strong></td>
<td><strong>524/618</strong></td>
<td><strong>5084/43999</strong></td>
</tr>
</tbody>
</table>
COMPLICATIONS: FREQUENCY OF TOP TEN CLINICALLY RELEVANT COMPLICATIONS

Number of Cases

Total N=169,998 (Excluding 13,038 cases from non TRACS centers)
# History of Burn Care

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500 BC</td>
<td>Black mud, boiled cow dung and goose</td>
</tr>
<tr>
<td>800 BC</td>
<td>Clarified butter mixed with ochre, bark of fig tree</td>
</tr>
<tr>
<td>400 BC</td>
<td>Pig fat and resin in bulky dressings</td>
</tr>
<tr>
<td>23-79 AD</td>
<td>Glue and ash of pigs bristles, wax</td>
</tr>
<tr>
<td>625 AD</td>
<td>Light earths mixed with vinegar</td>
</tr>
<tr>
<td>850 AD</td>
<td>Treatment with ointments and early excision</td>
</tr>
<tr>
<td>1600 AD</td>
<td>Treatment of contractures</td>
</tr>
<tr>
<td>1797 AD</td>
<td>Pressure dressings</td>
</tr>
</tbody>
</table>

“Home Remedies”

- Egg Whites
- Margarine
- Sour Cream
- Toothpaste
- Oatmeal
- Yogurt
- Tea bags
- Honey
- Potato peel
Honey dressing versus boiled potato peel in the treatment of burns: a prospective randomized study

M. Subrahmanyam
Department of Surgery, Dr Vaishampayan Memorial Medical College, Solapur, Maharashtra, India
A prospective randomised clinical and histological study of superficial burn wound healing with honey and silver sulfadiazine

M. Subrahmanyan*

Department of Surgery, Dr Vaishampayan Memorial Medical College, Solapur 413 003, Maharashtra, India

Accepted 15 September 1997

Abstract

Histological and clinical studies of wound healing have been made on comparable fresh partial thickness burns with honey dressing or silver sulfadiazine (SSD) in two groups of 25 randomly allocated patients. Of the wounds treated with honey 84 per cent showed satisfactory epithelialization by the 7th day, and in 100 per cent of the patients by the 21st day. In wounds treated with silver sulfadiazine, epithelialization occurred by the 7th day in 72 per cent of the patients and in 84 per cent of patients by 21 days. Histological evidence of reparative activity was seen in 80 per cent of wounds treated with the honey dressing by the 7th day with minimal inflammation. Fifty two per cent of the silver sulfadiazine treated wounds showed reparative activity with inflammatory changes by the 7th day. Reparative activity reached 100 per cent by 21 days with the honey dressing and 84 per cent with SSD. Thus in honey dressed wounds, early subsidence of acute inflammatory changes, better control of infection and quicker wound healing was observed while in the SSD treated wounds sustained inflammatory reaction was noted even on epithelialization. © 1998 Published by Elsevier Science Ltd for ISBI. All rights reserved.
Types of Burns

- Thermal
  - Flame
  - Steam
  - Scald
- Electrical
- Chemical
- Radiation
- Other
Burn Patients = Trauma Patients

- STOP THE BURN
- PRIMARY SURVEY
  - Airway
  - Breathing
  - Circulation
  - Disability
  - Exposure- Keep WARM!!!
Secondary Survey

- History
  - What
  - When
  - Where
  - How
  - Duration
  - Time of Incident
Secondary Survey

- Medical History
- Complete “Head to Toe”
  - Determine Severity of Burn
    - Size
    - Extent
    - Depth
Rule of 9’s

Anterior
- 9%
- 4.5%
- 4.5%
- 9%
- 9%
- 9%
- 9%
- 1%

Infant
- 18%
- 18% F
- 9%
- 18% B
- 9%
- 9%
- 9%
- 9%
- 14%
- 14%
- 6%

Posterior
- 9%
- 4.5%
- 4.5%
- 9%
- 9%
- 9%
- 9%

Palmar Method
(Patient’s palm)
- 1%
% Total Body Surface Area Burn

Be clear and accurate, and do not include erythema
(Lund and Browder)

<table>
<thead>
<tr>
<th>AREA</th>
<th>Age 0</th>
<th>1</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = 1/2 OF HEAD</td>
<td>9(\frac{1}{2})</td>
<td>8(\frac{1}{2})</td>
<td>6(\frac{1}{2})</td>
<td>5(\frac{1}{2})</td>
<td>4(\frac{1}{2})</td>
<td>3(\frac{1}{2})</td>
</tr>
<tr>
<td>B = 1/8 OF ONE THIGH</td>
<td>2(\frac{3}{4})</td>
<td>3(\frac{1}{4})</td>
<td>4 \</td>
<td>4(\frac{1}{2})</td>
<td>4(\frac{1}{2})</td>
<td>4(\frac{3}{4})</td>
</tr>
<tr>
<td>C = 1/8 OF ONE LOWER LEG</td>
<td>2(\frac{1}{2})</td>
<td>2(\frac{1}{2})</td>
<td>2(\frac{3}{4})</td>
<td>3 \</td>
<td>3(\frac{1}{4})</td>
<td>3(\frac{1}{2})</td>
</tr>
</tbody>
</table>
Adjuncts to Secondary Survey

- Gloves/Gowns/Mask/Cap
- NGT
- Foley is not optional
- Tetanus
In case you were wondering....

**NO**

**PROPHYLACTIC ANTIBIOTICS**!!!
Antibiotics proph. Study
Adjuncts to Secondary Survey

- Gloves/Gowns/Mask/Cap
- NGT
- Foley is not optional
- Tetanus
- **Vent**
  - inhalational injury
  - Soft tissue swelling
Inhalation Injury

- **Airway**
  - Patency
  - Soot
  - Singed hair
  - Stridor
  - Oral edema

- **Carbon Monoxide**

- **Injury ABOVE the glottis**

- **Injury BELOW the glottis**
# Symptoms and Signs at Various Concentrations of Carboxyhemoglobin

<table>
<thead>
<tr>
<th>COHb%</th>
<th>SYMPTOMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>none</td>
</tr>
<tr>
<td>10-20</td>
<td>Slight headache</td>
</tr>
<tr>
<td>20-30</td>
<td>Headache and throbbing in the temples</td>
</tr>
<tr>
<td>30-40</td>
<td>Sever Headache, weakness, dizziness, nausea, vomiting, collapse</td>
</tr>
<tr>
<td>40-50</td>
<td>Syncope, tachycardia, tachypnea</td>
</tr>
<tr>
<td>50-60</td>
<td>Syncope, tachycardia, tachypnea, coma, intermittent convulsions</td>
</tr>
<tr>
<td>60-70</td>
<td>Coma, depressed cardiac and respiratory function</td>
</tr>
<tr>
<td>70-80</td>
<td>Weak pulse, slow respirations, death within hrs</td>
</tr>
<tr>
<td>80-90</td>
<td>Death in less than 1 hour</td>
</tr>
<tr>
<td>90-100</td>
<td>Death within minutes</td>
</tr>
</tbody>
</table>
Inhalation Injury-Supraglottic

- Thermal or chemical
- Nasopharynx, oropharynx, larynx
- Hoarseness
- Stridor
- Difficulty Breathing
- Early Intubation
Inhalation Injury - Infraglottic

- Chemical
- Bronchial injury
- Parenchymal injury
- Impaired ciliary activity
- Edema
- Hypersecretion
- Ulcerations
- Spasm
Adjuncts to Secondary

- Gloves/Gowns/Mask/Cap
- NGT
- Foley..... is not optional
- Tetanus
- Vent for possible inhalation injury
- **Pain Management**
- **Evaluate Extremity Perfusion**
Escharotomy

- Circumferential Full thickness and Deep Dermal Burns
  - Chest
  - Abdomen
  - Limbs
- Circulatory or Respiratory Compromise
Escharotomy
Compartment Syndrome

- High-voltage electric injury
- Crush injury
- Delayed escharotomy
- Massive IV fluid infusion
- Abdominal Compartment Syndrome
Adjuncts to Secondary

- Gloves/Gowns/Mask/Cap
- NGT
- Foley is not optional
- Tetanus
- Vent for possible inhalation injury
- Pain Management
- Evaluate Extremity Perfusion
- **Fluid Resuscitation**
Fluid Resuscitation

- 2 Large Bore IV’s
- Parkland Formula
  - 4cc LR  X  Weight in kg  X  % TBSA Burn
  - Half of the calculated amount is given in the first 8 hours and the other half over the next 16 hours
| Table 1. Formulas for estimating adult burn patient resuscitation fluid needs. |
|--------------------------------------------------|------------------|-----------------|------------------|
| **Colloid Formulas**                             | **Electrolyte**  | **Colloid**     | **D5W**          |
| Evans                                            | Normal saline 1.0 cc/kg/% burn | 1.0 cc/kg/% burn | 2000 cc         |
| Brooke                                           | Lactated Ringer’s 1.5 cc/kg/% burn | 0.5 cc/kg | 2000 cc         |
| Slater                                           | Lactated Ringer’s 2L/24 hrs | Fresh frozen plasma 75 cc/kg/24 hrs |                |
| **Crystalloid Formulas**                         | **Lactated Ringer’s** | **Lactated Ringer’s** |                |
| Parkland                                         | 4 cc/kg/% burn     | 2 cc/kg/% burn   |                |
| Modified Brooke                                  |                  |                |                |
| **Hypertonic Saline Formulas**                   | **Volume to maintain urine output at 30 cc/hr** | **Lactated Ringer’s + 50 mEq NaHCO₃ (180 mEq Na/L) for 8 hours to maintain urine output at 30–50 cc/hr** | **Lactated Ringer’s to maintain urine output at 30–50 cc/hr beginning 8 hours postburn** |
| Hypertonic saline solution (Monafo)              | Fluid contains 250 mEq Na/L |                  |                |
| Modified hypertonic (Warden)                     | Lactated Ringer’s |                  |                |
| **Dextran formula (Demling)**                     | Dextran 40 in saline – 2 cc/kg/hr for 8 hours | Lactated Ringer’s – volume to maintain urine output at 30 cc/hr | Fresh frozen plasma – 0.5 cc/kg/hr for 18 hours beginning 8 hours postburn |
Fluid Resuscitation

- 2 Large Bore IV’s
- Parkland Formula
  - 4cc LR X Weight in kg X % TBSA Burn
  - Half of the calculated amount is given in the first 8 hours and the other half over the next 16 hours
- Use as a guide
- UOP > 0.5ml/kg/hr
“Fluid Creep”

- The Parkland Formula Isn’t Accurate, Especially for Very Large Burns
- Modern Clinicians are Careless
- “Opioid Creep”
- The Influence of Goal-Directed Resuscitation
- Influence of Excessive Crystalloid Infusion on Starling Forces

“Fluid Creep”

1. Restrict Early Fluid Resuscitation
2. Consider Routine Colloid, or “Colloid Rescue”
3. Use Resuscitation Protocols
Protocol for Fluid Resuscitation of the Adult Burn Patient:

Begin LR using burn center fluid resuscitation calculations

**STEP ONE**
Infuse at calculated rate as ordered by MD.
Measure Urine Output after one hour

- **Vitals Signs Stable:** HR < 140, BP > 90/60, SaO₂ > 90
  - **Urine Output**
    - < 15 mL
      - Increase IV rate by 20% or 200mL/hr (whichever is more)
    - 15-30 mL
      - Increase IV rate by 10% or 100mL/hr (whichever is more)
    - 30-50 mL
      - Leave IV as is
    - 50-200 mL
      - Decrease IV rate by 10% or 100mL/hr (whichever is more)
    - > 200 mL
      - Decrease IV rate every 1/2 hour by 10% or 100mL/hr, whichever is more. Measure blood sugar, lactate, hemoglobin, Call physician with questions.

- **Vitals Unstable:** HR > 140, < 60
  - BP < 90/60
  - SaO₂ < 90

**REPEAT STEP ONE EVERY HOUR UNTIL:**

- **Urine Output < 15 mL/hr for two or more hours despite increasing fluid rate**
  - CALL PHYSICIAN: Check urinary catheter, assess breath sounds, vital signs, bladder pressure. Consider albumin protocol.

- **Calculated maintenance rate is reached and held for two hours AND patient is at least 24 hours post-burn**
  - Fluid resuscitation is complete: switch patient to maintenance IV of D5/0.45 NaCl = 20 mEq KCl/liter at calculated maintenance rate
  - If patient again develops oliguria or hemodynamic instability, CALL PHYSICIAN. Restart patient on LR at current rate and return to STEP ONE.

- **Patient requires increasing fluids or more than twice current calculated rate for two or more hours.**
  - Patient may need colloid resuscitation: CALL PHYSICIAN to discuss. Check Foley catheter, vital signs, bladder pressure

- **Switch IV fluid to plain LR and repeat STEP ONE**

- **Albumin protocol:** begin a combination of 5% albumin at 1/3 of current IV rate, plus LR at 2/3 current rate. Repeat STEP ONE. Decrease IV as tolerated, maintaining the ratio of 1/3 albumin: 2/3 LR until maintenance rate is maintained for two hours.
“Fluid Creep”

1. Restrict Early Fluid Resuscitation
2. Consider Routine Colloid, or “Colloid Rescue”
3. Use Resuscitation Protocols
4. Other Resuscitation Alternatives
5. Monitor Resuscitation and Complications
Transfer Criteria

- Partial Thickness >10%
- Burns to Face, genitalia, perineum, or major joints
- Third Degree Burns- any area
- Burns to patients with pre-existing medical problems that may complicate treatment
Transfer Criteria

- Electrical Burns
- Chemical Burns
- Inhalation Injury
- Burns associated with Traumatic injury
- Any burned Child
Burn Admission Criteria

- Transfer Criteria
- Pain not controlled by PO medication (despite TBSA)
- Infected Burns
- Social “issues”
- Elderly
Zones of Injury

Coagulation
Stasis
Hyperaemia
Superficial or 1st Degree Burn

- Dry, no blisters
- Erythema
- Painful
- Heals in 7-10 days
Superficial Partial Thickness

- Superficial Second
- Painful
- Heals in 7-14 days

Characteristics:
1. Necrosis confined to upper dermis
2. Zone of necrosis lifted off viable wound by edema
3. Small zone of injury
Deep Partial Thickness

- Deep Second
- Heals in 4-10 weeks
- Consider grafting

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Full Thickness

- Third Degree
- Eschar
- Early excision and grafting
- Prophylactic IV Abx
  NOT indicated
Fourth Degree

- All layers of skin
- Including
  - Tendon
  - Muscle
  - Bone
Non-burn Admissions

- Stevens-Johnson Syndrome
- Toxic Epidermal Necrolysis
- Pemphigus
- Graft versus Host
Non-burn Admissions

- Stevens-Johnson Syndrome
- Toxic Epidermal Necrolysis
- Pemphigus
- Graft versus Host
Non-burn Admissions

- Stevens-Johnson Syndrome
- **Toxic Epidermal Necrolysis**
- Pemphigus
- Graft versus Host
Non-burn Admissions

- Stevens-Johnson Syndrome
- Toxic Epidermal Necrolysis
- Pemphigus
- Graft versus Host
Non-burn Admissions

- Stevens-Johnson Syndrome
- Toxic Epidermal Necrolysis
- Pemphigus
- Graft versus Host
Infection in Burns

- Surgical wound infection
- Fungal
- Sepsis
- Burn Wound Surveillance
- Biopsy
Infection in Burns

- Viral - CMV, HSV, Zoster
- Burn wound impetigo - MC Staph
- Cellulitis
<table>
<thead>
<tr>
<th>Group</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gram-positive organisms</td>
<td><em>Staphylococcus aureus</em></td>
</tr>
<tr>
<td></td>
<td>Methicillin-resistant <em>S. aureus</em></td>
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<tr>
<td></td>
<td>Coagulase-negative staphylococci</td>
</tr>
<tr>
<td></td>
<td><em>Enterococcus</em> spp.</td>
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<tr>
<td></td>
<td>Vancomycin-resistant enterococci</td>
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<tr>
<td>Gram-negative organisms</td>
<td><em>Pseudomonas aeruginosa</em></td>
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<tr>
<td></td>
<td><em>Escherichia coli</em></td>
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<tr>
<td></td>
<td><em>Klebsiella pneumoniae</em></td>
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<td></td>
<td><em>Serratia marcescens</em></td>
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<tr>
<td></td>
<td><em>Enterobacter</em> spp.</td>
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<tr>
<td></td>
<td><em>Proteus</em> spp.</td>
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<tr>
<td></td>
<td><em>Acinetobacter</em> spp.</td>
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<tr>
<td></td>
<td><em>Bacteroides</em> spp.</td>
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<tr>
<td>Fungi</td>
<td><em>Candida</em> spp.</td>
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<tr>
<td></td>
<td><em>Aspergillus</em> spp.</td>
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<tr>
<td></td>
<td><em>Fusarium</em> spp.</td>
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<tr>
<td></td>
<td><em>Alternaria</em> spp.</td>
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<tr>
<td></td>
<td><em>Rhizopus</em> spp.</td>
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<tr>
<td></td>
<td><em>Mucor</em> spp.</td>
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<tr>
<td>Viruses</td>
<td>Herpes simplex virus</td>
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<tr>
<td></td>
<td>Cytomegalovirus</td>
</tr>
<tr>
<td></td>
<td>Varicella-zoster virus</td>
</tr>
<tr>
<td>Topical agent</td>
<td>Preparation</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Silver nitrate (AgNO&lt;sub&gt;3&lt;/sub&gt;)</td>
<td>0.5% solution</td>
</tr>
<tr>
<td>Silver sulfadiazine (Silvodene, Flamazine, Thermazine, Burnazine)</td>
<td>1% water-soluble cream (oil-in-water emulsion)</td>
</tr>
<tr>
<td>Mafenide acetate (Sulfamylon)</td>
<td>10% water-soluble cream (oil-in-water emulsion), 5% solution</td>
</tr>
<tr>
<td>Nanocrystalline silver dressings (Acticoat A.B. dressing, Silverlon)</td>
<td>Dressing consisting of two sheets of high-density polyethylene mesh coated with nanocrystalline silver</td>
</tr>
</tbody>
</table>
OR

- Tangential Excision
- Fascial Excision
- Versajet
- Grafts
  - Sheet
  - STSG
- Vac

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OR

- Tangential Excision
- Fascial Excision
- Versajet
- Grafts
  - Sheet
  - STSG
- Vac
Outpatient Burn Care

- First Degree
  - Wash
  - Moisturizer/ Vit A&D
  - Dry dressing
  - Pain Medication
  - Clinic
Outpatient Burn Care

- Second Degree
  - Wash
  - Debride loose skin
  - Blisters.....
To Pop or NOT to Pop

……..BLISTERs

☐ Leave intact
   - Small- <2cm
   - Clean
   - Intact

☐ Debride or Decompress
   - Large, over joints
   - Persistence >7-10 days
   - Hand- unable to obtain FROM
Outpatient Burn Care

- Second Degree
  - Wash
  - Debride loose skin
  - Blisters
  - Range of Motion
  - Pain Medication
  - Clinic
Outpatient Burn Care

- Biobrane
- Mepilex Ag
- “Triple Xero”
- Aquacel Ag
- Acticoat “flex”
Dressings....

- Biobrane
- Mepilex Ag
- “Triple Xero”
- Aquacel Ag
- Acticoat “flex”
Biobrane

- Silicone film with nylon fabric
- Wound visualization
- Easy to apply
- Reduced pain
- Increased mobility
- Biobrane glove!!
- Superficial 2\textsuperscript{nd} degree burns
Dressings....

- Biobrane
- Mepilex Ag
- “Triple Xero”
- Aquacel Ag
- Acticoat “flex”
Mepilex

- Soft Silicone foam dressing
- Absorbs
- Change every 5-7 days
- Examine wound and replace
- Removes without pain
Dressings:

- Biobrane
- Mepilex Ag
- “Triple Xero”
- Aquacel Ag
- Acticoat “flex”
Dressings....

- Biobrane
- Mepilex Ag
- “Triple Xero”
- Aquacel Ag
- Acticoat “flex”
Aquacel Ag

- Hydrofiber dressing with silver
- Up to 7 days
- Staph, Psa, MRSA, VRE, Candida A., anaerobes
Dressings ....

- Biobrane
- Mepilex Ag
- "Triple Xero"
- Aquacell Ag
- Acticoat "flex"
Case Presentation #1

- 26 year old male s/p RLE Partial Thickness Burns while campfire jumping.
- PMHx: Healthy
- PSxHx: none
- Meds: none
- All: none
Case Presentation #2

- 55 yr old female s/p partial and full thickness burns to back. Her shirt caught fire while she was using a gas stove.
Case Presentation #3

- 83 yr old male
- Syncope while taking shower
- PMHx: A-fib, HTN
- PSxHx: Pacemaker
- Meds:
  - Citalopram
  - Cartia XL
  - Coumadin
- Allergies: PCN
- Social Hx:
  - Lives alone, widowed
  - Veteran of WWII
- PE: 98.6  112/64  P:86  R: 16  95% 3LNC
  - Neuro: A&OX3
  - Chest: CTAB, irreg, irreg
  - Abdomen: Soft, NT/ND
- **PE**

  - BACK: Linear burn - second degree 30cmX4cm
  - EXT: RLE circumferential second degree burn knee to below calf
  - Pulses: 2+ palp DP/PT
Hospital Course

- Syncope workup
- Conservative Management with QD Dressing changes
  - Wash wounds daily with soapy water
  - “Triple Xero”
  - Kerlix
- Elevate RLE
- Monitor Pulses and RLE exam
- Tangential excision
- Versajet
- STSG 2:1
  - Back
  - RLE
- VAC
  - 5 days
D/C

- Discharged to rehab
- Wash wounds daily with soapy water
- Xeroform
- PT for ROM
Follow-up in Clinic
Follow-up in Clinic

- Continue PT for contracture- R knee
- Lotion to graft sites TID
- Fitted for Jobst pressure garments
  - Reduce swelling
  - Softens scars
  - Reduces itching
  - Hypertrophic scars
  - Must be fitted
  - Wear for 23 hours per day
  - 12-18 months
Case Presentation #4

- 28 Patients mass cal
- ?inhalation injury
- Burning to skin
- Burning to eyes
- Burning to skin
- Burning to eyes…..

- White Phosphorous
References

- BurnSurgery.org
- American Burn Association
- Advanced Burn Life Support
- Total Burn Care (Third Edition) Copyright 2007 Elsevier Inc. David N. Herndon, MD, FACS
- Burn Surgery, Reconstruction and Rehabilitation, Rajiv Sood MD, Bruce M Achauer MD
THANK YOU!

"YOU THINK YOU’VE GOT PROBLEMS MATE - I’VE JUST FOUND THE EXIT POINT FROM MY ELECTRICAL BURN!"