INITIAL MANAGEMENT OF THE

BURN PATIENT

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Introduction
A number of advances in early management of major, moderate and minor burns have substantially reduced mortality and morbidity, especially reducing the degree of pain, the rate of infection, the degree of scarring and have increased healing rate.

Initial assessment and treatment of life threatening problems of airway, breathing and circulation followed by recognition of burn severity, depth, size, as well as the current treatment approach, will be the focus of this manual.

The transfer criteria to a Burn Center are also presented.

Sequences of Events and Priorities in Management
- **Stop the Burning Process**
- Management of Airway and Pulmonary Problems
- Restoration of Hemodynamic Stability
- The Burn Wound
  - Assessment
  - Initial management
  - Determine disposition
Transfer Criteria to Burn Center
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Initial Burn Assessment Tool</td>
</tr>
<tr>
<td>II.</td>
<td>Initial Management Protocols</td>
</tr>
<tr>
<td>III.</td>
<td>Managing the ABC’s in the Burn Patient:</td>
</tr>
<tr>
<td></td>
<td>• Airway</td>
</tr>
<tr>
<td></td>
<td>• Breathing</td>
</tr>
<tr>
<td></td>
<td>• Circulation</td>
</tr>
<tr>
<td>IV.</td>
<td>Burn Center Transfer Criteria</td>
</tr>
<tr>
<td>V.</td>
<td>Burn Injury: Initial Assessment and Management</td>
</tr>
<tr>
<td></td>
<td>• Skin functions</td>
</tr>
<tr>
<td></td>
<td>• Burn assessment</td>
</tr>
<tr>
<td></td>
<td>• Initial management</td>
</tr>
<tr>
<td></td>
<td>• Burn severity and outcome</td>
</tr>
<tr>
<td>VI.</td>
<td>Chemical Burns</td>
</tr>
<tr>
<td></td>
<td>• General Principles and Management</td>
</tr>
<tr>
<td></td>
<td>• Eye injury</td>
</tr>
<tr>
<td></td>
<td>• Specific chemical injury</td>
</tr>
<tr>
<td>VII.</td>
<td>Electrical Burns</td>
</tr>
<tr>
<td></td>
<td>• Terminology</td>
</tr>
<tr>
<td></td>
<td>• Initial assessment and Management</td>
</tr>
<tr>
<td></td>
<td>• High voltage injury</td>
</tr>
<tr>
<td></td>
<td>• Low voltage injury</td>
</tr>
<tr>
<td>VIII.</td>
<td>Burns to High Risk Areas</td>
</tr>
<tr>
<td></td>
<td>• Hands, feet, perineum, face, ears</td>
</tr>
<tr>
<td>IX.</td>
<td>Cold Injuries: Hypothermia and Frostbite</td>
</tr>
</tbody>
</table>
# I. INITIAL BURN ASSESSMENT TOOL

**Name____________________**

**Age ________     Sex__________**

**Injury Date and Time:**

**Assessment Date and Time:**

<table>
<thead>
<tr>
<th>Pulmonary</th>
<th>0-36 Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a facial burn?</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there an airway injury: (redness, edema)</td>
<td>Yes</td>
</tr>
<tr>
<td>Is smoke inhalation injury present? If present, what is the Carbon Monoxide level? CO HGB</td>
<td>Yes</td>
</tr>
<tr>
<td>Current pulmonary status getting better or worse?</td>
<td>Yes</td>
</tr>
<tr>
<td>Is there a deep chest wall burn?</td>
<td>Yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cardiovascular Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the patient stable?</td>
</tr>
<tr>
<td>Is status changing?</td>
</tr>
<tr>
<td>Is vascular access and fluid treatment adequate?</td>
</tr>
<tr>
<td>Are there any circumferential extremity burns or jewelry which can impair perfusion?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Outcome Predictors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Burn: Flames?</td>
</tr>
<tr>
<td>Explosion?</td>
</tr>
<tr>
<td>If yes, is there injury to eye or ear?</td>
</tr>
<tr>
<td>Hot Liquids?</td>
</tr>
<tr>
<td>Chemical?</td>
</tr>
<tr>
<td>If yes, is there eye injury?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Electrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was it low or high voltage?</td>
</tr>
<tr>
<td>Low (&lt;500 volts)</td>
</tr>
<tr>
<td>High (&gt;1500)</td>
</tr>
<tr>
<td>Is there evidence of muscle or nerve damage?</td>
</tr>
<tr>
<td>Are there other traumatic injuries present? If yes, specify</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skin Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>What body parts are burned: head, face, neck, chest, back, arms, hands, legs, feet (circle)</td>
</tr>
<tr>
<td>What percent total body surface area is burned?</td>
</tr>
<tr>
<td>Are there high risk areas involved? If yes, specify area: face, hands, feet, perineum (circle)</td>
</tr>
<tr>
<td>What depth is the burn? 1st, 2nd, 3rd</td>
</tr>
<tr>
<td>Criteria for Burn Center transfer present?</td>
</tr>
</tbody>
</table>
### II. INITIAL MANAGEMENT PROTOCOLS

**A. Initial Management: Airway and Pulmonary Problems**

#### Management of Carbon Monoxide Exposure

<table>
<thead>
<tr>
<th>Awake</th>
<th>Obtunded</th>
</tr>
</thead>
<tbody>
<tr>
<td>High flow by mask oxygen</td>
<td>Intubate and provide 100% oxygen via a</td>
</tr>
<tr>
<td>*(FiO2 100%) until</td>
<td>ventilator</td>
</tr>
<tr>
<td>COHgb &lt; 5%)</td>
<td>Hyperbaric oxygen therapy (HBO) is used if</td>
</tr>
<tr>
<td></td>
<td>if patient not responding to 100% oxygen</td>
</tr>
<tr>
<td></td>
<td><em>(specific indications for HBO remain undefined.</em></td>
</tr>
</tbody>
</table>

#### Management of the Upper Airway

Stridor Retraction or
Respiratory Distress present or
Deep Burns: Face, Neck

- If Present
  - *Intubate now!*
  - Use adequate size tube
  - Humidified oxygen
  - Elevate Head
  - Transport to Burn Center

- If Absent
  - Provide 100% Oxygen
  - Look for Signs of Airway Injury
    - Oropharyngeal erythema
    - Hoarseness
    - Pulmonary status
  - Can perform laryngoscopy
  - If edema present, intubate now
### Management of Lower Airway Injury

<table>
<thead>
<tr>
<th>Asymptomatic</th>
<th>Symptomatic</th>
<th>Symptomatic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cough, wheezing, bronchorrea, good gas exchange</strong></td>
<td><strong>Shortness of breath, progressive symptoms, impaired gas exchange</strong></td>
<td></td>
</tr>
<tr>
<td>- Continued assessment</td>
<td>- Intubate (use tube size 7 or greater)</td>
<td></td>
</tr>
<tr>
<td>- Reassessment</td>
<td>- Begin 100% O₂ to maintain O₂ sat &gt;95% and displace CO-HGB</td>
<td></td>
</tr>
<tr>
<td>- Oximetry</td>
<td>- Clinically assess lower airways function</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Provide 100% oxygen by mask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Aggressive pulmonary toilet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Bronchodilators</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Monitor oximetry and blood gases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Continued reassessment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Bronchodilators</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Monitor oximetry and blood gases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Clinically assess lower airways function</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Observe chest x-ray for evidence of lower airways injury</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Consider chest wall escharotomy for 3° circumferential burn</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Placement of supraglottic airway (SGA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Reassessment</td>
<td></td>
</tr>
</tbody>
</table>

*As the injury process evolves, modifications will be necessary.*
B. Initial Maintenance of Hemodynamic Stability (0-24 hrs)

<table>
<thead>
<tr>
<th>Patient Not Stable</th>
<th>Patient Reasonably Stable</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Remove clothing, assess for other injuries</td>
<td>• Remove clothing, assess for other injuries, keep warm</td>
</tr>
<tr>
<td>• Keep warm</td>
<td>• Remove dirt (and dead epidermis if burn is small)</td>
</tr>
<tr>
<td>• Determine if patient meets burn criteria for transfer to burn center</td>
<td>• Use intravenous route for pain and anxiety meds</td>
</tr>
<tr>
<td>• If so, continue to stabilize and make Arrangements</td>
<td>• If major burn, transfer arrangements to burn center and cover wound with clean dry dressings</td>
</tr>
</tbody>
</table>

### Fluid Resuscitation

All patients with burns more than 15% Total Body Surface (Burns less than 15% TBS may not need IV resuscitation)

- **Large Bore Peripheral Intravenous Lines**
- **Begin lactated Ringers Solution**:
  - Estimate Initial Rate: 4cc/kg/%TBS burn (half in first 8 hrs)
  - Can add colloid 5% albumin if fluid requirements exceeding the predicted formula
  - Adjust fluid rate according to patient response

- **Expect increase in fluid requirements in**
  - Elderly, small children
  - Smoke inhalation
  - Electrical burns

- **Consider low dose dopamine if urine output low in the presence of hemodynamic stability**
### Monitoring Guidelines

- **Pulse:**
  - Young patient – pulse less than 120, reasonable perfusion; pulse >130, increase fluid
  - Elderly or with heart disease – pulse not accurate reflection of perfusion
  - Electrocardiogram – particularly important for patient more than 45 years old
  - Urine output – 0.5 to 1 cc/kg/hr is adequate in absence of diuretic such as alcohol
  - Exception: Myoglobin or hemoglobinuria where over 1 cc/kg/hr is indicated
  - Peripheral perfusion: for circumferential arm, leg burns
    - Use of Doppler to monitor
    - If circumferential burn with decreasing pulse pressure consider escharotomy

- **Temperature** – Avoid hypothermia

- **Blood gases** – high risk of hypoxemia, hypercapnia due to direct pulmonary complications of burn and treatment
- **Acid-base** – Base deficit very useful indicator of tissue oxygenation (if increasing give more fluid)
- **Hemoglobin** (increasing value indicator of decreasing blood volume or greater than 5 meq/l)
- **Blood pressure** – only reliable as volume indicator if low
- **Electrolytes** – initial abnormality may be hyper- or hypokalemia, HCO₃⁻ value dependent on acid-base balance
- **Prothrombin time, partial thromboplastin time, platelets** – moderate burn: usually near normal
- **More than 50% total body surface:** abnormal due to consumption coagulopathy

(Transfer to Burn Center if a major burn is present)

### Steps for the Prevention and Treatment of Impaired Distal Perfusion

- Remove constricting objects, such as jewelry
- Immediate elevation of burned extremities
- Escharotomies in circumferential third or forth degree burns, if perfusion is impaired (preferably done in Burn Center)
- Monitor using pulse palpation and Doppler
- Escharotomies in circumferential third or fourth degree burns, if perfusion is impaired (preferably done in Burn Center)

### C. Initial Wound Management

- Assure adequate ventilation and perfusion
- Remove heat source and any constricting items
- Maintain body temperature
- Cool water for small second degree burns only
- Assess size and depth “Rule of Nine”
- Tetanus Prophylaxis

### Minor to Moderate Burn (To be managed and not transferred)
# Superficial Partial Thickness

<table>
<thead>
<tr>
<th>Wound Relatively Clean</th>
<th>Wound Dirty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can use Xeroform gauze with dressing</td>
<td>Gentle cleaning</td>
</tr>
<tr>
<td>Consider temporary skin substitute</td>
<td>Use antibiotic ointment</td>
</tr>
<tr>
<td>First treat open with Bacitracin</td>
<td>Elevate burned extremity</td>
</tr>
<tr>
<td>Perineum, feet use silver sulfadiazine</td>
<td></td>
</tr>
<tr>
<td>Elevate burned extremity</td>
<td></td>
</tr>
</tbody>
</table>

## Mid-dermal burn
- Can use topical antibiotic ointment
- Closed dressing technique, exception: face, perineum
- Consider temporary skin substitutes (TransCyte) if wound bed clean
- Elevate burn extremity

## Deep Burn
- Use topical silver cream or dressing
- No prophylactic antibiotics
- Closed dressing technique, exception: face, perineum
- Elevate burn extremity
- Consider escharotomy

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## III. Managing the ABC’s in the Burn Patient

- Stop the Burning Process
- Treat Carbon Monoxide Toxicity immediately
- Manage airway injury from Smoke and Heat
- Manage Pulmonary Problems from Smoke
- Correct Chest wall Restriction
- Recognize The Burn Induced Plasma Shift
- Begin Fluid Resuscitation for Major Burns
- Correct Blood Flow Restriction from Burn Tissue Compression
A. Stop the Burning Process

- **Flame Burns**
  - eliminating any ongoing burning, (i.e. from burning clothes)
  - synthetics in clothes can retain heat which needs to be neutralized
  - cover with dry clean sheets

- **Chemical Burn**
  - chemicals continue to burn if in contact with skin
  - remove chemically contaminated clothing
  - continuous flushing with water

Management of Airway and Pulmonary Problems

Smoke inhalation is a major cause of morbidity and mortality in the immediate post burn period. These, often life threatening, effects of smoke inhalation must be recognized and aggressively managed. The degree of lung damage is usually not evident for several hours and **Early transfer to a Burn Center is highly recommended, if smoke injury is suspected.**

The three injury processes, resulting from smoke exposure, are presented in the order in which peak symptoms occur.

- **Carbon Monoxide Toxicity**
  - peak symptoms immediate
- **Upper Airway Injury with Potential Obstruction**
  - peak symptoms can be delayed for an hour or more
- **Lower Airway Injury with Impaired Gas Exchange**
  - peak symptoms can be delayed for hours

1. **Carbon Monoxide Toxicity**
   **Pathophysiology**
   Carbon Monoxide binds to the hemoglobin molecule displacing oxygen thereby decreasing the oxygen delivered to tissue. Over 99% of tissue oxygen is provided by the oxygen carried on hemoglobin.

**Risk Factors**

- Any exposure to smoke
- Any exposure to fumes
**Diagnosis**

- A high index of suspicion in any fire victim with a history of smoke exposure
- A carboxyhemoglobin level exceeding 10% total (morbidity is related to peak level at scene not the first value obtained)
- Unexplained metabolic acidosis

*CO Hgb – carboxyhemoglobin

<table>
<thead>
<tr>
<th>Hgb Level</th>
<th>Carbon Monoxide Intoxication</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO High</td>
<td>Symptoms</td>
</tr>
<tr>
<td>0-5</td>
<td>Normal Value</td>
</tr>
<tr>
<td>15-20</td>
<td>Headache, Confusion</td>
</tr>
<tr>
<td>20-40</td>
<td>Disorientation, fatigue, nausea, visual changes</td>
</tr>
<tr>
<td>40-60</td>
<td>Hallucination, combativeness, coma, shock, shock state</td>
</tr>
<tr>
<td>60 or above</td>
<td>Cardiopulmonary arrest, Death</td>
</tr>
</tbody>
</table>
Treatment of Carbon Monoxide Exposure

<table>
<thead>
<tr>
<th>Awake</th>
<th>Obtunded</th>
</tr>
</thead>
<tbody>
<tr>
<td>High flow by mask oxygen (FiO2 100%) until COHgb &lt; 5%</td>
<td>Intubate and provide 100% oxygen via positive pressure ventilation Hyperbaric oxygen therapy (HBO) is used if patient not responding to 100% oxygen (specific indications for HBO remain undefined).</td>
</tr>
</tbody>
</table>

**Treatment**
Immediate use of high flow 100% oxygen to remove the carbon monoxide from the hemoglobin and replacing with oxygen.

**Effect of O2 on COHgb Level**

The carbon monoxide is rapidly displaced by breathing oxygen compared to breathing room air.

**Cyanide Toxicity**
Cyanide is also found in smoke, especially from burning polyurethane. Plasma cyanide levels are difficult to obtain so treatment is usually based on a high index of suspicion, usually due to an unexplained severe metabolic acidosis not corrected by oxygen and fluids.

In general, for cyanide poisoning, cardiopulmonary support is usually sufficient treatment, since the liver, via the enzyme rhodenase, will clear the cyanide from the circulation. Sodium nitrite is used (300mg IV over 5-10 minutes) in severe cases, especially in those patients in which the diagnosis is made by blood cyanide levels. The nitrite, in turn, binds with the cyanide. Ordinarily, thiosulfate is also given, which in turn binds the cyanide to form thiocyanate. One must be reasonably sure of the diagnosis of cyanide toxicity before giving sodium nitrite as a side effect is the production of methhemoglobin.
2. Upper Airway Injury

**Risk Factors**

- **Oral Burn:** rapid swelling of tongue and mucosa impeding airway patency
- **Supraglottic Edema:** progression to obstruction
- **Cord and Infraglottic Edema:** progression to obstruction

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**Laryngoscopic Assessment for Smoke Inhalation**

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**Diagnosis**

- History of smoke exposure (or exposure to high temperature e.g. explosion)
- Direct laryngoscopic evidence of injury
- Symptoms of stridor, dyspnea (often delayed in onset)

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Edema and erythema with decreasing airway lumen is noted on initial assessment.

**Treatment**

- 100% oxygen
- Airway Support
- Early intubation may be required
- Transfer to Burn Center if smoke inhalation injury suspected
### Initial Assessment and Management of the Airway

**Stridor Retraction or**

**Respiratory Distress present**

**or Deep Burns: Face, Neck**

<table>
<thead>
<tr>
<th>If Present</th>
<th>If Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Intubate now!</em></td>
<td>*Provide 100% Oxygen</td>
</tr>
<tr>
<td>*Use adequate size tube</td>
<td>*Look for Signs of Airway Injury</td>
</tr>
<tr>
<td>*Humidified oxygen</td>
<td>*Oropharyngeal erythema</td>
</tr>
<tr>
<td>*Elevate Head</td>
<td>- Hoarseness</td>
</tr>
<tr>
<td>*Transport to Burn Center</td>
<td>- Pulmonary status</td>
</tr>
<tr>
<td></td>
<td>*Can perform laryngoscopy</td>
</tr>
<tr>
<td></td>
<td>*If edema present, intubate now</td>
</tr>
<tr>
<td></td>
<td>*Transfer to Burn Center if history or findings are positive for smoke inhalation injury</td>
</tr>
<tr>
<td></td>
<td><strong>REMEMBER:</strong> DETERIORATION IS OFTEN DELAYED IN ONSET.</td>
</tr>
</tbody>
</table>
3. Lung Damage From Smoke

- Onset of symptoms is often Delayed
- Early transfer to Burn Center if suspect of smoke injury

### Lung Injury from Toxins in Smoke

<table>
<thead>
<tr>
<th>Compounds</th>
<th>Source</th>
<th>Effect</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia, Sulfur Dioxide, Chlorine</td>
<td>Clothing, Furniture, Wool, Silk</td>
<td>Mucous membrane irritation, Bronchospasm, Bronchorrhea</td>
<td>Early Onset (first several hours)</td>
</tr>
<tr>
<td>Hydrogen Chloride, Phosgene</td>
<td>Polyvinyl Chloride, Furniture, (wall, floor coverings)</td>
<td>Severe mucosal damage; Ulcers, Mucous plugging, Mucosal slough, Pulmonary edema</td>
<td>Delayed often 1-2 days</td>
</tr>
<tr>
<td>Acetaldehyde, Formaldehyde, Acrolein</td>
<td>Wallpaper, Lacquered wood, Cotton, Acrylic</td>
<td>Severe mucosal damage; Ulcers, Mucous plugging, Mucosal slough, Pulmonary edema</td>
<td>Delayed often 1-2 days</td>
</tr>
<tr>
<td>Cyanide</td>
<td>Polyurethane upholstery,</td>
<td>Tissue Hypoxia</td>
<td>IMMEDIATE</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>Any combustible substance</td>
<td>Tissue Hypoxia</td>
<td>IMMEDIATE</td>
</tr>
</tbody>
</table>

4. Chest Wall Burn and Impaired Ventilation

A full thickness burn of the anterior and lateral chest wall can lead to severe restriction of chest wall motion, especially as edema develops beneath the non-viable tissue (eschar), even in the absence of a completely circumferential burn. Chest wall escharotomy may be required to relieve the restriction; This procedure is best done in a Burn Center unless ventilation is severely impaired.

Impaired Breathing from deep chest wall burn

The restriction to ventilation is further compromised by the abdominal burn diminishing the movement of the diaphragm.
The escharotomy incisions are placed along the anterior axillary lines with bilateral incisions connected by a subcostal incision. The incisions must extend completely through the eschar so that the subeschar space can expand and decrease tissue pressure. In a full thickness burn, nerve endings are destroyed along with the entire epidermis and dermis. Analgesics are usually not necessary for escharotomy.

C. Restoring and Maintaining Hemodynamic Stability

1. Restoring loss of Plasma Volume (Hypovolemia)
Loss of plasma volume is rapid after a burn injury as fluid collects in the burn tissue. The magnitude of loss can be easily underestimated as plasma is not visibly lost from the surface but rather is hidden beneath the burn. Early fluid resuscitation is required for burns exceeding 20% of body surface.

Assessment
• Look for other traumatic injuries (falls, explosions, blunt trauma)
• Estimate percent of body surface burned in order to estimate isotonic fluid requirements “Rule of Nines”
• Use burn resuscitation formula remembering to add more fluid or blood for other traumatic injuries
Estimating the size of the Burn as a percent of the Total Body Surface (TBS)

This formula divides the body into parts considered to be 9% (arms, head) to 18% (legs, front, back) of total body skin surface in adults. The small child has a different surface area breakdown. The burn size (as % of total) can then be used in the resuscitation formula.

Remember that a formula is only an estimate and adjustments need to be made based on patient's status.

Thoracic Vertebral Fracture in burn patient after a two story fall.

Fluid loss beneath the burn surface can be massive.
Fluid Resuscitation Protocol

- Establish and maintain adequate circulation
- Burns >20% TBS require initial fluid resuscitation
- Use at least one large bore intravenous catheter. Begin Ringer's Lactate. Estimate initial rate according to the estimated percent of total body skin surface burned (%TBS). Estimated body weight (4cc/kg/%TBS burn in 24 hours giving half of the estimate in 1-8 hours.)
  - Foley catheter
  - Nasogastric tube
- Maintain:
  - Blood Pressure >90 systolic
  - Urine output 0.5-1.0ml/kg/hr
  - Pulse <130
  - Temperature >37°C
- Modify protocol in the presence of massive burns, inhalation injury, shock, and in elderly patients
  - Fluid requirements are greater to prevent burn shock
  - Include colloid: either Hespan or Albumin in the patients from the beginning

Transfer to Burn Center if a Major Burn is Present
(or Moderate burn, depending on Local Resources)

2. Impaired Distal Perfusion from Burn Tissue Compression

As subeschar edema develops under the burn tissue, tissue pressure increases. This is of particular concern in extremities with a circumferential burn where the increasing pressure cannot be dissipated by expansion of neighboring tissue. The increased pressure initially impedes venous return, which markedly accentuates further edema production, raising pressure to a level that then impedes arterial blood flow.

Perfusion to the distal extremity must be closely monitored. Pain and color will be unreliable indicators of perfusion in the presence of a burn to the area. A warm extremity invariably indicates good flow during the period, but a cool skin does not always indicate that the problem is due to proximal burn constriction. Hypovolemia may well be the problem.

Circumferential burn impairing circulation to hand.

Escharotomy: releasing tissue pressure and restoring perfusion (Preferably performed in a Burn Center).
Steps for the Prevention and Treatment of Impaired Distal Perfusion

1. Remove constricting objects, such as jewelry
2. Immediate elevation of burned extremities Escharotomies in circumferential third or forth degree burns, if perfusion is impaired (preferably done in Burn Center)
3. Monitor using pulse palpation and Doppler
4. Escharotomies in circumferential third or fourth degree burns, if perfusion is impaired (preferably done in Burn Center)

The monitoring of distal pulsatile flow by palpation and then by the use of a Doppler flowmeter is the most practical method of assessment. Pulsatile flow must be present.

D. Criteria for Referral to a Specialty Burn Center

The American Burn Association (ABA) has identified those injuries that should be treated in a specialized burn center. Patients with these burns should be treated in a specialized burn facility after initial assessment and treatment at an appropriate hospital emergency department. Sometimes major burns are directly transferred to a burn center from scene if the center is within a safe transport time.

A large burn | A deep burn | High risk due to location
IV. Transfer Criteria

The American Burn Association (ABA) has identified those injuries that should be treated in a specialized burn center. Patients with these burns should be treated in a specialized burn facility after initial assessment and treatment at an appropriate hospital emergency department. Sometimes major burns are directly to a burn center from scene if the center is within a safe transport time.

Burn Injuries that should be referred to a burn unit include the following:

1. Partial thickness burns greater than 10% total body surface area (TBSA)
2. Burns that involve the face, hands, feet, genitalia, perineum or major joints (see High Risk section)
3. Third degree burns in any age group
4. Electrical burns, including lightning injury (see Electrical Burn section)
5. Chemical burns (see Chemical Burn section)
6. Inhalation injury
7. Children with any of the above burn injuries
8. Burn injury in patients with preexisting medical disorders that could complicate management
9. Any patients with traumatic injury (such as fractures) in which the burn injury poses the greatest risk of morbidity or mortality. If the trauma poses the greater immediate risk, the patient must be initially stabilized in the nearest appropriate facility before being transferred to a burn unit.
10. Any burned children if the hospital initially receiving the patient does not have qualified personnel or equipment for children.

V. Burn Injury: Initial Assessment and Management

- The Normal Structure and Barrier Properties of the Skin
- Burn Injured Skin
- Initial Burn Management
- Burn Severity and Outcomes (for Burn Size see Section 1)
A. The Normal Properties of Skin
Normal skin is a very complex organ with a wide variety of properties mainly protective barriers, which are critical to survival. Loss of these barrier functions occur with a skin burn. Understanding of these alterations in skin function will greatly assist in initial management.

Skin Barrier Function

<table>
<thead>
<tr>
<th>Skin Barrier Functions: Epidermis (outer layer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Protection from drying</td>
</tr>
<tr>
<td>• Protection from bacterial entry (infection)</td>
</tr>
<tr>
<td>• Protection from toxin absorption, like chemicals on the skin</td>
</tr>
<tr>
<td>• Fluid balance: avoiding excess evaporative water loss that would cause dehydration</td>
</tr>
<tr>
<td>• Neurosensory (touch, pain, pressure, sensation)</td>
</tr>
<tr>
<td>• Social-interactive (visible portion of the body covering)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skin Barrier Functions: Dermis (inner layer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Regulation of body temperature to avoid hypothermia with cold air exposure or high body T° with exercise and a hot environment</td>
</tr>
<tr>
<td>• Prevention of excess loss of body heat</td>
</tr>
<tr>
<td>• Protection from injury because of the properties of elasticity and durability</td>
</tr>
</tbody>
</table>

Skin Structure

**Epidermis:** The outer thinner layer known as the epidermis is composed mainly of epithelial cells. The deepest epidermal cells are immature cells which are continually dividing and migrating toward the surface, to replace lost surface cells; e.g. after an injury. The same types of regenerating epidermal cells are found in hair follicles and other skin appendages, which are anchored in the dermis. As the cells mature and migrate to the surface, they form keratin, which becomes an effective barrier to environmental hazards such as infection and excess water evaporation.

**Stratum Corneum:** is the “outer most” layer of the epidermis consisting of several flattened layers of dead keratinocytes as well as keratin. This layer protects against entry of bacteria and toxins. The epidermal layer regenerates every 2-3 weeks but regeneration requires the presence of the dermis.

**Dermis:** The dermis is the deeper layer responsible for skin durability and flexibility. The nerves for touch and pain, blood vessels and hair follicles are present in the dermis.
dermis is responsible for reforming the outer epidermis. So, if the outer layer is burned, the wound can heal as long as there is dermis. If the dermis is totally destroyed, the burn cannot heal.

B. Burn Injury

A skin burn is the damage to the skin caused by heat or other caustic materials like chemicals. The most immediate and obvious injury is one due to heat. Excess heat causes rapid protein denaturation and cell damage. The depth of heat injury is dependent on the depth of heat penetration. Wet heat (scald) travels much more rapidly into tissue than dry heat (flame). A surface temperature of over 156°F (68°C) by wet heat produces immediate tissue death as well as vessel clotting. A higher temperature would be required with dry heat (flames). The dead tissue on the surface is known as eschar. The depth of the burn is dependent on the temperature of the heat insult, the contact time, and the medium (air-water). In addition, the thickness of the skin layer is critical as the thinner the skin, the deeper the burn. Children and the elderly have very thin skin. Chemicals destroy skin by chemically killing the tissue. It is now clear that toxic agents released by inflammation, which are activated with the burn, cause much of the tissue damage after he burn, especially in the deeper burns.

It is important for to know that a burn can become deeper than that present initially, due to any continued exposure to the heat source, any degree of shock or later infection.

Reasons for Burn Worsening:

- continued contact with the heat or chemical source
- decrease in burn blood flow: shock or constriction
- infection

Burn Severity is determined by:

- burn depth
- burn size
- burn location
Burn with loss of barrier protection

Deep hand burn:
* Increased risk of infection
* Increased pain and risk of scar formation
* Increased risk of loss of skin elasticity leading to disability
* Increased risk of dessication

* Increased surface fluid and heat loss

C. Burn Assessment

Burn Depth: How deep is the burn?
Burn depth is defined by how much of the two skin layers is destroyed by the heat source. Burns can be categorized by degree:

1st degree: confined to the outer layer only
2nd degree: also involves part of the dermis
3rd degree: destruction of both layers

or

Partial thickness: is a second degree burn consisting of injury to part if the dermis
Full thickness: is a third degree burn consisting of injury to both layers

Only burns extending into the second layer (the dermis) are considered significant.
1. First-degree burn
A first-degree burn is confined exclusively to the outer surface and is not considered a significant burn. No barrier functions are altered. The most common form is a Sunburn which heals by itself in less than a week without scar.

2. Second-Degree or Partial Thickness Burn
This degree burn destroys the epidermal layer and portions of the dermis. Since it does not extend through both layers, it is termed a partial thickness burn.

There are a number of depths of a second-degree or partial thickness burn typically used to characterize the burn. Each corresponds with a predictable healing time, treatment modalities and outcomes. However, it is not necessary to make these distinctions with initial assessment but more knowledge is always better.

- **Superficial Second-Degree:** Involves the entire epidermis and no more than the upper third of the dermis is heat destroyed. Rapid healing occurs in 1-2 weeks, because of the large amount of remaining skin and good blood supply. Scar is uncommon. Initial pain is the most severe of any burn, as the nerve endings of the skin are now exposed to the air.

This depth of burn is at low risk for infection unless grossly contaminated. Initial cleansing should include removal of dirt, broken blisters and dead epidermis. Large blisters can be debrided off if using a temporary skin substitute or left intact for a few days. Often blisters get larger with time and impede movement at which time they should be removed. Topical antibiotics are not needed, especially cream based agents such as silver sulfadiazine as these agents impede healing and are only used if infection risk is high.

**Definition:** Second-degree burns are defined as those burns in which the entire epidermis and variable portions of the dermis layer are heat destroyed. A superficial second-degree (partial thickness) burn is characterized by heat injury to the upper third of the dermis leaving a good blood supply.

**Cause:** Usually hot water.

**Appearance:** The micro vessels perfusing this area are injured resulting in the leakage of large amounts of plasma, which in turn lifts off the heat-destroyed epidermis, causing blister formation. The blisters will continue to increase in size in the post-burn period as well and protein breakdown occurs. A light pink, wet appearing very painful wound is seen as blisters are disrupted. Frequently, the epidermis does not lift off the dermis for 12 to 24 hours and what appears initially to be a first degree is actually a second-degree burn.

**Outcomes:**
**Healing rate:** Despite loss of the entire basal layer of the epidermis, a burn of this depth will heal in seven to fourteen days if non-infected due to repopulation of the epithelial cells that are also present in skin appendages, anchored deep in the dermis. Minimal to no scarring is expected to occur. There is a relatively small zone of injury and conversion is uncommon except at extreme of age or chronically ill. Most antibiotic creams will slow the healing rate.
Characteristics:
- Confined to upper third of dermis
- Usually caused by hot liquids
- Blisters, wet pink, painful
- Low risk of infection
- Heals in 10-12 days without scar

Treatment:
1. Clean, remove small blisters; apply grease gauze and soft gauze dressing (occlusion, absorbent dressing, changed daily)
2. On face, perineum, apply bacitracin or neomycin ointment, applying several times a day.
3. Excellent alternative is the use of a synthetic skin substitute which seals the wound and decreases pain.
4. Use a water-soluble topical antibiotic if the wound is grossly contaminated or if one is unsure if the wound is superficial or deep.
5. Prophylactic systemic antibiotics are not needed.
Superficial Partial Thickness Burns
Covered with Synthetic Skin Substitute

Proper use requires initial debridement of blisters to allow firm adhesive
Closed Dressing Approach

The soft gauze over the primary dressing will protect the wound and help soak up fluid leaking from the surface

- **Mid Second Degree (mid-partial thickness) burn:**
  Destruction to about half of the dermis occurs. Healing is slower (2-4 weeks) due to the fact that there is less remaining dermis and less blood supply. Pain can be severe but is less intense than superficial 2°. The reason is that part of the nerve is now heat destroyed.

  It is not necessary to distinguish a superficial from a mid-dermal burn on initial assessment as initial management is basically the same.

  **Definition:** A mid second degree extends to the mid portion of the dermis. Longer exposure to hot liquids (5-10 seconds) or flash flames (not direct contact of flames with skin) are the most common causes.

  **Cause:** Brief exposure to flames or flash explosion: hot water in infant or elderly.

  **Appearance:** The burn surface may have blisters but is more red, less wet and only moderately painful.
Outcome: These burns usually heal in about two to four weeks. The exception is the very young and elderly where the dermis is thin and depth of burn is invariably deeper. However, there is a large zone of injury and risk of conversion. If a burn heals in two weeks, then minimal to no scarring is expected. With healing time beyond three weeks scarring will occur, the degree being greater in dark skinned individuals.

Treatment:
1. In patients six years to 60 years, without diabetes, chronic illness, etc., treatment is with a grease gauze, an occlusive dressing and a topical antibiotic ointment. The depth can be underestimated and a switch to an antibiotic cream or dressing may be needed because of risks of infection.
2. In very young, and very old patients, or those with chronic illness, contaminated wounds or perineal wounds, the traditional choice is a topical antibiotic. First choice is silver sulfadiazine or silver dressing with closed dressing technique.
3. New approach is the use of a temporary skin substitute which can increase healing, protect the wound and decrease pain.

MID-DERMAL BURN

<table>
<thead>
<tr>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Transfer to burn center due to location (bilateral feet)</td>
</tr>
<tr>
<td>2) Temporary use of cold to control pain</td>
</tr>
<tr>
<td>3) Debride loose tissue</td>
</tr>
<tr>
<td>4) Grease gauze, topical antibiotic ointment or silver dressing with closed gauze dressing</td>
</tr>
<tr>
<td>5) Consider temporary skin substitute</td>
</tr>
</tbody>
</table>
Deep Second Degree (Deep Partial Thickness) Burn:

Most of skin is destroyed except for small amount of remaining dermis. The wound looks white or charred indicating dead tissue. Blood flow is compromised and a layer of dead dermis or eschar adheres to the wound surface. Pain is much less as the nerves are actually destroyed by the heat. Usually, one cannot distinguish a deep dermal from a full thickness (third degree) by visualization. The presence of sensation to touch usually indicates the burn is a deep partial injury.

Definition: A deep partial thickness or deep second-degree burn extends well into the dermal layer and fewer viable epidermal cells remain. Therefore, re-epithelialization is extremely slow, sometimes requiring months. Grafting is often the preferred treatment for long-term function.

Appearance: In these patients, blister formation does not characteristically occur because the dead tissue layer is sufficiently thick and adherent to underlying viable dermis that it does not readily lift off the surface. The wound surface may be red and dry in appearance with white
areas in deeper parts (dry since fewer blood vessels are patent). There is a marked decrease in blood flow making the wound very prone to conversion to a deeper injury and to infection. It is often not possible to distinguish a deep partial from a full thickness burn by initial appearance. Frequently the wound is a mixed second and third degree. Direct contact with flames is a common cause. Most chemical burns are also deep. The appearance of the deep dermal burn changes dramatically over the next several days as the area of dermal necrosis along with surface coagulated protein turns the wound a white to yellow color. The amount of surface coagulum is accentuated with the use of a topical antibiotic, making the deep second degree burn difficult to differentiate from a third degree burn. The presence of some pain can assist in the diagnosis because pain is usually absent in a full thickness injury. Fluid losses and the metabolic effects of dermal burns are basically the same as that seen with the third degree burn.

**Outcome:** A deep dermal burn will require 4-10 weeks or longer to heal. Since the new epidermis is very thin and not adhered well to dermis (no rete pegs), wound breakdown is common. Excision and grafting is the preferred treatment. Dense scarring is usually seen if the wound is allowed to heal primarily.

**Characteristics:**

- Involves majority of the inner dermal layer
- Cause is usually flames
- Dry, white, or charred skin
- Pain is minimal
- High risk for infection
- May heal in 2-3 months
- If heals: scar is severe
- Readily converts to a full thickness burn

Deep Partial Thickness Burn
General Treatment Principles:
Deep Partial Thickness Burn

1. Admit if over 2% due to need for early grafting
2. Transfer to Burn Center based on Transfer Criteria
   (no need to perform burn care if transfer is immediate)
3. Gentle washing with antibacterial soap
4. Silversulfadiazine using a closed dressing
5. Or silver impregnated dressing
6. Cold is not beneficial once the burning has stopped as pain is minimal

Deep dermal burn to forearm. Note patches of white indicating a deeper burn. Less pain is usually present in the deeper burn.

Deep burn to back
Treated with silver dressing
Silver is constantly released over a 3-5 day period resulting in excellent infection control but with fewer dressing changes.
Med to Deep Hand Burn

treated with silver cream

Note fingers are wrapped separately to maintain motion

3. Third degree (Full Thickness) Burn:
Both layers of skin are completely destroyed leaving no cells to heal. Any significant burn will
require skin grafting. Small burns will heal with scar.

Definition: A full thickness or third degree burn occurs with destruction of the entire epidermis
and dermis, leaving no residual epidermal cells to repopulate. This wound will therefore not re-
epithelialize and whatever area of the wound is not closed by wound contraction will require skin
grafting.

Appearance: A characteristic initial appearance of the avascular burn tissue is a waxy white
color. If the burn produces char or extends into the fat as with prolonged contact with a flame
source, a leathery brown or black appearance can be seen along with surface coagulation veins.
Direct exposure with a flame is the usual cause of a third degree burn. However, contact with
hot liquids such as hot grease, tar or caustic chemicals will also produce a full thickness burn.
The burn wound is also painless and has a coarse non-pliable texture to touch. A major difficulty
is distinguishing a deep dermal from a full thickness (third degree) burn that extends just
through the dermis. This burn is termed an indeterminate burn.

Outcome: Except for a very small wound, e.g. 2x2 inches, the burn wound will require excision
and a skin graft.

Characteristics:

- Complete destruction of both layers
- Cause is usually flames
- White, char, dry, painless
- High risk for infection
- Needs to be excised and skin grafted
General Treatment Principles: Full Thickness Burn

1. Transfer to Burn Center based on Transfer Criteria (no need to perform burn care if transfer is immediate)
2. Gentle washing with antibacterial soap.
3. Silversulfadiazine using a closed dressing twice a day.
4. Or use of a silver impregnated dressing
5. Cold is not beneficial once the burning has stopped as pain is minimal.

4. Visually Deceiving Burns
Some burns usually caused by contact with flames or extremely hot temperatures like explosions have destroyed epidermis still present in the wound. The depth can be underestimated unless the wound is gently washed and debrided after which the size and depth is more clearly defined.
5. **Immersion Scalds**

Scald burns in which a part or all of the body is immersed in hot water. Hot water contact can be prolonged, producing a deep burn. This process is characteristically seen in the elderly or in young children who cannot escape hot water. Forced immersion or abuse must be considered. The water vehicle transmits heat to tissues 20 times greater than air, therefore the tissue is injured deeper than with a flash flame of short exposure. However, the water $T^\circ$ is usually not hot enough to immediately coagulate vessels, so the wound looks red like a superficial burn but soft tissue injury including nerves can be severe and the burn can be very deep.

**Appearance:** The major characteristic is a dark red color due to myoglobin and hemoglobin pigment released in the tissues, which can be mistaken for viable tissue. The depth of a long term scald exposure is invariably underestimated.

**Outcome:** Since the burn is usually deeper with this form of scald and the area is often buttocks and/or feet, morbidity both short term and long term is high.

Flame Burn (direct contact) looks superficial with blisters but mechanism suggest a deep burn.

When gently cleansed, the wound is noted to be a combination of deep second and third degree burn.

**Treatment:**

1. Gently wash, removing all loose epidermis
2. Application of silver cream or dressing

Typical appearance: looks red, like a Mid Second burn but is not wet and is less painful. The burn is actually a Full Thickness.
Treatment:
1. Burn size and area are indicators that patient needs care in a Burn Center
2. Notification of Social Service

D. Burn Severity and Outcome

<table>
<thead>
<tr>
<th>Second Degree (Partial Thickness)</th>
<th>Cause</th>
<th>Appearance</th>
<th>Pain</th>
<th>Healing</th>
<th>Scar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial</td>
<td>Hot liquid, short exposure</td>
<td>Wet, pink blisters</td>
<td>Severe</td>
<td>10-14 days</td>
<td>Minimal</td>
</tr>
<tr>
<td>Mid-Dermal</td>
<td>Hot liquid, hot grease, or flash flame with longer exposure</td>
<td>Less wet, red + blisters</td>
<td>Moderate</td>
<td>2-4 weeks</td>
<td>Moderate</td>
</tr>
<tr>
<td>Deep Dermal</td>
<td>Chemicals, direct contact with flames</td>
<td>Dry, white</td>
<td>Minimal</td>
<td>3-8 weeks</td>
<td>Severe, usually needs skin graft</td>
</tr>
<tr>
<td>Third Degree (Full Thickness)</td>
<td>Chemicals, flames, explosion with very high temperature</td>
<td>Dry, white or char</td>
<td>None</td>
<td>Needs skin graft</td>
<td>Mild to severe, depending on timing and type of graft</td>
</tr>
</tbody>
</table>

Factors Affecting Burn Severity and Outcome
- Burn depth
- Amount of skin burned (measured as percent of total skin)
- Age (very young and very old are high risk)
- Chronic illness and overall health
- Part of the body burned
- Presence of smoke inhalation injury

Note the sharp borders of the burn indicating the child was unable to move.
Burn survival has markedly improved in recent years when optimum care is provided from the injury scene to discharge. The burn size, as percent of total body, is shown with the comparison to age. This chart does not consider the presence of smoke inhalation injury.

Survival Rate from Burn Centers
(Data obtained from Specialized Center for Mean Survival Rate (%) Comparing Age and Burn Size)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>0-1</th>
<th>2-4</th>
<th>5-34</th>
<th>35-49</th>
<th>50-59</th>
<th>60-74</th>
<th>&gt;75</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>&gt;95</td>
<td>&gt;95</td>
<td>&gt;95</td>
<td>&gt;95</td>
<td>&gt;95</td>
<td>&gt;95</td>
<td>90</td>
</tr>
<tr>
<td>10-20</td>
<td>&gt;95</td>
<td>&gt;90</td>
<td>&gt;95</td>
<td>&gt;90</td>
<td>&gt;90</td>
<td>&gt;70</td>
<td>&gt;60</td>
</tr>
<tr>
<td>20-30</td>
<td>&gt;90</td>
<td>&gt;90</td>
<td>&gt;90</td>
<td>&gt;90</td>
<td>&gt;75</td>
<td>50</td>
<td>35</td>
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<tr>
<td>30-40</td>
<td>75</td>
<td>80</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>40</td>
<td>&gt;20</td>
</tr>
<tr>
<td>40-50</td>
<td>50</td>
<td>65</td>
<td>80</td>
<td>60</td>
<td>40</td>
<td>10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>50-60</td>
<td>50</td>
<td>60</td>
<td>70</td>
<td>60</td>
<td>40</td>
<td>&lt;25</td>
<td>&lt;10</td>
</tr>
<tr>
<td>60-70</td>
<td>40</td>
<td>50</td>
<td>60</td>
<td>40</td>
<td>25</td>
<td>&lt;10</td>
<td>0</td>
</tr>
<tr>
<td>70-80</td>
<td>35</td>
<td>40</td>
<td>45</td>
<td>30</td>
<td>25</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>80-90</td>
<td>30</td>
<td>35</td>
<td>30</td>
<td>30</td>
<td>&lt;20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>90-100</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>15</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* The body surface burn, combined second and third degree

Note that survival is very high for even massive burns (over _ of the body) in older children and young adult. Survival decreases in the elderly due to the presence of pre-existing disease and inability to withstand severe stress. Survival is also less for babies and toddlers for the same size.

Survival Statistics

- Burn of 15% of body in a 12 year old.
- Over 95% chance of survival.
Burn of 20% of the body in a 40 year old. Over a 90% survival.

Burn of 60% of the body in a 20 year old. About a 70% chance of survival.

Burn of 25% of the body in an 80 year old. About a 25% chance of survival.
VI. Chemical Burns

- General Characteristics, Assessment and Treatment
- Eye Injury
- Specific Chemical Injuries

Chemical burns are commonly seen in the home but especially in the workplace. The most common categories of toxic chemicals will be described. These chemicals can produce local tissue injury and some have potential to be absorbed resulting in body poisoning. Toxic chemicals can be in the form of gases, liquids or solids. The *gas form* typically causes injury through breathing like smoke exposure. The liquid and solid forms are more likely to cause damage to the skin, with the exception of fuming sulfuric acid, heat or thermal injury play a minor role in chemical burn.

A. Characteristics of Chemical burns
- Usually deeper than it looks as the skin is destroyed mainly by chemicals. Appearance is often brown to gray as opposed to the typical white or char with a flame burn.
- Continue to get deeper and later appearance is usually worse.
- Severe persistent pain is often present indicative of ongoing skin damage.
- Chemical toxins like phenol or hydrocarbons like gasoline may cause only skin irritations, but absorption can lead to systemic poisoning.
B. Treatment and Assessment

1. Airway
   - Support airway as fumes can cause swelling

2. Breathing
   - Fumes or absorption of toxins cause injury to lungs
   - Chemical explosions can cause chest damage
   - Assess and assist breathing

3. Circulation
   - Assess adequacy of circulation with vital signs, skin color and temperature
     (Hypovolemic shock is usually not present in the immediate post burn period)
   - Intravenous catheter indicated mainly for administration of medications
   - Local circulation
   - removal of constricting objects, like jewelry
   - deep chemical burn can produce constriction of local blood flow similar to thermal burn

4. Disability
   - Absorption of some chemicals can lead to impaired brain function
   - seizures
   - Unconscious state
   - Altered consciousness can also be due to head injury (if explosion)
   - Assess and document level of consciousness A-V-P-U
   - Management based on protocol

5. Expose and Examine
   - Remove clothing and constricting objects

6. History
   Once the ABC’s and initial removal of the chemical have been initiated, further details as to
   history of the event must be obtained
   - Place of exposure (was it enclosed?)
   - Nature of exposure (spill, fall, explosion?)
   - Duration of exposure (how long was the chemical exposure before initial treatment)
   - What is the chemical/chemicals?
     - acid, alkali, hydrocarbon
   - specific toxic properties (information usually available if industrial accident)
   - Relevant patient history
   - health status
   - current symptoms

7. Wound Management
   - Initial management of the chemical burn has a major impact on outcome
   - Continuous water irrigation if the area should be initiated
     - use of showers in the workplace is optimum
     - use tepid water if possible, to avoid long exposure to cold or hot water
     - irrigation for strong acid or alkali exposure is 30-60 minutes
Continuous irrigation if eye is exposed to chemicals
- do not attempt to neutralize acids with alkali or vice versa, just use copious water

- Solid chemicals should be brushed off first prior to irrigation using safety gloves
- Continue irrigation through transport while maintaining body T°
- Cover the patient with clean dry sheet or blanket after irrigation stopped (per protocol)

**CHEM-TREC - Chemical Transport Emergency Center**
This 24-hour service established in 1971 provides information to rescue teams responding to chemical emergencies and can provide direct contact with the chemical company. The phone number for CHEM- TREC is 1-800-424-9300

**7. Pain Management**
- Water irrigation should begin to decrease pain
- Pain medications (Intravenous administration in small amounts)

**Significant chemical burns meet criteria for transfer to a Burn Center**

**Eye Injury (Prevention and Treatment)**
- Permanent eye damage can be prevented if copious, continuous irrigation with water, saline or Ringer’s Lactate
- Remove contact lenses
- Hold eyelids apart and begin gentle, continuous irrigation
- Use if IV bag and tubing provides continuous controlled irrigation

<table>
<thead>
<tr>
<th>Eye injury from splattered alkali</th>
<th>Alkali burn to eye</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.jpg" alt="Image" /></td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>

Treatment is continuous water irrigation

Delayed treatment resulted in permanent corneal damage
## C. Specific Chemical Burns

### Strong Acid Burn from Sulfuric Acid

- Note the brownish-gray appearance. Characteristic of a deep skin burn from a strong acid or alkali.
- Persistent pain is present. Wound usually looks deeper at 24 hours.
- Treatment is removal of clothing and water irrigation.
- Burn is Full Thickness.

### Chemical Burn by Nitric Acid

- Burn is caused by a nitric acid spray. A brown discoloration is characteristic.
- Persistent pain is present. Treatment is water irrigation.

### Deep Lime powder burn to lower leg

- Lime powder at a construction site entered the patient’s boot. The deep burn was noted when pain developed. Initial treatment is water irrigation.
### Full Thickness Sodium hydroxide burn to the back (at 24 hours)

Brownish dry appearance indicates the burn is full thickness. Patient did not seek medical attention for 24 hours.

---

Other Chemical Injuries:

**Petroleum (Hydrocarbon) Exposure**

These agents carry the risk of not only a skin injury from exposure but the exposed patient is highly flammable. In addition these chemicals can be rapidly absorbed leading to a life threatening poisoning.

- Agents include: gasoline, fuel, solvents, phenol
- Protection from any sparks or flame source as these agents make clothes and skin highly flammable
- Absorption of these toxins can lead to poisoning
- Initial skin burn from chemical is often superficial

Early removal of clothing and copious irrigation needed - A small exposure to water can actually spread the agent and lead to further damage

#### Hot Tar Burns

Tar in its liquid form is superheated and therefore any direct contact e.g. roofers, will usually lead to a **deep** burn. Pain may be minimal as the burn is deep, and under estimation of the degree of burn is common. The tar typically remains adherent to the skin.

A secondary exposure, e.g. stepping on already poured but still sticky tar, will likely produce a more superficial but still significant burn.

Initially cool the tar to decrease retained heat

- use of copious water
- Do not attempt to remove the tar in the pre-hospital setting
  - careful removal will further damage the skin burn
- Cover area with clean, dry sheet or cloth
- Removal in definitive care can be done using fat emulsifiers

- Neosporin ointment
- mineral oil
- not flammable solvents
<table>
<thead>
<tr>
<th>Deep Hot Tar Burn to Hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image of hand]</td>
</tr>
<tr>
<td>Note the white area in the exposed wound, indicating the burn to be very deep. Pain is minimal and injury can be easily underestimated.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Skateboarder versus Poured Asphalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image of face]</td>
</tr>
<tr>
<td>The asphalt was still hot upon contact. The burn was partial thickness. Initial management is cooling the tar with water then transport to Burn Center due to facial burn. An eye assessment will be needed.</td>
</tr>
<tr>
<td>Agent</td>
</tr>
<tr>
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</tr>
<tr>
<td>General Category of Acids</td>
</tr>
<tr>
<td>Hydrofluoric Acid</td>
</tr>
<tr>
<td>General Category of Alkali</td>
</tr>
<tr>
<td>General Category Organic Components Gasoline immersion</td>
</tr>
<tr>
<td>Phenol</td>
</tr>
<tr>
<td>Tar</td>
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