Burn Education Day

ACI Statewide Burn Injury Service
Fluid Management

ACI Statewide Burn Injury Service
Burn Pathophysiology

- Unique total body response in large thermal injury (>20% adults/>10% paeds)

- Increased capillary permeability persists for ~ 24 hours (starts to resolve at 8-12hrs)
How to administer fluids
Goals of resuscitation

- The maintenance of vital organ function at the least physiological cost.

- The restoration and preservation of tissue perfusion in order to avoid ischaemia.
Differences in children

- Limited physiological reserve
- Tendency to hypoglycaemia
- Greater surface area to mass ratio
- IV fluid required at lower % TBSA
- Need higher volume per kilogram
- Increased requirement = normal daily maintenance
Fluid Resuscitation

- Modified Parkland Formula:
  Area burnt x Weight x 3
- Use Hartmann’s solution.
  - Half in first 8 hours from injury.
  - Second half in next 16 hours.
  - Add maintenance + glucose for children <16yrs

Calculation starts from TIME OF INJURY

Revise according to urine output
Age: 18yo
Weight: 80kg
TBSA: 40%
Time of burn: 0800
Time of presentation: 0900
Fluid calculation – first 24 hours

3ml x 80kg x 40%  =

Fluid to be given in first 8 hours =

Rate =
Fluid calculation – first 24 hours

3ml x 80kg x 40% = 9600 ml

Fluid to be given in first 8 hours = 4800 ml

Rate = 685 ml/hr
Fluid resuscitation for children

3mls x kg body weight x TBSA = total fluid for 24 hour period from the TIME of injury

+ Maintenance fluid
Maintenance Fluids (Paeds)

- 0.9% (normal) saline + 5% dextrose
  - 4ml / kg / hr up to 10kg
  - 2ml / kg / hr from 11-20kg
  - 1ml / kg / hr for each kg over 20kg
Age: 2yo
Weight: 10kg
TBSA: 30%
Time of burn: 0700
Time of presentation: 0800
Fluid Calculation – first 24 hours

3ml x 10kg x 30% =

Fluid to be given in first 8 hours =

+ Maintenance fluid
Fluid Calculation – first 24 hours

$3\text{ml} \times 10\text{kg} \times 30\% = 900\text{ml} \text{ (over 24 hrs)}$

Fluid to be given in first 8 hours = $450\text{mls}$

$= 64\text{ml/hr}$

$+$

Maintenance fluid

$4\text{ml} \times 10\text{ kg}$

$= 40\text{ ml/hr} \text{ (constant rate)}$
Formulae are only guides
Fluid should be administered via *Two* large cannulae (16G at least in adults) preferably inserted through non-burnt skin.
Monitoring resuscitation

Urinary Output

Adults: 0.5 ml/kg/hr (30-50 ml/hr)

Children (<16yrs): 1.0 ml/kg/hr
Urinary is vital in

>10% TBSA Children

>20% TBSA Adults

Genital burns
Monitoring resuscitation

- Urinary output
- Heart rate
- Blood pressure
- Central invasive haemodynamic
- Electrolytes
- Blood gases
- pH (<7.39 - lactic acidosis?)
Extra fluid is required in

- Inhalation injury
- Electrical injury
- Delayed resuscitation
- Dehydration
  - Fire-fighters
  - Intoxicated patients
Haemochromogenuria

- Extensive deep burn
- Electrical injury
- Blunt trauma
- Tissue ischaemia

- Urinary excretion of
- Haemoglobin from destruction of RBCs
- Myoglobin from muscle break down
Haemochromogenuria

- Urine becomes dirty red colour
- Haemochromogens deposited in proximal renal tubules
- Acute renal failure
Haemochromogogenousuria Treatment

- Increase urine output to 1-2 ml/kg/hr
- Mannitol 12.5 g/l resuscitation fluid
- Sodium bicarbonate 25 meq/l (Alkalinise urine)
Tetanus

- Check immunisation status on admission
- Give tetanus prophylaxis if indicated
Inhalation Burn
Inhalation Injury

- Can be caused by heat, chemical compounds in the atmosphere or soot particles

- May increase mortality by up to 40%
Inhalation Injury

- Upper airway (supra-glottic)
- Lower airway (sub-glottic)
- Systemic intoxication (CO, HCN poisoning)
Supra-glottic Injury

- Upper airway is a good heat exchanger.
- Hot gases cause thermal injury.
- Loose mucosa allows rapid swelling.
- Obstruction in first 5 to 12 hours.
- Diagnosis on history, examination.
- Treat by EARLY intubation.
Sub-glottic Injury

- Smoke is a mixture of particles.
- Particles penetrate to different levels.
- Dissolve to give variety of chemicals (acids and alkalis).
- Cause inflammation of all airways.
- Best diagnosed by bronchoscopy.
- Onset can be days after injury.
- Merges with lung component of SIRS.
Systemic Intoxication

- Chiefly CO & HCN.
- Closed space injury.
- Displaces $\text{O}_2$ from Hb; blocks cytochromes.
- Symptoms of headache, dyspnoea, irritability, confusion, coma, death.
- Usually combined with hypoxia.
- Treat with $\text{O}_2$.
- Usual cause of death at scene of fire.
Inhalation Injury

- Obtain adequate history
- Examine for signs of airway burn
- Give Oxygen
- Consider intubation early
- Monitor $O_2$ saturation
Escharotomy
Circumferential Burns

- Burnt skin → rigid = eschar.
- Around limbs → venous occlusion.
- Venous occlusion → arterial occlusion.
- Around chest → restricted expansion.
- Child’s front → restricts diaphragm.
  - Elevation reduces swelling.
  - ? escharotomy
Be careful of:

- Ulnar nerve posterior to medial epicondyle
- Common peroneal nerve winding around head of fibula
- Posterior tibial artery and nerve, posterior to medial malleolus.
Burn Depths
Burn Wound Healing = re-epithelisation

Burn Depth Classification

Epidermis

Dermis - capillaries - nerves

Fat

Epidermal
Superficial Dermal
Mid Dermal
Deep Dermal
Full Thickness
## Burn Depth Assessment

<table>
<thead>
<tr>
<th>Depth</th>
<th>Colour</th>
<th>Blisters</th>
<th>Cap Refill</th>
<th>Sensation</th>
<th>Healing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Epidermal</strong></td>
<td>Red</td>
<td>No</td>
<td>Present</td>
<td>Present</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Superficial Dermal</strong></td>
<td>Pale Pink</td>
<td>Small</td>
<td>Present</td>
<td>Painful</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Mid-dermal</strong></td>
<td>Dark Pink</td>
<td>Present</td>
<td>Sluggish</td>
<td>+/-</td>
<td>Usually</td>
</tr>
<tr>
<td><strong>Deep Dermal</strong></td>
<td>Blotchy Red</td>
<td>+/-</td>
<td>Absent</td>
<td>Absent</td>
<td>No</td>
</tr>
<tr>
<td><strong>Full thickness</strong></td>
<td>White</td>
<td>No</td>
<td>Absent</td>
<td>Absent</td>
<td>No</td>
</tr>
</tbody>
</table>
Epidermal Burn

- Skin intact, red, brisk capillary refill
- Erythema not included in % TBSA assessment
- Heal spontaneously within 3-7 days with moisturiser or protective dressing
Superficial Dermal Burn

- Blisters present or denuded
- Pink, brisk capillary refill
- Should heal within 7-14 days with minimal dressing requirements
Mid Dermal Burn

- Heterogeneous, variable depths
- Dark pink, sluggish capillary refill
- Should heal within 14 - 21 days
- Deeper areas or over a joint may need surgical intervention and referral
Deep Dermal Burn

- Heterogeneous, variable depths
- Blotchy red/white
- Sluggish to absent capillary refill
- Surgical intervention
- Refer to specialist unit
Full Thickness Burn

- Outer skin, and some underlying tissue dead
- White, brown, red, black
- No capillary refill
- Surgical intervention and long-term scar management required
Full Thickness Burn
Burns are Dynamic

- The first impression may not be the most accurate

Day 1

Day 2

Day 5
# Structure of EMSB

<table>
<thead>
<tr>
<th>Look</th>
<th>Do</th>
<th>Fluids</th>
<th>Analgesia</th>
<th>Tests</th>
<th>Tubes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway</td>
<td>Spine</td>
<td>Oxygen</td>
<td>Haemorrhage control &amp; I.V. access</td>
<td>AVPU &amp; Pupils</td>
<td>Environmental Control (Estimate TBSA)</td>
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<tr>
<td>Breathing</td>
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<td>Circulation</td>
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<td>Disability</td>
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<td>Exposure</td>
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</tbody>
</table>

- A.M.P.L.E. History
- Head to Toe Examination
- Tetanus
- Documentation and Transfer
- Support

Primary Survey

- Check First Aid

Secondary Survey
References

- http://www.skinhealing.com/3_1_burntreatments.shtml
- http://www.burnsurgery.org/Betaweb/Modules/skinsubstitutes/sec2.htm
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