IN THE NAME OF GOD

Burn Injuries in pediatric

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Burns are a leading cause of unintentional death in children, 2nd only to motor vehicle crashes. There has been a decline in the incidence of burn injury requiring medical care over the last decade. This has coincided with an increased focus on burn treatment, prevention, increased fire and burn prevention education, greater availability of regional treatment centers, widespread use of smoke detectors, greater regulation of consumer products and occupational safety and societal changes such as reduced smoking and alcohol abuse.

Indications for hospitalization for Burns

- Burns affecting > 15% of BSA
- Electrical burns caused by high- tension wires
- Inhalation injury, regardless of the amount of BSA burned
- Inadequate home situation
- Suspected child abuse or neglect
- Burns to the hands, feet, or genitals

Categories of Burn Depth

	1st – degree burn	2nd - degree burn (partial thickness)	3rd – degree burn (full thickness)
Surface appearance	Dry, no blisters/ erythematous/ minimal or no edema	Moist bleb, blister Fair capillary refil	Dry, leathery scar
Pain	Very painful	Very painful	Insen sate insensate
Histologic depth	Epidermal layer only	Epidermis , dermis	Down to and may include fat, sc tissue, fascia, muscle, bone
Healing time	2-5 days, with no scar	Superficial; 5-21 days with no graft deep: 21-35 days with no infection	Large area require grafting , but small area may heal from the edges after WK

Estimation of BSA for a burned child

	newborn	3y/0	6y/0	≥ 12y/0
Head	18%	15%	12%	6%
Trunk	40%	40%	40%	38%
Arms	16%	16%	16%	18%
Legs	26%	29%	32%	38%

Acute treatment of burns

- First aid
- Fluid resuscitation
- Provision of energy requirements
- Control of pain
- Prevention of infection (early excision and grafting)
- Prevention of excessive metabolic expenditures
- Control of bacterial wound flora
- Use of biologic and synthetic dressings to close the wound

Outpatient management of minor burns

A patient with 1st and 2nd –degree burns of< 10% BSA may be treated on an outpatient basis unless there is inadequate family support or there are issues of child neglect or abuse.

- These outpatients do not require a tetanus booster or prophylactic penicillin therapy.
- Blisters should be left intact and dressed with bacitracin or silver sulfadiazine cream (silvadene)
- Dressings should be changed once daily.

Fluid resuscitation

- Parkland formula: 4cc/kg/BSA% (½ IN 1ST 8hr / ½ over the next 16 hr)
- Urine output > 1cc/kg/h
- Vital signs, acid- base balance and mental status reflect the adequacy of resuscitation.
- Because of interstitial edema and sequestration of fluid in muscle cells, patient may gain up to 20% over baseline pre-burn BW.
- Patients with burns of 30% BSA require a large venous access (CV line) to deliver the fluid required over the critical 1st 24hr.
- In addition to fluid resuscitation, children should receive standard maintenance fluids.

Fluid resuscitation

- Patients with burns of > 60% BSA may require a multilumen C.V catheter; these patients are best cared for in a specialized burn unit.
- During the 2nd 24hr after the burn, patients begin to reabsorb edema fluid and to diurese.
- Controversy exists as to whether colloid should be provided in the early period of burn resuscitation.
- Oral supplementation may start as early as 48hr post burn.

- A 5% albumin infusion may be used to maintain the serum albumin level at a desired 2g/d.l
  - 30-50% BSA: 0.3cc/kg/BSA%
  - 50-70% BSA: 0.4cc/kg/ BSA%
  - 70-100% BSA: 0.5cc/kg/ BSA%

- P.C Infusion is recommended if the HCT falls to < 24% (Hb=8g/d.l). Some recommend treating HCT of < 30% (Hb< 10g/d.l) in patient with systemic infection, Hb-pathy, cardiopulmonary disease, ongoing blood loss (repeated excision/ grafting)

- FFP is indicated if clinical and laboratory assessment shows a deficiency of clotting factor, a P.T level of > 1.5 control or a P.T.T level of > 1.2 control

- Sodium supplementation may be required for children with burns of > 20% BSA, if 0.5% silver nitrate solution is used as the topical antibacterial burn dressing, sodium losses with silver nitrate therapy are regularly as high as 350 mmol sodium/m^2 BSA. Oral sodium chloride supplement of 4 g/m^2 burn area/24hr is usually well tolerated, divided in to 4-6 equal doses to avoid osmotic diarrhea. The aim is to maintain serum sodium level of> 130 meq/L and urinary sodium concentration of > 30meq/L. I.V potassium supplementation is supplied to maintain a serum potassium level of> 3meq/d.L. potassium losses may be significantly increased when 0.5% silver nitrate solution is used as the topical antibacterial agent or when aminoglycoside , diuretic or amphotericin is required.

Prevention of infection and surgical management of the burn wound

- Accurate preoperative and intraoperative determination of burn depth.
- The choice of excision area and appropriate time
- Control of intra operative blood loss
- Specific instrumentation
- The choice and use of perioperative AB
- The type of wound coverage chosen

Burn wound infections

- Gram positive bacteria
  - S. aureus (MRSA)
  - CONS (s. epidermidis)
  - Enterococcus (VRE)
  - GAS
- .Gram negative bacteria
  - P. aeruginosa
  - Klebsiella
  - Acinetobacter
  - E. coli
  - Serratia
  - Enterobacter
  - proteus

*****	**Multi –drug resistant(MDR)**	**Extensively –drug resistant(XDR)**	**Pan- drug resistant (PDR)**
Definitions	Resistance to at least Three class of drug: 1) Cephalosporins 2) Fluroquinolones 3) Aminoglycosides	MDR Acinetobacter + Resistance to Carbapenems	XDR Acinetobacter + Resistance to Polymyxins
Therapeutic Options	Carbapenems Polymyxins	Polymyxins Tigecycline	Combinations

Burn wound infections

- Fungi (TBSA : 30-60%)
  - Candida
  - Aspergillus
  - Fusarium
  - Zygomycetes
  - Phaeohyphomycetes
- virus
  - HSV
  - CMV
  - VZV

Complications

- Catheter – associated bacteremia
- U.T.I
- VAP
- Endocarditis
- T.S.S
- Meningitis
- Suppurative chondritis (ear burns)
- Suppurative thrombophlebitis
- Osteomyelitis
- Septic arthritis
- Sinusitis (long – term nasotracheal intubation)
- Necrotizing fasciitis
- cellulitis

Nutritional support

- Children with a burn of 40% of total BSA require approximately 50-100% predicted basal energy expenditure.
- High carbohydrate caloric support
- High protein (3- 4 gr/kg of protein/day)
- Vit. A/B/C / Zinc
- Anabolic agent (G.H, oxandrolone, low – dose insulin)
- Anticatabolic agent (propranolol)
- probiotics

*** sepsis increase metabolic rates, and early enteral nutrition initially with high – carbohydrate, high protein caloric support (1800 cal/m^2 /24hr maintenance plus 2200 cal/m^2 of burn/ 24hr reduces metabolic stress.

Topical therapy

- Silver sulfadiazine
- Silvadene cream
- Mafenide acetate (sulfamylon)
- 0.5% silver nitrate solution
- Aquacel Ag^{+}
- Accuzyme ointment
- Nystatin solution (mycostatin TBSA> 40%)
- Bacitracin / gentamicin/ mupirocin/ polymyxin B
- Hypochlorite solution
- Octenisept

Pain Relief and psychologic adjustment

- Reduce early metabolic stress
- Decrease the potential for PTSD
- Allow future stabilization early and physical and psychologic rehabilitation
- **Opiate analgesia :**
  - Morphine sulfate

    Oral : 0.3 -0.5 mg/kg every 4-6hr

    I.V: 0.05-0.1 mg/kg every 2hr

    Rectal supp. : 0.3-0.6 mg/kg every 4 hr
- **Anxiolytic medication:**
  - **Lorazepam**
    - **Oral : 0.05 – 0.1 mg/kg/dose Q8h**
  - **Midazolam (versed)**

    I.V : 0.05 -0.1 mg/kg (max dose : 0.2 mg/kg)
- **Reconstruction and rehabilitation**
- **School re-entry and long – term outcome**

term disabilities in patients with burn injuries –Common long

- Disabilities affecting the skin and soft tissue
- Orthopedic disabilities
- Metabolic disabilities
- Psychiatric and neurologic disabilities
- Long – term complications of critical care
- Pre – existing disabilities that contributed to the injuries

Renal failure in burn injury

- Early: ATN, hemoglobinuria, myoglobinuria
- Late (1-3 wk) : sepsis , drug toxicity

  renal failure in burn injury is best classified in relation to the time of onset after the burn injury. Most cases present as nonoliguric renal failure; carful monitoring of fluids and electrolytes is critical. Special considerations concerning renal failure in a child with burn injury include the initial phase of capillary leak, making resuscitation difficult; severe catabolic stress, with increased risk of hyperkalemia; require high caloric and protein intake to prevent catabolic stress and promote wound healing.

Electrical injury: clinical considerations

- General
- Cardiac (dysrhythmia)
- Pulmonary (arrest, ARDS , aspiration)
- Renal (ATN, myoglobinuria)
- Neurologic
  - Immediate : L.O.C, motor paralysis , amnesia, ICH
  - Secondary: paraplegia, brachial plexus injury, SIADH
  - Delayed: seizure, headache , peripheral neuropathy
- Cutaneous/ oral : tongue/dental injuries , arc burns
- Abdominal : ileus, perforation
- Musculoskeletal: compartment syn., fractures, spine injuries
- Ocular: optic neuritis, visual changes, cataract, extra ocular muscle paresis


Thank
you