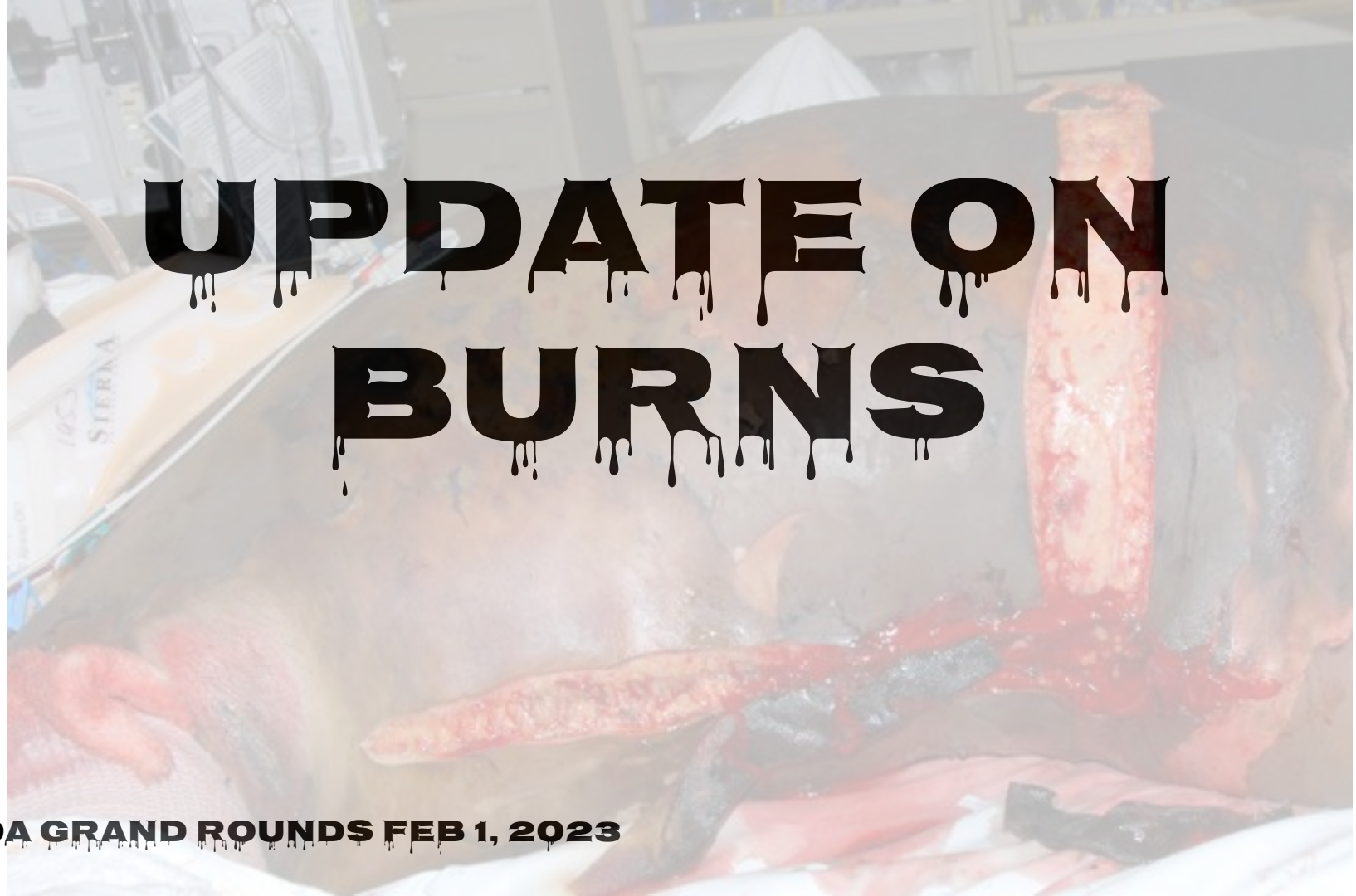


UPDATE ON BURNS

VADA GRAND ROUNDS FEB 1, 2023

Outline (list of topics to discuss)

Review of Burn Pathophysiology - NC

Initial Resuscitation - NC

Tips and tricks for Operative Management - NC

Evidence around use of vasopressors - MW

Analgesia for Burns Dressing Changes - MW

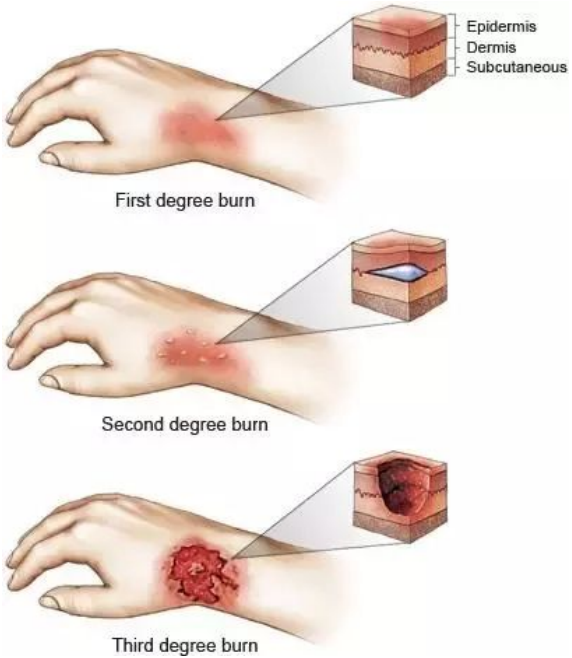
Transfusion Threshold - MW

Burn Pathophysiology

Type of burn:

- Thermal → Tissue damage → Cytokine release
- Chemical → treat like thermal
- Electrical → more serious than surface with concomitant rhabdo
- Inhalational → toxic products of combustion and direct airway trauma

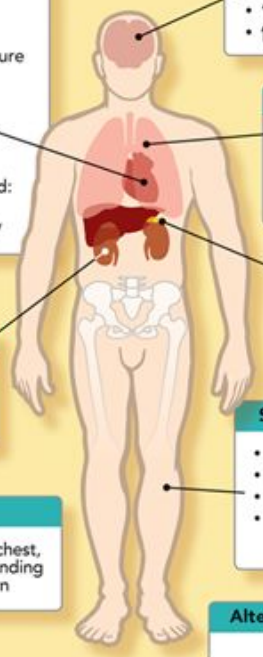
Burn Pathophysiology



Shock maturation

- 1st 24 hours
  - **Hypovolemic shock +/- cardiogenic**
  - Decreased response to catecholamines
  - Decreased contractility & coronary blood flow
  - Increased SVR
- 24 - 48 hours
  - **Distributive shock, hyperdynamic state**, increased capillary permeability (fluid shifts)
  - Tachycardia, Increased CO, decreased SVR
  - Increased inflammatory mediators

Pathophysiologic Changes in the Early Phase (24-48 hrs) of Burn Injury



Heart & Circulation

- Tachycardia
- ↓ Cardiac index
- ↓ Stroke volume
- Normal or low blood pressure
- ↓ SvO_2
- ↑ PVR and SVR
- ↑ Hematocrit
- CVP variable
- Metabolic acidosis
- Echocardiogram/ultrasound:
  - Small chambers
  - Decreased contractility

Brain

- Altered mental status
- ? Cerebral edema
- ↑ Pain response
- ↑ ADH

Lungs – Inhalation Injury

- Pulmonary edema
- Bronchospasm, bronchorrhea
- Acute respiratory distress syndrome

Adrenal gland

- ↑ Aldosterone
- ↑ Cortisol

Kidney-Bladder

- Myoglobinuria
- Oliguria
- Urine fractional Na^+ <1%

Skin

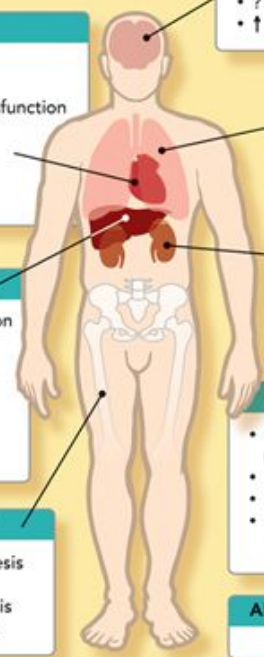
- Non-blanching burned skin
- Mottled clammy non-burned skin
- Fluid loss through burned skin
- Generalized edema in >25% body burn

Circumferential burn

- Compartment syndrome of chest, abdomen and/or limbs depending on site of circumferential burn

Altered pharmacological responses

Pathophysiological Changes During Hypermetabolic/hyperdynamic Phase of Burn (> 48 hrs)



Brain

- Altered mental status
- ? Cerebral edema
- ↑ Pain response

Heart & Circulation

- Tachycardia
- ↑ Cardiac index
- Subclinical myocardial dysfunction
- Echocardiogram
  - Altered contractility
- ↑ SvO_2
- ↓ SVR

Lungs – Inhalation Injury

- Pulmonary edema
- Bronchospasm, bronchorrhea
- Acute respiratory distress syndrome
- Pneumonia

Kidney

- ↑ Glomerular filtration rate
- ↓ Tubular function

Liver

- Altered metabolic function
- Altered drug clearance
- Fatty liver
- ↑ Live blood flow
- ↑ Gluconeogenesis
- ↓ Coagulation factors
- Albuminemia

Systemic inflammatory response

- High energy expenditure (↑O_2 consumption & ↑CO_2 production)
- Muscle catabolism
- Insulin resistance - hyperglycemia
- Persistence of generalized edema with >25% body burn

Bone marrow

- ↓ Hematopoiesis
- Anemia
- Immunoparesis
- Osteoporosis

Altered pharmacological responses

Initial Resuscitation

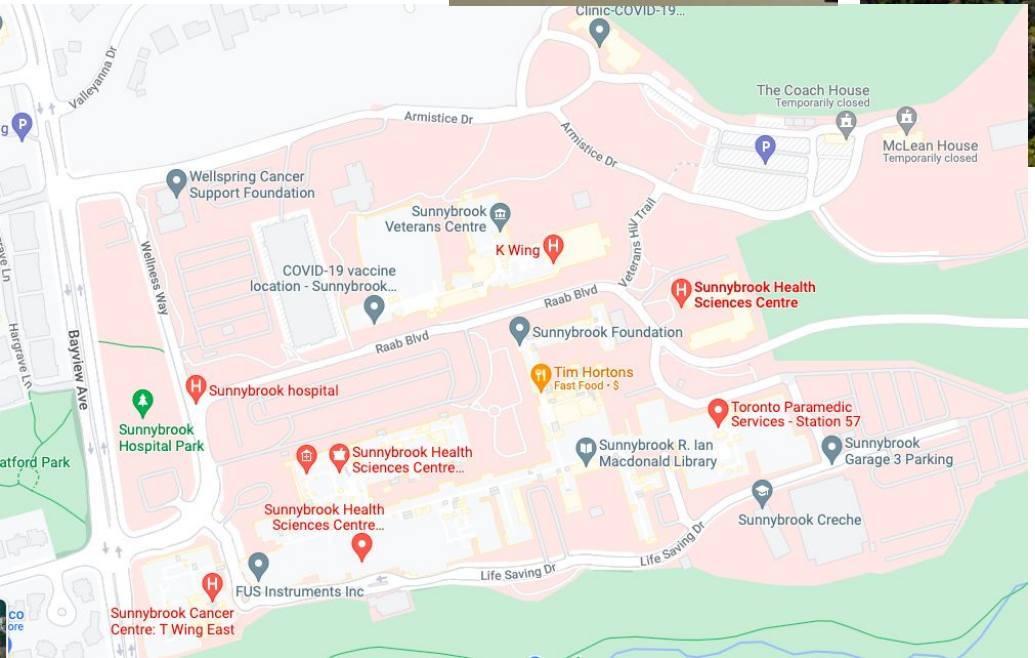
- Same principles of ATLS: ABCDE
- Pitfalls
  - Increased analgesic requirements
  - Hypotension and decreased GCS are uncommon in solitary burn injuries
  - Extreme susceptibility to hypothermia
  - Compartment syndrome risk increases after 8 - 12 hours
  - Diuresis in Hyperglycemic and EtOH intoxicated patients confounds picture

Fluid Resuscitation

- Modified Parkland formula
  - 3 mL/kg/%TBSA of Ringers Lactate
  - ½ volume in first 8 hours, ½ volume in next 16 hours
- Advanced Burns Life Support
  - Rule of thumb %TBSA x 10 - Initial rate (ex. 30% TBSA = 300 mL/hr)
  - Benchmark for resuscitation - re-assess q1-2h
  - Target: U/O 30 - 50 mL/hr (best indicator of burn resuscitation)
    - Increase/decrease IVF by 20% if not meeting goal
    - Target normal hemodynamics, normalizing lactate and base deficit
- No more than 6 mL/kg/%TBSA
  - Consider albumin (at ⅓ IVF + ⅔ RL)

Sunnybrook


Ross Tilley Burn Centre


Clinic-COVID-19...
Valleyanna Dr
Armistice Dr
Armistice Dr
The Coach House
Temporarily closed
McLean House
Temporarily closed
Wellspring Cancer Support Foundation
Sunnybrook Veterans Centre
K Wing
COVID-19 vaccine location - Sunnybrook...
Veterans Hill Trail
Sunnybrook Health Sciences Centre
Wellness Way
Raab Blvd
Raab Blvd
Sunnybrook Foundation
Bayview Ave
Tim Hortons
Fast Food · $
Sunnybrook hospital
Sunnybrook Hospital Park
Toronto Paramedic Services - Station 57
Sunnybrook Health Sciences Centre...
Sunnybrook R. Ian Macdonald Library
Sunnybrook Garage 3 Parking
Sunnybrook Health Sciences Centre...
Sunnybrook Creche
Life Saving Dr
Life Saving Dr
FUS Instruments Inc
Sunnybrook Cancer Centre: T Wing East


W 10th Ave
Hospital Emergency Dept
Vancouver General Hospital
Starbucks
Brown Sugar Hour


Ross Tilley Burn Centre
EXIT


O.R. Suite
R.T. Suite
Rooms
D7 20 to D7 22


MAQUET


MAQUET

Ross Tilley Burn Centre

- Canada’s largest burn centre
  - 300+ patients/year
- Dedicated and segregated burn ICU and OR
- 4 burns surgeons with ICU training
- Daily burn OR

Dr. Shahriar Shahrokhi

Dr. Stephanie Mason

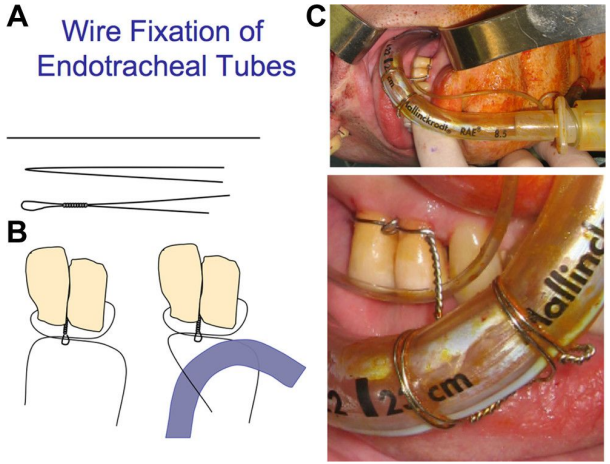
Dr. Alan Rogers

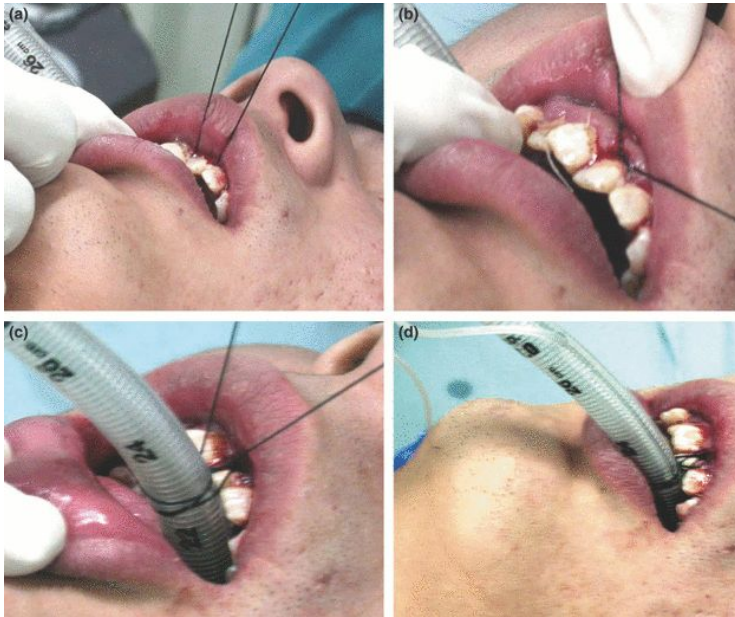
Robert Cartotto

Operative Management

Preparation - Room temp, clean set up, briefing and surgical plan, bail out point

- Airway
  - Often difficult in facial burns
  - Securement - Ties, suture, arch bar, wiring
  - Inhalational injuries = physiologically difficult airway

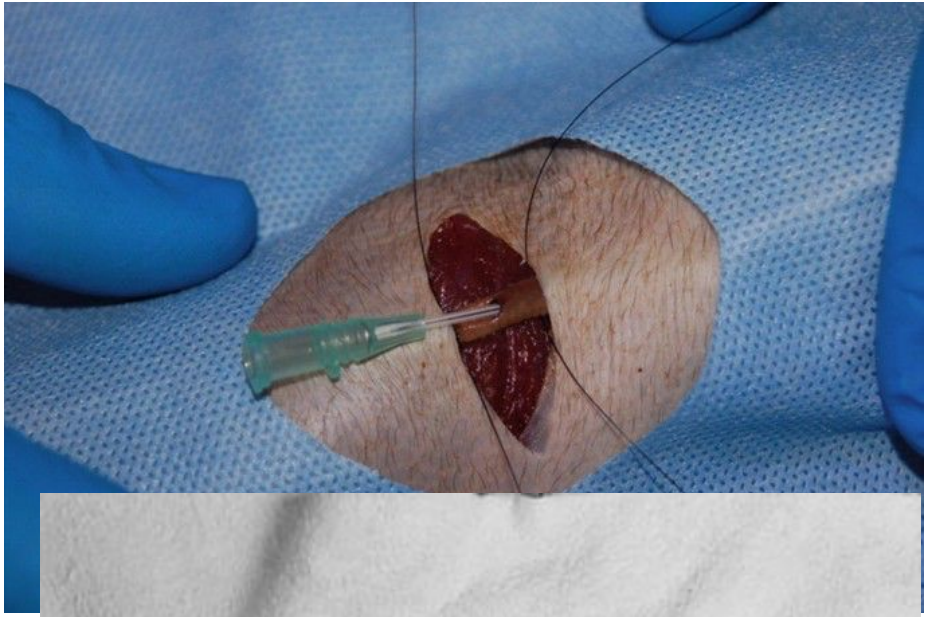


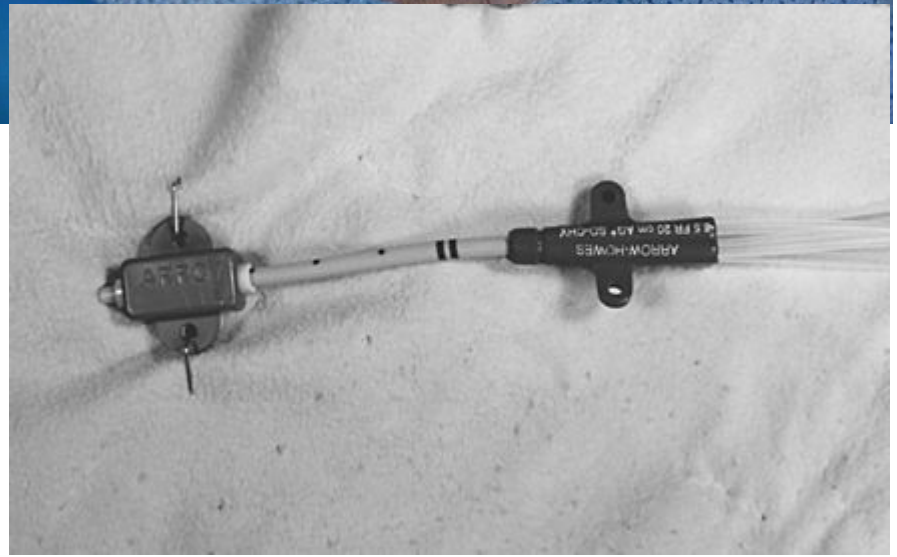


Operative management

Access

- Security over complacency
- Unburnt skin > Burnt skin
  - Central > peripheral
- Dialysis catheter
- Balanced xstld, albumin, and blood
- Securement key - suture
- I/O very valid option





Operative Management

Monitoring

- EKG - suture or staple electrodes, or pins
- Pulse ox - any viable location
- BP monitoring - central arterial tracing
  - CO monitor
- Temperature probe - as close to core as possible
- Foley - to guide resuscitation
- Bloodwork - hourly ABGs, lactate, glucose; RoTEm prn

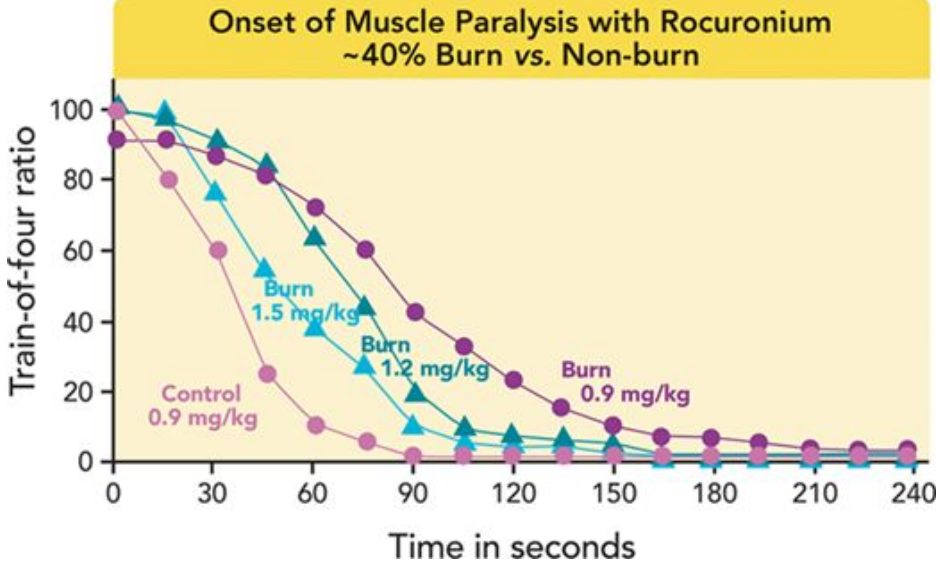
Operative Management

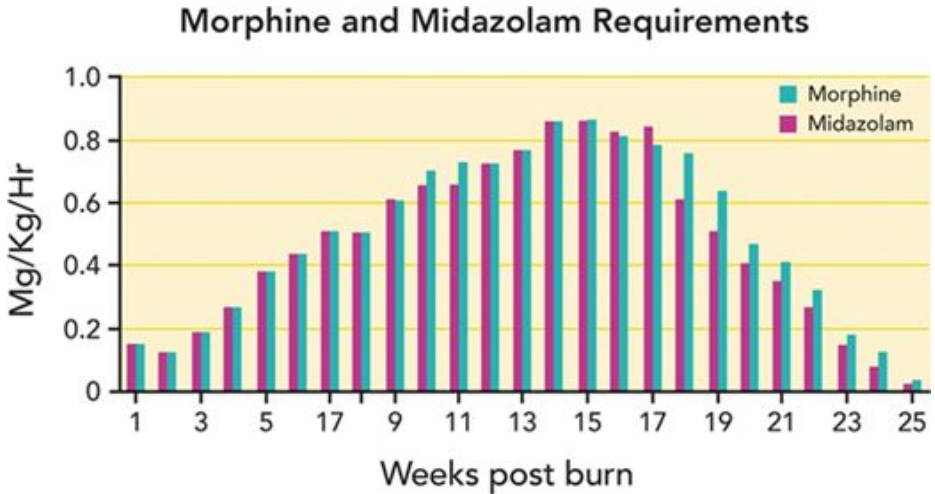
Pharmacology

- Hypermetabolic in general
- Resistance to nondepolarizing muscle relaxants
- Increased opioid and anesthetic requirements
- Optimize MMA → ketamine
- Consider acute opioid rotation

Temperature management

- Fluid warmer
- Sterile air warmer
- Astropad
- Core CVC warmer

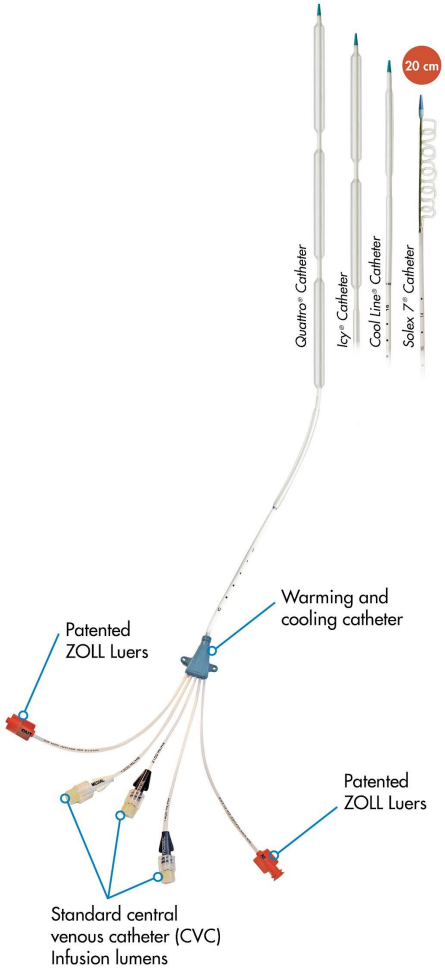




Astopad

Solex 7 Warmer

Catheter Name	Solex 7®
Dwell Time	7 and 4 Days*
Cooling Power (Watts) with IVTM	144
Insertion Site	Subclavian, Internal Jugular
Outer Diameter (OD) at Insertion Site	9.3F
Length	20 cm



Hemodynamics

- Epinephrine mask
  - Epi-saline injection and epi soaked sponges
  - 2 mg/L
- Debridement
  - Most stimulating, most fluid loss
  - 3% TBV per 1% burn excised
- Resuscitative goals
  - **U/O > 30 - 50 mL/hr**
  - Consider decreasing MAP targets if good peripheral perfusion
  - Vasopressors prn

Timing of Burn Excision

- Early excision (24-72h) has improved:
  - Mortality
  - Pain
  - Scarring
  - Hospital LOS

Table 12.1 Mortality Following Burn Over Time for Different Age Groups, Shown as the Burn Size at Which 50% Live or Die

	LA50 (% TBSA)		
Age [years]	**1942–1952**	**1980–1991**	**1992–2004**
0–14	49	98	99
15–44	46	70	88
45–64	27	46	75
>65	10	19	33

TBSA, Percentage of total body surface area burned; *LA50*, lethal burn area for a 50% mortality.

From Branski LK, Barrow RE, Herndon DN, unpublished data, 1992–2004.

Are Vasopressors Bad?

- Concern for decreased perfusion to partially burned skin and/or new grafts
- Not much evidence:
  - Systematic Review from 2022:
    - < 200 patients, only two trials
    - No evidence of harm or benefit
  - Retrospective Review from 2022
    - 50 patients
    - No change in mortality
- European Guidelines:
  - *Add vasopressors in the case of life-threatening hypotension despite adequate fluid resuscitation, and inotropes if tissue hypoperfusion persists despite adequate fluid resuscitation and vasopressor administration.*

Knappskog, Kristine et al. “Vasoactive and/or inotropic drugs in initial resuscitation of burn injuries: A systematic review.” *Acta anaesthesiologica Scandinavica* vol. 66,7 (2022): 795-802.

PREDICTING EBL DURING BURNS EXCISION

- 2 to 5% of blood volume per % BSA *excised*
  - *Housinger TA, Lang D, Warden GD. A prospective study of blood loss with excisional therapy in pediatric burn patients. J Trauma 1993; 34:262–263.*
- 2.6 to 3.4% of the blood volume for every 1% TBSA excised.
  - *<Anesthesiology 2015; 122:448-64>*

Using 3% for a 70 kg Patient:

10% BSA = 1.5L

20% BSA = 3L

30% BSA = 4.4L

40% BSA = 6L

Rule of Thumb: BSA x 0.15 = EBL in L

TRANSFUSION THRESHOLD

- Transfusion threshold in major burns variable across different centers
- Argument that burns type patients “different” from average ICU patient *(hypermetabolic, infected)*; and
- they would be excluded from TRICC *(b/c they are bleeding)*

TRANSFUSION THRESHOLD

Transfusion Requirement in Burn Care Evaluation (TRIBE)

A Multicenter Randomized Prospective Trial of Blood Transfusion in Major Burn Injury

- Prospective randomized trial restrictive (Hgb 70-80) vs liberal (100-110) target
- Multicenter *(18 sites: Canada, US, NZ)*
- All had BSA > 20%;
- 345 Patients *(severe TBI excluded)*

Palmieri TL, Holmes JH 4th, Arnoldo B, et al Transfusion Requirement in Burn Care Evaluation (TRIBE): A Multicenter Randomized Prospective Trial of Blood Transfusion in Major Burn Injury. Ann Surg. 2017 Oct;266(4):595-602.

TRANSFUSION THRESHOLD

Transfusion Requirement in Burn Care Evaluation (TRIBE)

A Multicenter Randomized Prospective Trial of Blood Transfusion in Major Burn Injury

- ⅔ of transfusions done in the ICU; ⅓ OR.
- Restrictive group received half as many transfusions as the traditional group.
- Transfusion threshold was safely maintained even during OR
- ***No differences in any outcomes including infections and 30-day mortality***

Should I Run TXA?

- Hyperfibrinolysis not generally seen.

  Welling H, Ostrowski SR, Stensballe J, et al. Management of bleeding in major burn surgery. Burns 2018. pii: S0305-4179(18)30754-X.

- “Use of tranexamic acid (TXA) should be restricted to patients with objective (e.g. ROTEM) evidence of fibrinolysis.”

Analgesia + Sedation Strategy for Burns Showers

Black Saturday 2009; 173 deaths; 19 patients with major burns admitted to Alfred in first 72 hours

- Opioid based sedation:
  - Anxiolysis: Nozinan, Ativan
  - Calculate total morphine equivalent in last 24h → give 20-30% of this dose PO 30-45 min prior to burns shower
  - Additional IV pushes of long acting opioids during procedure
  - +/- ketamine and precedex
  - +/- relatively low dose propofol infusion