Pre-hospital Burns

Adapted for Prolonged Field Care

Dr Winston F de Mello

Co-Founder & Instructor

College of Remote & Offshore Medicine

Malta

Paris Special Operation Forces
Combat Medical Care Conference
October 20-21, 2022
Paris, France

Declaration of interests:

- Medical Officer RAMC 1976-2013
- Colonel TA BATLS 2006-2013
- Consultant in Anesthesia & Pain Medicine, Regional Burn Centre, Manchester UK 2003 -2020
- Founding Member Pre-hospital Faculty RCSEd, Edinburgh & College of Remote & Offshore Medicine, Malta
- Chair Pre-hospital SIG British Burns Association

The Challenge?

"..requires flexibility, common sense and an appreciation of imposed limitations.."
"..based on available material, personnel, operating room time and patient condition.."
"Forget how you do things back home"

Barillo DJ & Brisam M (2012)

RUCK:
what you carry

TCCC ("Ruck")

TRUCK:
additional kit carried in SUV

CASEVAC ("Truck")

HOUSE:
gear stored in remote clinic

PATIENT HOLD ("Stuck")

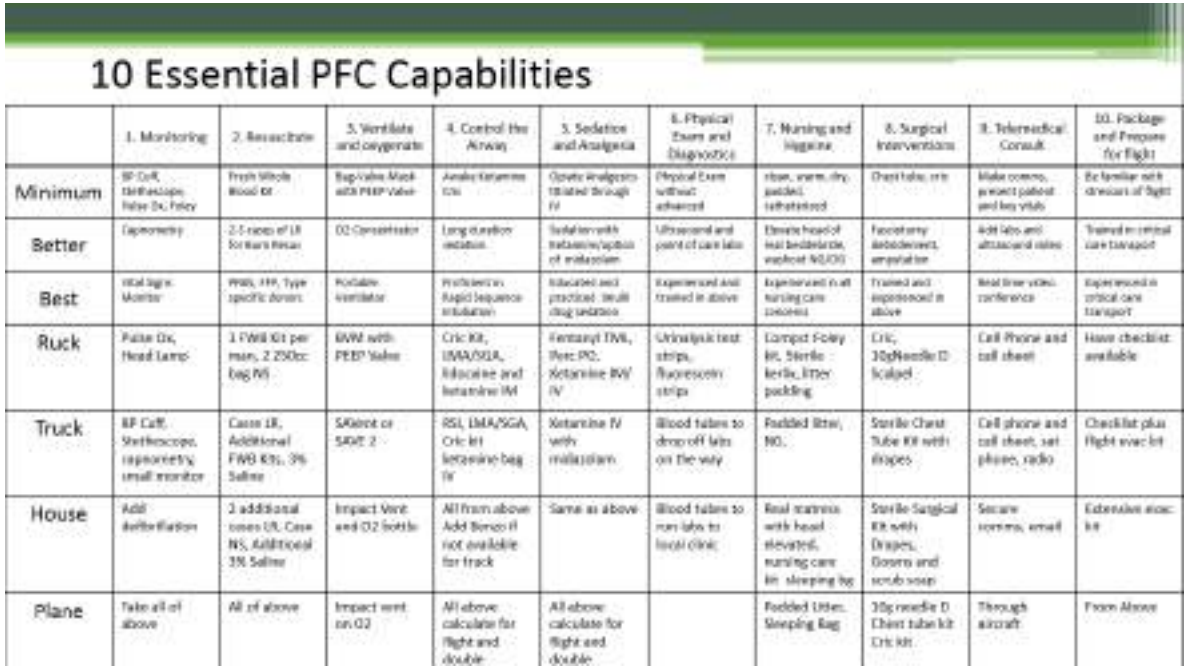
PLANE:
move casualties on aeromedical platforms

MEDEVAC ("Plane")

Proportion of burns in conflict:

CONFLICT	%
Vietnam 1965-1973	4.6
Israeli Six Day War	4.6
Yom Kippur War 1982	10.1
Falklands War 1982	**14.0**
Lebanon War 1982	8.6
Panama Police Station 1989	2.3
Operation Desert Shield/Storm 1990-1991	7.9
Operation Iraq & Enduring Freedom 2003-2005	1.8-10.5

Tactical Situation
Physical Environment
Resources
Training
Communication
Casualty Count



10 Essential PFC Capabilities

	1. Monitoring	2. Resuscitate	3. Ventilate and oxygenate	4. Control the Airway	5. Sedation and Analgesia	6. Physical Exam and Diagnostics	7. Nursing and Hygiene	8. Surgical Interventions	9. Telemedical Consult	10. Package and Prepare for Flight
Minimum	BP Cuff, Stethescope, Pulse Ox, Foley	Fresh Whole Blood IO	Bag-Valve-Mask with PEEP Valve	Awake Ketamine Cric	Opiate Analgesia titrated through IV	Physical Exam without advanced	clean, warm, dry, padded, catheterized	Chest tube, cric	Make comms, present patient and key vitals	Be familiar with stressors of flight
Better	Capnometry	2-3 units of LR for burn resus	O2 Concentrator	Long duration sedation	Sedation with ketamine/opiate of midazolam	Ultrasound and point of care labs	Elevate head of bed/backside, explicit NG/OG	Fasciotomy debridement, amputation	Add labs and ultrasound video	Trained in critical care transport
Best	Vital Signs Monitor	PRBC, FFP, Type specific donors	Portable ventilator	Proficient in Rapid Sequence Intubation	Educated and practiced Versed drug sedation	Experienced and trained in above	Experienced in all nursing care process	Trained and experienced in above	Real time video conference	Experienced in critical care transport
Ruck	Pulse Ox, Head Lamp	1 FWB Kit per man, 2 250cc bag IVI	BVM with PEEP Valve	Cric Kit, LMA/SGA, Lidocaine and ketamine IM	Fentanyl TMS, Prec PO, Ketamine IMV IV	Urinalysis test strips, fluorescein strips	Compct Foley kit, Sterile kerlix, litter padding	Cric, 10gNeedle D Scalpel	Cell Phone and cell sheet	Have checklist available
Truck	BP Cuff, Stethescope, capnometry, small monitor	Case LR, Additional FWB Kits, 3% Saline	SAVeat or SAVE 2	RSI, LMA/SGA, Cric kit ketamine bag IV	Ketamine IV with midazolam	Blood tubes to drop off labs on the way	Padded litter, NG,	Sterile Chest Tube Kit with drapes	Cell phone and cell sheet, sat phones, radio	Checklist plus flight evac kit
House	Add defibrillation	2 additional cases LR, Case NS, Additional 3% Saline	Impact Vent and O2 bottle	All from above Add Benzo if not available for track	Same as above	Blood tubes to run labs to local clinic	Real mattress with head elevated, nursing care kit sleeping bag	Sterile Surgical Kit with Drapes, Gowns and scrub soap	Secure comms, email	Extensive evac kit
Plane	Take all of above	All of above	Impact vent on O2	All above calculate for flight and double	All above calculate for flight and double		Padded Litter, Sleeping Bag	10g needle D Chest tube kit Cric kit	Through aircraft	From Above

If you can't bring the patient back, you have to push capability forward

Col Keenan, PFC Working Group (2012)

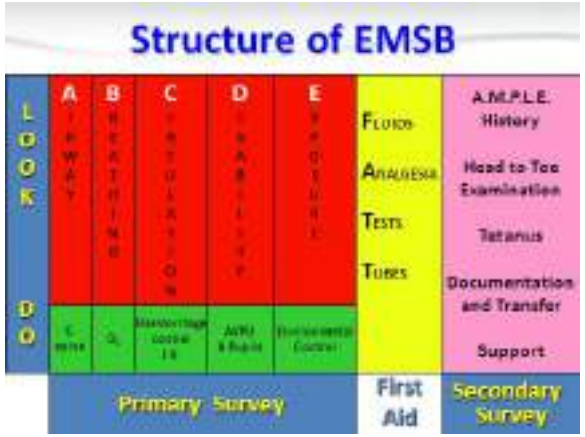
Aim:

- To provide a clean granulating burn wound, with splintage to prevent contracture; in an active, well nourished patient in a PFC environment

- With all the duties of a multidisciplinary burn team provided by one SF medic
- Reducing TBSAB% and doing interventions that reduce morbidity and mortality and the post-burn PTSD

MARCH & Ten clinical pearls:

1. The first few hours
2. Airway mitigation techniques
3. Pragmatic fluid resuscitation
4. Alternative analgesic approaches
5. Escharotomy
6. Fasciotomy
7. Managing burn wounds
8. Physiotherapy interventions & positioning
9. Feeding
10. Palliation



Mechanism of injury

- Flame is coagulopathic
- Acid is coagulopathic
- Alkali is liquefactive
- Friction is superficial trauma but can be extensive as in a degloving injury
- Electrical injury can cause limb or life threatening + compartmental syndrome and rhabdomyoglobinuria
- Confined spaces risk of inhalational injury and systemic poisoning

Types of burns

- Heat: flame, flash, scalds, contact
- Friction (ejection)
- Chemical: acid, alkali (cement), phosphorous
- Electrical: flash or conductive
- Radiation: civilian (sun exposure) industrial & military
- Cold: frostbite

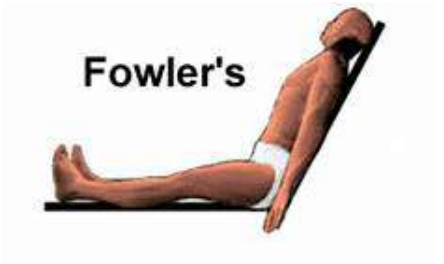
1. The first few hours:

Good early resuscitation reduces the zone of stasis and reduces the %TBSAB and depth of burn
Jackson's Zones (1953)

- Burn is distracting injury
- Trauma and burn may co-exist
- History & mechanism of injury (AMPLE)
- Consider need for PPE
- Photograph scene for telemedicine
- **S**hout for help
- **A**ssess scene
- **F**ree from danger
- **E**valuate: MARCH
- Stop the burning process and cool the burn but not the victim
- **M:***On the floor plus 4 more:* Chest, Abdomen, Pelvis and Long bones
- **Shock in major burns before 12 hours look for another source of M**

2.Airway mitigation

- Inhalational injury ? CO/CN toxicity, upper airway obstruction> pneumonia
- Oxygen supplementation
- Upper airway compromise or > 40% TBAB > early intubation (oedema formation ceases between 18-30 h
- Consider nebulised epinephrine (1 mg in 10 ml) before advanced airway techniques
- Fowler position (Bali bombings – Prof Fiona Wood) Negated intubation



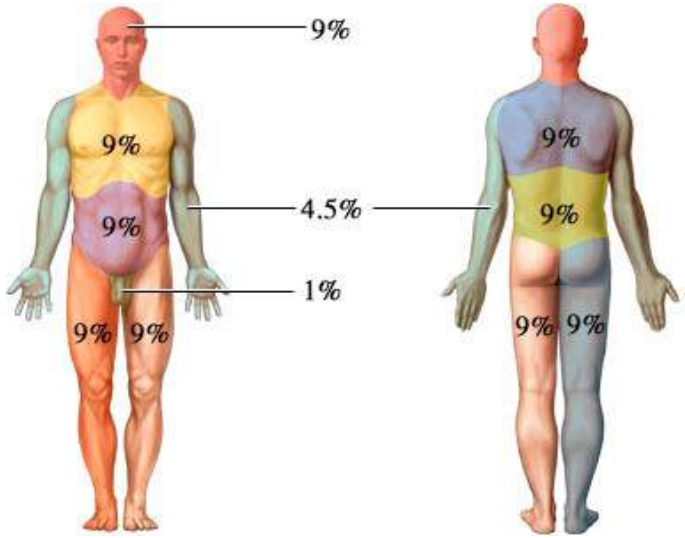
Respiration

- Is there adequate bilateral gas movement?
- Ensure ventilation is not restricted by circumferential chest burn
- Seal, needle and drain

Circulation

- Adequate radial pulse? Systolic >90
- Fluid resuscitation: oral route if possible
- CRT< 2s
- Urinary bladder catheterization: monitor urine output **0.5 – 1ml/kg/h**
- Escharotomy needed?

Assessment of TBAB% + Depth



- Size: Palm with fingers = 1 %, Rules of 9, Serial halving
- Is overestimated in prehospital setting (blisters)
- Depth

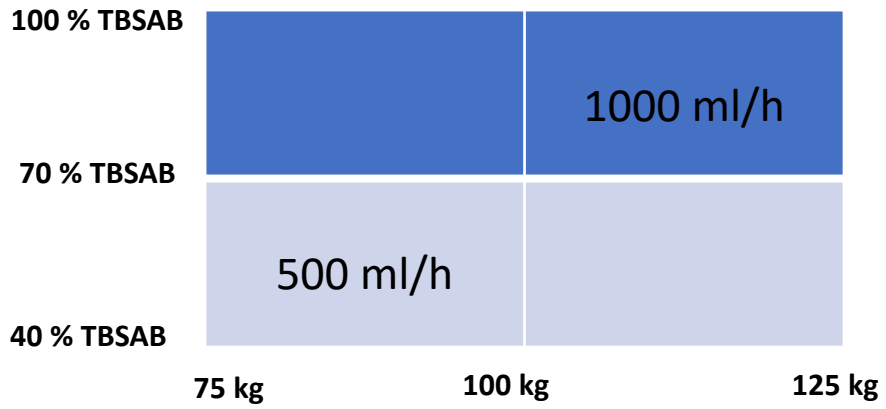
Burn Size and Fluid Routes of Administration

- Consider oral/enteral fluids – “coached” drinking for 10 - 40% TBAB
- Rectal infusion up to 500 ml/h

1. WHO ORS: 1L potable water + 6 level tsp sugar + 0.5 level tsp salt
2. Mix 1L water + 8 tsp sugar + 0.5 tsp salt + 0.5 tsp baking soda

3. Pragmatic Fluid resuscitation

- Parkland, Brooke or Consensus Formula (Use lower figure)
- The Burns Fluid Grid: A pre-hospital guide to fluid resuscitation in burns.
  de Mello WF & Greenwood NPA. JRAMC (2010)



- "Big man, big burn, big bag; small man, small burn, small bag"

+

Boluses of 250 ml to maintain radial pulse

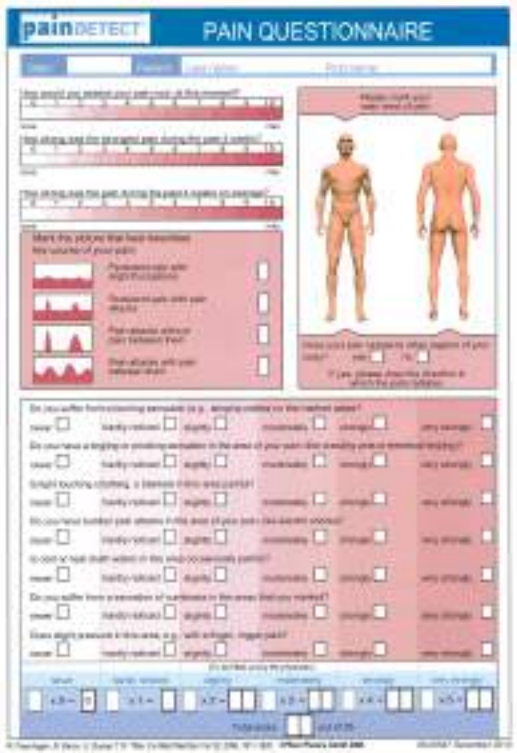
Head

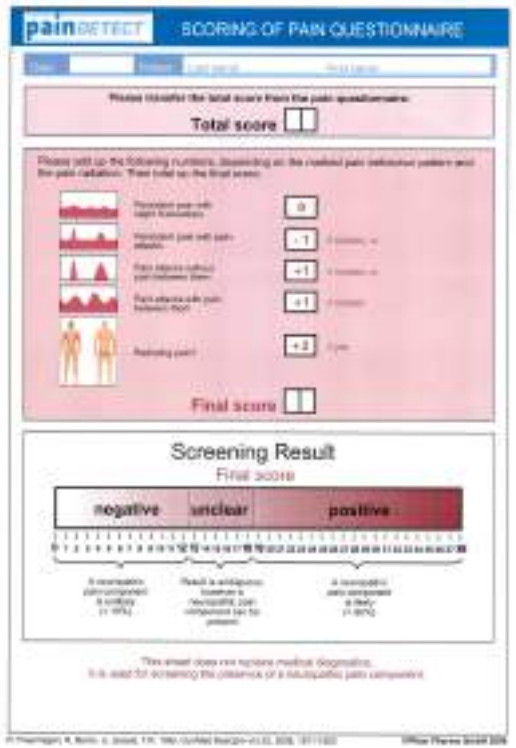
- LOC: hypovolemia, head injury, systemic poisoning etc
- Use of supplemental oxygen in carboxyhaemoglobin poisoning

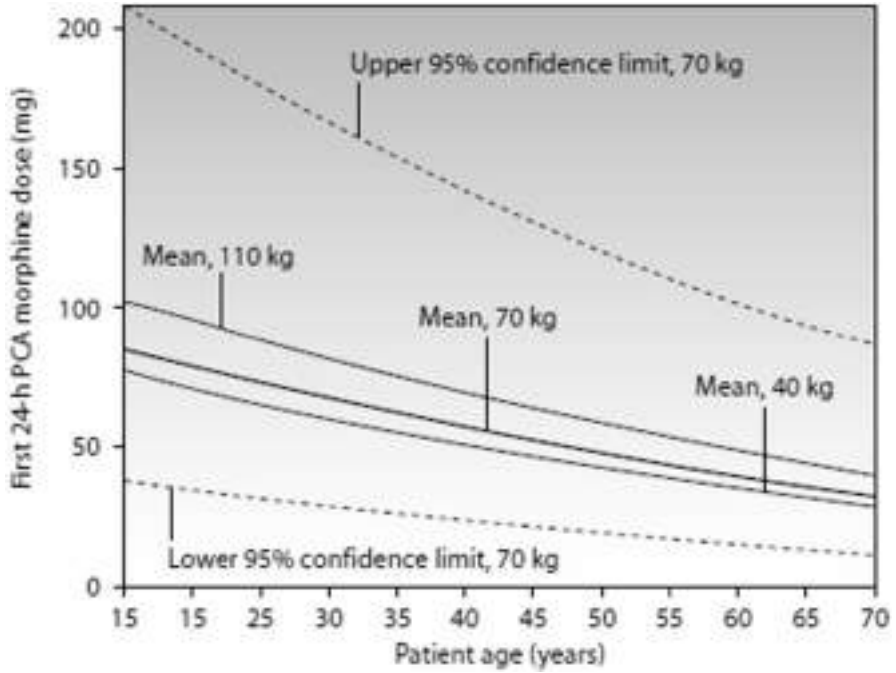
- Cyanide toxicity : Hydroxycobalamin (Cyanokit™) and sodium thiosulfate and sodium nitrite (Nithiodote™) iv

4.1 Alternative analgesic techniques

- Battlefield analgesia (2006) Hodgetts T, de Mello WF et al. Surgeon Generals Office, HMSO, UK
- Efficacy of topical morphine on burns EMJ (2007) de Mello WF
- The use of topical morphine on burn wounds 20 mg in 10-20 ml sterile water
- The early detection and management of neuropathic pain following combat injury. JRAMC (2009) Mercer J, de Mello WF et al
- Early introduction of pregabalin 75 mg BD orally or amitriptyline 10 mg orally at 1900
- Battlefield analgesia 2009 – 10 years on. JRAMC (2010) de Mello WF & Hemmings V



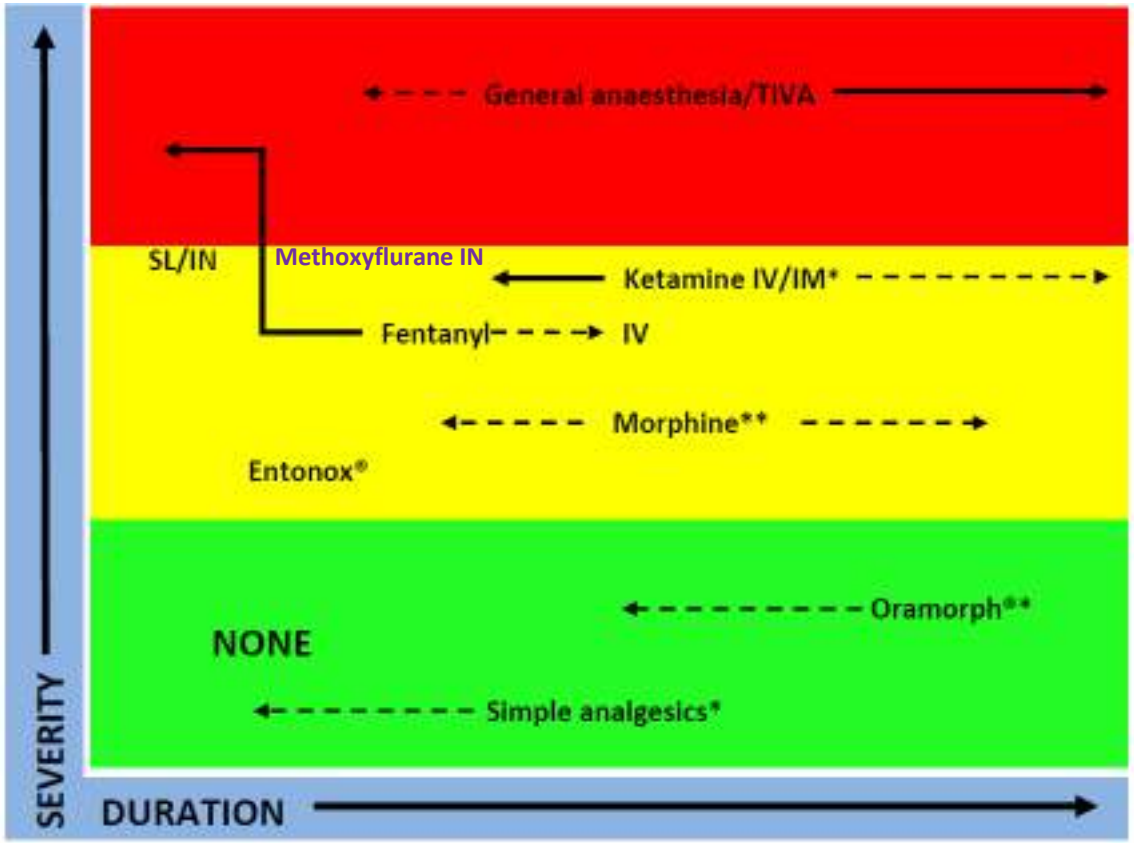


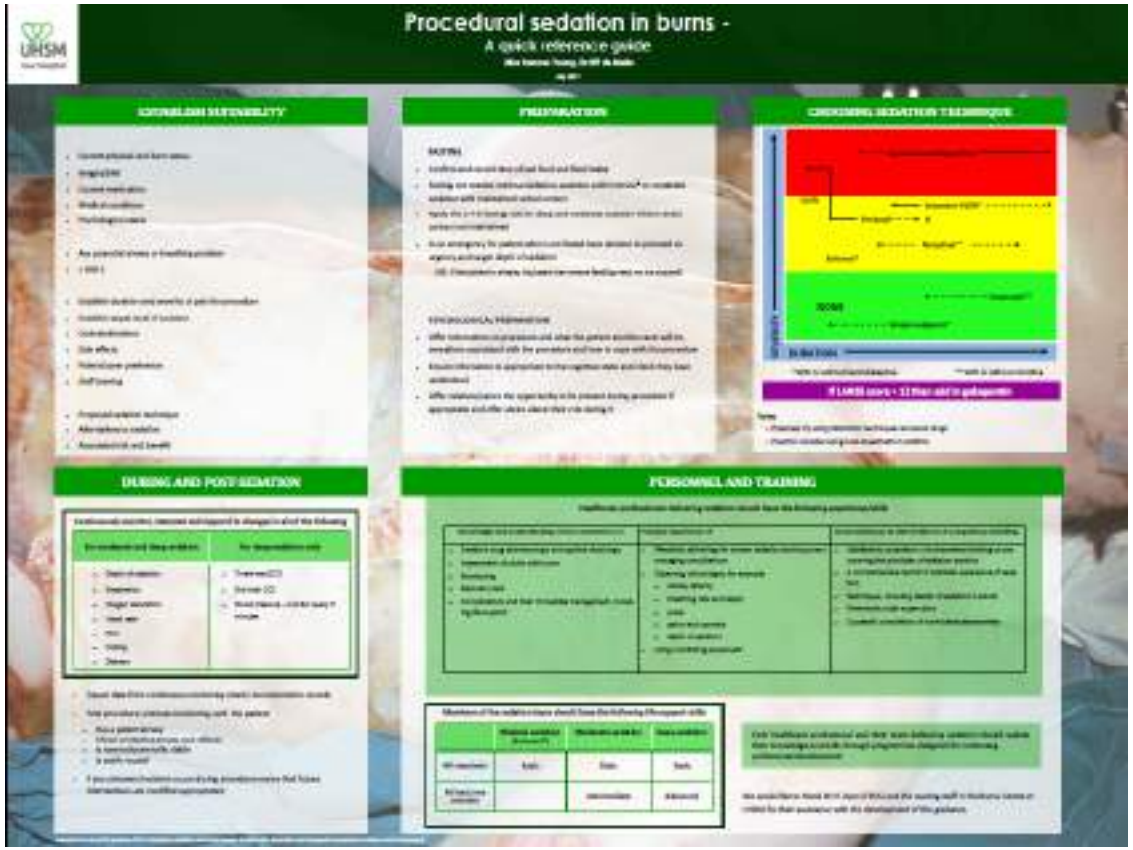


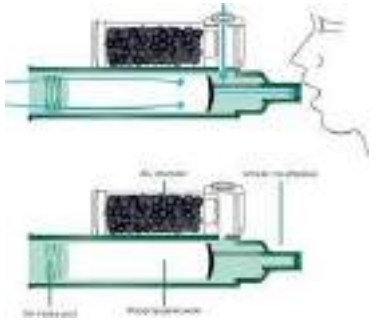
- Morphine requirements in first 24 hours after major trauma = 100 - Age in years (MaCintyre P & Jarvis DA Anaesthesia 1996)
- Morphine use after combat injury in Iraq and post-traumatic stress disorder Holbrook TL et al NEJM 2010; 362:110-7 + letter) NEJM (2010) , Schofield J, de Mello WF et al
- Sublingual fentanyl for post burn therapy (poster) IBSI (2012) Rajan J & de Mello WF
- Fentanyl is cardio-stable in comparison with morphine
- Ketamine is versatile for analgesia and anaesthesia

4.2 Procedural pain matrix:

Young & de Mello (2011)







Use Penthrane™ (methoxyflurane) for procedural pain

Environment

- Personal safety
- Cool the burn only - cold wet towel 20 min up to 3 h postburn
- Large burn patients are poikilothermic
- Commercial polyethylene clingfilm in longitudinal strips as initial dressing
- Consider contamination by exotic organisms - necrotizing mucormycosis (Walsh TJ et al 2019)

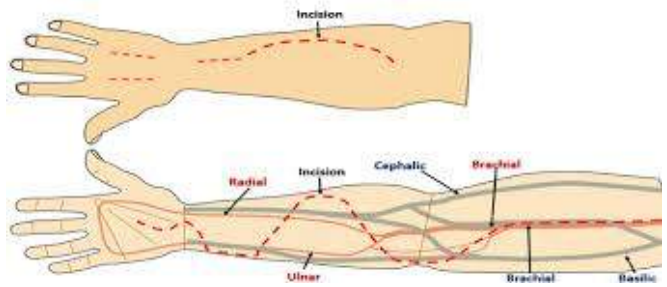
5. Escharotomy:

- For circumferential burns of chest, abdomen or long limbs
- Cut skin only along red dotted lines: Will open up under internal pressure
- Cut from beyond burnt area at either end

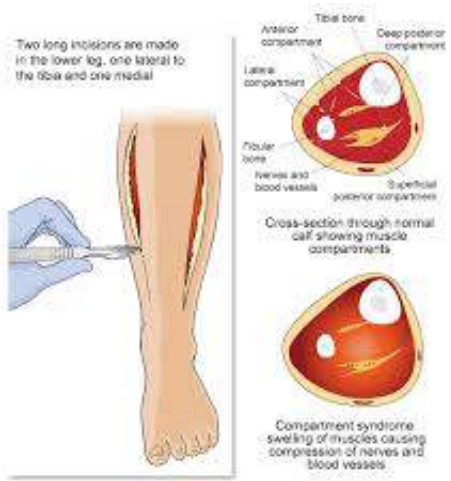
Management of escharotomy bleeding
Avoid cutting blood vessels
Pack wound with alginate dressing
Epinephrine 1/1000 soaks : 1 mg in 1000 ml N Saline
Haemostatic bandages
Pressure dressings
Elevate affected limb
Tranexamic acid 1-2 Gms IV

6. Limb saving Fasciotomy

- Causes: High voltage electrical injury, crush or forearm fractures
- Upper Limb:



- Lower limb:



7.1 Initial wound cleaning

Handwashing
PPE
Clean working surface

- Use baby wipes initially to clean burn wound
- Followed by octenidine dihydochloride + ethylhexylglycerine (Octenilin™)

or 0.5% Silver Nitrate ($AgNO_3$)

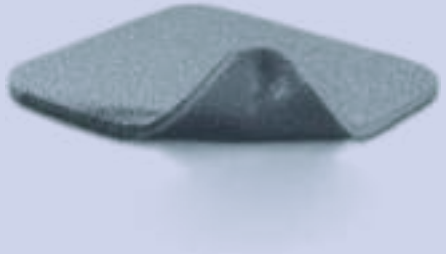
- Re-assess TBAB% and depth

7.2 Burns dressings

- Aim to keep wound moist, clean and reduce environmental contamination
- Simplest is dry gauze dressings and clean linen
- Choice and schedule (daily or if soiled) will depend on the mission
- Adding topical antibiotic is not a substitute for dead tissue; so debride with forceps and scissors
- Regular inspection of wound
- Treat with antibiotic topically if local or intravenously if spreading or systemic
- Reclean wound and dress with Acticoat™ 3 or 7 day version

- Dressings have 3 components:

1. Contact Layer
2. Absorbent layer
3. Holding layer

	Option 1	Option 2
Contact	 Silver impregnated (Mepilex Ag™)	 Jelonet +  Silver Impregnated (Acticoat™ 3 or 7)
Absorbent	 Drymax™	Gamgee (heavy duty cotton) 
Holding layer	 Mefix™	 Velband +  Crepe bandage

7.3 Topiceuticals

- Lidocaine (20 ml 1%) + Morphine (20-40 mg)

- Metronidazole -perineum

- Honey

- Plantain peel and Papaya as natural enzymatic debridement

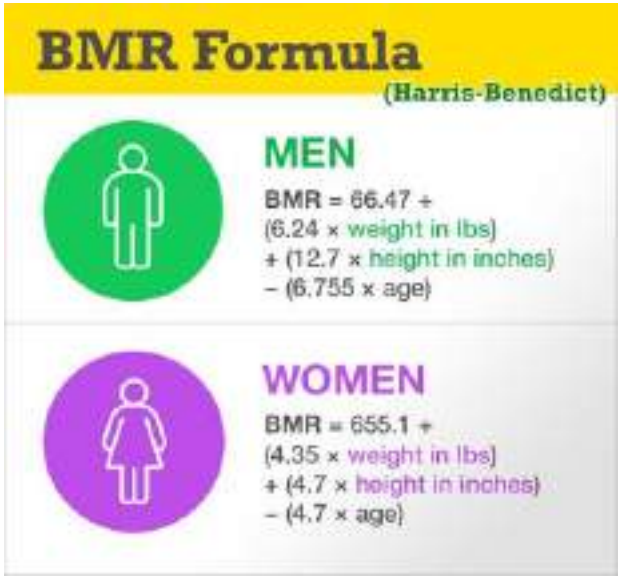
8. Physiotherapy intervention and positioning

- Chest care and putting major joints through passive and active range of movements

- Splintage

- **Neck:** avoid use of pillow – keep in extension
- **Fingers:** individually wrap with gelonet, gauze and bandage
- **Whole hand:** Plastic bag with 0.05% chlorohexidene sachet then tape round wrist
- **Forearm & Hand fracture or complex injury:** splint palm, hand & forearm : do not wrap hands in a fist but keep thumb web open with dressings
- **Arms and legs:** keep extended
- **Feet:** in 'boot position'

9.Feeding



- Hypercatabolic state

- **Harris-Benedict Equation**
- **Calories required= Basal Energy Expenditure (BEE) x Stress Factor (SF) x Activity Factor (AF)**

BEE = 66+(14 x weight kg) + (5 x height in cm) - (6.8 x age in years)

SF = 2.1 in major burns or 1.3 if minor procedures

AF = 1.2 if on bed rest or 1.3 if mobilising

- Use early oral route nutrition if possible if >15% TBSAB or NGT
- Stress ulceration use PPI cover: omeprazole 20 mg OD
- Gut-brain axis: importance of faecal microbiome > use natural probiotics (Yoghurt, Kefir, Sauerkraut etc)

10. Palliation

- The top 3 complaints by military survivors:

1. Lack of communication
2. Failure to relieve pain
3. Failure to quench thirst

- Modified Baux Score = Age + TBSAB % + 17 (if inhalation) **Sturdevant et al (2001)**
- > 160 non survivable
- > 109 50% risk of death **Roberts G et al 2012**

- Be aware of the emotional impact on patient, team, family and friends

In Summary: Immediate Tasks at Point of Injury

- Don’t let the burn distract from life/limb/sight threatening injuries
- Decontaminate (irrigate or dust off)
- Follow MARCH sequence
- Administer fluids orally if possible
- Cool the burn but keep patient warm
- Cover with Clingfilm longitudanally
- Rapid assessment size of burn: palm + fingers = 1% TBSAB
- Check site of burn does not compromise ventilation, urine output (secondary abdominal compartmental syndrome) limb or visual loss
- Wash and apply dressings

Thank you for your attention!

Paris Special Operation Forces
Combat Medical Care Conference
October 20-21, 2022
Paris, France

w.demello@corom.edu.mt

Thanks to Mr Ken Dunn BSc FRCS (Clinical Director) and the MDT at the Burn Centre, Manchester, UK