Anaesthesia for Plastic and Reconstructive surgery

Burn trauma

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Department of Anaesthesia, Middlemore Hospital
New Zealand National Burns Centre

19th June 2018
Auckland ANZCA Part 2 short course

Plastic and reconstructive surgery			
SS_PB 1.1	Describe the physiological principles relevant to optimising blood flow to tissue flaps, including: • Oxygen transport and delivery • Determinants and control of cardiac output • Physics of blood flow • Determinants and regulation of blood flow through the various components of the vasculature • Autonomic nervous system control of systemic vascular • Resistance and redistribution of blood volume • The integrated cardiovascular responses to anaesthesia and a central neuraxial block • The physiological mechanisms controlling and regulating body temperature and the effects of anaesthesia	ME	FEx
SS_PB 1.2	Describe the different types of tissue flaps and the implications for flap survival	ME	FEx
SS_PB 1.3	Discuss the issues involved with and the anaesthetic management of patients having surgery for tissue flaps. Including: • Optimising conditions for flap survival • Prolonged anaesthesia • Limited access to the patient • Potential for major occult blood loss over a period of time	ME	FEx
SS_PB 1.4	Describe the common co-morbid disease and patient factors encountered in patients having plastic or reconstructive surgical procedures	ME	FEx
SS_PB 1.5	Discuss the surgical requirements and implications for the perioperative anaesthetic management of patients having: • Removal of multiple skin lesions • Cosmetic surgery • Split skin graft • Full thickness graft • Resection or debridement of tissue (minor and major)	ME	FEx
SS_PB 1.6	Discuss pain management for patients undergoing plastic surgery	ME	FEx

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EXAMINATION REPORT
FINAL FELLOWSHIP EXAMINATION

- A 23 year old male is scheduled for limb salvaging reconstructive surgery after sustaining massive lower leg trauma from a motor vehicle accident seven days previously. Surgery time is expected to be 18 hours. External fixateurs were applied at that time because the wounds were contaminated.
- Discuss the issues that you might encounter.

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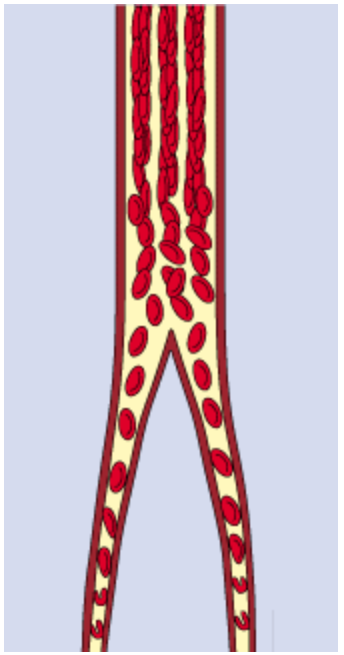
Positioning
Pressure cares
Lines, IDC, arterial line
Fluid management
Temperature
Thromboprolylaxis
Team fatigue

Anaesthesia for microvascular surgery

- Flow
  - Hagen Poiseuille: pressure gradient, viscosity, radius, length of tube
  - Laplace: transmural pressure
  - Shear stress

$$F \propto \frac{\Delta P \cdot r^4}{\eta \cdot L}$$



- Arterial pressure control
- Hypervolemic haemodilution
- Normocarbia
- **Temperature control**
- Positioning
- Pain control
- Long anaesthesia time

Failing flaps

- Decreased blood flow through flap
  - Hypothermia
  - Warm ischaemia
  - Vasoconstriction
  - Pain
- Hyperventilation: resp alkalosis, ↓cardiac output, peripheral vasoconstriction
- Hypoventilation: Resp acidosis, reduced red cell deformability
- Hyperoxia : vasoconstriction, reduced functional capillary density
- Core-periphery gradient >2° C
- Balanced anaesthesia, regional, TIVA vs inhalational
- Avoid shivering

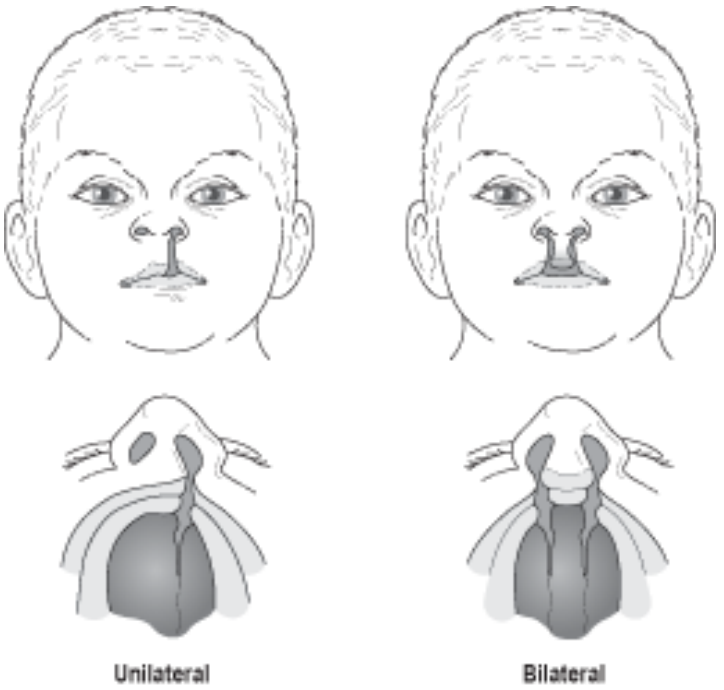
- A 65 year old female patient is two hours into debridement and skin grafting for a 40% burn to her thorax and legs. She is intubated and paralysed. An arterial blood gas now shows:
  pH 7.12
  PaO2 150
- PaCO2 45
  HCO3 15
  K 6.3
  a. Outline the potential causes for this patient's hyperkalaemia. b. Describe your management of this hyperkalaemia.
- Borderline Candidate
- Part A
- Relates the causes to the large burn pathology.
- (30%)
  (70%).
- Mentions two contributors to hyperkalaemia that are considered significant (e.g. tissue damage and renal impairment)
- Part B
- Demonstrates a logical management pathway
  Provides sufficient detail for the examiner to identify:
  (a) the candidates trigger for management of hyperkalaemia in this patient, (b) initial therapy that would work in this scenario.

Cleft lip and palate

- 1 in 600 to 700 live births
- 4th most common congenital defect
- 70% non syndromic, isolated defect

- Timing of surgery
- 4% of cleft children have cardiac defect

- Difficult intubations likely:
  - Treacher Collins
  - Pierre Robin sequence
    - Stickler, velocardiofacial, foetal alcohol
  - Hemifacial microsomia (Goldenhaar)



Syndromes and difficult airways

Improves with age

- Pierre-Robin sequence (micrognathia, jaw size increases)
- Goldenhar (asymmetrical

Worsens with age

- Treacher-Collins syndrome (micrognathia, small mouth, funnel shaped larynx)
- Apert (midface anomalies, cervical fusion)
- Hunter and Hurler syndrome (mucopolysaccharide accumulation in tongue and larynx)
- Beckwith-Wiedemann (macroglossia)
- Freeman-Sheldon syndrome (circum-oral fibrosis and microstomia)

Craniofacial syndromes

- Craniosynostosis

  Apert, Crouzon, Pfeiffer, Saethre-Chotzen, Jackson-Weiss, Carpenter, Antley-Bixler

- Abnormal contour

  Encephalocele (with absent corpus callosum, clefting, Dandy-Walker and Arnold-Chiari malformations, ectrodactyly, and hypothalamic-pituitary ysfunction)

- Orofacial clefting

  Facial clefts and associated anomalies, Tessier clefting system, lateral facial clefts, oblique facial clefts, and median mandibular defects

- Branchial arches

  Goldenhar, Treacher Collins, Nager, Miller, Wildervanck, Bixler, Möbius, and orofaciodigital syndromes (I-VIII)

- Unusual facies

  Opitz BBB, Opitz G, Noonan, Robinow, Binder, and Coffin-Siris

Anaesthesia for plastics and reconstructive surgery

- Complex wound closure
  - Musculocutaneous flaps
  - Free flap tissue transfers
  - Re-implantation microsurgery

- Congenital reconstructive surgery
- Cleft lip and palate surgery
- Craniofacial surgery
- Cancer surgery
- Pressure ulcers
- Burns
- ……

- Aesthetic surgery

30 MINUTES

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COUNTIES MANUKAU HEALTH

Anaesthesia for BURN trauma

Francois Stapelberg, FANZCA

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Burns			
SS_PB 1.8	Describe the pathophysiology of burns and the multisystem effects commonly encountered in these patients	ME	FEx
SS_PB 1.9	Discuss temperature homeostasis in burns patients and the implications of hypothermia in this group	ME	FEx
SS_PB 1.10	Evaluate warming measures used to maintain the temperature of burns patients intra-operatively	ME	FEx
SS_PB 1.11	Discuss the methods of managing the metabolic effects of burns in the perioperative period	ME	FEx
SS_PB 1.12	Discuss the problems associated with monitoring and venous cannulation in burns patients and their management	ME	FEx
SS_PB 1.13	Discuss the implications for the perioperative anaesthetic management of patients with the following burn injuries: • Airway and facial burns (also refer to the *Resuscitation, trauma and crisis management* clinical fundamental) • Respiratory burns (also refer to the *Airway management* clinical fundamental and the Intensive care medicine specialised study unit) • Electrical burns • Chemical burns • Associated trauma	ME	FEx
SS_PB 1.14	Discuss the methods of minimising or managing blood loss during the debridement of burns	ME	FEx
SS_PB 1.15	Discuss the perioperative assessment and management of fluid status and blood transfusion requirements for the burns patient	ME	FEx
SS_PB 1.16	Outline infection control in burns patients and the prevention of secondary sepsis	ME	FEx
SS_PB 1.17	Outline the methods and materials used to provide temporary and long term coverage of burns	ME	FEx
SS_PB 1.18	Discuss the specific pain issues encountered in the burns patient and their management (also refer to the *Pain medicine* clinical fundamental)	ME	FEx
SS_PB 1.19	Discuss the risk of a hyperkalaemic crisis in burns patients	ME	FEx
SS_PB 1.20	Describe the anaesthetic issues and the management of patients returning for scar revision following burns, especially for neck and facial scarring (also refer to the *Airway management* clinical fundamental)	ME	FEx

AT_RT 1.16	Describe the initial assessment and management of the patient with severe burn injury including: • Fluid management • Pain management • Inhalational injury (also refer to the *Airway management* clinical fundamental) • Carbon monoxide poisoning	ME	FEx
SS_IC 1.102	Outline the intensive care management of: • Electrocution • Burns • Near drowning • Envenomation • Drug overdose • Corrosive ingestion • Altitude sickness • Decompression syndromes	ME	FEx
SS_PB 1.7	Evaluate the use, safety and methods of providing induced hypotension to minimise blood loss and improve surgical operating conditions during dissection and extensive excision of tissue (also refer to the *Head and neck, ear, nose and throat, dental surgery and electro-convulsive therapy* specialised study unit)	ME	FEx
SS_PA 1.47	Describe the initial assessment and management of the child with (also refer to the *Resuscitation, trauma and crisis management* clinical fundamental) severe burn injury including: • Fluid management • Pain management • Diagnosis and management of inhalational injury (also refer to the *Airway management* clinical fundamental) • Diagnosis and management of carbon monoxide poisoning • Electrocution • Drowning and near drowning • Envenomation • Severe hypothermia	ME	FEx

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Borderline Candidate

Part A

Relates the causes to the large burn pathology.

Mentions two contributors to hyperkalaemia that are considered significant (e.g. tissue damage and renal impairment)

Part B

Demonstrates a logical management pathway
Provides sufficient detail for the examiner to identify:
(a) the candidates trigger for management of hyperkalaemia in this patient,
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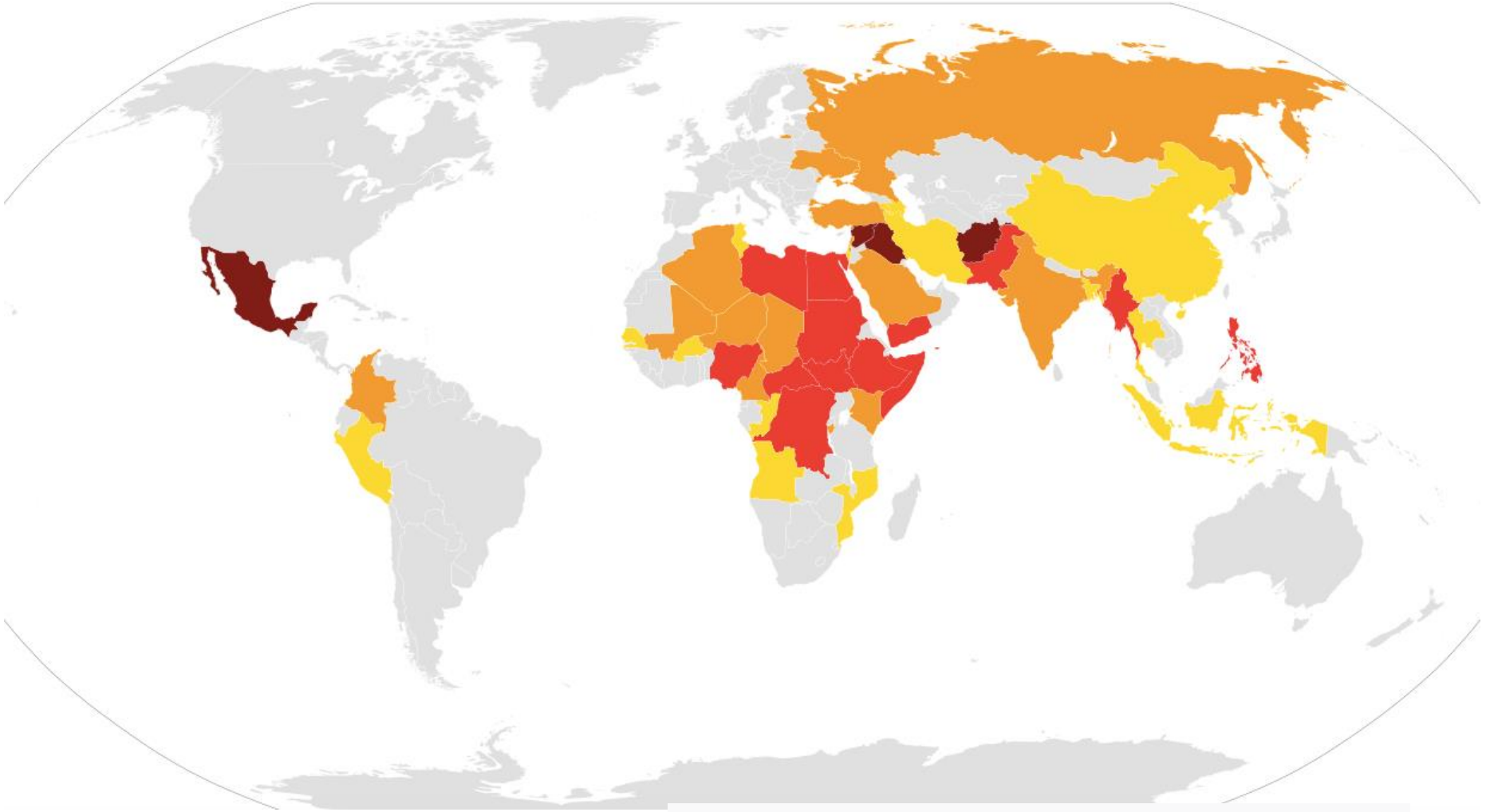
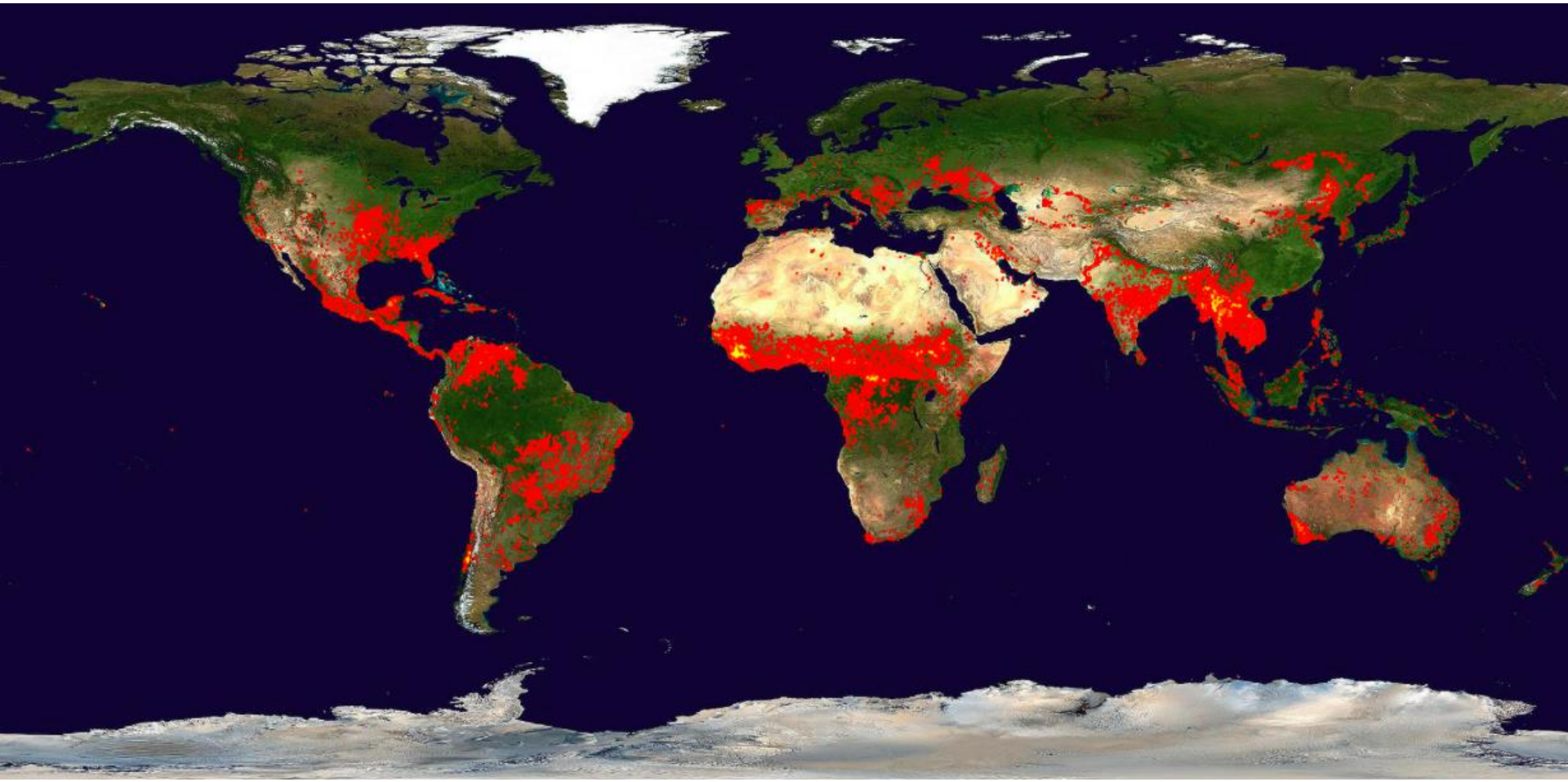

Ongoing armed conflicts in 2018; updated June 2018.
Major wars, 10,000+ deaths in current or past year
Wars, 1,000–9,999 deaths in current or past year
Minor conflicts, 100–999 deaths in current or past year
Skirmishes and clashes, fewer than 100 deaths.

Wildfires 2017, NASA satellite imagery



What is the question?

- Primary issue
  - Other issues
- What is your plan?
- BE SAFE
- Communicate
- Follow up

Modern burn care

- ABCDE
- Resuscitate and prevent burn shock
- Early wound excision and covering with autograft skin
    - ↓ hypermetabolism
    - ↓ mortality

- Manage inflammatory responses
- Prevent infection
- Pain management
- Nutritional support
- Psychological support
- Rehabilitation

Acute burn care

- Decompressive surgery
  - Escharotomy
  - Fasciotomy
  - Laparotomy
- Early burn wound excision
- Surgical airway/tracheostomy
- Damage control surgery
- Fracture stabilisation

Burn phases

- Anaesthetic involvement may be in one of 3 phases:
  - Resuscitation
  - Acute debridement and skin grafting
  - Reconstruction and scar revision.

Emergency Management of Severe Burns

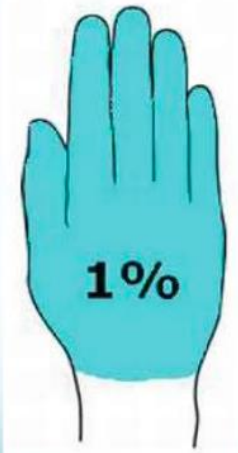
LOOK	**A** AIRWAY	**B** BREATHING	**C** CIRCULATION	**D** DISABILITY	**E** EXPOSURE	FLUIDS ANALGESIA TESTS TUBES	A.M.P.L.E. History Head to Toe Examination Tetanus Documentation Referral Support
DO	C spine	O_2	Haemorrhage control & I.V. access	AVPU & Pupils	Environmental Control (& Estimate TBSA)		
	Primary Survey					Check First Aid	Secondary Survey

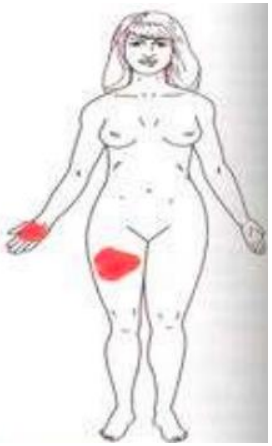
Inhalation injury

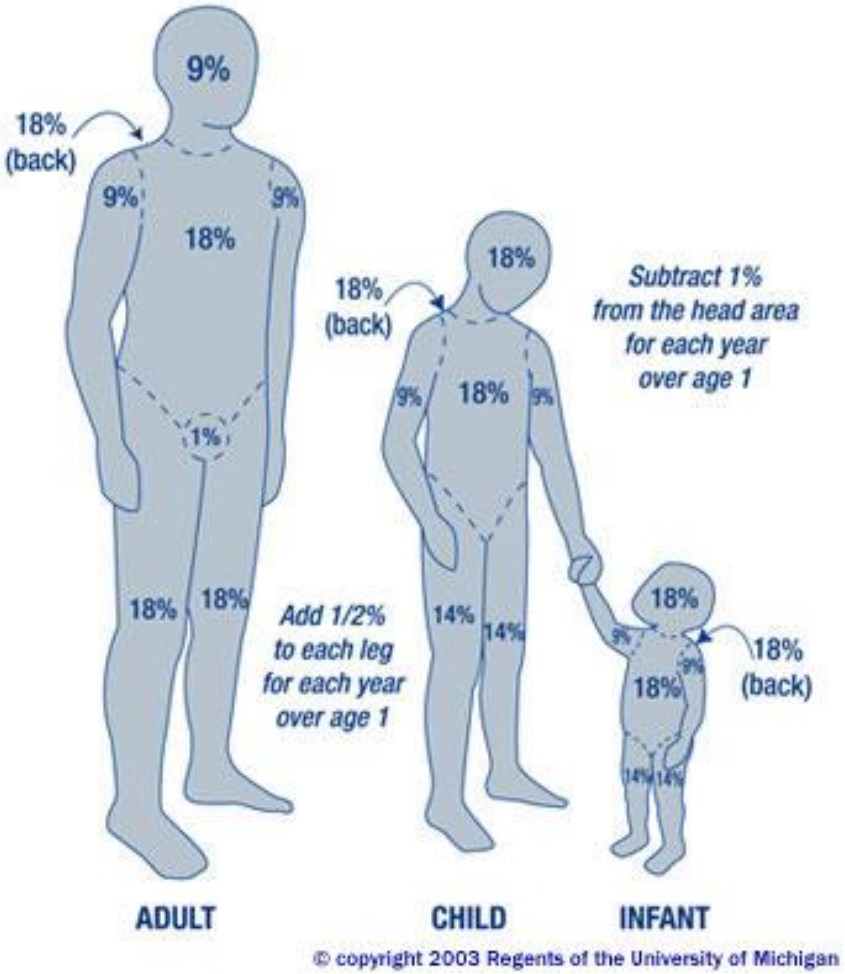
- Classification
  - Airway above larynx
    - hot gases, potential for worsening
  - Airway below larynx
    - inhaled products of combustion
  - Systemic effects, CO, cyanide
- History
- Examination
  - Nasendoscopy
- Indications for intubation
  - Worsening airway status
  - Oxygenation failure
  - Airway protection
  - Transport time to burn centre

Estimating burn size

- Lund Browder charts
- Rule of NINES
- Palm area =1%
- Children have large head
  - Age < 10
  - 18%, subtract 1% each year of life, add to legs







Haemocromogenuria

- Extensive deep burns
- Electrical injury
- Blunt trauma
- Reperfusion injury

- Increased volume resuscitation
- Aim to increase urine output
  - 75-100mL per hour
  - 2ml/kg/hour in children

- Mannitol could be considered

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Comparison of Albumin and Saline for Fluid Resuscitation in the Intensive Care Unit

The SAFE Study Investigators*

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care

John A. Myburgh, M.D., Ph.D., Simon Finfer, M.D., Rinaldo Bellomo, M.D., Laurent Billot, M.Sc., Alan Cass, M.D., Ph.D., David Gattas, M.D., Parisa Glass, Ph.D., Jeffrey Lipman, M.D., Bette Liu, Ph.D., Colin McArthur, M.D., Shay McGuinness, M.D., Dorrilyn Rajbhandari, R.N., Colman B. Taylor, M.N.D., and Steven A.R. Webb, M.D., Ph.D., for the CHEST Investigators and the Australian and New Zealand Intensive Care Society Clinical Trials Group*

Colloids versus crystalloids for fluid resuscitation in critically ill patients (Review)

Perel P, Roberts I, Ker K

THE COCHRANE COLLABORATION®

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Hydroxyethyl Starch 130/0.42 versus Ringer's Acetate in Severe Sepsis

Anders Perner, M.D., Ph.D., Nicolai Haase, M.D., Anne B. Guttormsen, M.D., Ph.D., Jyrki Tenhunen, M.D., Ph.D., Gudmundur Klemenzson, M.D., Anders Åneman, M.D., Ph.D., Kristian R. Madsen, M.D., Morten H. Møller, M.D., Ph.D., Jeanie M. Elkjær, M.D., Lone M. Poulsen, M.D., Asger Bendtsen, M.D., M.P.H., Robert Winding, M.D., Morten Steensen, M.D., Pawel Berezowicz, M.D., Ph.D., Peter Søe-Jensen, M.D., Morten Bestle, M.D., Ph.D., Kristian Strand, M.D., Ph.D., Jørgen Wiis, M.D., Jonathan O. White, M.D., Klaus J. Thornberg, M.D., Lars Quist, M.D., Jonas Nielsen, M.D., Ph.D., Lasse H. Andersen, M.D., Lars B. Holst, M.D., Katrin Thormar, M.D., Anne-Lene Kjældgaard, M.D., Maria L. Fabritius, M.D., Frederik Mondrup, M.D., Frank C. Pott, M.D., D.M.Sci., Thea P. Møller, M.D., Per Winkel, M.D., D.M.Sci., and Jørn Wetterslev, M.D., Ph.D., for the 6S Trial Group and the Scandinavian Critical Care Trials Group*

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COUNTIES MANUKAU HEALTH

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Balanced Crystalloids versus Saline in Critically Ill Adults

Matthew W. Semler, M.D., Wesley H. Self, M.D., M.P.H., Jonathan P. Wanderer, M.D., Jesse M. Ehrenfeld, M.D., M.P.H., Li Wang, M.S., Daniel W. Byrne, M.S., Joanna L. Stollings, Pharm.D., Avinash B. Kumar, M.D., Christopher G. Hughes, M.D., Antonio Hernandez, M.D., Oscar D. Guillamondegui, M.D., M.P.H., Addison K. May, M.D., Liza Weavind, M.B., B.Ch., Jonathan D. Casey, M.D., Edward D. Siew, M.D., Andrew D. Shaw, M.B., Gordon R. Bernard, M.D., and Todd W. Rice, M.D., for the SMART Investigators and the Pragmatic Critical Care Research Group*

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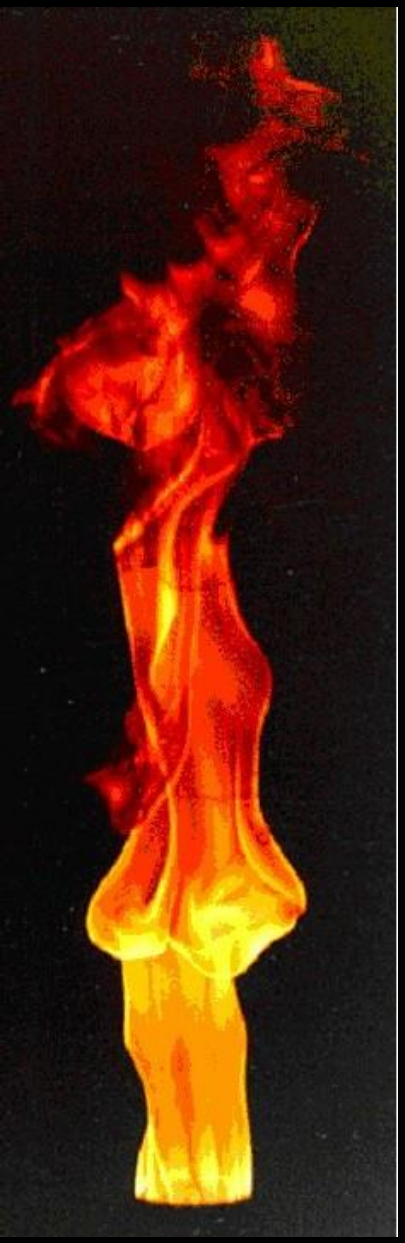
BURN resuscitation: What fluids, and when?

- First 24 hours
- Balanced crystalloid solution
  - Hartmann's (or Plasmalyte or Lactated Ringers)
- Avoid giving boluses
- Resuscitation failure, consider adding:
  - Vasopressin
  - Noradrenaline
  - Estimate 24 hours fluids
  - Consider early albumin at 12 hours
  - Bladder pressures, consider abdominal decompression
- At 24 hours, and absence of shock:
- Titrate fluid resuscitation down to maintenance
- Consider adding albumin
  - 0.3-0.5mL/kg/TBSA



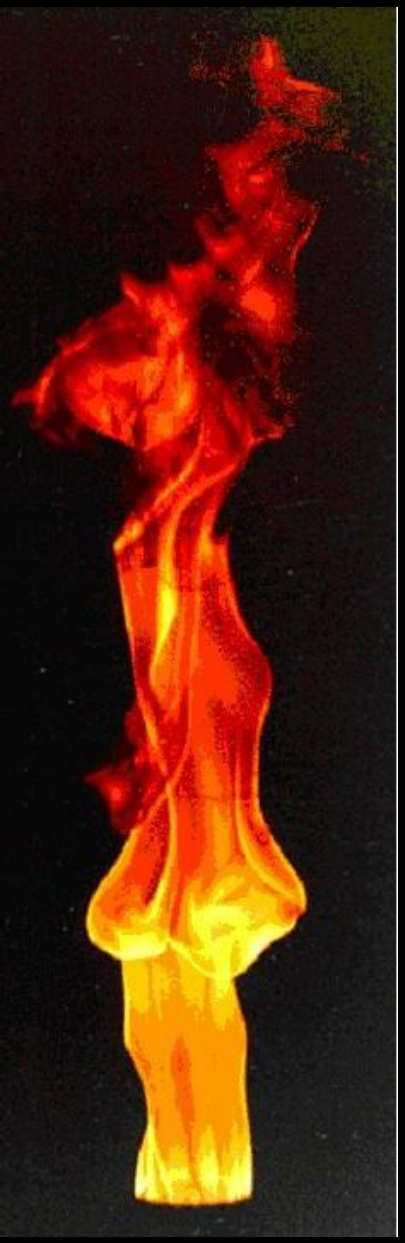
Metabolic modulation

Stress response to injury effects: Cuthbertson classic ebb and flow

ambient temperature effects
nutrition
hormonal modulation
growth factors and cytokines

- GH/Growth hormone binding protein complex
- platelet derived growth factor
- fibroblast growth factor
- transforming growth factor
- epidermal growth factor
- topical growth factor application
- GH/insulin like growth factor axis
- systemic GH effects in burns
- insulin like growth factor

β-adrenergic-receptor blockers: propranolol
anabolic steroids, oxandrolone



Nutrition support

- Hypermetabolism
  - REE rates increase 30%
  - Hyperpyrexia
  - Acute phase proteins
  - ↑ glucose levels, insulin resistance

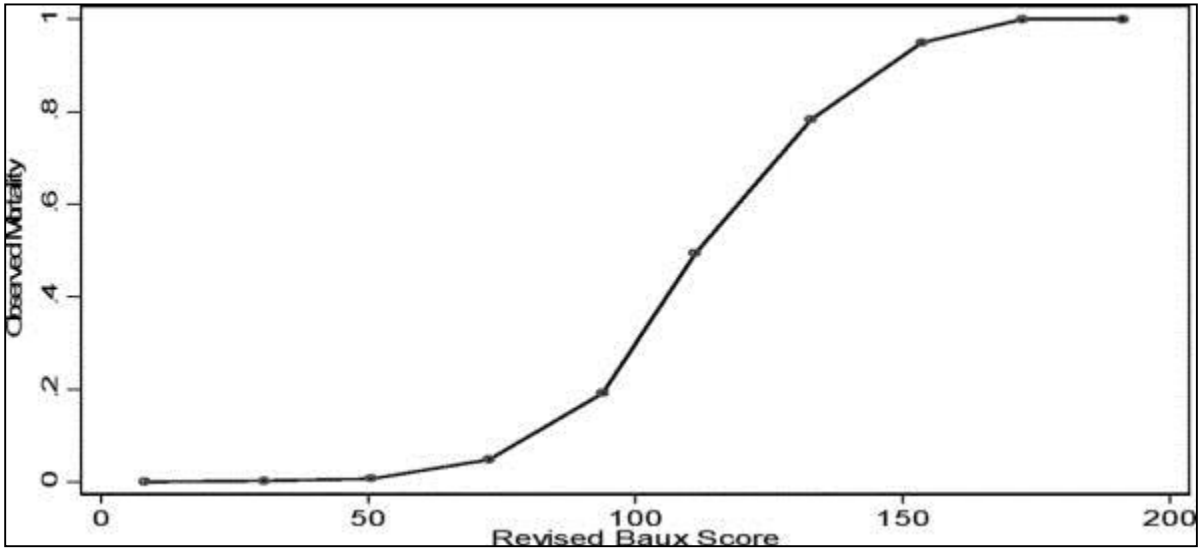
- Feed early (24-48 hours)
- Enteral route, post-pyloric preferred

- Minimise interruption
- Continue NJ feeds throughout surgery

Survival prediction

- Baux score
  - Age + TBSA
  - Age +TBSA + 17 (inhalational burn)

- Burn size >40% (RR12)
- Age >50 (RR 7.3)
- Inhalation injury (RR 3.6)
- Male (RR 1.8)



ANZBA referral criteria to a burn centre

- TBSA criteria
  - >10% in adults
  - >5% in children
  - >5% fill thickness burns
- Inhalational burn
- Special areas
  - Face/Hands/Feet/perineum/circumferential/overlying major joints
- Electrical burns
- Chemical burns
- Extremes of age
- Co-morbidity
- Major trauma with burns
- Burn following assault (Non-accidental injury)

Anaesthetic planning

- Assessment
- Airway plan
- Fluid and blood requirements
- Pharmacological changes
- Monitoring difficulties
- Vascular access
- Pain management
- Nutritional interruption

Airway planning

- Facemasks slide off their (sore) face
  - Gel pad mask donuts
  - Gauze pads

- LMA’s can be your get out-of-jail-free-pass
- Videolaryngoscopes (Glidescope ®)

- Low threshold for awake fibre-optic intubation
  - Neck contractures
  - Woody submental tissue
- Fixation problems
  - Interdental wire the ETT to a Maxillary screw

- Have a plan B, C, and a surgeon nearby

Pediatric Anesthesia

Pediatric Anesthesia ISSN 1155-5645

REVIEW

Airway management of recovered pediatric patients with severe head and neck burns: a review

Thomas J. Caruso, Luke S. Janik & Gennadiy Fuzaylov

Department of Anesthesia, Critical Care, and Pain Medicine, Shriners Hospital for Children, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA

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Maxillary fixation technique

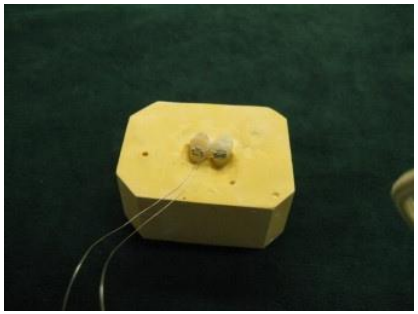
BURNS

Easy come, easy go: A simple and effective orthodontic enamel anchor for endotracheal tube stabilization in a child with extensive facial burns

Shinichiro Sakata [a,*], *Kerrod B. Hallett* [b], *Matthew S. Brandon* [a], *Craig A. McBride* [a]

[a] *The Stuart Pegg Paediatric Burns Centre, Royal Children's Hospital, Herston, Queensland 4029, Australia*
[b] *Children's Oral Health Service, Royal Children's Hospital, Herston, Queensland 4029, Australia*

- Resin bonded technique
- Maxillary incisors
- Wires to secure oral ETT



Minimise bleeding during burn surgery

- Early wound excision
- Tumescent infiltration
  - Adrenaline 1:500,000 solution
  - Local anaesthetic agent
- Topical adrenaline
- Algae preparations
- Positioning
- Tourniquets
- Tranexamic acid

- Transfusion triggers
- Be prepared
- Vascular access

Transfusion Requirement in Burn Care Evaluation (TRIBE)

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

Tina L. Palmieri, MD, James H. Holmes IV, MD,† Brett Arnoldo, MD,‡ Michael Peck, MD, ScD,§ Bruce Potenza, MD,¶ Amalia Cochran, MD,|| Booker T. King, MD, Col,** William Dominic, MD,†† Robert Cartotto, MD,‡‡ Dhaval Bhavsar, MD,§§ Nathan Kemalyan, MD,¶¶ Edward Tredget, MD,|||| Francois Stapelberg, MD,*** David Mozingo, MD,††† Bruce Friedman, MD,‡‡‡ David G. Greenhalgh, MD,* Sandra L. Taylor, PhD,§§§ and Brad H. Pollock, PhD, MPH§§§*

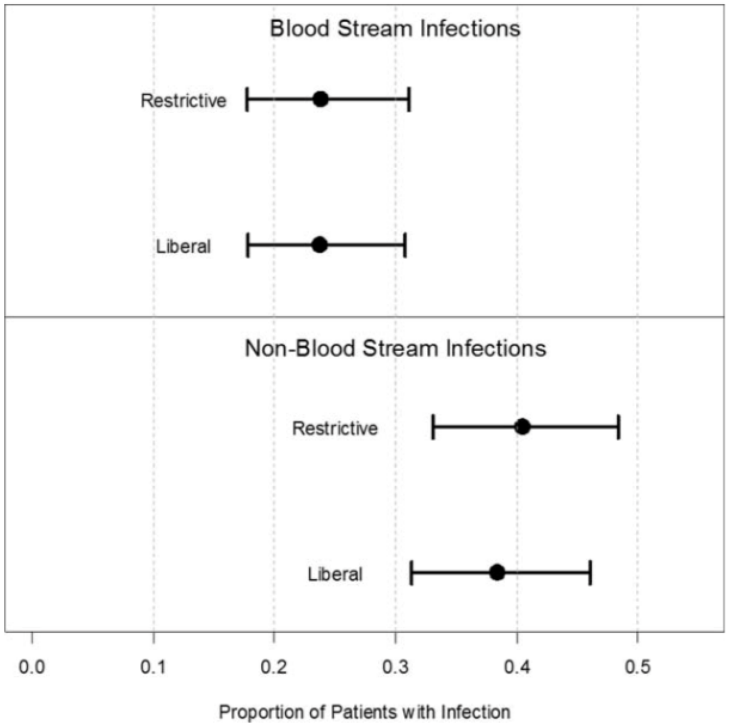


TABLE 4. Secondary Outcome Measures for Each Treatment Group

Variable	Liberal (n = 177)	Restrictive (n = 168)	*P*
30-Day mortality	8.5% (n = 15)	9.5% (n = 16)	0.89
Overall mortality (%)	11.3% (n = 20)	13.7% (n = 23)	0.26
LOS (days)	31 (20, 59.2)	31 (21, 58.2)	0.84
Ventilator days	6 (0, 20)	6 (1, 27.5)	0.64
ICU days	20 (9, 40)	22.5 (11, 42.2)	0.61
Days to wound healing	24 (14, 43)	23 (15, 41)	0.70
Days on study	26 (16, 51)	27.5 (17, 56)	0.66
Maximum MOD score	7 (4, 10)	8 (4, 11)	0.22
Surgery (Y/N)	93.8% (n = 166)	94.0% (n = 158)	1.00
Number of operations	3 (1, 5)	2 (1, 5)	0.18

Data expressed as medians (25th, 75th quantiles) or percentage (n) of outcomes for each treatment group.

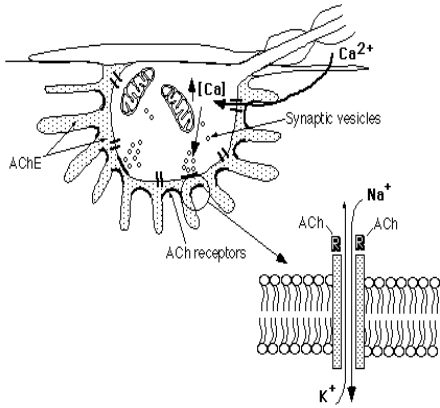
Pharmacology of burns

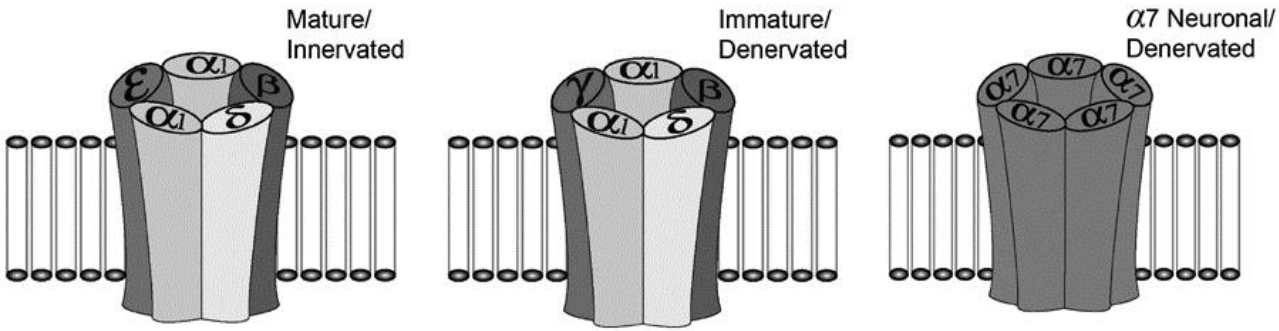
- AChR upregulation
  - Avoid using suxamethonium after hours post-burn
  - Safe again 1-2 years post-burn, or wound closure, mobilising, absence of sepsis

- Non depolariser resistance
- Cardiac output changes
- Decreased renal clearance

- Opioid tolerance

- Ketamine





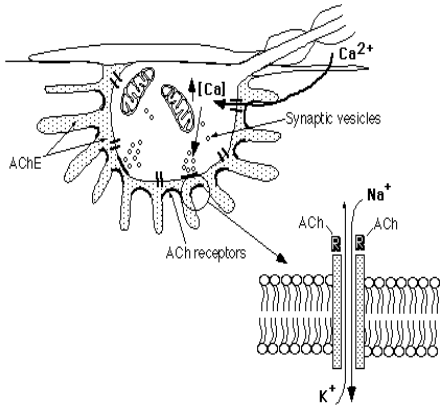
Pharmacology of burns

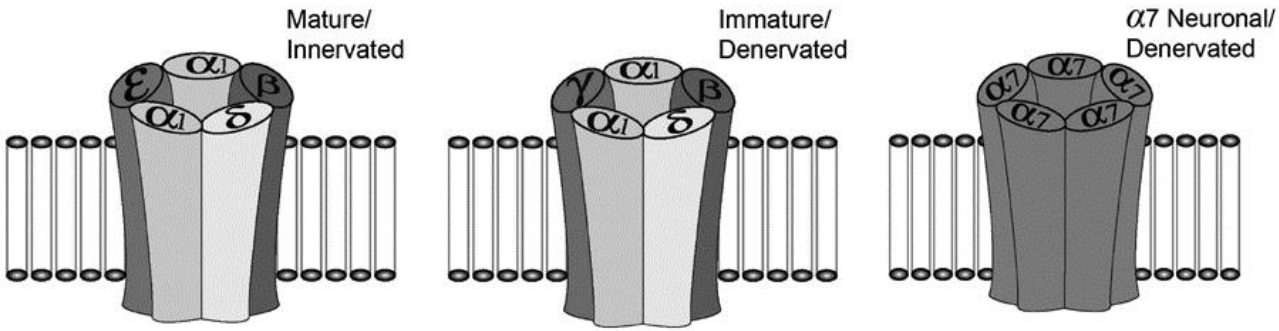
- AChR upregulation
  - Avoid using suxamethonium after **48** hours post-burn
  - Safe again 1-2 years post-burn, or wound closure, mobilising, absence of sepsis

- Non depolariser resistance
- Cardiac output changes
- Decreased renal clearance

- Opioid tolerance

- Ketamine





AUSTRALIAN AND NEW ZEALAND COLLEGE OF ANAESTHETISTS
ABN 82 055 042 852

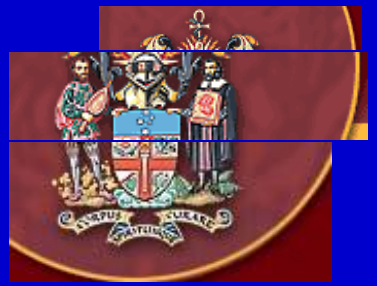
EXAMINATION REPORT
FINAL FELLOWSHIP EXAMINATION

- You are called to assist with the resuscitation of an 35 year old male electrician injured in a electrical explosion. He has respiratory distress.

- Outline your initial planning.

What is the question?

- Primary issue
  - Other issues
- What is your plan?
- BE SAFE
- Communicate
- Follow up



Emergency Management of Severe Burns

LOOK	**A** AIRWAY	**B** BREATHING	**C** CIRCULATION	**D** DISABILITY	**E** EXPOSURE	FLUIDS ANALGESIA TESTS TUBES	A.M.P.L.E. History Head to Toe Examination Tetanus Documentation Referral Support
DO	C spine	O_2	Haemorrhage control & I.V. access	AVPU & Pupils	Environmental Control (& Estimate TBSA)		
	Primary Survey					Check First Aid	Secondary Survey

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NPDGB

- Children
- Victims of abuse
- Trauma victims
- Self harm with immolation
- Brave pilots
- Elderly frail patients
- P-lab cooks and their clients

- and the list goes on…

What is the question?

- Primary issue
  - Other issues
- What is your plan?
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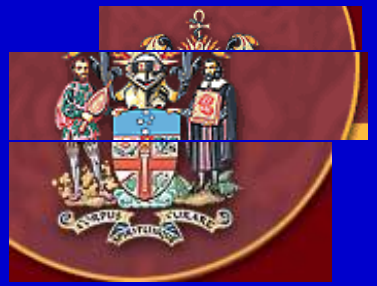
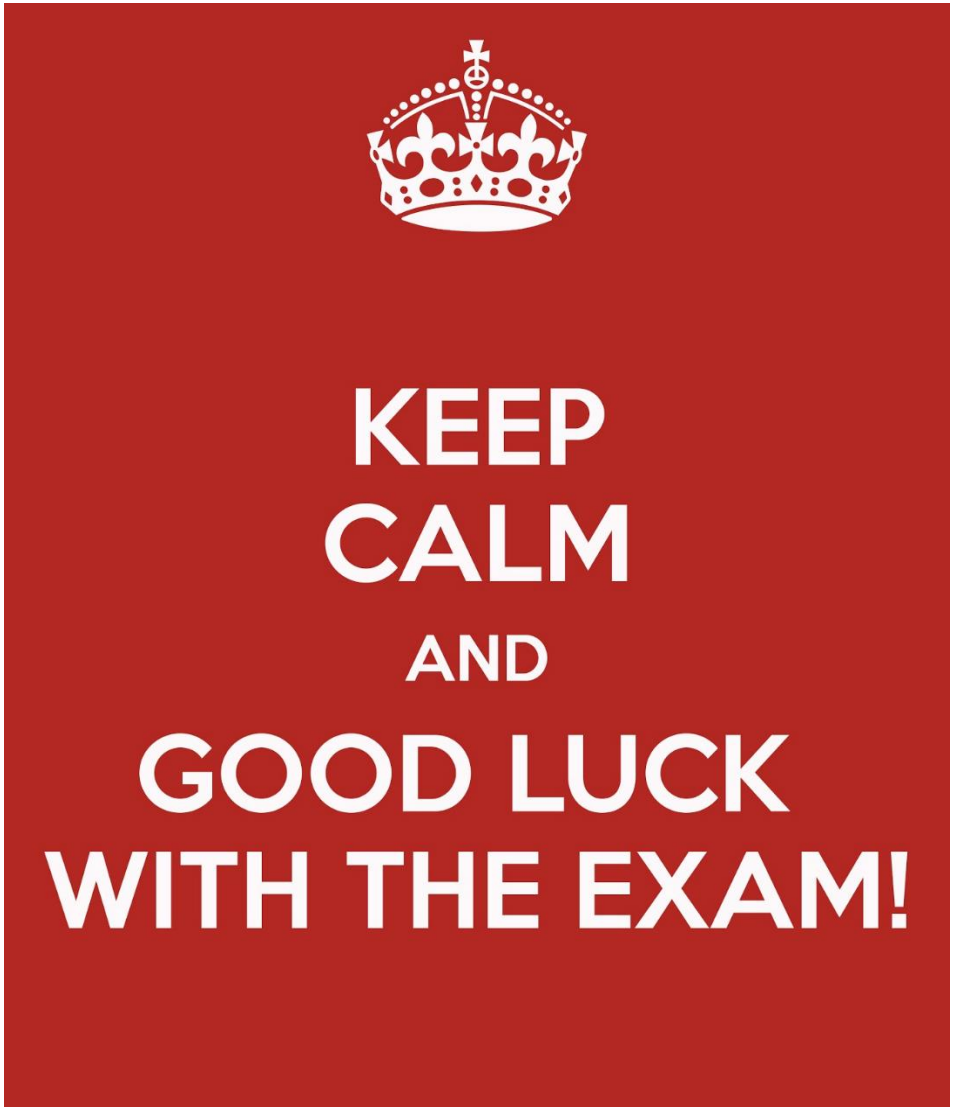


NEVER BE AFRAID TO SAY WHAT YOU FEEL


KEEP
CALM
AND
GOOD LUCK
WITH THE EXAM!