

FExNet 2026

Collated SAQs: Trauma in Special Circumstances

ANSWER BOOKLET

Model answers for the 22 trauma-special SAQs. References cited at the foot of each question. Items marked [core] are required for full marks. Drug doses confirmed with current ANZBA / ATLS / EAST / ANZCOR / Wilderness Medical Society guidelines.

22 questions • 230 marks

ACEM-aligned format. Sub-questions labelled a) b) c). Mark allocations indicative; references cited in the Answer Booklet. Question and answer indexes are clickable.

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Click any entry to jump to its answer. Marks shown right.

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Question 1 | Burns — Initial Assessment and Fluid Resuscitation (12 marks)

A 55-year-old man weighing 80 kilograms is brought by ambulance to your urban emergency department after a domestic barbecue gas explosion. He has flame burns to his face, anterior trunk, and circumferentially around both upper limbs. He is conscious with a Glasgow Coma Score of 15 but is hoarse, has soot in his nostrils, and has a brassy cough. His vital signs are: heart rate 115 beats per minute, blood pressure 130/80 millimetres of mercury, respiratory rate 28 breaths per minute, peripheral oxygen saturation 96 percent on a non-rebreather mask, temperature 36.4 degrees Celsius.

a) Calculate this patient's percentage total body surface area burnt using the Wallace 'rule of nines' (face = 4.5, anterior trunk = 18, each upper limb = 9 percent in adults). (3 marks)

- Face / head (anterior half) = 4.5 percent [core]
- Anterior trunk = 18 percent [core]
- Both upper limbs (circumferential) = 9 + 9 = 18 percent; total = 4.5 + 18 + 18 = 40.5 percent total body surface area [core]
- Confirm with palmar (whole hand including fingers = 1 percent) for irregular distributions; do NOT count superficial (epidermal) burns in the percentage

b) Calculate fluid resuscitation requirements using the modified Parkland formula AND state the rate for the first 8 hours. (3 marks)

- **Modified Parkland:** 3-4 millilitres × weight (kg) × percentage TBSA = 3 × 80 × 40 = **9,600 mL** of crystalloid (Hartmann's preferred over saline) over the first 24 hours from the time of injury [core]
- **Half (4,800 mL) in the first 8 hours** = approximately 600 mL/h; remainder (4,800 mL) over the next 16 hours = approximately 300 mL/h [core]
- **Titrate to urine output** 0.5-1 mL/kg/h (adults) or 1-1.5 mL/kg/h (children <30 kg, or electrical burns); do not give blanket boluses — Parkland is a STARTING estimate only [core]
- If patient has significant inhalational injury, fluid needs may be 30-50 percent higher
- Avoid albumin or other colloids in first 24 hours (equivalent outcomes, more cost)

c) List 6 criteria from ANZBA for transfer to a specialist burns centre. (6 marks)

- Total body surface area burns greater than 10 percent in adults (greater than 5 percent in children) [core]
- Full-thickness burns greater than 5 percent total body surface area in adults [core]
- Burns to special areas — face, hands, feet, perineum, genitalia, joints [core]
- Inhalational injury [core]
- Electrical or chemical burns [core]
- Circumferential burns [core]
- Significant comorbidities (diabetes, immunocompromise, anticoagulation)
- Pregnancy
- Suspected non-accidental injury
- Inadequate local resources / expertise

References: ANZBA Burns Standards / Emergency Management of Severe Burns (EMSB) • ATLS 10th edition (current) • Tintinalli's Emergency Medicine 9e Ch 216 • ACEM clinical policies and statements

Question 2 | Inhalational Injury and Airway Burns (11 marks)

A 25-year-old firefighter is brought to your tertiary emergency department after being pulled unconscious from a house fire. He has been exposed to smoke for approximately 10 minutes. On arrival, his Glasgow Coma Score is 12 (E3 V4 M5), heart rate 105 beats per minute, blood pressure 120/60 millimetres of mercury, respiratory rate 28 breaths per minute, peripheral oxygen saturation 95 percent on 15 litres oxygen via non-rebreather mask. He has burns to his face and circumferential burns to his neck, with carbonaceous sputum, hoarse voice, and singed nasal hairs.

a) List 5 examination features that indicate an airway-threatening burn. (5 marks)

- Singed nasal vibrissae or facial hair, soot in the nostrils or oropharynx [core]
- Hoarse voice, brassy cough, stridor [core]
- Carbonaceous sputum or burnt particulate matter in oropharynx [core]
- Burns to face, lips, intra-oral mucosa, or neck (particularly circumferential) [core]
- Mucosal oedema, blistering, or erythema visible on direct inspection of oropharynx or via laryngoscopy [core]
- Drooling, dysphagia
- Tachypnoea, accessory muscle use, increased work of breathing

b) List 4 specific considerations when intubating this patient. (4 marks)

- **Anticipate difficult airway** — progressive oedema; perform early before deterioration; prepare for surgical airway [core]
- **Use a smaller endotracheal tube** than predicted (e.g. 7.0-7.5 mm in an adult instead of 8.0 mm) due to anticipated swelling; preserve a larger tube size if possible to facilitate later bronchoscopy [core]
- **Senior consultant operator with surgical team and difficult-airway equipment available**; double set-up — anaesthetic and surgical (cricothyrotomy) [core]
- **Avoid suxamethonium in major burns more than 24 hours old** (extrajunctional acetylcholine receptor proliferation → severe hyperkalaemia); rocuronium is preferred [core]
- Adequate pre-oxygenation; rapid sequence induction principles
- Cuff pressures may need monitoring as oedema develops
- Secure tube carefully — facial burns, oedema make tape fixation difficult; suture or umbilical-tape method

c) List 2 specific toxin-mediated injuries to consider AND state the antidote for each. (2 marks)

- **Carbon monoxide poisoning** — high-flow 100 percent oxygen via non-rebreather (or via endotracheal tube); hyperbaric oxygen if severe (loss of consciousness, neurological deficit, carboxyhaemoglobin greater than 25 percent, pregnancy, ischaemia) [core]
- **Cyanide toxicity** (from synthetic combustion products) — **hydroxocobalamin 5 g intravenous over 15 min** (preferred); alternative sodium thiosulfate 12.5 g intravenous; consider if persistent metabolic acidosis with raised lactate despite adequate oxygenation [core]

References: ANZBA Burns Standards / Emergency Management of Severe Burns (EMSB) • ATLS 10th edition (current) • Tintinalli's Emergency Medicine 9e Ch 216 • eTG (Therapeutic Guidelines, current)

Question 3 | Circumferential Burns and Escharotomy (10 marks)

A 42-year-old man has been transferred to your tertiary centre 6 hours after sustaining 35 percent total body surface area flame burns including circumferential deep partial-thickness burns to both upper limbs and the entire anterior trunk. He has been adequately fluid-resuscitated and intubated. You note that his right upper limb is becoming cool, pulseless, and swollen, with progressive loss of capillary refill in the fingers. His ventilator pressures are rising (peak inspiratory pressure 38 cm H₂O on volume control).

a) List 3 indications for escharotomy. (3 marks)

- **Limb:** progressive distal ischaemia — loss of pulses, capillary refill greater than 3 seconds, reduced sensation, motor weakness, or compartment pressure greater than 30 millimetres of mercury **[core]**
- **Chest / trunk:** ventilatory compromise — rising peak inspiratory pressures, reduced tidal volume on pressure-controlled ventilation, hypoxia / hypercapnia from restricted chest expansion **[core]**
- **Neck:** respiratory distress from circumferential neck burns compressing trachea **[core]**
- Abdomen: developing abdominal compartment syndrome from circumferential abdominal burns

b) Describe the technique for upper-limb escharotomy. (4 marks)

- **Site:** medial AND lateral mid-axial lines of the limb (avoiding underlying neurovascular structures); extend across affected joints (elbow extends through to the medial / lateral epicondyles) **[core]**
- **Depth:** incise full thickness through burnt eschar into subcutaneous fat — eschar should spring open on incision; deeper fasciotomy NOT routinely required (different indication) **[core]**
- **Anaesthesia:** infiltrate non-burnt skin edges with local anaesthetic; in fully anaesthetised patient, escharotomy through full-thickness burn requires no additional analgesia **[core]**
- **Verify:** distal pulses (Doppler if needed), warmth, capillary refill, and pressure relief on chest; haemostasis with diathermy **[core]**
- Performed by burns / general surgeon ideally; in remote settings, retrieval medicine can advise / perform with senior support
- Must be re-evaluated regularly post-procedure; ongoing oedema may require fasciotomy

c) List 3 complications of escharotomy. (3 marks)

- Bleeding — escharotomy through deep partial burn may cause significant haemorrhage from viable tissue **[core]**
- Infection / wound colonisation **[core]**
- Iatrogenic injury to underlying structures (nerves, vessels, tendons) if too deep or wrong line **[core]**
- Inadequate decompression if incision too short, shallow, or wrongly sited
- Cosmetic / functional sequelae (scarring)

References: ANZBA Burns Standards / Emergency Management of Severe Burns (EMSB) • ATLS 10th edition (current) • Tintinalli's Emergency Medicine 9e Ch 216

Question 4 | Chemical Burns (11 marks)

A 32-year-old industrial worker is brought to your emergency department after a 5-litre container of concentrated hydrofluoric acid spilled over his right forearm and hand at work approximately 30 minutes ago. He has had cold-water irrigation at the scene for 20 minutes. He is now complaining of severe, deep, throbbing pain disproportionate to the visible skin injury. There is mild erythema over his right forearm but no obvious burn. His vital signs are: heart rate 95 beats per minute, blood pressure 130/85 millimetres of mercury, respiratory rate 18 breaths per minute.

a) Explain the unique mechanism of injury for hydrofluoric acid AND the clinical relevance. (3 marks)

- **Hydrofluoric acid is a weak acid** that penetrates skin and deeper tissues over hours, binding intracellular calcium and magnesium (forming insoluble fluoride salts) **[core]**
- **This sequestration of calcium** causes severe tissue injury, intense pain, and **systemic hypocalcaemia and hyperkalaemia** with risk of life-threatening ventricular arrhythmias **[core]**
- **The skin appearance underestimates depth and severity** — minimal cutaneous signs may overlie significant deeper damage; pain out of proportion is the hallmark **[core]**
- Concentration of acid and contact time / area exposed predict severity of systemic toxicity

b) State 5 management priorities specific to hydrofluoric acid burns. (5 marks)

- **Continue copious irrigation** with running water for further 30-60 minutes; remove contaminated clothing **[core]**
- **Topical calcium gluconate gel 2.5 percent** applied to affected skin and rubbed in for 15 minutes; reapply 4-6 hourly until pain settles **[core]**
- **Subcutaneous infiltration of 10 percent calcium gluconate** (0.5 mL/cm²) for ongoing pain — beware compartment syndrome with large volume **[core]**
- **Intra-arterial calcium gluconate** via radial arterial line (10 mL of 10 percent calcium gluconate in 40 mL saline over 4 hours) if extensive; alternative: Bier's block with calcium gluconate **[core]**
- **Cardiac monitoring with serial calcium, magnesium, potassium**, electrocardiogram; intravenous calcium replacement for systemic hypocalcaemia (calcium gluconate 10 percent 10 mL slow IV); treat hyperkalaemia aggressively (calcium, insulin/dextrose, salbutamol) **[core]**
- Specialist toxicology / poisons centre consultation (13 11 26) — hydrofluoric acid burns can be lethal
- Consider plastic / burns surgery for fasciotomy if deep tissue involvement

c) List 3 differences in management of acid versus alkali burns. (3 marks)

- **Alkali burns penetrate deeper** via liquefactive necrosis (saponification of fat); acid burns produce coagulative necrosis with self-limiting depth (except hydrofluoric and phenol) **[core]**
- **Irrigation duration** — alkali burns require prolonged irrigation (1-2 hours or until pH normalised); acid burns 30 min-1 hour usually sufficient **[core]**
- **Eye injury** — alkali burns to the eye are particularly destructive (penetrate anterior chamber, damage stem cells); demand urgent ophthalmology and prolonged irrigation **[core]**
- Avoid NEUTRALISING agents — exothermic reaction worsens injury; only water (or sterile saline) irrigation
- Neutralisation may be appropriate for specific agents (calcium gluconate for HF, polyethylene glycol for phenol) — check local poisons advice

References: ANZBA Burns Standards / Emergency Management of Severe Burns (EMSB) • ATLS 10th edition (current) • Tintinalli's Emergency Medicine 9e Ch 216 • eTG (Therapeutic Guidelines, current) • Australian Poisons Information Centre 13 11 26

Question 5 | High-Voltage Electrical Injury (12 marks)

A 36-year-old male electrician is brought to your emergency department after being electrocuted by an 11,000-volt power line. He was thrown approximately 8 metres against a metal panel. Bystander cardiopulmonary resuscitation was performed immediately; ambulance crew found him in ventricular fibrillation and successfully defibrillated to return of spontaneous circulation after a down-time of approximately 20 minutes. He is now intubated and ventilated. On arrival his vital signs are: heart rate 84 beats per minute, blood pressure 145/90 millimetres of mercury, respiratory rate 15 breaths per minute (mandatory), peripheral oxygen saturation 98 percent on hand-bag ventilation. He has entry wounds on his right hand and exit wounds on his left foot.

a) List 4 factors that determine the severity of electrical injury. (4 marks)

- **Voltage** — high-voltage (greater than 1000 V) causes more severe injury than low-voltage; current density determined by voltage **[core]**
- **Current type** — alternating current more dangerous than direct current at the same voltage (causes muscle tetany and preventing release; also lowers fibrillation threshold) **[core]**
- **Duration of contact** — longer contact = greater current dose and tissue damage; AC tetany prolongs contact **[core]**
- **Pathway through body** — hand-to-hand or hand-to-contralateral-foot crosses the heart and is most dangerous; vertical pathways through the body involve more vital organs **[core]**
- **Tissue resistance** — bone > fat > tendon > skin > muscle > blood > nerve; current follows path of least resistance
- Skin moisture, ground contact

b) List 4 organ-system injuries in this patient AND state the pathophysiological mechanism for each. (4 marks)

- **Cardiac** — ventricular fibrillation, asystole, conduction abnormalities; mechanism: depolarisation during the vulnerable period of cardiac cycle, direct myocardial injury **[core]**
- **Neurological** — central (TBI from fall, brainstem dysfunction, seizures) and peripheral nerve injury; mechanism: direct current effect, secondary trauma, compartment syndrome **[core]**
- **Musculoskeletal** — deep tissue burns, rhabdomyolysis (myoglobin release), compartment syndrome; mechanism: heat generation by current passing through high-resistance tissue (Joule heating) **[core]**
- **Renal** — acute kidney injury from myoglobinuria and hypovolaemia; mechanism: myoglobin precipitation in renal tubules, direct nephrotoxicity **[core]**
- **Skin** — burns at entry and exit points (often deep, charred); also flash burns
- **Trauma** — fractures, dislocations from violent muscle contraction or fall
- **Eye / cataract** — delayed cataract formation (months to years post-injury)

c) State 4 specific management priorities beyond standard trauma care. (4 marks)

- **Aggressive intravenous fluid resuscitation** targeted to urine output of 1-1.5 mL/kg/hour (higher than standard trauma) for myoglobin clearance; 0.9 percent saline or Hartmann's; consider alkalinisation of urine (pH greater than 6.5) with sodium bicarbonate **[core]**
- **Continuous cardiac monitoring** (minimum 24-48 hours given high-voltage exposure with cardiac arrest) — delayed arrhythmias possible **[core]**
- **Investigate for compartment syndrome / rhabdomyolysis** — serial creatine kinase, urine myoglobin, compartment pressures of all involved limbs; early fasciotomy if indicated **[core]**
- **Trauma series** — c-spine immobilisation, computed tomography of head, chest, abdomen, pelvis given high-energy mechanism with trauma from being thrown **[core]**

- Reverse anticoagulation / antiplatelets if relevant
- Investigate for deep tissue injury — magnetic resonance imaging useful for hidden burns
- Tetanus update; broad-spectrum antibiotics for burns if extensive

References: *ATLS 10th edition (current)* • *eTG (Therapeutic Guidelines, current)* • *ANZBA Burns Standards / Emergency Management of Severe Burns (EMSB)* • *Tintinalli's Emergency Medicine 9e Ch 215*

Question 6 | Lightning Strike Injury (9 marks)

A 28-year-old male is brought to your regional emergency department after being struck by lightning while sheltering under a tree during a thunderstorm. He had cardiopulmonary arrest at the scene and received 5 minutes of bystander cardiopulmonary resuscitation before return of spontaneous circulation. On arrival, he is conscious but confused. His vital signs are: heart rate 110 beats per minute, blood pressure 140/85 millimetres of mercury, respiratory rate 22 breaths per minute, peripheral oxygen saturation 96 percent on 8 litres oxygen via Hudson mask, temperature 36.0 degrees Celsius. Examination shows feathery (Lichtenberg) marks across the right side of his chest, ruptured tympanic membrane on the right, and mild left-sided motor weakness.

a) Explain why the 'reverse triage' concept applies to lightning strike with multiple casualties. (3 marks)

- Standard mass-casualty triage assigns 'expectant / black' to patients in cardiac arrest given limited resources **[core]**
- **Lightning-induced cardiac arrest is different** — primary respiratory arrest (brainstem effect) often follows the depolarising shock; the heart may resume spontaneous activity and the patient may be salvaged **[core]**
- **Therefore:** in a lightning mass-casualty event, prioritise (resuscitate) those WITHOUT signs of life FIRST, as those spontaneously breathing are likely to survive without intervention **[core]**

b) List 3 specific injury patterns of lightning strike. (3 marks)

- **Cardiac** — asystole or ventricular fibrillation; subsequent ECG changes; rarely persistent arrhythmia (very high-energy direct current) **[core]**
- **Neurological** — keraunoparalysis (transient flaccid paralysis with vasospasm); seizures; cerebellar / autonomic dysfunction; tympanic membrane rupture **[core]**
- **Cutaneous Lichtenberg figures** (arborescent / fern-like erythema, pathognomonic, transient), superficial flash burns; generally not deep burns (unlike industrial electrocution) **[core]**
- Ocular injury — cataracts, retinal damage
- Musculoskeletal — fractures from violent muscle contraction or fall
- Psychological / cognitive — depression, anxiety, post-traumatic stress disorder, memory difficulties

c) List 3 management priorities. (3 marks)

- Standard trauma assessment and resuscitation with c-spine precautions; address injuries from being thrown **[core]**
- **Continuous cardiac monitoring** for at least 24 hours, particularly if any electrocardiographic abnormality, dysrhythmia, or arrest **[core]**
- Generally **less aggressive fluid resuscitation than industrial electrical injury** — myoglobinuria less severe given shorter contact time; but assess for rhabdomyolysis **[core]**
- Examine and assess for tympanic membrane rupture, ocular injury, neurological deficits
- Mental health screening; debrief; family support

References: Wilderness Medical Society practice guidelines • Tintinalli's Emergency Medicine 9e Ch 215 • ANZCOR Guidelines (current)

Question 7 | Accidental Hypothermia (11 marks)

A 65-year-old man with a history of alcohol use disorder is brought to your emergency department by ambulance after being found unresponsive in a snow-covered drainage ditch following an evening of drinking. The ambient temperature was -2 degrees Celsius. He has been outside for an estimated 6 hours. On arrival, his core (oesophageal) temperature is 26 degrees Celsius. He is unresponsive (Glasgow Coma Score 4), with a slow regular heart rate of 30 beats per minute, blood pressure 70 millimetres of mercury systolic by Doppler, respiratory rate 6 breaths per minute (shallow). His pupils are mid-sized, sluggishly reactive.

a) State the Swiss Staging classification for hypothermia AND the stage applicable to this patient. (3 marks)

- **HT I (mild):** 32-35°C — conscious, shivering. **HT II (moderate):** 28-32°C — impaired consciousness, no shivering. **HT III (severe):** 24-28°C — unconscious with vital signs. **HT IV (apparent death):** less than 24°C — apparent absence of vital signs **[core]**
- **This patient = HT III (severe at 26°C)** — unconscious but vital signs preserved **[core]**
- Approximate temperature can be estimated from clinical signs if no direct measurement (Swiss Staging clinical version)

b) List 5 management priorities for severe hypothermia (drug, dose, technique). (5 marks)

- **Gentle handling** — avoid sudden movement, jostling (myocardial irritability predisposes to fatal ventricular fibrillation); keep horizontal during transfer **[core]**
- **Monitor core temperature** with oesophageal probe (most accurate) or epitympanic; rectal/bladder unreliable in severe hypothermia; warm patient and avoid further heat loss **[core]**
- **Active external rewarming** — Bair Hugger, warm blankets, warm room; **active internal rewarming** — warm humidified oxygen (40-43°C) via endotracheal tube, warm intravenous fluids (Hartmann's at 38-40°C), lavage of body cavities (gastric, peritoneal, bladder, pleural) **[core]**
- **Extracorporeal membrane oxygenation** (or cardiopulmonary bypass) is first-line for HT IV with cardiac arrest, OR HT III with cardiovascular instability — provides active core rewarming and circulatory support; can rewarm 8-12°C/h **[core]**
- **If cardiac arrest** — defibrillate up to 3 shocks; if unsuccessful, hold further shocks until core temperature greater than 30°C; **limit / withhold drugs** while core less than 30°C; double drug intervals between 30-35°C **[core]**
- Endotracheal intubation via standard rapid sequence induction with neuroprotective principles
- Investigate underlying cause / contributing factors (alcohol, hypothyroidism, sepsis, drug use)

c) State the principle 'no one is dead until warm and dead' AND give 3 indications to terminate resuscitation. (3 marks)

- Hypothermia is protective for cerebral metabolism; resuscitation should continue until core temperature is restored to at least 32-35°C before declaring death (absent in extreme circumstances) **[core]**
- Witnessed prolonged submersion (greater than 60 min) with avalanche burial; serum potassium greater than 12 mmol/L (suggests pre-existing death rather than hypothermia) **[core]**
- Massive trauma incompatible with life; rigor mortis; signs of obvious irreversible death (decomposition, lividity) **[core]**
- Inability to access ECMO / cardiopulmonary bypass in remote settings — local senior decision
- After prolonged resuscitation in a normothermic patient where ROSC unsuccessful

References: ANZCOR Guideline 11.10 — Resuscitation in Special Circumstances • Wilderness Medical Society practice guidelines • Tintinalli's Emergency Medicine 9e Ch 213

Question 8 | Drowning / Submersion Injury (11 marks)

A 23-year-old woman was rescued by surf lifesavers from rough surf after submersion of approximately 5 minutes. Bystander cardiopulmonary resuscitation was commenced. On arrival to your tertiary emergency department, she remains intubated. Her vital signs are: heart rate 65 beats per minute, blood pressure 100/60 millimetres of mercury, peripheral oxygen saturation 90 percent on 100 percent inspired oxygen with positive end-expiratory pressure of 5 centimetres of water, temperature 33 degrees Celsius. Her chest radiograph shows bilateral patchy infiltrates.

a) List 4 components of immediate emergency department management. (4 marks)

- **Airway and ventilation optimisation** — ensure correct endotracheal tube position; lung-protective ventilation strategies (low tidal volume 6 mL/kg ideal body weight, permissive hypercapnia, plateau pressure less than 30 cm H₂O); higher positive end-expiratory pressure for oxygenation; suction airway secretions **[core]**
- **Active rewarming** if hypothermic — warm fluids, blankets, ambient temperature; monitor core temperature **[core]**
- **C-spine precautions** if mechanism suggests trauma (diving, fall, surfing); maintain in-line stabilisation until cleared **[core]**
- **Monitor and manage haemodynamics** — fluid resuscitation cautiously (avoiding overload); vasopressor support if shock; treat hypoxaemia and acidosis **[core]**
- Insert nasogastric tube to decompress swallowed water (gastric distension common)
- Investigate and treat triggers — seizure (long QT, Brugada), syncope, intoxication, trauma, suicide attempt
- Bedside glucose; arterial blood gas; lactate; investigate for aspiration (chest radiograph, bronchoscopy if needed)
- Targeted temperature management 32-36°C for 24 hours post-arrest

b) List 4 prognostic factors. (4 marks)

- **Submersion duration** — most important single predictor; less than 5 min = favourable, greater than 25 min = very poor **[core]**
- **Time to first effective basic life support / advanced life support** — shorter is better; bystander cardiopulmonary resuscitation reduces morbidity **[core]**
- **Initial rhythm and Glasgow Coma Score on arrival** — asystole, fixed dilated pupils, Glasgow Coma Score 3 = poor prognosis **[core]**
- **Water temperature** — cold-water submersion (less than 6°C) may be neuroprotective; warm-water submersion predicts worse outcome **[core]**
- Witnessed vs unwitnessed; immersion vs full submersion
- Time to return of spontaneous circulation
- Need for ongoing high inotrope or vasopressor support

c) Describe 3 specific complications of drowning to anticipate. (3 marks)

- **Acute respiratory distress syndrome / aspiration pneumonitis** — bilateral infiltrates, hypoxia; lung-protective ventilation, may require extracorporeal membrane oxygenation **[core]**
- **Hypoxic-ischaemic brain injury** — post-cardiac arrest neurological syndrome; 72-hour neuroprognostication delayed by sedation / hypothermia **[core]**
- **Aspiration pneumonia** (subacute, 48-72 hours) — cover Gram-negatives and atypicals if salt or fresh water; prophylactic antibiotics not routinely indicated (treat infection if it develops) **[core]**
- Delayed cardiac arrhythmia — long QT, Brugada (may be the cause)

- Cervical spine injury (if not yet excluded)
- Disseminated intravascular coagulation, acute kidney injury, multi-organ dysfunction

References: *ANZCOR Guidelines (current)* • *ANZCOR Guideline 11.10 — Resuscitation in Special Circumstances* • *ATLS 10th edition (current)* • *Tintinalli's Emergency Medicine 9e Ch 199*

Question 9 | Exertional Heat Stroke (10 marks)

A 42-year-old male athlete is brought to your emergency department from a marathon run on a hot summer day (ambient temperature 38 degrees Celsius, high humidity). He collapsed at the 35-kilometre mark and was confused and combative on arrival of the ambulance. On examination in your resuscitation bay, his core temperature (per oesophageal probe) is 41.2 degrees Celsius, heart rate 150 beats per minute, blood pressure 95/55 millimetres of mercury, respiratory rate 32 breaths per minute, peripheral oxygen saturation 96 percent on room air, Glasgow Coma Score 12 (E3 V3 M6). His skin is hot and dry.

a) Distinguish heat exhaustion from heat stroke (state 3 differentiating features). (3 marks)

- **Heat exhaustion:** core temperature less than 40°C; CNS function PRESERVED (may have weakness, syncope, headache but no significant alteration); hot skin, often sweating [core]
- **Heat stroke:** core temperature greater than 40°C with **CNS dysfunction** (altered mental state, seizures, coma); may be classic (sedentary, elderly, slowly evolving) or exertional (athletic, rapid evolution, often sweating) [core]
- **End-organ damage** develops in heat stroke — rhabdomyolysis, acute kidney injury, acute respiratory distress syndrome, disseminated intravascular coagulation, hepatic injury, multi-organ failure [core]

b) State 4 cooling techniques in order of preference for exertional heat stroke. (4 marks)

- **Cold-water immersion** (1-7°C) — first-line, fastest cooling rate (0.15-0.35°C/min); best evidence in exertional heat stroke [core]
- **Ice-pack application to neck, axillae, groin** + cold-water spray and fanning (evaporative cooling) — alternative if immersion not feasible [core]
- **Cold intravenous fluids** (0.9 percent saline at 4°C) — adjunctive, slower than external methods [core]
- **Cold gastric, bladder, or peritoneal lavage** — for severe cases; extracorporeal cooling (continuous renal replacement therapy or cardiopulmonary bypass) for refractory cases [core]
- **Target core temperature 38°C** — stop active cooling to avoid overshoot
- Avoid antipyretics (paracetamol, aspirin) — ineffective in heat-related core temperature rise and may worsen hepatic / renal injury

c) List 3 supportive management priorities. (3 marks)

- **Aggressive intravenous fluid resuscitation** — 0.9 percent saline or Hartmann's, monitor for fluid overload; target urine output 1-2 mL/kg/h; treat rhabdomyolysis (bicarbonate alkalinisation if myoglobinuria) [core]
- **Treat seizures** — benzodiazepines (midazolam 0.05-0.1 mg/kg intravenous); monitor for cerebral oedema; intubation if needed for airway protection [core]
- **Treat coagulopathy and disseminated intravascular coagulation** — transfuse blood products as guided by coagulation profile and ROTEM/TEG; intensive care unit admission [core]
- Avoid alpha-adrenergic vasopressors initially (further skin vasoconstriction worsens cooling); noradrenaline if hypotension persists
- Monitor and treat metabolic acidosis, hyperkalaemia, hypoglycaemia

References: Wilderness Medical Society practice guidelines • eTG (Therapeutic Guidelines, current) • Tintinalli's Emergency Medicine 9e Ch 212 • Australian Sports Medicine Heat Policy

Question 10 | Hanging and Strangulation (10 marks)

A 35-year-old woman presents to your emergency department after being found by a friend with a ligature around her neck (suspected suicide attempt). She was cut down within an estimated 2-3 minutes and was reported as having brief cardiac arrest with bystander cardiopulmonary resuscitation. She had return of spontaneous circulation on arrival of the ambulance. On arrival to your emergency department, she has a Glasgow Coma Score of 9 (E2 V2 M5), heart rate 110 beats per minute, blood pressure 110/65 millimetres of mercury, respiratory rate 22 breaths per minute, peripheral oxygen saturation 94 percent on 8 litres oxygen via Hudson mask. There is a horizontal ligature mark on her anterior neck with petechial haemorrhages on her conjunctivae and face.

a) List 4 immediate complications to assess for. (4 marks)

- **Cervical spinal cord / vertebral injury** (particularly C2 'Hangman's fracture' in judicial hanging; less common in suicidal attempts but possible) [core]
- **Laryngeal / tracheal injury** — fracture of thyroid cartilage, hyoid bone, or cricoid; tracheal disruption; airway compromise from oedema [core]
- **Vascular injury** — carotid artery dissection or thrombosis (blunt cerebrovascular injury), jugular venous thrombosis; post-hanging stroke [core]
- **Hypoxic-ischaemic brain injury** — from cerebral hypoxia; cerebral oedema; secondary brain injury [core]
- Aspiration pneumonia from loss of consciousness
- Acute respiratory distress syndrome

b) List 3 examination findings supporting non-fatal strangulation. (3 marks)

- **Petechiae** on face, conjunctivae, or oropharynx (suggests venous obstruction with arterial preservation) [core]
- **Ligature marks** or contusions on the neck [core]
- Voice change — hoarseness or aphonia; stridor; subcutaneous emphysema [core]
- Subconjunctival haemorrhage
- Loss of consciousness or memory disturbance during or immediately after
- Loss of bladder or bowel control
- Headache, dizziness, neurological deficits

c) List 3 specific investigations to consider beyond standard trauma series. (3 marks)

- **Computed tomography angiography of head and neck** — assess for blunt cerebrovascular injury (carotid / vertebral dissection); cervical spine fracture; soft tissue injury [core]
- **Computed tomography of head** — ischaemic injury, oedema, haemorrhage [core]
- **Flexible laryngoscopy / fibre-optic examination** — laryngeal oedema, vocal cord injury, cartilage fracture [core]
- Magnetic resonance imaging of head if subacute presentation
- Ophthalmology examination for retinal haemorrhages
- Mental health assessment with CYMHS / mental health team and safety planning given the suicide attempt

References: EAST Practice Management Guidelines (current) • ATLS 10th edition (current) • Tintinalli's Emergency Medicine 9e Ch 252 • ACEM clinical policies and statements

Question 11 | Globe Rupture and Penetrating Eye Injury (11 marks)

A 45-year-old man presents to your emergency department with right eye pain and reduced vision after a metal-on-metal injury at work involving hammering. He reports a sudden sharp pain in the right eye while hammering. On examination, his right visual acuity is reduced to counting fingers, the pupil is teardrop-shaped (peaked superiorly), there is a dark spot on the cornea, and the anterior chamber appears shallow. Tonometry has not been performed. His left eye examination is normal.

a) List 4 examination features supporting globe rupture / penetrating eye injury. (4 marks)

- **Teardrop / peaked pupil** due to iris incarceration in the wound (peaks toward the perforation site) **[core]**
- **Reduced visual acuity**; potentially no light perception in severe cases **[core]**
- **Shallow or flat anterior chamber** (loss of aqueous humor through wound) **[core]**
- **Visible foreign body or extruded uveal tissue** (dark brown / black material — iris, choroid, or retina) **[core]**
- **Seidel sign positive** — fluorescein streaming from leak site under cobalt-blue light
- Subconjunctival haemorrhage (often circumferential, 8-ball-haematoma)
- Hyphaema (blood in anterior chamber)
- Hypotony (low intraocular pressure)

b) State 4 management priorities — emphasise what you would NOT do. (4 marks)

- **Apply a rigid eye shield (Fox shield)** — **do NOT pad the eye** with anything that applies pressure; do NOT remove any protruding object **[core]**
- **Do NOT attempt tonometry, do NOT use topical eye drops** (anaesthetic, antibiotics, dilating drops); do NOT irrigate; do NOT examine further than necessary **[core]**
- **Anti-emetics** (ondansetron 4-8 mg intravenous) — vomiting will increase intraocular pressure and worsen extrusion; treat pain **[core]**
- **Broad-spectrum intravenous antibiotics** — vancomycin 25 mg/kg + ceftazidime 2 g every 8 hours, OR per local protocol; tetanus update **[core]**
- Urgent ophthalmology referral and theatre booking for primary repair
- Computed tomography orbits to localise foreign body (magnetic resonance imaging contraindicated if metallic foreign body)
- Nil by mouth pending theatre
- Avoid Valsalva — keep patient calm and supine

c) List 3 long-term complications. (3 marks)

- Endophthalmitis (intraocular infection) — particularly with retained intraocular foreign body **[core]**
- Sympathetic ophthalmia — autoimmune uveitis in the contralateral eye (rare but devastating; may require enucleation if severe) **[core]**
- Vision loss (permanent) — varying degree from reduced acuity to no light perception; blindness **[core]**
- Retinal detachment, traumatic cataract, glaucoma
- Cosmetic deformity, phthisis bulbi (shrunken eye)

References: RANZCO Ophthalmology Trauma Guidelines • Tintinalli's Emergency Medicine 9e Ch 244 • ATLS 10th edition (current)

Question 12 | Hyphaema After Blunt Eye Trauma (9 marks)

A 22-year-old male presents to your emergency department after being hit in the right eye with a tennis ball during a match approximately 1 hour ago. He complains of pain, blurred vision, and headache. Examination of his right eye reveals blood layered in the anterior chamber occupying the lower one-third of the chamber. Visual acuity is reduced to 6/24. His intraocular pressure is 28 millimetres of mercury (normal 10-21). The pupil reacts sluggishly. There is no obvious globe rupture.

a) Describe the grading of hyphaema AND state the grade applicable to this patient. (2 marks)

- **Grade I:** less than 1/3 of anterior chamber. **Grade II:** 1/3 to 1/2. **Grade III:** 1/2 to total. **Grade IV (8-ball):** total filling of anterior chamber with clotted blood [core]
- **This patient = Grade I** (approximately 1/3 of chamber) [core]

b) List 3 examination components beyond the slit-lamp examination. (3 marks)

- Visual acuity (in each eye separately, with pinhole correction); document [core]
- Pupillary examination (light reflex, swinging light test for relative afferent pupillary defect) [core]
- Tonometry — exclude raised intraocular pressure (only if globe intact); fundoscopy for retinal injury / detachment [core]
- Fluorescein staining — exclude corneal abrasion or Seidel-positive globe rupture
- Extraocular movement assessment — exclude orbital wall fracture / muscle entrapment
- Examine for associated facial / orbital fractures
- Sickie screen if appropriate ethnicity (sickle cell disease worsens raised intraocular pressure and clot formation)

c) List 4 management priorities. (4 marks)

- **Bed rest with head elevation 30°** — promotes layering of blood, gravitational settling and reabsorption; avoid Valsalva, lifting, exertion [core]
- **Eye shield** (rigid Fox shield, NOT a pressure pad) over the affected eye; outpatient with strict re-presentation criteria for low-grade hyphaema in compliant patient; admission for higher grades [core]
- **Topical management** — cycloplegic (atropine 1 percent twice daily) reduces ciliary spasm and pain; topical steroid (prednisolone 1 percent every 2-4 hours) for inflammation; treat raised intraocular pressure with timolol or acetazolamide [core]
- **Ophthalmology review within 24 hours**; daily review while hyphaema present; warning regarding rebleed risk (peaks 3-5 days post-injury, occurring in 5-30 percent) [core]
- Avoid antiplatelets / anticoagulants if avoidable
- Surgical evacuation considered for total hyphaema, uncontrolled raised intraocular pressure, or corneal blood staining

References: RANZCO Ophthalmology Trauma Guidelines • Tintinalli's Emergency Medicine 9e Ch 244 • eTG (Therapeutic Guidelines, current)

Question 13 | Chemical Eye Injury (9 marks)

A 28-year-old construction worker presents to your emergency department 15 minutes after sustaining a splash of liquid alkali drain cleaner (pH 13) to his left eye while at work. He has had no first aid since the incident. He reports severe eye pain, blurred vision, and inability to open the eye. Examination of the left eye reveals diffuse conjunctival injection, blepharospasm, and a hazy cornea. The right eye is uninvolved.

a) State 4 immediate management steps in order of priority. (4 marks)

- **IMMEDIATE copious irrigation** — sterile saline or Hartmann's via Morgan lens, gravity-fed bag, OR continuous lavage; minimum 30 minutes; longer for alkali burns (alkali penetrate deeper) **[core]**
- **Topical anaesthetic** (e.g. tetracaine 1 percent or oxybuprocaine 0.4 percent) before irrigation to allow tolerance and effective lavage **[core]**
- **Check pH** with litmus paper or pH strip in conjunctival sac BEFORE and AFTER irrigation; continue irrigation until pH is 7.0-7.5 and stable for 30 minutes **[core]**
- **Eyelid eversion and sweep of fornices** to remove particulate matter / chemical deposits; cotton-tip applicator or forceps; examine under cobalt blue with fluorescein **[core]**
- Urgent ophthalmology consultation for grading and ongoing care
- Pain management — topical and systemic analgesia
- Tetanus update if appropriate

b) Describe 3 features that grade severity (Roper-Hall classification). (3 marks)

- **Corneal opacification / clarity** — grade 1 (clear), grade 2 (hazy with iris details visible), grade 3 (total opacity, no view), grade 4 (no view, opaque) **[core]**
- **Limbal ischaemia** (clock-hours of limbal blanching) — Roper-Hall: 0, <1/3, 1/3-1/2, >1/2 of limbus blanched **[core]**
- **Conjunctival epithelium / chemosis** extent; conjunctival vessel involvement **[core]**
- Hughes / Roper-Hall grade I has best prognosis; grade IV has very poor prognosis

c) List 2 long-term complications of severe alkali eye burn. (2 marks)

- Corneal scarring / opacification / neovascularisation → blindness **[core]**
- Limbal stem cell deficiency (irreversible loss of corneal regeneration); persistent epithelial defects **[core]**
- Symblepharon (adhesions between conjunctiva and eyelids)
- Glaucoma; cataract; phthisis bulbi

References: RANZCO Ophthalmology Trauma Guidelines • Tintinalli's Emergency Medicine 9e Ch 244 • eTG (Therapeutic Guidelines, current)

Question 14 | Geriatric Trauma — Anticoagulated Elderly (11 marks)

An 82-year-old woman from a residential aged-care facility presents to your emergency department after an unwitnessed fall. She has a history of permanent atrial fibrillation (on apixaban), severe osteoarthritis, hypertension, mild dementia, and macular degeneration. On arrival, she is conscious with a Glasgow Coma Score of 14 (E4 V4 M6) — her carer states this is her baseline. She has visible bruising over her left chest wall and complains of pain on inspiration. Her vital signs are: heart rate 100 beats per minute (irregular), blood pressure 110/65 millimetres of mercury, respiratory rate 26 breaths per minute, peripheral oxygen saturation 91 percent on room air, temperature 36.8 degrees Celsius. Examination reveals tenderness over the left lateral chest wall with bony crepitus over ribs 5-9.

a) List 4 specific concerns / vulnerabilities in the elderly trauma patient. (4 marks)

- **Anticoagulation** — significantly increased risk of haemorrhagic complications, particularly intracranial haemorrhage and haemothorax **[core]**
- **Reduced physiological reserve** — may appear deceptively stable initially due to limited compensatory tachycardia (β -blocker use, pacemaker dependence, blunted response with age) **[core]**
- **Pre-existing comorbidities** mask or complicate trauma assessment (cognitive impairment, vision loss, hearing impairment, fragile skin, osteoporosis) **[core]**
- **Fragility / osteoporotic fractures** — minor mechanism causes major injury; rib fractures are clinically significant in elderly with mortality rising 19 percent per additional rib fracture **[core]**
- **Frailty** — pre-existing functional status determines rehabilitation potential
- **Polypharmacy** — drug interactions, sedation, delirium risk
- **Atypical / occult presentations** (no peritoneal signs despite intra-abdominal pathology)

b) List 4 management priorities specific to this patient. (4 marks)

- **Reverse apixaban** if significant bleeding suspected — andexanet alfa if available, OR **4-factor prothrombin complex concentrate 50 IU/kg intravenous**; consider tranexamic acid 1 g intravenous **[core]**
- **Computed tomography head AND chest** — low threshold given anticoagulation; Canadian CT Head Rule mandates computed tomography (age >65); chest imaging for rib fractures and underlying lung injury **[core]**
- **Multimodal analgesia** — paracetamol regularly; cautious opioid (titrated low-dose); regional anaesthesia (serratus anterior plane block, intercostal blocks); AVOID non-steroidal anti-inflammatory drugs **[core]**
- **Active monitoring** — high-acuity bed with hourly observations; serial neurological checks, repeat computed tomography if any deterioration **[core]**
- Investigate / treat secondary causes of fall (syncope, infection, medications, hypoglycaemia)
- Multidisciplinary team — geriatrics, physiotherapy, occupational therapy, social work; delirium screening
- Identify pre-injury functional status and goals of care; engage patient/family in shared decision-making

c) List 3 measures for secondary prevention of future falls. (3 marks)

- **Comprehensive falls assessment** — Berg Balance test, Timed Up and Go; home environmental review by occupational therapist **[core]**
- **Medication review** using STOPP/START criteria — particularly anticholinergic and sedative load; consider continuing vs ceasing anticoagulation after multidisciplinary risk-benefit discussion **[core]**
- **Bone health** — DEXA scan, calcium and vitamin D supplementation, bisphosphonate or denosumab if osteoporotic **[core]**

- Vision and hearing assessment and correction
- Strength and balance training (physiotherapy referral)
- Postural blood pressure measurement; treat orthostatic hypotension

References: *ATLS 10th edition (current)* • *EAST Practice Management Guidelines (current)* • *eTG (Therapeutic Guidelines, current)* • *ACEM clinical policies and statements* • *RACGP Falls in Older Adults Guideline*

Question 15 | Bariatric Trauma (10 marks)

A 38-year-old male with a body mass index of 52 kilograms per square metre (estimated weight 210 kilograms) is brought to your tertiary emergency department after being involved in a rollover motor vehicle accident. He has obvious facial and chest injuries. He is conscious with a Glasgow Coma Score of 13 (E3 V4 M6), and his vital signs are: heart rate 118 beats per minute, blood pressure 130/80 millimetres of mercury, respiratory rate 26 breaths per minute, peripheral oxygen saturation 88 percent on 15 litres oxygen via non-rebreather mask.

a) List 4 ways obesity affects assessment and management of airway and breathing in this patient. (4 marks)

- **Difficult airway anatomy** — short thick neck, redundant tissue, increased Mallampati score, restricted neck extension, OSA risk; rapid desaturation (reduced functional residual capacity) **[core]**
- **Difficult mask ventilation** — increased airway resistance, chest wall weight, abdominal pressure on diaphragm; may require two-person technique **[core]**
- **Higher risk of failed intubation and hypoxia** — pre-oxygenation in 25-30° head-up / ramped position essential; consider awake fibre-optic intubation if predicted difficult; video laryngoscopy first-line **[core]**
- **Mechanical limitation of chest movement** — atelectasis common; need high positive end-expiratory pressure (10-15 cm H₂O); reduced thoracic compliance; difficult chest imaging interpretation (poor quality) **[core]**
- Difficult identification of anatomical landmarks for procedures (intercostal catheter, central venous access)
- Higher risk of OSA / sleep-disordered breathing

b) List 3 considerations for vascular access and fluid resuscitation in this patient. (3 marks)

- **Difficult peripheral venous access** — ultrasound guidance recommended; intraosseous access (sternum or proximal humerus better than tibia) is rapid alternative **[core]**
- **Central line placement** may be required earlier — femoral easier than internal jugular; ultrasound essential **[core]**
- **Fluid dosing** — based on lean body weight or adjusted body weight, NOT actual body weight (avoid excessive volume — pulmonary oedema, abdominal compartment syndrome risk) **[core]**
- Massive transfusion calculations also based on ideal body weight; over-transfusion risk

c) List 3 considerations for imaging this patient. (3 marks)

- **Computed tomography weight / table limits** — most table limits 200-225 kg, gantry diameter 70-80 cm; this patient may exceed limits; bariatric scanners (300+ kg, larger gantry) required **[core]**
- **Image quality degraded** by body habitus — increased radiation dose to achieve adequate images; longer scan times **[core]**
- **Plain radiograph penetration** limited; bedside ultrasound (extended FAST) may be more difficult / less sensitive **[core]**
- Patient transfer logistics — bariatric stretcher, additional staff required
- Echocardiographic windows poor — transoesophageal echocardiography may be required

References: ATLS 10th edition (current) • EAST Practice Management Guidelines (current) • NSW Institute of Trauma & Injury Management (ITIM) guideline • Tintinalli's Emergency Medicine 9e Ch 30

Question 16 | Crush Injury and Compartment Syndrome (11 marks)

A 40-year-old male labourer was trapped under a collapsed concrete wall for 4 hours during a construction-site accident. He has been freed and brought to your emergency department by ambulance. On arrival he is alert with a Glasgow Coma Score of 15. His vital signs are: heart rate 115 beats per minute, blood pressure 105/65 millimetres of mercury, respiratory rate 22 breaths per minute, peripheral oxygen saturation 98 percent on room air, temperature 35.8 degrees Celsius. His left lower limb is markedly swollen, tense, with diminished pedal pulses, severe pain on passive stretch of the toes, and tea-coloured urine in the catheter.

a) List 3 triad components of crush syndrome AND their physiological basis. (3 marks)

- **Hyperkalaemia** — release of potassium from damaged muscle cells; risk increased with reperfusion of compressed tissues **[core]**
- **Hypovolaemia** — third-space loss into damaged muscle (oedema with reperfusion); haemorrhage from associated injuries **[core]**
- **Acute kidney injury / rhabdomyolysis** — myoglobin precipitates in renal tubules; hyperphosphataemia, hyperuricaemia, metabolic acidosis **[core]**
- Disseminated intravascular coagulation
- Hypocalcaemia (calcium binds to released phosphate)

b) List 5 immediate management priorities. (5 marks)

- **Aggressive intravenous fluid resuscitation** — Hartmann's or 0.9 percent saline 1-2 L/h initially; targets urine output 1-2 mL/kg/h to flush myoglobin; anticipate large fluid requirements (10-20 L/24 h) **[core]**
- **Treat hyperkalaemia** — electrocardiogram immediately; calcium gluconate 10 percent 10 mL intravenous (membrane stabilisation); insulin 10 units + 50 mL 50 percent dextrose; salbutamol 10 mg nebulised; potassium exchange resin / haemodialysis if refractory **[core]**
- **Compartment pressure measurement and fasciotomy** — pressure greater than 30 millimetres of mercury OR delta pressure (diastolic blood pressure – compartment pressure) less than 30 mandate fasciotomy of all four leg compartments **[core]**
- **Urinary alkalinisation** — sodium bicarbonate to maintain urine pH greater than 6.5 (reduces myoglobin precipitation); evidence is limited but commonly recommended **[core]**
- **Renal replacement therapy** if anuric or refractory hyperkalaemia / metabolic acidosis; intensive care unit admission **[core]**
- Tetanus update; broad-spectrum antibiotics if open wounds
- Investigate for other injuries — chest, abdomen, pelvis with computed tomography

c) List 3 features of acute compartment syndrome on examination (the 5 P's — list 3 most reliable). (3 marks)

- **Pain out of proportion** to injury, worsening, often poorly responsive to analgesia (most reliable — earliest sign) **[core]**
- **Pain on passive stretch** of muscles in the affected compartment (very sensitive) **[core]**
- **Paraesthesiae / hypoaesthesia** in the distribution of nerves traversing the compartment (mid-stage finding) **[core]**
- **Pallor** (loss of capillary refill) — late
- **Pulselessness** — very late, often after irreversible damage
- **Paralysis** — late, irreversible damage
- Tense compartment on palpation

References: EAST Practice Management Guidelines (current) • ATLS 10th edition (current) • World Society for Abdominal Compartment Syndrome • Tintinalli's Emergency Medicine 9e Ch 269 • eTG (Therapeutic Guidelines, current)

Question 17 | Trauma in Pregnancy — Retrieval Considerations (11 marks)

You are the on-call retrieval consultant for a state helicopter retrieval service. A 32-year-old woman (known to be 32 weeks pregnant) has been involved in a high-speed motor vehicle collision in a remote area approximately 350 kilometres from the nearest tertiary obstetric service. Local ambulance on scene reports she is conscious (Glasgow Coma Score 14), with heart rate 130 beats per minute, blood pressure 95/65 millimetres of mercury, respiratory rate 26, peripheral oxygen saturation 92 percent on 15 litres oxygen via non-rebreather. She is complaining of abdominal pain and vaginal bleeding. The local hospital has no obstetric or operative service.

a) List 4 specific retrieval considerations for trauma in pregnancy. (4 marks)

- **Maternal positioning during transfer** — left lateral tilt 15-30° or manual left uterine displacement throughout transport (avoid aortocaval compression) **[core]**
- **Destination hospital choice** — must have obstetric, operative, blood bank, AND neonatal intensive care services to manage both mother and fetus; level III or IV centre at this gestation **[core]**
- **Communication and team composition** — activate trauma + obstetric + neonatal teams at receiving facility before arrival; consider obstetric consultant transfer or telemedicine support for retrieval **[core]**
- **Aircraft considerations** — pressurise to as low as possible (minimise hypoxia from altitude, gas expansion); avoid vibration / turbulence where possible; fixed-wing preferable over helicopter at this gestation if available **[core]**
- Fetal monitoring during transport (cardiotocography if equipped; otherwise serial fetal heart auscultation)
- Anticipate complications en route — preterm labour, abruption, perimortem caesarean indication; clear decision triggers

b) List 4 phone-based clinical advice priorities to give to the local ambulance / hospital team. (4 marks)

- **Activate trauma management** per ATLS with maternal-priority resuscitation — high-flow oxygen, two large-bore intravenous access, fluid bolus 1-2 L crystalloid, crossmatch 4 units, prepare blood for transport **[core]**
- **Manual left uterine displacement** or left lateral tilt; avoid supine position **[core]**
- **Anti-D 625 IU intramuscular** if Rh-negative (within 72 hours); send Kleihauer-Betke test **[core]**
- **Continuous cardiotocographic monitoring** if available; minimum 4 hours observation; longer if any concerning features (prepare to manage preterm labour, abruption) **[core]**
- Obstetric ultrasound if available — fetal heart, placental position
- Avoid drugs contraindicated in pregnancy where alternatives exist (nonsteroidal anti-inflammatory, warfarin, ACE inhibitors)
- Identify and document gestation, antenatal care history, blood group, allergies, last meal

c) State 3 indications for emergency / perimortem caesarean delivery during retrieval / on arrival. (3 marks)

- **Maternal cardiac arrest with no return of spontaneous circulation by 4 minutes** AND fundal height at or above the umbilicus (~20 weeks gestation) — aim for delivery by 5 minutes to relieve aortocaval compression and improve maternal resuscitation **[core]**
- **Fetal distress with maternal stability and viable gestation** (this case at 32 weeks) — emergency caesarean by obstetric team at receiving centre **[core]**
- **Severe placental abruption with fetal compromise** — operative delivery if viable; vaginal delivery if controlled and fetus deceased **[core]**
- Severe maternal trauma / shock where uterine evacuation aids resuscitation

References: ATLS 10th edition (current) • RANZCOG Statement (current) • NSW Institute of Trauma & Injury Management (ITIM) guideline • ACEM / CRRS retrieval medicine guideline (current)

Question 18 | Suspected Non-Accidental Injury — Infant (11 marks)

A 3-month-old infant boy is brought to your emergency department by his father, who states the baby has been sleepy all day and not interested in feeds. He also reports a recent cough and fever. On arrival the infant is pale, quiet, and unresponsive. His vital signs are: heart rate 50 beats per minute, blood pressure 95/50 millimetres of mercury, respiratory rate 14 breaths per minute (poor effort), peripheral oxygen saturation 84 percent on room air, temperature 34.8 degrees Celsius. Faint bruising is noted on the cheeks. Initial computed tomography of the head demonstrates bilateral subdural haematomas of mixed ages and diffuse cerebral oedema.

a) List 4 immediate medical management priorities. (4 marks)

- **Airway and ventilation** — endotracheal intubation given hypoxia, bradypnoea, decreased Glasgow Coma Score; rapid sequence induction with neuroprotective principles (ketamine 1-2 mg/kg, rocuronium 1.2 mg/kg) **[core]**
- **Fluid resuscitation** — 0.9 percent saline 20 mL/kg intravenous bolus (= 60 mL for estimated 5 kg infant); consider vasopressor support **[core]**
- **Treat raised intracranial pressure** — head-up 30°, hyperosmolar therapy (3 percent saline 5 mL/kg or mannitol 0.5-1 g/kg intravenous); avoid hyponatraemia **[core]**
- **Active warming** — Bair Hugger, warm fluids; correct hypothermia (worsens coagulopathy); bedside glucose, treat hypoglycaemia (10 percent dextrose 2 mL/kg) **[core]**
- Investigate and treat cause of bradycardia and shock — Cushing response from raised intracranial pressure most likely; treat as severe traumatic brain injury
- Empirical antibiotics if any suspicion of sepsis (cefotaxime + ampicillin per neonatal protocol)
- Continuous neurological monitoring; senior paediatric intensive care, neurosurgical, and trauma input

b) List 3 features supporting non-accidental injury (abusive head trauma). (3 marks)

- **Subdural haematomas of mixed ages** — indicating multiple separate injury events over time **[core]**
- **Bruising in pre-mobile infant** ('those who don't cruise rarely bruise') — facial bruises particularly suspicious **[core]**
- **History inconsistent with injury severity / mechanism**; vague or evolving history; no witnessed mechanism **[core]**
- Retinal haemorrhages on dilated fundoscopy (bilateral, multilayered)
- Other findings — fractures of differing ages, metaphyseal corner fractures, posterior rib fractures
- Delay in seeking medical care

c) Outline 4 management priorities related to non-accidental injury concern (separate from medical management). (4 marks)

- **Mandatory notification to child protection** per state legislation (e.g. NSW Department of Communities and Justice, Vic Department of Families) — all medical practitioners are mandatory reporters in Australia **[core]**
- **Detailed contemporaneous documentation** with diagrams / photographs (with consent), verbatim history; preserve clothing and any evidence as forensic specimens **[core]**
- **Skeletal survey + retinal examination + head magnetic resonance imaging** (in addition to computed tomography) within 24 hours to identify other occult injuries **[core]**
- **Examine siblings** for similar concerns; social work and paediatric protection unit involvement; police if escalation needed **[core]**
- Inform carers respectfully of clinical concerns and process; admit to hospital for safety while investigation under way

- Consider parental capacity / mental health, family stressors, prior domestic violence
- Multidisciplinary team — paediatrician, social work, child protection, police, possibly mental health

References: Royal Children's Hospital Melbourne — Clinical Practice Guideline • ACEM clinical policies and statements • RACP NAI guidelines • State child protection legislation

Question 19 | Pre-Hospital Triage at Multi-Casualty Scene (12 marks)

You are deployed as a flight medical officer with the state helicopter retrieval service to a road traffic crash approximately 270 kilometres north-west of the regional trauma centre. On arrival less than half an hour later, two patients remain trapped by their legs inside the vehicle. Fire and Rescue and ambulance are in attendance. Patient A: A male in his twenties; pulse 119 beats per minute, capillary refill 5 seconds, respiratory rate 34, Glasgow Coma Score 12, estimated extrication time 15 minutes. Cyanosed. Patient B: A female in her twenties; pulse 98, capillary refill 2 seconds, respiratory rate 46, Glasgow Coma Score 14, estimated extrication time 5 minutes. Eyes closed and screaming.

a) Decide which patient should be extricated FIRST AND justify your decision. (3 marks)

- **Patient A should be extricated first [core]**
- **Justification:** Patient A has signs of haemorrhagic shock (tachycardia 119, delayed capillary refill 5 seconds, tachypnoea 34, decreased Glasgow Coma Score 12, cyanosis suggesting hypoxia). He is physiologically unstable and his longer extrication time means he will deteriorate further if not prioritised [core]
- **Patient B** has more normal physiology (pulse 98, capillary refill 2, Glasgow Coma Score 14), is awake and vocalising, and has a shorter extrication time. Her eyes-closed, screaming presentation suggests pain and distress rather than physiological compromise [core]

b) List 4 injuries you are concerned that Patient B may have sustained AND state the reason for concern. (4 marks)

- **Lower-limb injury** (femur, tibia/fibula, pelvic fracture) — leg trapping; high-energy mechanism [core]
- **Severe pain** from undifferentiated soft-tissue / orthopaedic injury — eyes closed and screaming despite preserved Glasgow Coma Score and stable physiology [core]
- **Tachypnoea (respiratory rate 46)** may reflect pain, anxiety, head injury, or early respiratory compromise — must exclude pneumothorax / blunt thoracic injury [core]
- **Crush syndrome** developing during prolonged entrapment — risk of rhabdomyolysis, hyperkalaemia, compartment syndrome on reperfusion [core]
- Cervical spine injury (high-energy MVC)
- Closed head injury (Glasgow Coma Score 14 — needs thorough neurological examination)

c) List 5 management priorities for Patient A before extrication / transport (including specific medications and procedures). (5 marks)

- **Airway management** — high-flow oxygen via non-rebreather mask 15 L/min; consider rapid sequence induction with ketamine 1-2 mg/kg + rocuronium 1.2 mg/kg if Glasgow Coma Score deteriorates or airway compromise; in-line c-spine stabilisation throughout [core]
- **Two large-bore intravenous access** (or intraosseous if peripheral unsuccessful); 1-2 L 0.9 percent saline or Hartmann's bolus; activate massive transfusion protocol; tranexamic acid 1 g intravenous within 3 hours [core]
- **Pelvic binder application** at level of greater trochanters; splint long-bone fractures; control external haemorrhage with direct pressure or tourniquet [core]
- **Pre-extrication anti-crush** measures — 1 L Hartmann's prior to release of compression; calcium gluconate 10 percent 10 mL intravenous available; anti-arrhythmic medications drawn up; monitor for hyperkalaemia post-release [core]
- **Identify and treat reversible causes** of cyanosis — needle thoracocentesis if tension pneumothorax suspected; relieve any external compression; warm the patient [core]

- Splint and immobilise; cover with thermal blanket
- Communicate with retrieval coordination centre regarding receiving facility and ETA
- Document dynamic vital signs and interventions

References: *ACEM / CRRS retrieval medicine guideline (current)* • *ATLS 10th edition (current)* • *NSW Institute of Trauma & Injury Management (ITIM) guideline* • *EAST Practice Management Guidelines (current)*

Question 20 | Remote Penetrating Trauma — Telephone Advice (10 marks)

You are the on-call trauma consultant at a tertiary centre. A junior doctor at a small rural hospital (approximately 4 hours by road; 90 minutes by helicopter) telephones for advice. He is treating a 28-year-old male farmer who has been impaled by a metal fence-post through his left posterior chest, with the post still in situ. The patient is conscious, in pain, with vital signs: heart rate 110 beats per minute, blood pressure 105/65 millimetres of mercury, respiratory rate 24 breaths per minute, peripheral oxygen saturation 92 percent on room air. The local hospital has no on-site surgical team.

a) List 4 priorities you would advise the rural doctor regarding the impaled object. (4 marks)

- **DO NOT REMOVE the impaled object** in the rural setting — risk of catastrophic haemorrhage; the object may be tamponading vascular injury **[core]**
- **Stabilise the object in situ** with padding and bandages; trim if needed for transport but do not move the embedded portion **[core]**
- **Position the patient** as comfortably as possible; lateral decubitus with affected side down may improve ventilation; avoid supine if compromising the object **[core]**
- **Avoid removal even at receiving facility** until cardiothoracic / vascular surgical team available in operating theatre with cardiopulmonary bypass capability; CT will guide whether thoracotomy or sternotomy required **[core]**

b) List 3 priorities for stabilisation prior to transfer. (3 marks)

- **Two large-bore intravenous access** in upper limbs; bloods including group and crossmatch (4 units); commence balanced fluid / blood resuscitation; activate massive transfusion protocol **[core]**
- **High-flow oxygen, definitive airway if needed** (with consultant support — anticipate difficult RSI and possible need for surgical airway); consider intercostal catheter for pneumothorax / haemothorax **[core]**
- **Pain management and tetanus** — intravenous morphine titrated; antiemetic; tetanus update; broad-spectrum antibiotics (cefazolin) **[core]**
- Continuous cardiac monitoring, peripheral oxygen saturation, capnography if intubated

c) List 3 logistical / coordination priorities. (3 marks)

- Activate retrieval service immediately; receiving trauma centre to activate trauma team, cardiothoracic, vascular surgical, and operating theatre teams **[core]**
- **Aircraft considerations** — assess whether object will fit in aircraft (size, stretcher dimensions); may need pre-trimming with rural team's assistance **[core]**
- **Maintain communication** with referring team during retrieval (changes in physiology, evolving clinical picture); document all advice and interventions **[core]**
- Senior cardiothoracic / vascular consultant input from receiving centre by phone if needed during transfer

References: ACEM / CRRS retrieval medicine guideline (current) • ATLS 10th edition (current) • EAST Practice Management Guidelines (current) • NSW Institute of Trauma & Injury Management (ITIM) guideline

Question 21 | Diving Injury — Decompression Illness (9 marks)

A 35-year-old male recreational scuba diver is brought to your emergency department 2 hours after surfacing from a 30-metre dive (multiple deep dives over the previous 3 days). He developed progressive joint pain, fatigue, and confusion approximately 30 minutes after surfacing. On arrival to your emergency department he is alert (Glasgow Coma Score 14, mildly confused), with right shoulder pain, paraesthesia in both lower limbs, and hesitancy on bladder palpation suggesting urinary retention. His vital signs are otherwise stable on room air.

a) Distinguish decompression sickness from arterial gas embolism (3 features). (3 marks)

- **Decompression sickness:** nitrogen bubbles formed in tissues / blood from rapid ascent (Henry's law); typically delayed onset (minutes to hours); typically joint pain ('bends'), neurological, respiratory ('chokes'), or skin features **[core]**
- **Arterial gas embolism:** pulmonary barotrauma with air entering pulmonary veins → systemic embolism; **immediate onset** (within minutes of surfacing); stroke-like presentation, sudden cardiac arrest, focal neurological deficit **[core]**
- Both treated with hyperbaric oxygen therapy but arterial gas embolism is more time-critical and has higher mortality **[core]**
- Type I (mild) decompression sickness — joints, skin, lymphatic. Type II (severe) — neurological, respiratory, vestibular

b) List 3 management priorities. (3 marks)

- **100 percent oxygen via tight-fitting non-rebreather mask** (or endotracheal tube if intubated) — increases nitrogen elimination by accelerating diffusion gradient **[core]**
- **Supine / horizontal position** with left lateral tilt (suspected arterial gas embolism); intravenous access and isotonic fluid resuscitation **[core]**
- **Transfer to hyperbaric oxygen therapy facility** — definitive treatment (typically 6 atmospheres, US Navy Treatment Table 6); contact Diver's Emergency Service (DES Australia +61 8 8212 9242 / 1800 088 200) for advice **[core]**
- Avoid altitude during transport (helicopter at low altitude or pressurised aircraft)
- Monitor for deterioration; cardiopulmonary resuscitation if arrest

c) List 3 risk factors for decompression illness. (3 marks)

- **Rapid ascent** — exceeding safe decompression schedule **[core]**
- **Multiple repetitive dives** over consecutive days, especially deep dives **[core]**
- **Patent foramen ovale** (allows venous-to-arterial bubble passage) **[core]**
- Dehydration, alcohol use, fatigue
- Cold-water exposure
- Flying within 18-24 hours of diving

References: South Pacific Underwater Medicine Society guidelines (SPUMS) • Wilderness Medical Society practice guidelines • Tintinalli's Emergency Medicine 9e Ch 219

Question 22 | Trauma Care in a Resource-Limited Setting (9 marks)

You are working as the sole consultant at a small rural hospital with no on-site surgical service when a 32-year-old woman is brought in by family after falling from a ladder while picking fruit on her farm. She has fallen approximately 4 metres onto hard ground. On arrival she is alert with a Glasgow Coma Score of 15 but is complaining of severe back pain and unable to feel or move her legs. Her vital signs are: heart rate 60 beats per minute, blood pressure 85/55 millimetres of mercury, respiratory rate 18 breaths per minute, peripheral oxygen saturation 96 percent on 6 litres oxygen via Hudson mask, temperature 35.5 degrees Celsius. The nearest tertiary centre with neurosurgical service is 4 hours away by road or 90 minutes by helicopter.

a) List 4 immediate priorities specific to suspected spinal cord injury. (4 marks)

- **Strict spinal immobilisation** — log-roll for transfer; rigid cervical collar plus head blocks; spinal board for transfer only (not prolonged use) **[core]**
- **Maintain mean arterial pressure greater than 85 millimetres of mercury** with intravenous fluids and noradrenaline infusion (5-15 mcg/min titrated) to preserve spinal cord perfusion; treat neurogenic shock — atropine 0.5 mg intravenous for symptomatic bradycardia **[core]**
- **Active warming** — hypothermia common with high cord injury (loss of vasoconstriction); monitor core temperature **[core]**
- **Airway and ventilation** — high cervical injury (C5 or above) compromises diaphragm; anticipate respiratory failure; low threshold for intubation if any respiratory distress; manual in-line stabilisation during intubation **[core]**
- Insert nasogastric tube (paralytic ileus); urinary catheter (urinary retention)
- Avoid methylprednisolone (NASCIS evidence controversial; current ANZCOR / ITIM guidance AGAINST routine use)

b) State 3 priorities for retrieval coordination. (3 marks)

- **Immediate retrieval activation** — phone retrieval coordinator; provide structured handover (ISBAR); discuss patient stability, airway, urgency **[core]**
- **Tertiary centre activation** — neurosurgery, intensive care unit, trauma; alert to expected arrival; specialist input by phone during stabilisation **[core]**
- **Mode of transport** — helicopter if weather and resources allow (90 min vs 4 h road); fixed-wing for longer distances; balance speed vs altitude / vibration considerations for cord injury **[core]**
- Identify suitable accompanying personnel — advanced airway skills, vasopressor management
- Clinical record / imaging to be transferred with patient

c) List 2 documentation priorities for safe handover. (2 marks)

- **Detailed neurological examination** documented before transport — sensory and motor levels (ASIA classification), rectal tone, bulbocavernosus reflex; serial as condition evolves **[core]**
- **Drug administration log, fluid balance, vital signs trend, interventions**; clinical record / letter for receiving team; copy of imaging on transfer media **[core]**
- Information about family, allergies, medical history, allergies, last meal, current medications
- Time-stamped record of clinical events

References: ACEM / CRRS retrieval medicine guideline (current) • ATLS 10th edition (current) • NSW Institute of Trauma & Injury Management (ITIM) guideline • ANZCOR / ANZ Spinal Trauma