Chapter 1 Trauma, Shock, Head Injuries and Burns

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Multiple Choice Questions

[*Each single best answer (SBA) question comprises a stem and a number of answers. You are asked to decide which single item represents the best answer to the question.*]

1. The primary survey in trauma

a) Aims to identify all injuries
b) Should be completed before instituting any treatment
c) Staff must take relevant precautions to protect themselves
d) Should be performed only once
e) Includes AP X-rays of the c-spine, chest and pelvis

[Best Answer = c]

Explanation

The primary survey is intended to identify immediately life-threatening injuries in a systematic manner. It is broken down into steps which you will know as ABCDE (Airway, Breathing, Circulation, Disability, and Exposure). Appropriate diagnostic and resuscitative methods are employed simultaneously. Protection of the medical staff against communicable diseases is of paramount importance and a face mask, eye protection, water impervious apron and gloves should be considered minimum precautions. The patient should be constantly re-assessed to evaluate response to resuscitation. By repeating the primary survey regularly any deterioration in the patient's condition is noted and acted upon quickly. The secondary survey is a head-to-toe evaluation of the patient which begins only when the primary survey is complete, resuscitation well established with a return towards normalisation of the patients vital signs. A lateral c-spine, AP chest and AP pelvis are the initial trauma X-ray series carried out during the primary survey.

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2. Haemorrhage

a) Palpable carotid pulsation indicates normo-volaemia
b) Thirty per cent of circulating blood volume may be lost without changes in blood pressure
c) Leads to a decreased conscious level at an early stage
d) Normal capillary refill is > 2 seconds
e) Blood pressure is a good measure of tissue perfusion

[Best Answer = b]

Explanation

The human body's ability to compensate for fluid shifts is remarkable. Major organ perfusion is maintained by vasoconstriction of non-vital tissues such as the skin and splanchnic circulation, combined with an increase in cardiac rate and contractility. By the time hypovolaemia affects the cerebral circulation, and lowers the conscious level it will have reached a critical level. Haemorrhagic shock is "inadequate tissue perfusion and tissue oxygenation" as a result of haemorrhage. Perfusion is not synonymous with blood pressure and can be compromised before blood pressure falls. There are four stages of shock based on the percentage of blood loss as per the following table.

During stage I and II shock, the conscious level may be heightened.

Stage	Stage I	Stage II	Stage III	Stage IV
Blood loss (%)	<15%	15%–30%	30%–40%	>40%
Blood loss (ml)	<750	750–1500	1500–2000	>2000
Consciousness	Slightly anxious	Agitated	Confused	Depressed
Pulse rate	<100	>100	>120	>140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure	Normal	Decreased	Decreased	Decreased
Respiratory rate	14–20	20–30	30–40	>35
Urine output (ml/h)	>30	20–30	5–15	Negligible
Replacement	Crystalloid	Colloid	Colloid + Blood	Colloid + Blood

3. Cervical spine assessment

a) Adequate cervical spine (c-spine) immobilisation is obtained with either a hard collar or a spinal board head box
b) A normal lateral c-spine X-ray can exclude c-spine injury
c) The pre-vertebral tissue in the upper c-spine should be >5 mm on a lateral c-spine film
d) Swimmers view always shows the C7-T1 junction adequately
e) Intervertebral discs should be approximately of equal height

[Best Answer = e]

Explanation

C-spine assessment is often difficult in the acute situation where conscious level is altered and multiple injuries are present. Mechanical immobilisation of the c-spine requires a hard collar plus sand bags and tape or a head box. Clearing the c-spine in the emergency room requires a satisfactory clinical examination plus adequate c-spine radiology (C1-T1) and even then in cases of suspicion further imaging might be necessary. There should be a high index of suspicion of injury in multi-system trauma particularly if there is blunt injury above the clavicles. The pre-vertebral soft tissue in the upper c-spine should measure <5 mm, swelling in this area can signify underlying bony or ligamentous injury. Downward traction of the arms for lateral X-ray or a swimmers view aids visualising the C7-T1 junction but in some cases an adequate view cannot be obtained with plain X-rays and a CT scan is indicated.

4. Fluid replacement and venous access in trauma

a) Central venous cannulation is essential for initial fluid replacement in trauma
b) Venous cannulae flow rates increase in a linear fashion with the radius
c) Resuscitation fluids should be warmed to 60°C
d) Hartmann's solution (Ringers lactate) should be given carefully due to its potassium content
e) The internal jugular vein usually lies lateral to the carotid artery in the neck

[Best Answer = e]

Explanation

The flow rate of any tube is proportional to the fourth power of the radius. Hence, a central venous catheter (a long thin tube), whilst is useful to measure fluid status, is not ideal to replace fluid quickly. In contrast, a thick bore peripheral IV cannula (short and thick) is quicker to insert and has much better flow characteristics. Warmed fluids are important to prevent hypothermia and the temperature should ideally be 37°C–40°C. Hartmann's solution has a physiological potassium concentration and therefore will not induce acute hyperkalaemia with rapid infusion.

5. With regard to airway assessment in trauma

a) If a patient is talking, the assessor can move on to C for circulation.
b) Airway compromise should be suspected if noisy breathing is present
c) All trauma patients require intubation
d) C-spine control is only required if the patient has neck pain
e) Immobilisation devices should not be removed from the c-spine to facilitate intubation

[Best Answer = b]

Explanation

An unobstructed airway is paramount to facilitate delivery of oxygen. Patency must be ascertained before anything else and the ABC rule should always be followed. Airway obstruction can be partial or complete and may be associated with snoring, gurgling or stridor. Simple measures such as chin lift, jaw thrust and use of airway adjuncts such as a Guedel or nasopharyngeal airways may be sufficient to relieve obstruction, whilst c-spine stabilisation is maintained at the same time. A c-spine injury should be suspected in anyone with altered consciousness, injuries above the clavicles or where the history is suggestive of potential injury. Stabilisation equipment should be left in place until injury is excluded but may be removed temporarily to facilitate intubation providing manual in-line immobilisation of the head and neck is maintained.

6. Regarding chest drain insertion

a) Should be inserted in the mid-axillary line in the fifth intercostal space
b) When creating a track for the drain, keep close to the undersurface of the rib
c) It is the initial treatment for a tension pneumothorax
d) Asepsis can be overlooked in the trauma situation
e) A 12-French gauge (12G or 12F) drain is satisfactory for a tension pneumothorax

[Best Answer = a]

Explanation

The fifth intercostal space in the mid-axillary line is a safe site for chest drain insertion bilaterally. The neurovascular bundle of each rib lies in a groove on its undersurface; hence, the drain track should run on the upper surface of the rib. The initial management of a tension pneumothorax is by needle decompression. Preparation and insertion of a chest drain is not an instantaneous process and will often take longer than expected particularly in inexperienced hands. Standard aseptic techniques should still be used despite the hurried situation. A pneumothorax will be adequately drained with a 24G drain, however in the case where a haemothorax is present a larger size of drain (38G) is often more effective.

7. Regarding the physiology of head injuries

a) The skull vault allows for expansion as intracranial bleeding occurs
b) The normal intracranial pressure is usually close to the mean arterial pressure
c) It is possible to accommodate a mass of up to 100 ml without a significant raise in ICP
d) Increasing arterial pCO_2 causes cerebral vasoconstriction
e) Cerebral perfusion pressure = mean arterial pressure + the intracranial pressure

[Best Answer = c]

Explanation

The skull vault is a rigid cavity of a fixed volume. It contains brain, blood and cerebrospinal fluid (CSF) and increasing the volume of any one component will thus lead to a reduction in another or intracranial pressure will increase (Monroe-Kellie Doctrine). The cerebral perfusion pressure equals the mean arterial pressure minus the intracranial pressure; hence increasing the MAP or decreasing the intracranial pressure improves cerebral perfusion. Increasing levels of arterial CO_2 results in vasodilatation and should be avoided in the head injured patient.

8. Extradural haemorrhage

a) Is usually associated with a skull fracture
b) Often involves disruption of the middle cerebral artery
c) Loss of consciousness always occurs at the time of injury
d) Falling intracranial pressure leads to herniation of the uncus through the tentorium
e) Hemiparesis and third cranial nerve injury are both on the contralateral side

[Best Answer = a]

Explanation

Extradural haemorrhage occurs secondary to bleeding from the arteries supplying the skull. On CT there is typically a high density lens-shaped lesion on the inner surface of the skull. The middle meningeal artery is usually disrupted from a fracture in the temporal region of the skull. There is typically a brief loss of consciousness followed by a lucid interval. During this lucid interval the haematoma is expanding into the extradural space and compressing the brain inwards, stripping the dura off the skull as it expands (hence the convex appearance of the clot on the CT). The intracranial pressure (ICP) does not rise initially as the mass is accommodated; however, once the clot reaches a critical volume the ICP increases rapidly, causing a secondary lapse in the consciousness level. As the ICP rises further

the uncus (the medial aspect of the temporal lobe) herniates through the tentorium (the layer that divides the cerebral hemispheres from the brain stem and cerebellum). The third nerve passes through this opening and can be compressed at this point. The patient initially develops a constriction of the pupil on the affected side, which then begins to dilate up (Hutchinson's pupil). The fixed dilated pupil on the affected side is usually accompanied by a hemiparesis on the opposite side (remember the corticospinal fibres cross over). As the pressure continues to increase, the opposite pupil dilates up and eventually the brain stem "cones" through the foramen magnum.

9. Management of a burns patient

a) Carbon monoxide (CO) levels are rarely measured
b) CO-haemoglobin levels of >5% on arrival at hospital suggest serious poisoning
c) Circulatory optimisation for fluid losses takes priority over airway management
d) Increasing the inspired O_2 concentration reduces CO-haemoglobin half-life
e) Cherry red skin colouration is common in CO poisoning

[Best Answer = d]

Explanation

CO poisoning should be considered in all patients suspected of inhalation injury and those who have suffered burns in an enclosed area and such patients require CO measurement. Significant airway injury is suggested by facial burns, respiratory distress, inflammation/oedema of the mouth or oropharynx, hoarse voice, singed nasal hairs and carbonaceous sputum. An initial patent airway in this situation can be compromised as swelling develops, so early involvement of an anaesthetist is mandatory. CO-haemoglobin levels of >15% on arrival at hospital suggest serious poisoning. CO has a higher affinity for haemoglobin but its half-life can be reduced by giving high flow O_2. It should be remembered that the arterial oxygen concentration does not predict CO poisoning. Cherry red skin colouration is rarely seen.

10. Burns

a) One per cent of a patients body surface (BSA) area equates to the size of your palm
b) Partial thickness (second degree) burns are typically painless and insensate
c) In the "rule of 9's" the % body surface area of a whole leg equates to 18%
d) Superficial (first degree) burns frequently require skin grafting
e) In the acute setting, partial and full thickness burns are easily discernable

[Best Answer = c]

Explanation

The size of the patients palm (not the clinicians) approximates to 1% of their BSA. Partial thickness burns are painful, erythematous, mottled and associated with swelling and blisters. Superficial burns (first degree) cause erythema and cytokine release, and heal well without scarring. Differentiating between partial and full thickness burns is difficult in the acute setting and advice should be taken where uncertainty exists.

11. Regarding abdominal trauma in an unconscious patient

a) The diaphragm reaches xiphisternal level during inspiration
b) A laparotomy is indicated for blunt injuries
c) Major injuries can be reliably excluded by careful abdominal examination
d) Failure to respond to fluid resuscitation mandates an urgent CT scan
e) Diagnostic peritoneal lavage (DPL) is highly sensitive for intraperitoneal bleeding

[Best Answer = e]

Explanation

During expiration the diaphragm can reach nipple level. This is important to consider when dealing with penetrating injuries to the lower chest and so an intra-abdominal injury cannot be ruled out. In addition, the trajectory of the instrument may damage below the level

of the entry point. In general blunt trauma should be managed conservatively where at all possible although clinical examination is not always reliable. Failure to respond to fluid resuscitation in a patient suspected of having abdominal trauma indicates the need for urgent surgery. An unstable patient should not be transferred into a potentially dangerous environment for a CT scan.

12. With regard to pelvic fractures

a) Pelvic X-rays should be taken in all patients with multi-system trauma
b) Digital rectal examination is diagnostic
c) Urethral catheterisation should be performed as soon as urethral injury is suspected
d) Shenton's lines are always disrupted
e) Shock is common in isolated pubic rami fractures

[Best Answer = a]

Explanation

The pelvic X-ray is taken as part of the initial trauma series along with the chest and lateral c-spine. Digital rectal examination is important in identifying rectal injuries, a "high riding" prostate and diminished anal tone. A palpable sharp bone end should also increase your index of suspicion although a normal rectal examination clearly cannot rule out a pelvic fracture. If urethral trauma is suspected, a urethral catheter should not be inserted until a urethrogram is performed. Shenton's line is an imaginary line that follows the inferior margin of the neck of femur which continues with the superior margin of the obturator foramen. In certain pelvic fractures, such as those of the superior pubic ramus, Shenton's line can be disrupted. Usually, disruption of Shenton's line or asymmetry between sides is a sign of a fractured neck of the femur. Isolated pubic rami fractures are not usually associated with major haemorrhage.

13. Shock

a) Blood pressure is maintained in stage 3 shock
b) Neurogenic shock results in vasoconstriction
c) Systemic vascular resistance increases with anaphylactic shock
d) Cardiogenic shock may occur secondary to an arrhythmia
e) Thirty per cent blood loss equates to around 500 ml in a 70 kg adult

[Best Answer = d]

Explanation

Blood pressure falls in grade 3 shock, since the blood loss exceeds 30%. In neurogenic shock (where there is spinal transection) there is a loss of sympathetic outflow below the lesion, resulting in vasodilatation. Anaphylatic shock causes vasodilatation resulting in reduced systemic vascular resistance. Causes of primary cardiogenic shock include myocardial infarction, arrhythmia, and valvular heart disease. The normal circulating volume in an adult is 70 ml/kg which is approximately 5000 ml in a 70 kg man and hence 30% is approximately 1.5 L.

14. Burns

a) Arsenic poisoning should commonly be considered in house fires
b) In the Muir-Barclay formula the fluid volume is proportional to the patient's age
c) Tetanus immunisation must be given
d) IV cannulae for fluid resuscitation should never be placed through burned skin
e) Are a major cause of fatal accidents in children

[Best Answer = e]

Explanation

Burning plastic can cause hydrogen cyanide (not arsenic) poisoning which is particularly a problem with old style foam-filled furniture. Fluid requirements from the Muir-Barclay formula are the product of

(% Burn × Weight in kg) / 2. Whenever tetanus immunisation status is uncertain appropriate vaccination should be given. Burns covering >20% BSA require circulating volume support. Overlying burned skin is not a contraindication to IV cannula placement if lines cannot be established in unburned skin.

15. Central line insertion

a) The Seldinger technique is contraindicated
b) Head down tilt reduces the risk of air embolism
c) A chest X-ray is unnecessary post-procedure
d) In the mid internal jugular approach the cannula is aimed at the contralateral nipple
e) The subclavian vein is deep to the artery below the clavicle

[Best Answer = b]

Explanation

The Seldinger technique is the standard method for inserting central lines both in the subclavian and internal jugular approaches. Head down tilt reduces the risk of air embolus and distends the neck veins. A post-procedure X-ray is essential to check the line positioning and to rule out complications (pneumothorax and haemothorax). In the internal jugular approach, the cannula should be directed towards the ipsilateral nipple. The subclavian vein is superficial to the artery.

Case Studies

Case 1

Whilst out running a 25-year-old male is hit on his left side by a van travelling at 20 mph. On arrival of the ambulance he is alert, orientated and moving all his limbs. His heart rate and BP are 76 bpm and 116/70 mmHg, respectively. During transfer to hospital, venous access is obtained with a 14G cannula in his left antecubital fossa, through which 1000 ml of crystalloid is given. When he arrives at A&E his observations are 93 bpm & 117/90 mmHg.

a) How should oxygen therapy be administered?
b) Is venous access appropriate?
c) Comment on his vital signs.
d) What life-threatening chest injuries should be focused on in the primary survey?
e) The chest X-ray demonstrates fractures of the left ninth and tenth ribs laterally and blunting of the left costophrenic angle. What abdominal injury would you be suspicious of?

Answers

a) High flow oxygen should be delivered via a face mask with a reservoir bag to all trauma patients.
b) The location and size of the existing IV cannula is correct, but trauma patients should always have a minimum of two large bore cannulae.
c) His initial observations are acceptable, however, it is worth considering that fit patients compensate considerably for blood loss and his normal resting heart rate may be less than 60. Absolute vital sign measurements are important but so is their trend especially in response to treatment. In this case the patient's heart rate has increased despite 1000 ml of fluid. His systolic BP has not changed but his pulse pressure has decreased which suggests an increase in circulating catecholamines, and peripheral vascular resistance. A chest injury or intra-abdominal bleeding should be seriously considered.

d) Using the pneumonic ATOMIC, life-threatening chest injuries are, A — Airway obstruction, T — Tension pneumothorax, O — Open pneumothorax, M — Massive haemothorax, I — Intercostal disruption (note some people modify the mnemonic to ATOM FC, where F stands for "Flail chest"), C — Cardiac tamponade.
e) Patients with rib fractures of the left lower chest and those involved in rapid acceleration/deceleration injuries should be suspected of splenic injury.

Case 2

A 60-year-old lady with long standing COPD escaped from a house fire where an electric heater set fire to her bedroom furniture. She sustained partial thickness burns to the anterior aspect of both legs, thighs and right upper limb. Although there were no obvious burns to her face and her voice was audible she was continually coughing.

a) What is the first priority?
b) What signs might suggest an inhalation injury?
c) When should the anaesthetic team be involved?
d) What other investigations should be done at this stage?
e) What general management steps are required in this burns patient?

Answers

a) High flow humidified oxygen should be given immediately. If the patient has a patent airway she should be sat up in a comfortable position. This will reduce airway oedema and improve ventilatory function. Do not attempt to insert any airway devices until help has arrived, unless absolutely necessary, for fear of causing further distress to the patient.
b) Obvious signs include stridor and hoarseness, but more subtle signs include facial burns, singed eyebrows or nasal hair, carbonaceous sputum, and drooling/wheeze.
c) The anaesthetic team should be warned as soon as possible given a history suggestive of possible inhalation injury as the supraglottic airway can rapidly become obstructed due to oedema.
d) An arterial blood gas, CO-haemoglobin levels, and CXR are important initially. Note pulse oximetry is of limited value as it

cannot differentiate between oxy-haemoglobin and CO-haemoglobin and thus gives falsely high values.

e) Appropriate fluid resuscitation, assessment of burn depth and surface area affected, as well as identifying associated injuries and analgesia requirements.

Case 3

A young security guard sustained a stab would to the right side of his chest with a sharp object and was promptly driven to A&E by a colleague. Despite initially appearing well on arrival to A&E he was gasping for breath. The nursing staff immediately gave him high flow oxygen and connected him to monitoring — ECG, BP, HR, SpO_2, and RR.

a) You arrive on scene; the patient is obviously extremely unwell, what are your initial actions?

b) With tracheal deviation away from the site of injury, and a stab wound to the right eighth intercostal space what is the most likely diagnosis and what do you do?

After an initial improvement in his condition, it is now noted that the patient has become clammy and irritable. His heart rate has increased to 120 although his blood pressure is around the normal range.

c) In view of his deterioration what should be suspected?

d) How can this be confirmed?

Answers

a) Call for help; primary survey; adequate IV access; simultaneously treat problems that are identified in the ABC of the primary survey.

b) The clinical situation fits with a tension pneumothorax. This is a clinical diagnosis, and if suspected should initially be treated with an urgent needle decompression. Do not wait for a CXR to confirm your suspicion!

c) Assuming the chest drain is swinging satisfactory and the CXR post-drain insertion showed no other injuries and a good drain position, then concealed haemorrhage into the abdomen should always be at the back of your mind, when dealing with penetrating injuries to the lower chest.

Correct functioning of the chest drain can be checked either by looking for swinging of the fluid level with breathing or asking the patient to cough to see bubbles escaping. When abdominal trauma is considered there is a choice of investigations: Diagnostic Peritoneal Lavage (DPL), CT scanning and Ultrasound (USS). The choice of investigation should involve a senior clinician and will depend on the stability of the patient and in some centres the accessibility of the particular investigation. DPL — Is rapid, safe, and sensitive for the presence of intraperitoneal blood, but does not identify source of bleeding. It can also miss retroperitoneal injuries and is an invasive procedure. CT — Assists in managing certain types of injury conservatively, and identifies some injuries missed by DPL. In most hospitals CT scanning involves moving a potentially unstable patient into an isolated environment, which can be dangerous. USS — Portable, rapid (when available in close proximity), non-invasive, and accurate for significant haemorrhage. However USS requires skill to use, and cannot always identify all organs clearly and the source of the problem precisely.

Case 4

A 60-year-old man with chronic alcohol dependence falls down and bangs his head outside a social club after a "good" night out. Although he is alert and orientated a passerby calls for an ambulance as the patient is known to live alone. On arrival at hospital he is noted to have a mild occipital contusion. Neurological examination is unremarkable other than some mild ataxia.

a) What features in his social history are pertinent in his management?
b) Will a skull X-ray aid your management?
c) What observations should a "head injuries" (neurological observations) chart include?
d) What are the signs to look out for in a base of skull fracture?
e) What type of cerebral injury are chronic alcoholics at increased risk of, and what vessels are usually responsible?

Answers

a) Patients with chronic alcohol intake are at increased incidence of significant head injury. Alcohol intoxication makes assessment of the patient more difficult; but bear in mind that neurological findings cannot be assumed to be secondary to alcohol intake.
b) The presence of a skull fracture will indicate that the patient is at increased risk of a significant cerebral injury, but its absence alone cannot disprove a significant head injury. (Note: In a fully conscious patient the risk of an intracranial haematoma is 1:30 in the presence of a skull fracture and <1:1000 without a fracture).
c) Glasgow Coma Scale (GCS); pupilary response and size; limb movement; HR; BP; temperature; and respiratory rate should be recorded.
d) Signs of base of skull fracture include: CSF otorrhoea; CSF rhinorrhoea; haemotympanum; "Panda eyes" (bruising confined to the orbital margins); and "Battle's sign" (bruising over the mastoid process).
e) Patients with a history of chronic alcohol abuse develop cerebral atrophy and are at risk of subdural haemorrhage due to tearing of the cortical bridging veins.

Case 5

A 40-year-old engineer was electrocuted whilst working at an electrical substation. Contact was made between his right arm and the positive AC electrical supply.

a) In the absence of vital signs, what is the treatment of an electrocution victim?
b) What feature of the domestic electrical supply makes it particularly hazardous?
c) Why are electrical burns so damaging to tissues?
d) What is the significance of entry and exit sites?
e) What complications can occur secondary to muscle necrosis?
f) What syndrome is he at risk of with a muscle injury to his limb?

Answers

a) Cardiopulmonary resuscitation should be instituted along national guidelines (assumes the environment is now safe).
b) The frequency of current in a domestic electrical supply is 50 Hz. This frequency has a high risk of inducing ventricular fibrillation.

c) Electrical current will follow the routes of least resistance through the tissues. Nerves, blood vessels, and muscle are at particularly affected as they offer the least resistance to current flow. Injury is caused by direct heat and subsequent necrosis and thrombosis.

d) If electricity has passed through the patient there are usually two or more entry / exit wounds. Full thickness burns with a charred white edge suggest internal damage from an electrical burn. The internal damage (such as muscle necrosis) may far exceed the limited external appearance.

e) Muscle necrosis leads to myoglobin release, hyperkalaemia, and acidosis. Myoglobin release from damaged muscle cells can induce acute renal failure, hence adequate hydration and a good urine output should be maintained.

f) Electrical damage to muscle causes swelling and thereby increases the compartment pressure compromising tissue perfusion. All such patients must have careful circulatory observations to watch for the development of compartment syndrome.

Extended Matching Questions

EMQ 1

a. Tension pneumothorax
b. Pelvic fracture
c. Cardiac tamponade
d. Airway obstruction
e. Uncomplicated pneumothorax
f. Haemothorax
g. Aortic disruption
h. Flail chest injury

Choose a diagnosis from the list above, which most fits the trauma case scenarios described below:

1) Shock associated with absent breath sounds / dull percussion note of right lung field.
2) Injury to the chest with paradoxical motion of chest wall and hyperventilation.
3) Fractured left sided ribs after a fall, respiratory distress and trachea displaced towards the right.
4) Penetrating chest trauma; muffled heart sounds; jugular venous distension; and decreased BP.
5) Widened mediastinum.

Answers

1) f.
Dull percussion note to the chest with absent breath sounds would suggest fluid within the chest. In a shocked trauma patient, the most likely diagnosis would be a large haemothorax.

2) h.
Paradoxical moment of the chest wall suggests a chest wall injury with a flail segment.

3) a.
Respiratory distress and displacement of the trachea away from the injury suggest a tension pneumothorax. In addition you would expect absent breath sounds and a hyper-resonant chest on the affected side.

4) c.
Beck's triad consisting of increased central venous pressure, decreased blood pressure and muffled heart sounds are features of a cardiac tamponade. In reality, muffled heart sounds may be difficult to ascertain in a noisy trauma environment. In the trauma situation the key to correct diagnosis is having a high index of suspicion with the mechanism of injury, e.g. steering wheel trauma or chest stab wound.

5) g.
The patient reaching A&E with a disruption of the thoracic aorta will have a contained leak, free ruptures will have died on scene. There are a variety of other X-ray signs described, but a widened mediastinum is probably the easiest to appreciate.

EMQ 2

a. Pelvic fracture
b. Spinal injury
c. Urethral injury
d. Sternal fracture
e. Fractured neck of femur
f. Pneumothorax
g. Testicular torsion
h. Splenic rupture
i. Fracture to the femoral shaft
j. Microscopic haematuria

Select the most appropriate option for the patients described below:

1) Fall from a horse in a 25-year-old lady who has hypotension that responds to fluid resuscitation. She has a normal CXR. The abdominal USS shows minimal fluid in the abdomen and there is no evidence of long bone fracture.
2) A 70-year-old driver involved in a head-on collision with a wall at 30 mph. ECG demonstrated ST elevation in anterior leads and there is evidence of patchy pulmonary opacification.
3) A 30-year-old rugby player kicked in his flank. He is stable and has normal vital signs.
4) A 60-year-old man knocked down by a car. His right leg is shortened with swelling and deformity of the thigh. No other injuries are found and he is tachycardic on arrival.

5) A 35-year-old motorcyclist knocked off his bike at 50 mph. No evidence of long bone deformity. He has hypotension with bradycardia and paralysis of the legs.

Answers

1) a.
Hypotension that has responded to fluid resuscitation would suggest contained bleeding. Pelvic fractures should be considered in such a fall, particularly when other sources of blood loss are not apparent.

2) d.
Sternal fractures often occur in RTA's related to a seat belt injury or impact with the steering wheel. When severe they can be associated with pulmonary and cardiac contusion. Sternal fractures are best seen on a lateral sternal X-ray.

3) j.
Microscopic haematuria is not an uncommon finding in contact sports where blows occur to the loin. In the majority of cases there is no significant underlying renal injury.

4) i.
The location of a femoral fracture affects the limbs position. In a femoral shaft fracture there may be shortening of the leg, abduction at the hip, external rotation of the leg and thigh swelling. In addition haemorrhagic complications are greater from femoral shaft compared with femoral neck fractures.

5) b.
Spinal injuries should be suspected in trauma victims in the presence of any of the following: diaphragmatic breathing; hypotension with bradycardia (spinal shock); decreased anal tone; loss of sensation below the clavicles; and paralysis.

EMQ 3

a. CO level of 33%
b. Second degree burns to both legs and anterior abdominal wall
c. Extrication from house fire
d. Forty per cent superficial (first degree) burns
e. High-tension electrocution with entry and exit wound

f. Circumferential full thickness burns to forearm
g. Chemical burn with cement
h. Oxygen saturations of 85%
i. Paediatric non-accidental injury
j. Explosion from gas canister

Select the most appropriate scenario for the patients described below:

1) A patient requiring escharotomy.
2) An injury requiring copious washing with water.
3) A patient to be considered for hyperbaric O_2 therapy.
4) A patient with myoglobinuria.
5) A patient with a liver laceration.

Answers

1) f.
Circumferential full thickness burns to the forearm may compromise its viability and require fasciotomies to decompress the distal limb.

2) g.
Washing with copious amounts of water is particularly important in the case of chemical burns.

3) a.
Hyperbaric oxygen therapy should be considered in patients with CO levels >30%.

4) e.
Myoglobin release signifies muscle damage.

5) j.
Patients with burns involved in blast injuries and forceful accidents should be considered at high risk of other injuries such as blunt abdominal and chest trauma.

EMQ 4

a. CSF rhinorrhoea
b. Berry aneurysm
c. Childhood history of seizures

d. VII cranial nerve palsy
e. Severe acceleration / deceleration injury
f. Major blood loss
g. Treatment with warfarin
h. Whiplash
i. Lucid interval

Select the feature above most consistent with the following head injuries:

1) Base of skull fracture.
2) Extensive scalp laceration.
3) Extradural haemorrhage.
4) Subdural haemorrhage.
5) Diffuse axonal injury.

Answers

1) a.
CSF rhinorrhoea is leakage of CSF from the nose. It is a feature of a base of skull fracture as is Battle's sign, which is bruising over the mastoid.

2) f.
Do not underestimate the amount of blood loss from scalp lacerations, which can be major.

3) i.
Damage to the middle meningeal artery from fractures of the temporal bone is the usual cause of extradural haemorrhage. There is typically a loss of consciousness immediately post-head injury, and a return to full consciousness (lucid interval) before the neurological deterioration occurs as the haematoma develops.

4) g.
Patients on warfarin therapy are more prone to subdural haemorrhage following head injuries.

5) e.
Diffuse axonal injury results from shearing forces within the brain tissue from acceleration/deceleration injuries. It frequently has a poor prognosis and is often difficult to differentiate from hypoxic brain injury.

EMQ 5

a. High central venous pressure and low cardiac output
b. Hypercalcaemia
c. Urticaria and bronchospasm
d. Loss of sympathetic tone
e. Severe burns
f. Intracranial haematoma
g. Paracetamol overdose
h. Hypoglycaemia
i. Sinus arrhythmia
j. Fever and vasodilatation

Select the features/diagnosis most consistent with the following:

1) Neurogenic shock.
2) Anaphylactic shock.
3) Cardiogenic shock.
4) Hypovolaemic shock.
5) Septic shock.

Answers

1) d.
Neurogenic shock results from damage to the sympathetic pathways of the spinal cord. This causes loss of vasomotor tone and hypotension. In a multiple injured trauma patient this can exacerbate the physiological effects of hypovolaemia.

2) c.
Anaphylactic shock occurs as a result of immunological responses following exposure to a trigger agent. Typically the patient has angio-oedema, urticaria, dyspnoea and hypotension. Cardiovascular collapse occurs secondary to vasodilatation and loss of plasma from the circulating compartment. Bronchospasm is present in 50% of cases.

3) a.
Cardiogenic shock is caused by pump failure, which physiologically is reflected by a low cardiac output, increased filling pressures (CVP) and increased systemic vascular resistance.

4) e.
Hypovolaemic shock results as a loss of circulating volume (low CVP and BP). This can be due to loss of blood, plasma (as in major burns), or extravascular fluid (e.g. dehydration).

5) j.
Septic shock results in inadequate tissue perfusion caused by an infective agent. Inflammatory mediators are triggered which cause systemic effects such as increased capillary permeability, fever, and vasodilatation.