

SELF ASSESSMENT

Self Assessment Exercises in Emergency Medicine

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You are a medical officer attached to the Emergency Department of the British Military Hospital in Southern Iraq. It is your first day and you attend the department for the beginning of your morning shift where there are already two patients waiting to be seen.

1. A 45-year-old ex-Gurkha soldier, now employed as a civilian contracted security worker in Iraq, has noticed a painful swelling of his left ankle for the past three days. He does not recall any kind of trauma to his ankle preceding the onset of symptoms. He tells you that he was able to walk on the ankle at first but now finds he cannot bear weight at all on the affected side.

On examination you note that he is in significant discomfort. He has a pulse rate of 115 per minute and a temperature of 37.8°C (tympanic). The ankle is red, warm, generally swollen and tender with a marked restriction in both active and passive range of movement. X-ray investigation reveals features consistent with osteoarthritis but there is no sign of any acute bony problem.

- a. What other features of the history may be relevant?
- b. What other clinical examination(s) would you like to perform?
- c. What further investigations would you arrange?
- d. What is the likely diagnosis and what is your management plan?

2. A 19-year-old female private soldier presents requesting emergency contraception. She tells you that she had protected sexual intercourse twelve hours ago but the condom had split. She is usually fit and well and does not take any medications at all, having stopped the oral contraceptive pill 4 months before arriving in theatre.

- a. What important questions should be asked when taking a history from this patient?
- b. What examination(s) or investigation(s) should you carry out, and why?
- c. What treatment would you offer her, and what further advice would you give?

3. A 26-year-old officer is suddenly brought into the department being carried between

two other officers. He is unconscious and soaking wet. As you guide them to the resuscitation area you try to obtain a history from his companions. The two others tell you that the group had been undertaking their own endurance training by marching on a 5km loop around the base carrying 35lb of weight. Around 50 minutes after starting they had noticed their colleague staggering and looking unwell. They had encouraged him to keep going but after a further 5 minutes he had slowed to a stop and then collapsed. They poured all of the water they had left over him, loosened his clothing and flagged down a passing military vehicle to bring him to the hospital.

On examination he is breathing spontaneously but only responds to painful stimuli. He looks flushed and, despite much of his clothing being soaking wet, his skin feels hot. His pulse rate is 120 per minute, blood pressure 134/33mmHg and respiratory rate 32 per minute. The tympanic thermometer shows a reading of 39.6°C.

- a. What is the likely diagnosis?
- b. What are your management priorities?
- c. What initial investigations are indicated?
- d. What methods of cooling can be employed in hyperthermic patients such as this?

4. A tall, thin 21-year-old lance corporal has presented complaining of sudden right sided chest pain that he describes as sharp in nature, which started that morning at 0630hrs while he was out running with his section. He is now feeling quite short of breath even at rest. He is usually fit and well other than mild asthma for which he uses a salbutamol metered dose inhaler as required. He tells you that the last time he needed hospital treatment for his asthma was when he was 14 years old.

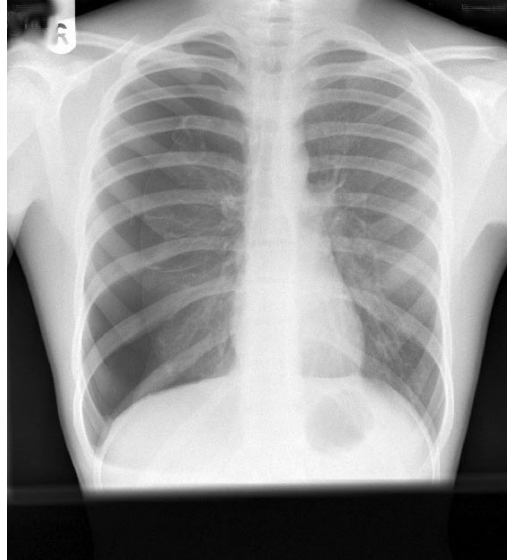
On examination he is breathless at rest with a respiratory rate of 28 breaths per minute but able to speak in full sentences. Pulse rate is 95 per minute and blood pressure 135/78mmHg. On examination of his chest you note that expansion is slightly reduced with a raised percussion note on the right side of his chest compared to the left. Auscultation reveals reduced respiratory sounds on the right hand side compared to the left. The trachea is not deviated. His peak expiratory flow rate (PEFR) is 550 l/min. An ECG shows normal sinus rhythm and you

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request a chest X-ray, which is shown in Figure 1.

Fig 1. Chest X-ray



- Describe the appearances on the chest X-ray and comment on the likely diagnosis.
- How would you manage this patient?
- What advice must you give the soldier before he leaves the department?

5. A 26-year-old senior aircrewman is evacuated by helicopter from Basra airport to the hospital by the Immediate Response Team (IRT). He has been involved in a fire 2 hours previously which occurred while he was filling a generator with fuel. A spark had ignited the fuel which exploded and splashed burning fuel onto his hands and arms, then set light to his clothing. The flames enveloped his head and neck. The fire was put out within seconds by bystanders. The IRT have administered high flow oxygen by mask and placed a large bore intravenous cannula into his right antecubital fossa. 1000ml of Hartmann's solution is running. He has been given 10mg of morphine and 10mg of metoclopramide IV. The burn wounds have been cooled and appropriately dressed.

On examination he is alert and orientated, able to speak clearly in full sentences with no signs of respiratory distress. You note that he has singed nostril hairs and eyebrows with partial thickness burns over the entire surface of his head and neck, distal half of the left arm and hand, with erythema over the entire anterior aspect of his right arm. He weighs 75kg.

- What are the priorities of assessment and immediate management of this patient?
- Estimate the total body surface area of skin affected (%TBSA) for this patient and calculate his fluid requirement in the first 24 hours.
- What are the management priorities for this patient following his initial resuscitation and stabilisation?

Answers to self assessment exercises

Question 1

- Obtain a thorough history regarding the possible presence of sexually transmitted diseases, a history of previous penetrating or blunt trauma (including iatrogenic) to the affected joint, a history of underlying joint disease (especially rheumatoid arthritis) or features suggestive of immunocompromise. A history of recent systemic illness, such as gastroenteritis or a respiratory tract infection may suggest a reactive arthritis. Symptoms of urethritis and conjunctivitis associated with arthropathy may suggest Reiter's syndrome.
- A careful examination of the whole lower limb is required to assess the peripheral neurology and circulation as well as to ascertain any lymphadenopathy. The unaffected side should also be examined for comparison. Evidence of bilateral oedema may indicate an alternative cause for tissue swelling such as right ventricular failure. Examination should be made of the whole body to explore for other joint swelling or tenderness and for other abnormalities such as psoriasis.
- Samples for full blood count, urea and electrolytes, liver function tests, glucose, C-reactive protein (and/or erythrocyte sedimentation rate) and blood cultures should be taken.
- Septic arthritis of the ankle. The differential diagnoses may have included reactive arthritis, osteomyelitis, gout or pseudogout.

Discussion

Infective arthritis may represent a direct invasion of joint space by a variety of micro-organisms, with bacterial pathogens being the most rapidly destructive. Failure to recognize and appropriately treat bacterial septic arthritis may lead to significant rates of morbidity and mortality. The incidence is approximately 8 cases per 100,000 person-years with males being slightly more commonly affected than females. In adults *Staphylococcus aureus* is the most common causative organism, followed by *Neisseria gonorrhoeae*. In children the most common infecting organism is *Haemophilus influenzae* followed by *Staphylococcus aureus*. The most commonly involved joint is the knee (50% of cases), followed by the hip (20%), shoulder (8%), ankle and wrists (7% each). In infants the most common joint affected is the hip. 10% of patients have multiple joint involvement (1, 2).

The principal sequel to infective arthritis is significant dysfunction of the joint, even if

treated appropriately. The mortality rate primarily depends on the causative organism. *Neisseria gonorrhoeae* has an extremely low mortality rate, while that of *Staphylococcus aureus* can approach 50%. Complications of septic arthritis include avascular necrosis (AVN) of the epiphysis, joint subluxation / dislocation, growth disturbances in children, secondary osteoarthritis and persistent or recurrent infection (2).

This patient requires admission and urgent orthopaedic review. With these clinical symptoms and signs, septic arthritis must be ruled out. Intravenous access is required for antibiotic treatment as well as for analgesia. A diagnostic joint aspirate is vital and this procedure must be performed under the most sterile conditions possible to prevent the introduction of infection. This sample should be sent for urgent gram stain, microscopy for organisms, crystals and cells, and culture. Empirical antibiotic therapy may be commenced based on likely organisms and then adjusted later depending on antibiotic sensitivities. Surgical management may be required and involves joint drainage and lavage which may be performed arthroscopically. Early joint mobilisation should be encouraged post-operatively (1-3).

Question 2

- You should take a quick though comprehensive sexual and gynaecological history including details of previous pregnancies, births, miscarriages or terminations, previous genito-urinary medicine (GUM) treatment and, most importantly, ask when her last menstrual period was. Enquire into any relevant medical history such as porphyria, hypertension or migraines and any regular medications (especially antiepileptics, or other enzyme inducing drugs). Also ask her if she thinks she may already be pregnant and if she will consent to having a pregnancy test performed in the department.
- A pregnancy test (urinary bHCG) should be carried out if hormonal emergency contraception is to be offered as current pregnancy is a direct contraindication to its use. Ask if she has successfully retrieved the condom herself - if she has 'lost' the condom this will need to be retrieved manually or by speculum examination.
- Progesterone-only emergency contraception (POEC) is indicated when there is non-compliance or accidents with the use of regular methods of contraception, or when women have had voluntary or imposed unprotected intercourse. Levonorgestrel 1.5 mg (two split doses or a single dose) and low or mid-doses (25-50 mg) of mifepristone offer high efficacy with an acceptable side-effect profile.

Discussion

A history of the event is important, including the time delay in seeking treatment. Contraindications to the use of emergency contraceptives should be specifically sought prior to administration. It is important to exclude the possibility that she has been the victim of a sexual assault as she may require counselling and further support as well as the provision of emergency contraception (4).

The current recommendations are to use progesterone-only emergency contraception (POEC). Single dose simplifies the use of levonorgestrel in this situation without an increase in side-effects (5, 6). Current pregnancy, a history of porphyria or a known allergy to the drug are the only stated absolute contraindications to use of levonorgestrel. However, caution should be exercised with a past history of ectopic pregnancy, with breast-feeding mothers or the concurrent use of enzyme inducing drugs (e.g. many antiepileptics, rifampicin, barbiturates etc). When taking enzyme inducing drugs the dose of levonorgestrel should be increased (usually double the dose to 3mg in total). If there are concerns about sexually transmitted diseases follow up should be arranged with the GUM clinic.

A routine pelvic examination is not indicated for the provision of hormonal emergency contraception (5). The patient should be advised that her next period may be early or late and that a barrier method of contraception needs to be used until then. She should be evaluated for pregnancy if menses have not begun within 21 days following emergency contraception. However, she should be reassured that some vaginal spotting and other changes in bleeding patterns following use of the POEC are not unusual (7).

Post-coital contraception has an approximate 0.5% - 1% failure rate (in the first 24 hours) but there is still a good chance of preventing pregnancy if taken up to 72 hours after unprotected sex. It is possible that she may still require further treatment at a later stage, including insertion of an intrauterine device up to 7 days or a termination of pregnancy. If she vomits within 3 hours of taking levonorgestrel then a replacement dose can be given (if necessary, domperidone is an effective anti-emetic). Finally, all clinicians should be alert to the possibility of an ectopic pregnancy in women who become pregnant or complain of lower abdominal pain after taking levonorgestrel (8).

Question 3

- Exertional heat illness. Differential diagnoses may include other causes of sudden collapse such as syncope, cardiac arrhythmias or hypoglycaemia.

- b. Assessment and resuscitation of Airway, Breathing and Circulation. Initiate external cooling.
- c. Clinical assessment should include a rectal temperature. A bedside glucose (BM stix) should be performed early to exclude hypoglycaemia. Blood samples should be taken for a full blood count, serum urea and electrolytes, liver function tests, glucose, creatine kinase and clotting studies. Arterial blood gases should be performed.
- d. The first and most practical form of cooling available is the 'strip-spray-fan' approach. The patient should be stripped to underwear, sprayed (or splashed) with lukewarm/tepid water and then fanned.

Discussion

Exertional heat illness is a medical emergency. The heat produced by the body during exercise exceeds heat loss mechanisms, resulting in an unchecked rise in core temperature. The exact pathophysiology is not clear, but several theories have been proposed (9,10). Predisposing factors among military personnel may include inadequate acclimatisation, sleep deprivation and fatigue, obesity, lack of physical fitness and dehydration as well as use of some drugs such as anticholinergics and alcohol (10, 11).

Typically, the patient collapses during exercise or work in a hot environment. By definition they will have a raised core temperature at the time of collapse, but if cooling has been initiated before arrival at hospital the temperature may have returned towards normal.

Definitions such as 'heat cramps', 'heat exhaustion' and 'heat stroke' are poorly reproducible terms and reflect a continuous spectrum of heat-related illness. Heat stroke implies raised core temperature in association with neurological compromise, most commonly a reduced conscious level.

This patient has a reduced level of consciousness (responding only to pain) and, therefore, may need rapid sequence induction and endotracheal intubation to secure his airway. High flow oxygen should be administered. Intravenous access should be obtained and an infusion of cold normal saline commenced. The cellular damage inflicted by heat-related illnesses is determined by the duration of hyperthermia, therefore cooling should be initiated immediately and run in parallel with other resuscitative measures.

This patient had a tympanic temperature reading on arrival. A rectal temperature is still considered to be the standard for core temperature assessment, and crucially continuous readings can be monitored using an indwelling probe (hence rate of cooling assessed). Central venous access will be necessary in some patients to enable closer

monitoring, regular blood sampling and assessment of the filling state. Urinary catheterisation is indicated in all but mild cases in order to enable more accurate monitoring of fluid resuscitation.

Rapid cooling is essential to reduce neurological morbidity. The 'strip-spray-fan' method is highly effective at facilitating heat loss by evaporation and convection in both pre-hospital and hospital settings and is recommended (11). Other methods include whole-body immersion, immersion of the wrists and hands, the use of ice packs, and invasive methods such as naso-gastric or bladder lavage with cold water. Practically, a combination of evaporative cooling and immersion of the wrists and hands in cold water is probably the most likely to be effective in the resuscitation room (12). In the event of violent shivering the use of chlorpromazine or benzodiazepines may be considered. However, there are arguments against the use of chlorpromazine due to the additional risk of hepatic toxicity and decreased threshold for seizures (13).

Investigations may reveal raised serum creatine kinase, transaminases, and LDH levels (from rhabdomyolysis). In severe cases evidence of organ failure will be evident, with abnormal renal function, hepatic function and coagulation abnormalities. In most cases, blood gas measurements initially reveal a respiratory alkalosis, secondary to hyperventilation, though a severe metabolic acidosis usually develops later due to glycosis and hyperlactaemia.

Following successful cooling measures patients will require supportive care with close monitoring. Despite normalisation of body temperature the inflammatory response and multi-organ dysfunction is not always prevented. The goals of further care are to control seizures, restore organ perfusion and tissue oxygenation, prevent myoglobin-induced renal injury and prevent cardiac dysrhythmias. Hypotension usually responds to volume expansion though vasopressor or inotropic agents may be required in individual cases.

Question 4

- a. The only abnormality of note is a large pneumothorax of the right side of more than 50% volume.
- b. The patient is symptomatic and has radiological evidence of a large pneumothorax (>2cm rim) and, therefore, simple aspiration is recommended as first line treatment (see discussion).
- c. Travel, diving and what to do if symptoms worsen should all be discussed with the patient prior to discharge.

Discussion

The diagnosis in this case is most likely a

spontaneous pneumothorax secondary to a rupture of subpleural bleb (note the history of asthma and the classic body habitus). Spontaneous pneumothoraces often occur in young healthy adult men (male to female ratio of 6:1). 85% of patients are less than 40 years old and the pneumothorax is bilateral in 10% of cases. It may occur as result of rupture of an acquired subpleural bleb. The frequency of spontaneous pneumothorax increases after each episode and most recurrences will occur within 2 years of the initial episode (14).

The volume of a pneumothorax may be estimated from a plain chest radiograph by assessing the largest distance from the chest wall to the pleural line. If this is below 2 cm then the pneumothorax may be defined as less than 50% and, if above 2 cm, more than 50% (15). The British Thoracic Society (BTS) guidelines for management of spontaneous pneumothorax (15) recommend that observation alone is safe for small, closed, mildly symptomatic spontaneous pneumothoraces. Repeated aspiration is reasonable for primary pneumothorax when the first aspiration has been unsuccessful (i.e. patient still symptomatic) and a volume of <2.5 litres has been aspirated on the first attempt. If simple aspiration or catheter aspiration drainage of any pneumothorax is unsuccessful in controlling symptoms, then an intercostal drain should be inserted. Primary pneumothorax patients treated successfully by simple aspiration should be observed to ensure clinical stability before discharge. Patients treated with simple aspiration are less likely to be hospitalised, less likely to suffer a recurrence of the pneumothorax over the next 12 months, have a reduction in total pain scores during hospitalisation and overall a shorter hospital stay (15).

Patients discharged without intervention should avoid air travel until a chest radiograph has confirmed resolution of the pneumothorax. Commercial airlines currently arbitrarily advise that there should be a 6 week interval between having a pneumothorax and travelling by air. There is no evidence that air travel precipitates recurrence of a pneumothorax, but recurrence during a flight may have serious repercussions. The BTS Air Travel Working Party stress that patients may travel safely 6 weeks after a definitive surgical procedure or resolution of the pneumothorax on the chest radiograph (15).

Strong emphasis should be placed on the relationship between the recurrence of pneumothorax and smoking in an effort to encourage patients to stop smoking. After a pneumothorax, diving should be discouraged permanently unless a very secure definitive prevention strategy such as surgical pleurectomy has been performed. The BTS guidelines on respiratory aspects of fitness

for diving deal with this in greater detail (16). All patients discharged after active treatment or otherwise should be given verbal and written advice to return to the Emergency Department immediately should they develop further breathlessness.

Question 5

- Priorities are management of airway, breathing and circulation. Early endotracheal intubation should be considered in this patient. High flow oxygen should be administered, and intravenous access achieved.
- For this patient the rule of nines suggests at least 9%TBSA for head and neck + around 5%TBSA for the distal half of his left arm and his left hand. The right arm is not included in the calculation as the skin on that side showed erythema only. Therefore the %TBSA in this case is estimated to be 14%.
Fluid requirement over first 24 hours is, therefore, 6700mls Hartmann's solution.
- Primary and secondary surveys. Analgesia. Cover burns. Arrange definitive burn care.

Discussion

The presence of head and neck burns with evidence of airway involvement represents a significant risk of airway compromise. Burns to the inside of the mouth or of the pharynx along with expectoration of soot and signs of respiratory distress would warn of an impending airway emergency and consideration should be given to early endotracheal intubation (17). Smoke inhalation with poisoning due to carbon monoxide (CO) and cyanide (CN) must also be suspected where relevant (unlikely in this case as the incident occurred outside in the open air). High concentration oxygen is mandatory for all significant cases of burn injuries.

There are two common conventions for the quick estimation of %TBSA, namely the Wallace 'rule of nines', and using the patient's own palmar surface area (minus fingers) to equal 1%. To obtain a more accurate calculation the Lund & Browder chart should be used and it should be noted that the rule of nines is only for use in patients aged 14 or over.

To calculate the fluid requirement in the first 24 hours from the burn injury, the Parkland formula should be used (4 mls per kg body weight per %TBSA burn). This uses Hartmann's solution (or Ringers Lactate), and should be in addition to normal daily fluid requirements. The first half of this fluid should be given in 8 hours and the second half over 16 hours. Adding to this the normal maintenance fluid requirements of approximately 2.5 litres per day suggests a total in 24 hours for this patient to be = 2500mls +

(4 x 14 x 75) mls = 6700mls. The best method of ensuring correct fluid resuscitation is to pay attention to clinical parameters, for example maintaining an adequate urine output (0.5 - 1.0ml / kg / hour in adults, 1.0 - 2.0ml / kg / hour in children) (18). With an inhalation injury the Parkland formula may overestimate fluid resuscitation requirements (19).

Once the airway is secure, breathing is being managed appropriately the correct fluid replacement strategy has been initiated, the next priorities follow normal ATLS principals. The patient should be fully exposed and a secondary survey carried out searching for associated wounds or injuries not seen during initial treatment and imaging requested as required. If respiratory thermal injury is suspected a baseline chest X-ray will be useful to assist with monitoring. A series of routine blood tests should be requested including full blood count, urea and electrolytes, glucose and a group and save in the event that blood products are required for resuscitation or peri-operatively (17).

Considerable analgesia will be required in most cases of partial thickness burns and should include opiates if necessary. Patient controlled analgesia (PCA) is a promising method but not always appropriate, and non-steroidal anti-inflammatories (NSAIDs) are also useful analgesics in burns. Appropriate and careful dressing of the wounds will markedly reduce pain from burns as well as other non-pharmacological methods (17). Fully circumferential limb burns or thoracic burns that limit respiratory excursion may require escharotomy and/or fasciotomy.

Guidelines for the treatment of burn injuries have been produced by the National Burn Care Review Committee (20) though facilities may vary nationally and, therefore, local guidelines should be consulted. Immediate referral to local burn centre or burn unit is recommended for people with complex burn injuries such as burns with dermal or full-thickness loss covering more than 5% TBSA (children) or 10% TBSA (adults). Special attention should be paid to burns to the face, hands, feet, perineum, or any flexure (particularly the neck or axilla) and circumferential dermal or full-thickness burns of the limbs, torso, or neck. Superficial partial thickness burns less than 5% TBSA in a fit and well patient aged between 5 and 60 years may be managed safely in primary care.

Basic wound care consists of cleaning (and keeping clean) the burn area with sterile water or saline and applying appropriate dressings. Controversy remains over whether to drain or de-roof blisters though, in practice, small or thick-walled blisters are often left intact, whereas large confluent or thin-walled blisters are usually drained.

Smoke inhalation is the principal cause of death in burn patients (21). Patients with as little as 15% total body surface burns with

mild smoke inhalation are at significant risk of respiratory failure and the need for ventilatory support. Age, burn size, inhalation injury, and co-morbid diseases are important factors in predicting survival of patients with burn injuries and important when attempting to objectively define the point when burn care may be futile (22).

Prophylactic antibiotics are not routinely indicated in any age group (23). However, extreme vigilance is required and with the development of signs of true infection, cultures should be taken and the wound inspected by senior clinician experienced with burn management prior to starting antibiotic therapy. Lastly, tetanus vaccination status should be checked and completion of primary course or booster offered as appropriate with the addition of human tetanus immunoglobulin for tetanus-prone wounds where the risk of infection is especially high.

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