

## SELF ASSESSMENT EXERCISES

### Self Assessment Exercises - Local Anaesthesia and Sedation

RM Heames, JE Smith

The use of local anaesthetics and sedation are an integral part of everyday practice for the general clinician or Medical Officer. These exercises illustrate situations where they may be utilised, and the discussions attempt to give some evidence base behind their use.

You are the Medical Officer in a tri-service training establishment. There is a district general hospital about 5 miles away with the usual facilities. The following patients may present to you during a normal working day.

1. A chef presents to you having sustained a 1cm laceration to the extensor surface of his left index finger whilst preparing food. Examination reveals no neurovascular deficit and tendon function appears intact.

- What are the options of anaesthetising the wound before primary closure?
- What is the local anaesthetic of choice?

2. An overweight soldier presents to you with a painful, tense, red, swollen, abscess in his groin. It looks ripe for incision. He gives no relevant past medical history.

- What are your options for anaesthetising the area?
- Why might it be problematic?
- What investigations might you perform to exclude a precipitating cause?

3. A 23 year old leading medical assistant is on his way to work when he is knocked from his bicycle, landing on the bonnet and windscreen of a car. He sustains a large scalp laceration that is bleeding profusely, but is otherwise apparently uninjured.

- What are the priorities in his management?
- How might you stop the bleeding?
- Are there any other considerations?

4. A 35 year old PTI presents to you having fallen over during circuit training. He has a gravel rash on his forearm, extending most of the way from the wrist to the elbow. He is otherwise uninjured.

- What are your options for anaesthetising the area?
- What are the maximum doses for the different options?
- What are the symptoms and signs of local anaesthetic toxicity?
- What is the treatment of local anaesthetic toxicity?

5. You are providing medical cover for a rugby match. During the game one of your front row players sustains an anterior dislocation to his left shoulder. He informs you that this has happened a couple of times before, and your clinical assessment suggests an uncomplicated anterior dislocation with no neurovascular deficit. You take him back to the medical centre and decide to attempt shoulder relocation.

- What is the definition of conscious sedation?
- How would you achieve it in this patient?
- What monitoring before, during and after the procedure would you consider essential?

### Answers to self assessment questions

#### Question 1

- Local infiltration or digital ring block.
- Plain lignocaine 1% - without adrenaline (epinephrine).

#### Discussion

These minor wounds are an extremely common part of medical practice, and the ability to adequately anaesthetise the area is vital in achieving a good outcome. The wound should first be assessed for neurovascular or tendon damage and may need exploration, cleaning and, assuming that there is no need for further intervention, closure. The choice between a digital ring block or local infiltration is usually down to the clinician, but a ring block has the advantages of anaesthetising the whole finger in case the wound needs to be extended or explored, and reducing the amount of tissue distortion from local infiltration of fluid (1).

Lignocaine (or lidocaine) 1% is the local anaesthetic of choice, due to its rapid onset of action and favourable side effect profile, but care should be taken to confirm that it is plain lignocaine without adrenaline. There is no requirement to use 2% lignocaine as its use will only increase the risk of side-effects. Adrenaline should not be used when anaesthetising extremities with an end-organ blood supply due to the theoretical risk of vasoconstriction and subsequent terminal ischaemia (including fingers, toes, ears, nose

Surg Lt Cdr RM  
Heames BM  
FRCA RN

Specialist Registrar in  
Anaesthetics  
Defence Medical  
Services  
Anaesthetic  
Department, North  
Hampshire Hospital,  
Aldermaston Road,  
Basingstoke,  
Hampshire,  
RG24 9NA.

E-mail:  
rheames@globalnet.co.uk

Surg Lt Cdr JE Smith  
MBBS  
MSc MRCP RN

Specialist Registrar in  
Emergency Medicine  
Defence Medical  
Services  
Emergency  
Department, Derriford  
MDHU, Plymouth,  
PL6 8DH.

E-mail:  
jason.smith75@virgin.net

and penis) (2,3). Local infiltration should be preceded by rinsing the wound in water, and local anaesthetic should be introduced through a fine (25G, orange) needle into the edges of the wound as the needle is withdrawn, having ascertained, by aspiration, that the needle is not in a vessel.

Before performing a digital ring block, anatomy of the neurovascular bundles should be considered. The common digital nerves are derived from the median and ulnar nerves, and divide in the distal palm into the volar digital nerves, to supply adjacent sides of the fingers, palmar aspect, tip and nail bed area. These main digital nerves are accompanied by digital vessels and run on the ventrolateral aspect of the finger beside the flexor tendon sheath. Small dorsal digital nerves derived from the radial and ulnar nerves supply the back of the fingers as far as the proximal joint, and run on the dorsolateral aspect of the finger. A 25 gauge needle should be inserted at a point on the dorsolateral aspect of the base of the finger and directed anteriorly to slide past the base of the phalanx (Figure 1). The needle is advanced until the resistance of the palmar dermis is felt, then 1ml of solution is injected as the needle is withdrawn 2-3mm to block the volar nerve, and 0.5ml is injected just under the point of entry to block the dorsal nerve. The procedure is repeated on the other side of the finger. This should cause numbness of the whole finger, enabling any necessary procedure to be carried out.



Fig 1. Digital ring block

### Question 2

- Local infiltration of lignocaine, regional anaesthesia or ethyl chloride.
- Infected tissue is acidic, therefore the efficacy of lignocaine is reduced.
- In any patient with an unexplained

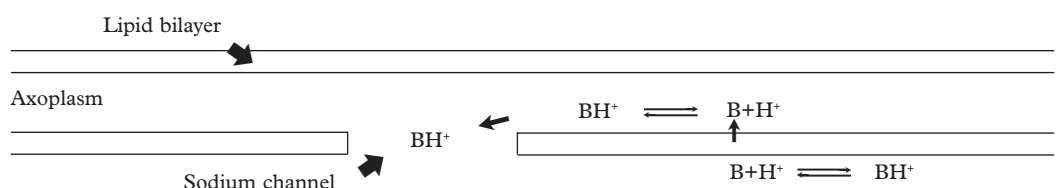


Fig 2. local anaesthetics cross the lipid bilayer in uncharged form (B) and re-ionize once inside the nerve (BH<sup>+</sup>). The BH<sup>+</sup> then sits inside the sodium channel thus blocking it.

infection, investigations (such as urinalysis and BM stix) should be performed to screen for predisposing factors such as diabetes mellitus.

### Discussion

The mode of action of local anaesthetics involves blocking the sodium channels which are responsible for nerve depolarisation and thus they stop an action potential travelling along the nerve fibre (Figure 2). This action is dependant on the local anaesthetic becoming non-ionized outside the nerve in order to pass through the lipid bi-layer before re-ionizing inside the nerve and being able to block the sodium channel (4). However, in infected tissue the pH is acidic, causing the local anaesthetic to remain ionised outside the nerve and less able to cross the lipid bi-layer (5). This results in less local anaesthetic inside the nerve and the effect of the local anaesthetic is, therefore, reduced.

Options for adequately anaesthetising the area include local application of a topical agent such as ethyl chloride, whose volatility allows the skin to transiently freeze. This is suitable if a quick procedure is necessary such as a simple incision and drainage of an abscess, as in this case. Otherwise regional anaesthesia proximal to the area of infection may be performed, where the pH of the tissues is normal (difficult to achieve in this case).

### Question 3

- Airway with cervical spine control  
Breathing with oxygen if available  
Circulation with haemorrhage control  
Disability assessment involving GCS, pupils and peripheral neurology  
Exposure and environment.
- Direct pressure over a clean dressing.  
Haemorrhage control may necessitate closing the wound with sutures, and a local anaesthetic with adrenaline may be used as an adjunct.
- There may be glass or other debris in the wound. Tetanus status should be checked. A full secondary survey should be performed.

### Discussion

As always this patient should be assessed and treated according to the ABC principles of

resuscitation. Care should be taken to immobilise the cervical spine until an injury can be excluded, and to control haemorrhage as part of circulatory assessment and treatment. Realistically in the given scenario, it is most appropriate that an emergency ambulance should take this patient directly to the nearby hospital, a place of definitive medical care, rather than delaying for assessment in the establishment medical centre. However, even in hospital, control of bleeding from scalp wounds is often forgotten in the assessment of trauma patients, but is important as external haemorrhage is one of the circumstances in which life-threatening amounts of blood can be lost (see Table 1). When assessing and closing such a wound the local anaesthetic of choice is lignocaine 1% with adrenaline 1 in 200,000 – the adrenaline causes vasoconstriction, diminishing local blood flow and aiding haemorrhage control. The addition of adrenaline also increases the duration of the nerve blockade by 50% and reduces absorption of the local anaesthetic into the systemic circulation by approximately 30%, thereby providing a greater margin of safety for systemic toxicity (6). From the history of the incident there may be other injuries so care must be taken to ensure a complete secondary survey has taken place. Finally, tetanus status must not be forgotten and a further dose should be given unless a firm history of tetanus toxoid vaccination has been given in the last 10 years.

Chest Abdomen Pelvis Retroperitoneum Bilateral or open long bone fractures External haemorrhage – onto the floor
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Table 1. 6 spaces where blood may be lost following trauma.

#### Question 4

- Topical lignocaine or infiltration of local anaesthetic.
- See Table 2.

Table 2. comparison of local anaesthetic agents.

Anaesthetic agent	Onset	Duration	Maximum dose without adrenaline	Maximum dose with adrenaline	Comments
Lignocaine	Fast	60-90 minutes	3 mg/kg	7 mg/kg	
Bupivacaine	Intermediate	3-10 hours	2 mg/kg	2 mg/kg	
Prilocaine	Fast	60-120minutes	6 mg/kg	8.5 mg/kg	
Tetracaine (Amethocaine)	Slow	60-180minutes	1.5 mg/kg		Ametop® contains tetracaine
EMLA (Eutectic Mixture of Local Anaesthetics)	Slow	Contains 2.5% prilocaine and 2.5% lignocaine. For doses see individuals above.			

- Perioral tingling and numbness, metallic taste, tinnitus, slurred speech, coma, light-headedness, seizures, apnoea, arrhythmias, cardiovascular collapse.
- Treatment of toxicity should be directed at looking after the Airway, Breathing and Circulation with adequate oxygenation, ventilation and control of seizures if they occur.

#### Discussion

Probably the most effective way to anaesthetise the area is to apply lignocaine gel and cover with an occlusive dressing for about half an hour. However, it is difficult to control the dose of lignocaine administered by this method, as absorption through the skin will vary. Other options include infiltration of a local anaesthetic around the edges of the wound, although this may not necessarily anaesthetise the entire area. If a large area has to be covered, the lignocaine may be diluted to achieve coverage. A comparison of local anaesthetic agents and their properties is given in table 2.

Adverse effects of local anaesthetics usually occur because of excessive dosage, rapid absorption or inadvertent intravascular injection. All local anaesthetics can cause toxicity of both the central nervous system and the cardiovascular system. Signs and symptoms tend to start with a metallic taste, numbness and perioral paraesthesia. This progresses onto slurring of speech, muscle twitching, grand mal convulsions, coma and apnoea. Cardiovascular symptoms tend to occur late with alterations in ECG morphology and arrhythmias (7). Treatment of any toxicity includes maintaining adequate ventilation and oxygenation, controlling seizures and cardiopulmonary resuscitation if appropriate (6-8).

#### Question 5

- Conscious sedation has been defined as “a technique in which the use of a drug or drugs produces a state of depression of the central nervous system enabling treatment to be carried out, but during which verbal

contact with the patient is maintained throughout the period of sedation. The drugs and techniques used to provide conscious sedation...should carry a margin of safety wide enough to render loss of consciousness unlikely" (9).

- b. Titration of intravenous morphine and midazolam.
- c. Pulse, blood pressure, oxygen saturations, ECG. Full resuscitation equipment, including airway and ventilatory support, should be available. Reversal agents should also be available. Somebody should be assigned to observe the patient during and after the procedure.

## Discussion

Conscious sedation has been a topic of much debate over the last few years, which has led to a tightening of regulations over who is able to practice it (in particular, control of general dental practitioners). If titrated to effect, it is a safe and effective method of providing pain relief during minor procedures such as reduction of a dislocated shoulder. If the level of sedation is deepened to the extent that verbal communication is lost, most of the advantages of conscious sedation are lost and the risks of the technique may be likened to those of general anaesthesia with an unprotected and uncontrolled airway (10).

Opioid and benzodiazepine combinations are frequently used to achieve sedation, amnesia and analgesia (in combination with an anti-emetic). Morphine is a naturally occurring opiate that can be administered orally or intravenously, but in this context should be given intravenously and titrated to effect to provide pain relief. Peak effect will occur 10-15 minutes after intravenous administration. Naloxone is an opioid receptor antagonist that displaces morphine from its receptor. Its half-life is much shorter than morphine so care should be taken to ensure that patients are observed following its administration. Midazolam is a benzodiazepine that provides anxiolysis and amnesia and should be titrated according to effect in a similar way to morphine. It may only take 1-2mg of midazolam in combination with morphine to obtain the desired effect. Flumazenil is the reversal agent for benzodiazepines and has a very short half-life of only 60 minutes, which is shorter than that of most clinically used benzo-

diazepines. Flumazenil may cause agitation, anxiety and rarely seizures if the patient is reversed too quickly. A low dose propofol infusion with or without a short acting opioid is another alternative and its acceptance and use may increase over time (11).

The Association of Anaesthetists of Great Britain and Ireland (AAGBI) recommend that the same monitoring used for general anaesthesia should be used for conscious sedation. This monitoring should be instituted before the start of the procedure and continued until the return of full consciousness. Minimal monitoring required is heart rate, ECG, pulse oximetry, non-invasive blood pressure and the continued presence of a person with appropriate skills. Full resuscitative facilities should be immediately available and intravenous access should be secured. Resuscitation drugs and specific reversal agents should also be at hand.

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