

1. Which is not an intraosseous insertion site using standard 25mm EZ IO needle
 - a) Proximal humerus
 - b) Proximal tibia
 - c) Distal femur
 - d) Sternum

2. Regarding blood tests taken from an IO, which has good correlation with venous blood
 - a) WCC
 - b) Platelet
 - c) pH
 - d) Potassium

3. Which is **not** a complication of IO access
 - a) Prolonged insertion time
 - b) Osteomyelitis
 - c) Compartment syndrome
 - d) Necrosis of epiphyseal plate

4. Which is a pediatric specific complication of CVC insertion
 - a) Pneumothorax in IJ and subclavian insertion
 - b) Infection and hip joint septic arthritis in femoral CVC insertion
 - c) Hepatic vein insertion of femoral CVC
 - d) Air embolism in IJ CVC insertion

5. Regarding umbilical vein cannulation which is correct
 - a) Can be used up to 1 month of life
 - b) Should not be used like a CVC
 - c) Should be inserted about 7mm from the umbilical stump in a 3kg neonate
 - d) Malposition areas include into atria or into portal vein

6. Regarding the three different CVC insertion sites (IJ, subclavian, Femoral) which is most correct
 - a) Internal Jugular CVC have the lowest bloodstream infection rate of the 3 sites
 - b) Femoral and internal jugular sites have similar bloodstream infection rates
 - c) Subclavian site has the highest risk of DVT
 - d) Internal Jugular and subclavian sites have similar risk of pneumothorax

7. Which is **not** true regarding blood pressure measurement devices
 - a) Automatic BP devices using Oscillometry measures maximum oscillations as Mean Arterial Pressure (MAP) then estimates systolic and diastolic BP by an empiric algorithm
 - b) NIBP measurement can underestimate SBP by more than 30 mmHg in a hypotensive vasoconstricted patient
 - c) The Allen test used to confirm collateral blood flow in radial artery line insertion is inaccurate in predicting post catheter hand ischaemia
 - d) MAP is inaccurate if an arterial line system is overdamped or underdamped

8. Which is true of recommendations of the international consensus conference for MAP targets in the following conditions
 - a) Aim MAP = 40 in uncontrolled hemorrhage due to trauma
 - b) Aim MAP = 65 in traumatic brain injury
 - c) Aim MAP > 90 in non-trauma related shock
 - d) MAP > 65 in septic shock will improve indices of organ perfusion such as lactic acidosis, urine output and capillary blood flow

9. Regarding CVP waveforms which is **not** correct
 - a) a wave is due to atrial contraction during diastole and is enlarged in pulmonary HT
 - b) c wave is due to bulging of tricuspid valve and is absent in AF
 - c) v wave is due to venous return rising atrial pressure and is enlarged in tricuspid regurg
 - d) x descent is due to atrial relaxation and y descent is due to atrial emptying during diastole; they can both be exaggerated in constrictive pericarditis

10. Regarding CVP measurement which is **not** correct
 - a) Ultrasound guided CVP measurements correlates well with formal echo measurements
 - b) CVP measures do not correlate with circulating blood volume or changes in blood volume
 - c) After a 250 ml fluid bolus challenge if the CVP increases > 5 mmHg a second fluid bolus should be given as it suggests a hypovolaemic state
 - d) CVP in a mechanically ventilated patient should increase with inspiration whilst in a spontaneously ventilating patient CVP should decrease with inspiration

11. Raising the legs by 30 degrees and holding for 1 minute will
 - a) Give approximately 500mL of blood in a 70kg person
 - b) Provide changes in HR, BP, CVP or CO that persists for approximately 10 minutes

- c) Be as sensitive and specific at predicting volume response as pulse pressure variation during positive pressure mechanical ventilation
 - d) Not produce any changes in a mechanically ventilated patient as intra-thoracic pressure is too high
12. With respect to central venous saturation of oxygen (ScvO₂) which is correct
- a) It is usually 2-3% higher than mixed venous saturation of oxygen (SmvO₂)
 - b) It can be up to 10% higher than SmvO₂ in shocked states
 - c) Trends in ScvO₂ do not reflect trends in SmvO₂
 - d) Low ScvO₂ with normal observations do not suggest global tissue hypoxia
13. Which does **not** typically cause a high serum lactate level in an unwell individual
- a) Ringers Lactate (Hartmanns solution) infusion
 - b) Thiamine deficiency
 - c) Carbon monoxide poisoning
 - d) Lactulose
14. Which is **not** true of elevated lactate levels
- a) Hyperlactatemia is not always accompanied by low bicarb and raised anion gap
 - b) Persistently elevated lactate >24 hours is associated with mortality up to 90%
 - c) In shocked patients, lactate clearance (levels decreasing) within 6 hours is associated with increased 60 day survival
 - d) Lactate >4 but with normal observations is not associated with increased ICU admission rates and mortality

Answers

1. D (Sternum requires a specialized device – LITFL IO access revised 10 JUNE 2015)
2. C (Although potassium has a 11% higher reading from IO compared to venous it may not be significant in resus.
Tintinalli states good correlations with Hb, Na, Cl, bili, pH, bicarb, urea, creat, Rh, ABO and poorer correlation with leuks, plt, glucose, K, LFTs, PCO₂, PO₂.
LITFL state good correlation with Hb, Cl, glucose, urea, creat, Alb and poorer correlation with WCC, plt, CO₂, Na, K, Ca)
3. A (Average insertion time seconds rather than minutes, other complications include extravasation; fracture; failure; air or fat microemboli; local haematoma; pain)
4. C (hip septic arthritis is more common in pediatrics but not unique to them)

5. D (Within 14 days of life, equivalent to a CVC, Depth in cm 1.5 x weight in kg or measure from shoulder to umbilicus and plot on graph so 4.5 cm on a 3 kg neonate. RCH guidelines Umbi VC)
6. B (Tintinalli states fem CVC has way higher infection rates BUT
Parienti et al. Intravascular complications of CVC by insertion site NEJM 2015: subclavian has lowest bloodstream infection and DVT rates, IJ and Femoral have similar infection and DVT rates, subclav has higher pneumothorax rate than IJ.
www.nejm.org/doi/full/10.1056/NEJMoa1500964?rss=searchAndBrowse#t=articleResults)
7. D (Overdamping can underestimate SBP and DBP whilst underdamping can overestimate SBP and DBP but MAP remains the same)
8. A (uncontrolled hemorrhage in trauma aim MAP 40, traumatic brain injury aim MAP 90, other forms of shock MAP > 65, in refractory septic shock increasing MAP > 65 with fluids and vasopressors increases oxygen delivery but does not improve indices of organ perfusion)
9. B (AF causes absent a wave and x decent, LITFL CVP measurement revised 8 March 2015)
10. C (If CVP rises by 2mmHg or less after a 250ml bolus then hypovolaemia is likely whilst volume overload is likely if it rises by > 5 mmHg)
11. C (equivalent to a 300ml bolus in a 70kg person, lasts up to 2-3 min)
12. B (ScvO2 usually 2-3% lower than SmvO2 since ScvO2 measures only upper portions of the body and it extracts more O2 than the lower body in healthy individuals, in shocked states ScvO2 is 5-10% higher than SmvO2 as bowel blood flow is redirected to cerebral circulation, trends in one reflect trends in the other, <70% indicates global tissue hypoxia even if obs normal)
13. A (Pathophysiological causes: shock, seizure, DKA, malignancy, thiamine deficiency, malaria, HIV infection, CO poison, cyanide poison, mitochondrial myopathies. Drugs: metformin, simvastatin, lactulose, anti-retrovirals, niacin, isoniazide, linezolid.
Ringers Lactate or Hartmanns does not cause a high lactate
<http://emcrit.org/pulmcrit/three-myths-about-plasmalyte-normosol-and-lr/>)
14. D (lactate >4 is associated with increased mortality and ICU admits regardless of obs)