

**PRACTICE QUESTIONS  
for the Certified Nurse in Critical Care – Canada examination**

The following questions are intended for practice only and represent a random sampling (but not exhaustive list) of possible topics that could be tested as part of the critical care certification examination. Questions have been designed to test assorted competencies listed in the blueprint for the Canadian Nurses Association Certified Nurse in Critical Care Examination. The blueprint is available from the Canadian Nurses Association website at:

[http://www.cna-aiic.ca/CNA/documents/pdf/publications/CERT\\_Critical\\_Care\\_Adult\\_e.pdf](http://www.cna-aiic.ca/CNA/documents/pdf/publications/CERT_Critical_Care_Adult_e.pdf)

The degree of difficulty for these questions may be higher or lower than questions on the actual examination; questions have been developed to encourage a review of a variety of topic areas. Questions have been developed independent of the Canadian Nurses Association Critical Care Certification Examination Committee review.

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**CASE 1**

Mr. Jackle, 68 yrs old, is admitted with hypotension and respiratory distress requiring intubation following a large ST elevation anterior-lateral wall myocardial infarction.

**Case 1: Question 1**

**Blueprint Competency Being Tested: 2.1a**

1. Shortly after insertion of a right subclavian catheter, he develops worsening shortness of breath and bibasilar crackles. Blood is noted to be backing up from the central venous catheter and his oxygen saturation decreases with supine positioning. Which one of the following problems is consistent with these findings?
  - a. Pulmonary embolus
  - b. Right heart failure
  - c. Cardiac pulmonary edema
  - d. Hemopneumothorax

**Rationale for Correct Response:**

c) Anterior wall MI is typically associated with left ventricular dysfunction with increased left ventricular pressures. High left ventricular pressures back up to the pulmonary system, causing pulmonary congestion. Hallmarks of cardiac pulmonary edema include bibasilar crackles and orthostatic hypoxemia or distress. Elevated pulmonary pressures are transmitted to the right side of the heart and cause CVP elevation (blood backing up from central line) and peripheral edema.

Although pulmonary embolus, hemopneumothorax or right heart failure can cause right atrial pressure elevation, the scenario is more consistent with right atrial pressure elevation secondary to left heart failure.

### Case 1: Question 2

#### Blueprint Competency Being Tested: 2.1b

2. Mr. Jackle will be monitored for signs of reinfarction. Which one of the following lab tests would best indicate reinfarction?
  - a. Creatinine kinase
  - b. Cardiac troponin
  - c. Lactate dehydrogenase
  - d. Venous oxygen saturation

#### Rationale for Correct Response:

a) Creatinine kinase (CK) and cardiac troponin follow a similar pattern of elevation following myocardial injury (CK ~2-8; cardiac troponin ~3-12 hours post injury). CK will fall and normalize within 1-3 days, while cardiac troponin will remain elevated for 5-14 days (There are two subtypes of cardiac troponin. Cardiac troponin I remains elevated for 5-9 days, whereas, cardiac troponin T can remain elevated for up to two weeks).

Cardiac troponin is a more specific marker of heart muscle injury than CK, making it a better diagnostic test of heart muscle damage. On the other hand, the rate of enzyme rise is more dramatic for CK than troponin, creating a stronger signal for early detection of myocardial infarction. As well, because CK returns to normal much faster than troponin, the CK is better for detecting reinfarction – as in this scenario (a second rise in the CK after its return to normal). Conversely, the persistent elevation in the troponin can be useful in detecting an infarct that is several days old.

LDH would not be useful for detecting reinfarction, because it takes much longer to rise than CK or troponin (72 hours) and remains elevated for over 2 weeks. Venous oxygen saturation (decrease) is useful for detecting a low cardiac output but is not specific to myocardial infarction.

### Case 1: Question 3

#### Blueprint Competency Being Tested: 2.1d

3. Mr. Jackle develops cardiogenic shock, respiratory failure and acute kidney injury. He is receiving epinephrine at 2 ug/min and is fully ventilated on an FiO<sub>2</sub> .6 with PEEP 10. His SpO<sub>2</sub> is 95%, HR 74 (sinus rhythm), BP 102/58 (MAP 72), CVP 14 mmHg, Hb 82 and central venous oxygen saturation (ScvO<sub>2</sub>) 42%. Which one of the following interventions is most appropriate?
  - a. Metoprolol
  - b. Captopril
  - c. Increased FiO<sub>2</sub>
  - d. Packed cells

**Rationale for Correct Response:**

d) A venous oxygen saturation below normal (< 70%) indicates increased tissue oxygen extraction (i.e., the tissues are removing more oxygen than normal from each hemoglobin molecule at the cell level, therefore, there is less oxygen “leftover” in the blood returning to the right side of the heart).

Oxygen Delivery is the total amount of oxygen delivered to the tissues. It can be calculated with the following equation:

$$\text{Oxygen Delivery} = \text{Cardiac Output (HR X SV)} \times \text{Oxygen Content (SaO}_2 \times \text{Hb)}$$

When there is a need for additional tissue oxygenation (e.g., when metabolic rate increases), we will first attempt to increase our oxygen delivery. Because we have little ability to raise our oxygen content above normal, our first compensatory response is to increase our cardiac output.

If we do not meet our tissue oxygen requirements by increasing our cardiac output, our second compensatory response will be to extract more oxygen than normal at the tissue level. If this fails, our final attempt at compensation will be through anaerobic metabolism.

In this example, the patient is still in shock (requiring epinephrine). Although we may want to get the patient converted to beta blockers, the patient is still requiring beta stimulation, therefore, metoprolol would be contraindicated at this point. ACE inhibitors are also part of the desired treatment following myocardial infarction, however, we would need to wait until his renal failure resolves to initiate captopril.

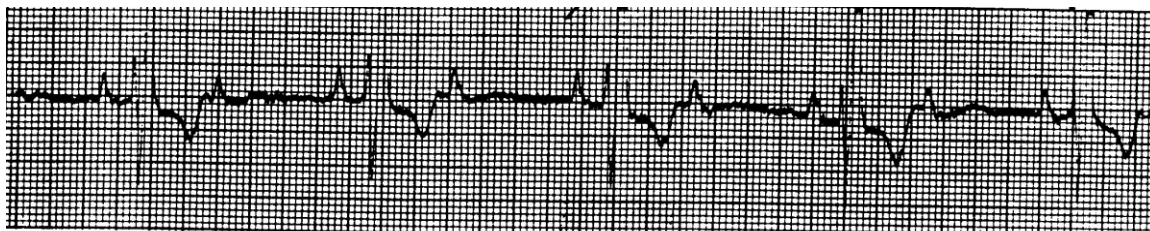
This patient is already on 60% oxygen with an SpO<sub>2</sub> of 95%. Additional oxygen would have minimal impact on the oxygen delivery. Anemia drops the oxygen content, and necessitates an increase in the cardiac output to maintain the oxygen delivery. Although a hemoglobin of 82 is generally well tolerated in patients without cardiac disease or among those who have an adequate oxygen delivery, in the setting of *coronary artery disease and ongoing shock*, transfusion to maintain a hemoglobin of at least 100 is recommended.

Although there is still much debate regarding when to treat a low hemoglobin, administration of packed cells is the only appropriate option among the choices provided in this question.

**Case 1: Question 4**

**Blueprint Competency Being Tested:** 2.1j

4. Mr. Jackle develops the following rhythm. Interpret this rhythm strip.



- a. First degree block
- b. Junctional rhythm
- c. Second degree block
- d. Complete heart block

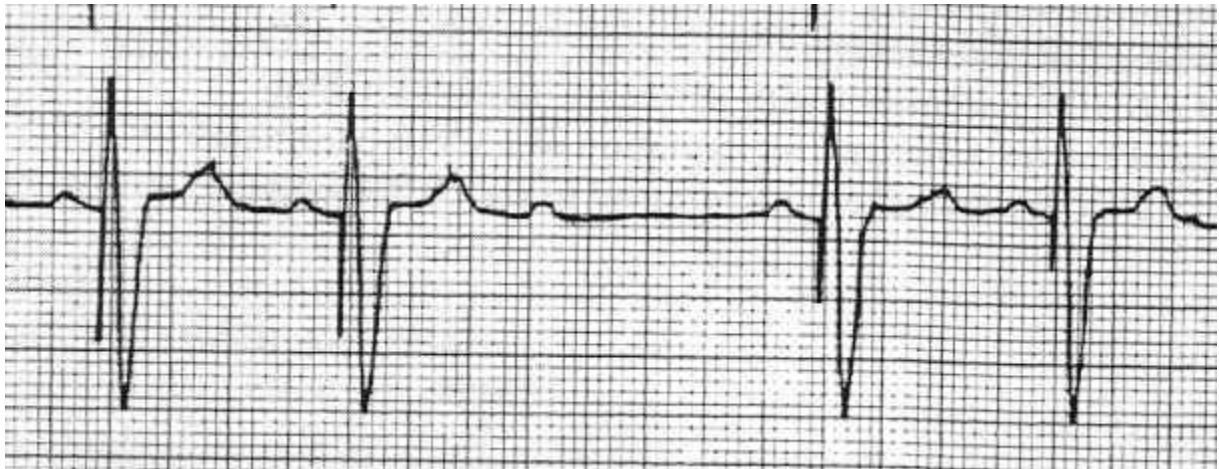
**Rationale for Correct Response:**

c) This is a sinus rhythm with a 2:1 second degree block. Note that the P waves that precede the QRSs have a consistent PR interval.

**Case 1: Question 5**

**Blueprint Competency Being Tested:** 2.1e

5. Mr. Jackle develops symptomatic bradycardia and requires a temporary pacemaker. The following rhythm strip displays his rhythm with a VVI pacemaker set at 75 beats/min. Identify the pacemaker problem.



- a. Failure to capture
- b. Failure to fire
- c. Oversensing
- d. Undersensing

**Rationale for Correct Response:**

c) Oversensing. There is a long pause between the second and third QRS, where there is no ventricular activity. To determine the ventricular escape interval (the time between from one paced beat to the next paced beat), measure the distance between the first and second spike. To confirm that this is the correct interval, you can count the number of small boxes between these two spikes (20) and divide this number into 1500 to confirm that it matches the set pacemaker rate ( $1500/20 = 75$  beats per minute). The distance following either a paced or native beat should never exceed the ventricular escape interval. If it does, the pacemaker did not fire when it should have fired. Note: many pacemakers have a built in pause following a native beat that prolongs this interval slightly after the patient initiates their own beat. This pause (hysteresis) gives the patient's own rhythm a chance to kick in.

The long interval after the third paced beat exceeds the ventricular escape interval. The absence of a pacemaker spike indicates that the pacemaker was inhibited, therefore, the pacemaker must have "believed that it saw a ventricular complex". The pacemaker is oversensing (or too sensitive).

### Case 1: Question 6

**Blueprint Competency Being Tested:** 3.3k

6. Mr. Jackle has a right chest tube inserted for a large pneumothorax. Immediately following insertion, the nurse notes that there is no fluctuation or bubbling in the underwater seal. Which one of the following interventions is the priority?
- Increase the level of suction
  - Increase the volume in the water seal
  - Strip the chest tube
  - Obtain a STAT chest xray

#### **Rationale for Correct Response:**

d) A chest tube that is successfully placed to resolve a pneumothorax should fluctuate (indicated it is patent and in the pleural space) and bubble (indicating it is evacuating the pneumothorax). The lack of fluctuation and bubbling from the onset of insertion indicates the tube is not in the proper position. The physician should be notified and a chest xray done to confirm correct placement. The patient should also be watched for signs of tension pneumothorax development/deterioration.

### Case 2

Mohammad is an 18 yr old man who was struck by a baseball bat in the L temple while playing baseball. He sustained a depressed skull fracture and is started on a dopamine infusion to support his BP.

### Case 2: Question 1

**Blueprint Competency Being Tested:** 1.2e

7. On his way to the CT scanner, Mohammad's L pupil suddenly becomes fixed and dilated. Which one of the following problems is consistent with these findings?
- Epidural hematoma with compression of CN V
  - Pupillary dilation secondary to dopamine administration
  - Left mass effect with tentorial herniation
  - Bleeding from the ophthalmic artery

#### **Rationale for Correct Response:**

c) Fixation and dilation of a pupil (new and acute finding) suggests compression of CN III (oculomotor) on the same side as the symptoms (left in this example). CN III sits at the top of the brainstem at the opening of the tentorium. The tentorium is the dural fold that separates the cerebrum and cerebellum at the back of the brain, and sits on top of the base of the skull at the front.

CN III is responsible for eye movement, eye opening and pupillary constriction. Sudden loss of CN III function causes the eye on the same side to be non-reactive to light and unable to constrict (dilated).

The mechanism of injury favours epidural hematoma (from middle meningeal artery injury) but this injury could also be associated with bleeding in other locations (e.g., parenchyma, subdural and/or subarachnoid). The likelihood of brain swelling is also high, and the depressed skull will decrease the cranial space. Blood and edema both create a mass effect that can lead to worsening symptoms. As a mass expands in one cerebral hemisphere, the brain attempts to dissipate the pressure by expanding through any available space. Initially, the brain will shift to the opposite side (midline shift). If this does not relieve the pressure, expansion continues through the opening in the tentorium, initially compressing on the third cranial nerve on the side of the injury (in this case, left). If the pressure is not relieved, herniation of the brain continues through the tentorial opening until CN III on the opposite side is compressed, producing bilateral dilation and fixation of the pupils.

### Case 2: Question 2

**Blueprint Competency Being Tested:** 1.4b

8. Mohammad's pupil remains dilated and his blood pressure has increased to 180/70 with a HR of 45. Which one of the following interventions is the priority?
- Position head of bed flat
  - Administer lasix
  - Hyperventilation
  - Administer labetalol

#### **Rationale for Correct Response:**

c) Hyperventilation is not routinely used for raised intracranial pressure, but in an acute life-threatening intracranial hypertensive crisis, lowering the PaCO<sub>2</sub> can reduce the cerebral blood flow to lower cerebral blood volume and ICP. This makes it an appropriate short term emergency intervention.

Lasix is never a first line agent for intracranial hypertension as hypovolemia can worsen the ICP. The most appropriate HOB position for ICP reduction is elevated to ~30 degrees. The hypertension is likely life-saving and should not be reduced.

### Case 2: Question 3

**Blueprint Competency Being Tested:** 1.4c

9. Which pharmacological agent would you anticipate to treat Mohammad's raised intracranial pressure with a BP of 180/55 and HR 45?
- Dobutamine
  - Nimodipine
  - Hypertonic saline
  - Atropine

#### **Rationale for Correct Response:**

c) Hypertonic saline is an osmotic diuretic that promotes reduction in cerebral edema. It supports blood pressure better than mannitol.

Nimodipine is a calcium channel blocker used to relax cerebral vasospasm following subarachnoid hemorrhage. Nifedipine is an arterial vasodilator used to lower systemic vascular resistance. Dobutamine might be used to augment the cardiac output, but it is not indicated in this example. The bradycardia with hypertension is suggestive of brainstem herniation; the treatment should be geared to lowering the ICP.

#### Case 2: Question 4

**Blueprint Competency Being Tested:** 1.4d

10. Mohammad undergoes an emergency craniectomy, evacuation of epidural hematoma and insertion of external intraventricular drainage catheter. When zeroing the cerebral spinal fluid collecting system, what landmark will you use?
- Mid axillary line
  - Base of occiput
  - Foramen of Monro
  - Cleft of chin

#### Rationale for Correct Response:

c) Acceptable landmarks include Foramen of Monro (channel between the lateral and third ventricle), mid point between outer aspect of eyebrow and tip of ear (which is the theoretical landmark for the Foramen of Monro) or external auditory meatus (used in some centres as an easy to locate reference that is close to the catheter tip).

#### Case 2: Question 5

**Blueprint Competency Being Tested:** 1.4e

11. Mohammad aspirated at the time of intubation and develops ARDS with worsening hypoxemia, with SpO<sub>2</sub> of 85% on FiO<sub>2</sub> 0.8 and PEEP 5 cmH<sub>2</sub>O. Which one of the following interventions is a priority.
- Increase his FiO<sub>2</sub> to 1.0 and accept SpO<sub>2</sub> of 90%
  - Increase the level of PEEP as required and monitor ICP
  - Initiate low tidal volume ventilation
  - Prepare for urgent bronchoscopy

#### Rationale for Correct Response:

b) ARDS is associated with intrapulmonary shunting due to alveolar volume loss. Hypoxemia on 80% oxygen indicates significant shunting, which will necessitate the use of PEEP to reopen areas of collapse. Although there is concern that high levels of PEEP can increase intracranial pressure, this generally only occurs if the level of PEEP is causing overdilatation of alveoli with central venous compression. PEEP at levels that are just high enough to reopen collapsed alveoli are less likely to raise the ICP. Because Mohammad has an ICP monitor, you can titrate the PEEP level to the blood oxygen level while monitoring for adverse events (e.g., increase in ICP). Hypoxia causes secondary brain injury and leaving it untreated would be more deleterious than an increase in the PEEP.

Prolonged use of high oxygen levels and inadequate PEEP may cause worsening lung injury. Hypoxemia is a serious threat to the injured brain. Without appropriate treatment it can cause secondary injury with increased ICP. An SpO<sub>2</sub> of 90% is too low in an acutely brain injured patient.

Low tidal volume ventilation is associated with higher P<sub>c</sub>O<sub>2</sub> levels, which can increase the ICP and cause secondary injury. Low tidal volumes may also worsen the hypoxemia if introduced before the PEEP is increased. Once the oxygenation is stabilized, low tidal volume ventilation should only be considered if it can be introduced without raising the P<sub>c</sub>O<sub>2</sub> above 40 mmHg in the setting of acute intracranial hypertension.

## Case 2: Question 6

**Blueprint Competency Being Tested:** 1.1f

12. Mohammad's condition deteriorates and he no longer responds to stimulation. Which one of the following lab tests is mandatory to confirm the diagnosis of neurological death (brain death)?
- PaO<sub>2</sub>
  - Lactate
  - PaCO<sub>2</sub>
  - Ammonia

### Rationale for Correct Response:

c) Apnea must be present to confirm neurological death (in addition to absence of all other brain function). Apnea indicates that the lowest portion of the brainstem (medulla) has stopped working. To confirm apnea, breathing must be absent despite a documented stimulus or reason to breathe (increase in PaCO<sub>2</sub>).

**Blueprint Competency Being Tested:** 7.1a

13. Mr. Sing has a massive GI bleed from a gastric ulcer. Following 12 units of packed cells and 4 units of fresh frozen plasma, he has the following labs: Hb 80 Platelets 82,000 INR 1.9 aPTT 58 and fibrinogen 0.4 g/L (normal 2-4 g/L). Which one of the following interventions is the priority?
- Potassium bolus
  - Octoplex
  - Cryoprecipitate
  - Protamine sulphate

### Rationale for Correct Response:

c) Cryoprecipitate contains fibrinogen, factors VII and VIII in concentrations higher than fresh frozen plasma. This fibrinogen is critically low, most likely due to excessive consumption and replacement with blood products that contain little fibrinogen. Potassium will usually rise following multiple blood products and calcium may be low due to citrate contained in the blood products. Additional fresh frozen plasma, packed cells (if bleeding has not resolved) and platelets may be required, and Factor VII administration may also be considered. Octoplex contains concentrated Vitamin K dependent clotting factors (Factors II, VII, IX, X, Protein C and Protein S), and is indicated for high INR due to coumadin therapy (which blocks



the production of Vitamin K dependent clotting factors) in the setting of bleeding or the need for urgent surgical intervention. Protamine sulphate is an antidote to heparin.

**Blueprint Competency Being Tested:** 3.3n

14. Ms. Tirani is on FiO<sub>2</sub> 0.5 PEEP 5 and PS 15. She has a total minute volume of 12 L and her RR has increased to 36 from 22. She is restless and agitated. Blood gases are:

PaO <sub>2</sub>	69
PCO <sub>2</sub>	49
pH	7.36
HCO <sub>3</sub>	30

Which one of the following interventions is most appropriate?

- a. Increase her FiO<sub>2</sub>
- b. Convert to AC
- c. Increase her Pressure Support
- d. Increase her sedation

**Rationale for Correct Response:**

c) Her average tidal volume is only 330 cc (TV = minute volume/RR). Although her gases are only showing a mild and compensated respiratory acidosis, her RR has increased, indicating she needs additional help. Increasing her PS may give her the additional assistance she needs to take a larger spontaneous tidal volume, which would reduce the number of breaths she would need to take per minute. If PS is the right intervention, the improvement in her tidal volume and reduction in her RR should be immediate.

Her rapid respiratory rate is unlikely to be due to hypoxemia with a PaO<sub>2</sub> of 69; the most likely reason is her low tidal volume. If the tachypnea continues despite correction of her PCO<sub>2</sub>, the reasons for her lowish PaO<sub>2</sub> should be investigated.

Sedation would be indicated if her increased respiratory rate was inappropriate (i.e, causing a respiratory alkalosis). Because her increased respiratory rate is most likely due to the low tidal volume and mild respiratory acidosis, sedation could depress her respiratory drive and worsen her gases.

If she does not improve with additional PS, she may need to return to an AC rate, however, her PS should be optimized first.

**Blueprint Competency Being Tested:** 7.1b

15. Mrs. Butovsky develops sepsis due to an infected prosthetic hip joint. She is started on antibiotic therapy. Which lab test can be used to evaluate her response to antibiotic therapy?
- Erythrocyte Sedimentation Rate (ESR)
  - Protein C levels
  - C-Reactive Protein
  - Ionized calcium levels

**Rationale for Correct Response:**

c) C-Reactive protein is an acute phase protein that increases during acute inflammation. It binds to the surface of dead or dying cells and to some bacteria, to activate the complement cascade. Although it is non specific and does not identify the cause of the rise (like ESR), it decreases quickly following resolution of inflammation (unlike ESR which remains elevated for a prolonged period of time), making it a useful marker to identify resolution of inflammation or infection (particularly in joint infections or acute coronary syndromes).

**Blueprint Competency Being Tested:** 1.1b

16. When administering mannitol for raised ICP, which one of the following lab tests is the priority?
- Serum arginine vasopressin (AVP)
  - Urine specific gravity
  - Serum creatinine
  - Serum osmolality

**Rationale for Correct Response:**

d) Mannitol is given to promote osmotic diuresis and reduce cerebral edema. Repeated dosing can cause excessive volume contraction. Osmolality should be measured with regular mannitol dosing. A serum osmolality > 320 mmol/L can be harmful.

**Blueprint Competency Being Tested:** 2.1c

17. Following cardiac surgery, Mr. Cassanza is noted to have new 2-3 mm ST segment elevation in Leads I, II, III, aVF, aVL and V5-V6. Which one of the following problems is most likely associated with these findings.
- Left ventricular hypertrophy
  - ST segment myocardial infarction
  - Pericarditis
  - Pulmonary embolus

**Rationale for Correct Response:**

c) The pericardium is dissected during cardiac surgery; pericarditis is a common post-op phenomenon. ST elevation across all leads (especially in leads I, II, III, aVF, aVL and V5-V6) is suggestive of

pericarditis. MI is localized to specific walls of the heart, based on the area supplied by an occluded vessel. ST elevation associated with MI is limited to the leads that look at the zone of injury/infarction.

Pulmonary embolus is rare post cardiac surgery due to intra-operative anticoagulation and would be identified by a right ventricular strain pattern on ECG. This may be identified by an S1Q3T3 (S wave in Lead I, Q wave in Lead 3 and inverted T wave in Lead 3). Left ventricular hypertrophy is identified by any one of the following: R wave height > 11 mm in aVL, total R wave height in Lead I + S wave depth in Lead III = 25 mm and S wave depth in V1 + R wave height in V5 = > 35 mm.

**Blueprint Competency Being Tested:** 3.c

18. Mr. Topias was admitted two days ago following emergency surgery for an ischemic bowel. He is hemodynamically stable, but has failed a spontaneous breathing trial. On chest xray, his lungs are hyperinflated with interstitial disease and his chest appears barrel shaped. Which of the following data would be most helpful?
- Total lung capacity
  - Minute volume
  - Preadmission FEV1/FVC
  - Peak Negative Inspiratory Pressures

**Rationale for Correct Response:**

c) Hyperinflation and barrel chested appearance suggest emphysema, while interstitial patterns could indicate either acute or chronic lung problems. Optimization of respiratory function may be required to facilitate liberation from the ventilator. FEV1/FVC ratio is the best test to differentiate restrictive from obstructive (e.g., emphysema) disease. Peak negative inspiratory pressures are difficult to obtain and often unreliable in a ventilated patient.

**Blueprint Competency Being Tested:** 3.1b

19. Mrs. Zena was admitted with 30% full thickness burns to the back and side of her head following a house fire. Her carboxyhemoglobin level is 0.35, SpO2 100% and PaO2 85 mmHg on 50% oxygen. Which one of the following is the priority?
- BiPAP
  - Intubation with PEEP
  - 100% oxygen
  - Diuretics

**Rationale for Correct Response:**

c) 100% oxygen is a priority for any patient with possible smoke or carbon monoxide poisoning and should be initiated immediately. Carboxyhemoglobin is a measure of the percentage of carbon monoxide bound to hemoglobin and is normally 0.01 or less. A level of 0.35 (35%) indicates a maximum capacity for oxyhemoglobin (oxygen saturation) of 65%. Carbon monoxide has an affinity for hemoglobin that is 210 times greater than oxygen. To prevent carbon monoxide from "beating out oxygen for hemoglobin binding sites", the PaO2 must be increased with 100% oxygen to help "push carbon monoxide" off hemoglobin and allow oxygen to bind preferentially. The goal is to push the PaO2 as high as possible (500-600 would

be normal lungs).

Saturation probes cannot reliably differentiate oxyhemoglobin from carboxyhemoglobin, therefore the SpO<sub>2</sub> of 100% may overestimate the true oxyhemoglobin. The carboxyhemoglobin level of 35% suggests an overestimation by the pulse oximeter. An inspired oxygen of 100% should be continued until the carboxyhemoglobin is normalized. Although intubation may also be indicated, 100% oxygen is the first intervention or priority.

**Blueprint Competency Being Tested:** 3.1d

20. Immediately following intubation, Mrs. Livert has an end tidal CO<sub>2</sub> reading of 1 mmHg. Which one of the following explanations is consistent with these findings?
- a. Mrs. Livert has a pulmonary embolus
  - b. The endotracheal tube is in the right mainstem bronchus
  - c. The endotracheal tube is well positioned
  - d. The endotracheal tube is in the esophagus

**Rationale for Correct Response:**

d) End tidal CO<sub>2</sub> reflects the amount of carbon dioxide in the airway at the end of exhalation. It should equilibrate with the carbon dioxide level in the blood. The absence (or near absence) of carbon dioxide indicates the tube is not in the airway.

**Blueprint Competency Being Tested:** 3.1e

21. Which one of the following options identifies the components of oxygen content.
- a. Cardiac output, SaO<sub>2</sub>, Hb
  - b. Hb, PaO<sub>2</sub>, SaO<sub>2</sub>, cardiac output
  - c. Hb, PaO<sub>2</sub>, SaO<sub>2</sub>
  - d. Hb, SaO<sub>2</sub>, SvO<sub>2</sub>

**Rationale for Correct Response:**

c) The formula for oxygen content (the total number of oxygen molecules in the blood) is:

$$\text{Oxygen Content: } (\text{Hb} \times 1.36 \times \text{SaO}_2) + (0.0031 \times \text{PaO}_2)$$

**Blueprint Competency Being Tested:** 1.1e

22. Calculate Cerebral Perfusion Pressure (CPP) based on the following data:

HR 75  
BP 140/80 (MAP 100)  
CVP 12  
ICP 15  
RR 25  
Minute Volume 10.5 L/min

- a. 65
- b. 85
- c. 125
- d. 60

**Rationale for Correct Response:**

b) Cerebral Perfusion Pressure = MBP – ICP (100-15=85).

**Blueprint Competency Being Tested:** 6.3d

23. Mr. Alberta is declared neurologically dead and his family consents to organ donation. Which one of the following interventions is the priority?

- a. Antibiotics, vasopressin and intensive insulin
- b. Vasopressin, methylprednisolone (Solumedrol) and levothyroxine
- c. Desmopressin (DDAVP), Epinephrine and dexamethasone (Decadron)
- d. Antibiotics, Immunoglobulin and Vasopressin

**Rationale for Correct Response:**

b) Hypothalamic dysfunction occurs following brain death. Antidiuretic hormone deficiency (diabetes insipidus) has been a well recognized consequence of severe brain injury. Deficiencies of other hormones within the hypothalamus-pituitary control have also been identified, including thyroid and cortisol. Antidiuretic hormone, thyroid and cortisol hormones all play an important role in hemodynamic stability and cardiac function. Consequently, all three of these hormones are now given to solid organ donors to enhance the success rate of the donated organs. These 3 hormones are referred to as “triple H therapy” (triple hormone).

**Blueprint Competency Being Tested:** 2.2a

24. Mr. Smith is admitted with pulmonary edema requiring intubation. His cardiac troponin and CK increase 5 fold, 2 hours after admission and he develops ST segment depression in his lateral leads. He has a history of diabetes, COPD and renal insufficiency. Which one of the following interventions is the priority?
- a. Tenectapase
  - b. IV Heparin
  - c. Drotrecogin alfa activated
  - d. Digitalis

**Rationale for Correct Response:**

b) These findings are consistent with an Acute Coronary Syndrome or Non-ST Elevation MI (NSTEMI). IV heparin is an example of an appropriate intervention (other appropriate agents include acetylsalicylic acid, other anticoagulants such as fondaparinux (low molecular weight heparins should be used with caution with renal insufficiency) or platelet inhibitors [such as glycoprotein inhibitors or Plavix]).

Tenectapase is only indicated in the setting of ST Segment Elevation MI (STEMI) or MI with new Left Bundle Branch Block. Drotrecogin alfa activated (Xigris) is only indicated for the treatment of severe sepsis or septic shock with organ failure. Although digitalis may be used in some situations, it is not a priority agent for the treatment of acute MI.

**Blueprint Competency Being Tested:** 2.2b

25. Mr. Viato had an open repair of an abdominal aneurysm involving his renal arteries. His fluid balance from the operating room is 3 litres positive and he is on FiO<sub>2</sub> .5 PEEP 10 and AC 14. Three hours following admission, his urine output is 25 ml/hr, CVP 12, HR 110 and BP 110/60. Which one of the following interventions is the priority?
- a. Lasix
  - b. Fluid
  - c. Beta blockers
  - d. Dobutamine

**Rationale for Correct Response:**

b) The first priority for decreased urine output with tachycardia is fluid. A CVP of 12 in a ventilated patient is difficult to interpret and does not necessarily indicate adequate intravascular volume. This patient has already experienced impaired renal blood flow intraoperatively and hypovolemia would increase the potential for pre-renal renal failure; acute resuscitation should always err on the side of volume replacement. The positive fluid balance from the operating room often excludes the actual operative losses and can be misleading. As well, large third space shifts and post operative fluid requirements should be expected with major vascular and abdominal surgeries.

**Blueprint Competency Being Tested:** 3.30

26. Mrs. Evans becomes more difficult to ventilate and her chest xray reveals worsening bilateral infiltrates. Her oxygen saturation falls to 80% despite an FiO<sub>2</sub> 1.0 and PEEP 18. Which one of the following interventions may help to improve her hypoxemia?

- a. High Frequency Oscillatory Ventilation
- b. Low tidal volume ventilation
- c. Bronchoscopy
- d. Manual bagging and suctioning

**Rationale for Correct Response:**

a) There are a number of strategies that may be tried to treat refractory hypoxemia that is due to alveolar derecruitment (as in ARDS). On an individual patient basis, any of these strategies may be successful, however, there are no randomized controlled trials to show that any of these strategies save lives overall. Examples of strategies that may be tried include: recruitment maneuvers, diuretics, prone positioning, nitric oxide or other pulmonary vasodilators or even paralytic agents. Ventilation strategies to increase oxygenation include modalities that increase the mean airway pressure to open up alveoli and keep them inflated. Examples of ventilation modalities that increase the peak airway pressure include: High Frequency Oscillatory Ventilation (HFOV), BiLevel modes (that include high and low PEEP), increased inspiratory;expiratory ratios and Airway Pressure Release Ventilation.

Of the options provided, HFOV is the only option that would increase the mean airway pressure (and reopen alveoli). Low tidal volume, although desired in the management of ARDS, may need to be aborted temporarily until the hypoxemia is corrected (low tidal volumes may decrease lung recruitment). There is no indication for bronchoscopy (the xray did not reveal a collapse). Disconnection of the PEEP to perform manual bagging could cause the patient to decompensate by worsening the collapse.

**Blueprint Competency Being Tested:** 2.4e

27. Identify a complication of Intra-aortic Balloon Pumping.

- a. Impaired R arm circulation
- b. Thrombocytopenia
- c. Deep Vein Thrombosis
- d. Prerenal failure

**Rationale for Correct Response:**

d) If the balloon is too low, it can compromise renal blood flow. If the balloon is too high, it can compromise flow to the left subclavian artery and the LEFT arm. The risk for DVT is the same as for other critically ill patients, and platelets will usually fall as a result of the foreign vascular body (thrombocytopenia is a high platelet count).

**Blueprint Competency Being Tested:** 2.5c

28. Which one of the following agents is an inotrope?

- a. Epinephrine
- b. Metoprolol
- c. Diltiazem
- d. Ramipril

**Rationale for Correct Response:**

a) Epinephrine stimulates beta inotropic receptors to increase contractility. Metoprolol and diltiazem decrease contractility by beta and calcium blockade respectively. Ramipril may indirectly improve contractility but it is an ACE inhibitor that causes mild afterload reduction and sodium/water elimination.

**Blueprint Competency Being Tested:** 3.1b

29. Mrs. Haberdean is admitted with exacerbation of COPD following an influenza like illness (ILI). She has increased sputum production and cough, with loud expiratory wheezes. Her blood gases are:

PaO <sub>2</sub>	48
PaCO <sub>2</sub>	58
pH	7.39
HCO <sub>3</sub>	40
BE	+10

What is the priority?

- a. BiPAP
- b. Prednisone
- c. Mechanical ventilation
- d. Acetylcysteine (Mucomyst)

**Rationale for Correct Response:**

b) Steroids are indicated for the treatment of COPD exacerbation. These gases are fully compensated (normal pH), suggesting chronic CO<sub>2</sub> retention with bicarbonate compensation. Bicarbonate compensation takes many hours to achieve; the presence of a high bicarbonate on admission is consistent with chronic compensated hypercarbia. Her PaO<sub>2</sub> is lower than expected for a hypoxic drive. The first step for correcting the PaO<sub>2</sub> would be to initiate oxygen by nasal prongs at 1 L and titrate until the SpO<sub>2</sub> is 88-91%.



**Blueprint Competency Being Tested:** 1.1a

30. Mr. Vera suffered a right hemispheric stroke. He does not open his eyes, extends his left arm, makes grunting sounds to central pain, and picks at the bed linen with his right hand. What is his score on the Glasgow Coma Scale.

- a. 5
- b. 7
- c. 8
- d. 9

**Rationale for Correct Response:**

c) 1 (eye opening); 2 (verbal); 5 (motor). Purposeful movement (picking at bed linen) is localization with his right hand. Choose the best response for each category.

**Blueprint Competency Being Tested:** 2.4b

31. Mrs. Ploutette is admitted with a hypertensive crisis. Her BP is 240/190. Which one of the following interventions would you anticipate?

- a. Labetolol (Tandate)
- b. Nitroglycerine
- c. Phenylephrine (Neosynephrine)
- d. Isoproterenol (Isuprel)

**Rationale for Correct Response:**

a) Labetolol is an antihypertensive agent that also lower heart rate. It works by blocking both alpha and beta receptors. Nitroglycerine can produce a mild reduction in blood pressure, however, it is a better venous dilator. A BP this high would need a drug that has better arterial vasodilating effects.

**Blueprint Competency Being Tested:** 3.1b

32. Interpret the following blood gas.

PaO <sub>2</sub>	78
PaCO <sub>2</sub>	29
pH	7.29
HCO <sub>3</sub>	14
BE	- 10

- a. Respiratory alkalosis
- b. Respiratory acidosis
- c. Metabolic acidosis
- d. Metabolic alkalosis

**Rationale for Correct Response:**

c) Metabolic acidosis (ph and bicarbonate are both acidotic).

**Blueprint Competency Being Tested:** 2.5i

33. Mr. Yablonski is awaiting a bed on the ward and is no longer on the bedside monitor. The nurse enters his room to assess him, and finds him cyanotic, apneic and pulseless. ECG leads are connected and reveal ventricular fibrillation. Which one of the following is the priority?

- a. Intubation and ventilation
- b. Compressions X 2 minutes at 100/minute
- c. Epinephrine 1 mg IV
- d. Defibrillation with 3 quick shocks

**Rationale for Correct Response:**

b) New guidelines published in 2005 emphasize high quality CPR. For a non-witnessed arrest or down time of > 5 minutes, 2 minutes of CPR at a rate of 100 good compressions per minute is recommended. Defibrillation should be performed after completion of 2 minutes of CPR with one quick shock. Following the shock, 2 more minutes of CPR should be provided.

<http://www.americanheart.org/downloadable/heart/1132621842912Winter2005.pdf>

**Blueprint Competency Being Tested:** 9.8

34. Mrs. Habernathy becomes agitated and is at risk for self-exubation. Which one of the following interventions is the priority?

- a. Apply restraints
- b. Assess cause of agitation
- c. Increase dose of sedatives
- d. Have family sit with Mrs. Habernathy

**Rationale for Correct Response:**

b) Agitation can be caused by a variety of problems such as delirium, pain, anxiety or constipation. An assessment should always be conducted to ensure that treatment options are geared toward the underlying cause, as the wrong treatment may worsen the agitation. A least restraint policy should be utilized; restraints should only be used following a thorough assessment and after attempts at other interventions fail.

**Blueprint Competency Being Tested:** 7.6b

35. Mrs. Fortein is admitted with urosepsis. Her blood pressure increases to 110/70 following 4 L of normal saline, however, she remains oliguric with a urine output of < 10 ml/hr. Her oxygenation deteriorates despite BiPAP, and she requires intubation. Labs reveal: Hb 101 Platelets 62,000 INR 1.9 aPTT 57. Her lactate has increased to 6 from 4. Which one of the following interventions is indicated?
- a. Steroids
  - b. Vasopressin
  - c. Drotrecogin Alfa Activated (Xigris)
  - d. Dobutamine

**Rationale for Correct Response:**

c) Xigris is indicated for severe sepsis or septic shock with 2 or more organ dysfunction. These findings indicate severe sepsis (BP restored with fluid), however, > 2 organ failure is present (lung, coagulopathy, lactic acidosis, renal). Steroids are only indicated for septic shock and vasopressin is indicated with hypotension. Dobutamine is indicated for low cardiac output (or low ScVO<sub>2</sub>), however, it can cause hypotension.

**Blueprint Competency Being Tested:** 7.7d

36. Mrs. Green is on Coumadin for atrial fibrillation. She is admitted with ischemic bowel and requires urgent surgery. Her INR is 10.4 and aPTT 52. Which one of the following interventions is the priority?
- a. Protamine sulphate
  - b. Octaplex
  - c. Cryoprecipitate
  - d. Vitamin K infusion

**Rationale for Correct Response:**

b) Coumadin blocks the production of vitamin K dependent clotting factors. Octaplex provides concentrated levels of Factors II, VII, IX, X and Protein C and S, the factors that are blocked by Coumadin. Vitamin K is never administered by infusion.

**Blueprint Competency Being Tested:** 7.8

37. Ms. Tabuski is admitted with septic shock. She presents following a 12 hour history of sore throat, decreasing level of consciousness and purpura. Which one of the following interventions should be instituted?
- a. Airborn precautions
  - b. Contact precautions
  - c. Droplet precautions
  - d. No precautions while on closed circuit ventilation

**Rationale for Correct Response:**

c) The mode of transmission for meningococcal meningitis is droplet or direct contact, therefore, droplet precautions should be applied. <http://www.phac-aspc.gc.ca/msds-ftss/msds109e-eng.php>

**Blueprint Competency Being Tested:** 8.1b

38. Six hours following a motor vehicle collision, Mr. Kibble has a 10 fold increase in his CK and myoglobin. Which one of the following interventions is the priority?

- a. Fluid
- b. Lasix
- c. Tissue plasminogen activator (tPA)
- d. Insulin and glucose

**Rationale for Correct Response:**

a) High CK and myoglobin indicates muscle injury due to trauma. The first priority is to maintain a high urine output with fluid. Lasix may become necessary if the patient develops a positive balance with declining urine output, but fluid should be given first. Insulin and glucose would only be indicated if hyperkalemia developed.

**Blueprint Competency Being Tested:** 8.1c

39. Following open repair of a ruptured aneurysm, Mr. Gregson's bladder pressure is 45 mmHg. Which one of the following interventions is the priority?

- a. Continuous bladder irrigation
- b. Fluid administration
- c. Decrease the amount of PEEP
- d. Continuous renal replacement therapy

**Rationale for Correct Response:**

b) A bladder pressure of 45 mmHg is consistent with abdominal compartment syndrome. Increasing intra-abdominal pressures can develop following major abdominal surgeries as a result of intra-abdominal edema. Rising pressures compress against gut organs, causing GI and renal ischemia, decreased venous return and cardiac output and ventilator failure. While this patient may require urgent OR and delayed primary closure, the first priority is to increase the intravascular filling volume with fluid, to maintain perfusion to organs. A higher PEEP may be required to maintain alveolar patency. Bladder irrigation is not indicated, and renal replacement therapy would only be indicated if the patient develops acute kidney injury.

**Blueprint Competency Being Tested:** 8.2b

40. Mr. Chen experiences full thickness circumferential burns to his chest, abdomen and back. Which one of the following interventions is the priority?
- Silver sulfadiazine
  - Wound debridement
  - Escharotomies
  - Topical analgesia

**Rationale for Correct Response:**

c. Full thickness burns create a leatherlike non-stretchable skin surface. When burns are circumferential, the loss of compliance causes a compartment syndrome. In a limb, this can cause muscle death and rhabdomyolysis, while in the chest, it can prevent lung expansion. Escharotomies to cut through the dead tissue and relieve any compartment/chest wall restriction is a priority.

**Blueprint Competency Being Tested:** 8.2d

41. Six hours following a traumatic brain injury due to a fall from a ladder, Mr. Plueth develops hypotension and a 4 gram drop in hemoglobin. Which one of the following problems would be consistent with these findings?
- Diabetes insipidus
  - Intracranial hemorrhage
  - Intra-abdominal bleeding
  - Fat embolism

**Rationale for Correct Response:**

c) Bleeding into the brain would not account for hypotension or a 4 gm drop in hemoglobin as there is not enough room in the cranial compartment to accommodate this much volume. Diabetes insipidus would not cause anemia. Fat embolism would be associated with hypoxemia and respiratory distress; mild anemia can occur with thrombocytopenia, but not a 4 gm drop. Missed injuries must always be suspected in trauma, and an unexplained drop in hemoglobin with hypovolemia/hypotension requires investigation to identify the source of bleeding. Intra-abdominal, thoracic, pelvic and femur injuries are the most common locations for hidden blood loss.

**Blueprint Competency Being Tested:** 8.3a

42. During surgery, Mrs. Zibert develops malignant hyperthermia. Which one of the following is the priority?
- Aggressive cooling
  - Potassium boluses
  - Sodium citrate
  - Dantrolene

**Rationale for Correct Response:**

d) Dantrolene is the antidote for malignant hyperthermia. It disrupts the sustained muscle contractions, which cause the hyperkalemia, fever and tetany.

**Blueprint Competency Being Tested:** 8.5

43. Which one of the goals for wound care should be included for a Stage II pressure ulcer?

- a. Wet to dry dressings
- b. Hydrocolloid dressings
- c. Cleansing with chlorhexidine
- d. Tight packing of wound cavity

**Rationale for Correct Response:**

b) Hydrocolloid dressings provide cost effective wound healing. Moist wound healing is the goal. Wet to dry causes disruption of new granulation tissue, may delay healing and increase pain. Wounds should be cleansed and irrigated with saline or ringers lactate; cleansers are not recommended. A stage II pressure ulcer is a shallow wound with a pink bed, packing is not indicated. In Stage III and IV, packing should be light.

**Blueprint Competency Being Tested:** 3.3I

44. Simone is a 22 year old woman admitted with ARDS following H1N1. Her blood gases on .8 PEEP 10 PC 34 (tidal volumes ~500 cc) and AC 28 are as follows:

PaO<sub>2</sub> 52 PaCO<sub>2</sub> 46 pH 7.32 HCO<sub>3</sub> 17

Which one of the following interventions is the priority?

- a. increase PEEP
- b. increase FiO<sub>2</sub>
- c. decrease PC
- d. increase AC

**Rationale for Correct Response:**

a) Her greatest problem is hypoxemia. She is already on FiO<sub>2</sub> 0.8 with persistent hypoxemia, indicating significant shunt. She needs her lung recruited with additional PEEP to increase the surface area for gas exchange. There would be little benefit (but increased harm) with higher oxygen concentrations. Lowering her PC would actually decrease her tidal volume, potentially decrecruiting more lung. An increase in her AC rate would have little impact on her PaO<sub>2</sub> but would reduce her PaCO<sub>2</sub> (mild hypercarbia is generally permitted).

**Blueprint Competency Being Tested:** 1.1a

45. Which pair of cranial nerves is being evaluated when a corneal reflex test is performed on the L eye.
- a. L CN V and VII
  - b. R CN V and VII
  - c. L CN III and VII
  - d. R CN III and VII

**Rationale for Correct Response:**

a) Touching the left cornea stimulates the V1 branch (ophthalmic division) of the left CN V (trigeminal nerve). CN V interprets sensation from the face, with the V1 branch (first of three branches) interpreting sensation from the forehead and eye. This causes a reflex stimulation of the left CN VII (facial nerve), which causes the left eye to blink (facial nerve causes facial movement and eye closure).

**Blueprint Competency Being Tested:** 3.3d

46. Ms. Frederick sustained a complete spinal cord injury at the level of C3 and underwent anterior fixation 3 days ago. Which one of the following interventions should be included in her care plan?
- a. Assisted cough during suctioning
  - b. Atropine pre suctioning
  - c. Mannitol x 24 hours post operatively
  - d. Early extubation

**Rationale for Correct Response:**

a) Spinal cord injury above ~T6 is associated with impaired cough and vital capacity (lack of abdominal muscles). Assisted cough is an important nursing intervention (breath stacking is also started as soon as feasible). At the point of maximal inspiration, an assistant applies gentle inward and upward diaphragmatic pressure to assist with maximal expiration.

Bradycardia can occur due to loss of autonomic nervous system control. It is usually induced by position changes or suctioning; atropine is only indicated if the bradycardia cannot be prevented or corrected with manual lung inflation/oxygen administration or repositioning. Mannitol is not routinely used following surgery, it would only be indicated if there was evidence of acute cord or cerebral edema. Early extubation would not be indicated; a cord injury at the Level of C3 is usually associated with loss of phrenic nerve stimulation. Anterior fixation is also associated with upper airway edema in the immediate post-operative period.

**Blueprint Competency Being Tested:** 3.3e

47. Mrs. Pitre is recovering from septic shock. After failing several spontaneous breathing trials, she received a percutaneous tracheostomy tube. Two days later, within 10 minutes of starting a tracheostomy mask trial, she complains of shortness of breath and demands to return to the ventilator. Her SpO<sub>2</sub> remains > 95% during the trial. Which one of the following interventions pre tracheostomy mask trial is most likely to reduce her dyspnea and facilitate spontaneous breathing?

- a. N-acetylsysteine (Mucomyst)
- b. Lorazepam (Ativan)
- c. Morphine
- d. Aminophylline

**Rationale for Correct Response:**

c) Narcotics are the best agent for relieving symptoms of dyspnea. If anxiety was the main component to the weaning trial, premedication with an anti-anxiety agent would be appropriate. There is no evidence for benefit of either acetylsysteine or aminophylline.

**Blueprint Competency Being Tested:** 3.3f

48. Mrs. Vidالية is one day postoperative repair fractured hip. She develops a sudden onset of hypoxemic respiratory failure and is diagnosed with an acute pulmonary embolus. Which one of the following interventions is the priority?

- a. Dalteparin (Fragmin) 5,000 units subcutaneous OD
- b. Drotrecogin alfa activated (Xigris)
- c. Coumadin (Warfarin) 10 mg loading dose
- d. Heparin IV 80 units/kg bolus

**Rationale for Correct Response:**

d) Treatment priority includes reaching a therapeutic anticoagulation level STAT. Only the loading dose of heparin is sufficient to achieve a rapid therapeutic level. High dose low molecular weight heparin (e.g., Dalteparin) can be used to treat venothrombosis, however, this dose is too low for therapeutic coverage (this is the venothrombotic prophylactic dose). This patient will eventually be converted to a 3-6 month course of Coumadin, however, it takes at least 2 days for Coumadin to reach a therapeutic level. If the patient is stable and rapid reversibility is not a concern, coumadin may be started simultaneously with IV heparin. Heparin should be continued until the Coumadin is in the therapeutic range. Xigris is not indicated in venothrombotic disease.



**Blueprint Competency Being Tested:** 3.3h

49. Mark is an 18 year old man admitted with pneumonia and exacerbation of his asthma. He complains of chest tightness and develops increased wheezes. Which one of the following interventions is the priority?

- a. Ipratropium bromide (Atrovent)
- b. Bethamethasone (QVAR)
- c. Salmeterol/fluticasone (Advair)
- d. Salbutamol (Ventolin)

d) The first line agent (priority) for the treatment of acute asthma is fast acting reliever medications (bronchodilators). Short acting (rapid onset) beta adrenergic agents (such as Ventolin) are the priority. Although Atrovent is also a bronchodilator, it is a parasympathetic blocker with a longer onset of action. It can be combined with salbutamol to provide synergistic bronchodilation (e.g., Combivent). Advair contains salmeterol, a long acting B2 agonist. This drug is used to provide long term bronchodilation, and is not indicated for acute exacerbations (short acting bronchodilator is needed). Finally, while this patient also needs either systemic or inhaled steroids (such as fluticasone or bethamethasone), reliever meds are the first priority during acute asthma. Steroids are used to decrease the inflammation and prevent the asthma symptoms.

**Blueprint Competency Being Tested:** 3.3i

50. Mrs. Greir develops hypercarbia and hypoxemia following extubation. She is started on BiPAP in an effort to avoid reintubation. Which one of the following interventions should be included in her plan of care.

- a. Integumentary inspection of nose and face
- b. Nasal-tracheal suctioning to facilitate secretion clearance
- c. Oral intake of high calorie milk shakes.
- d. Administer regular dose benzodiazepines

**Rationale for Correct Response:**

a) Skin breakdown with potential injury to the cartilage of the nose can occur with prolonged use, therefore, careful inspection and mask adjustment to rotate pressure is important. Suctioning should only be performed if secretions are present and the patient is unable to clear them with coughing. Oral intake should be limited during this acute exacerbation due to the potential for aspiration/need for intubation. Benzodiazepines should be used very sparingly/withheld in a non-intubated patient with hypercarbia.

**Blueprint Competency Being Tested:** 3.3j

51. Three days after insertion of a chest tube for pleural effusion/empyema, Mr. Butler's ventilator begins to alarm for low exhaled tidal volume. Upon examination, increased bubbling is noted in the underwater seal chamber of the chest drainage unit, and the set tidal volume is 200 cc > exhaled tidal volume. Which one of the following problems do these findings suggest?
- a. Chest tube obstruction
  - b. Bronchopleural fistula
  - c. Asynchrony with ventilator
  - d. Air trapping

**Rationale for Correct Response:**

b) The increased air leak indicates loss of additional air from the lung. The inhaled tidal volume and exhaled tidal volume should be very similar, when less air is exhaled than inhaled, it suggests another route for air elimination. The increased leak in the underwater seal indicates it is coming from a leak between the airways and the pneumothorax.

**Blueprint Competency Being Tested:** 1.1c

52. Mrs. Karver develops a sudden facial droop with dysphagia. Which diagnostic test is best for identification of an acute cerebral infarction?
- a. MRI
  - b. EEG
  - c. CT scan
  - d. Cerebral angiogram

**Rationale for Correct Response:**

a) MRI is best for identification of an acute infarction. It can take a few days before an acute infarction will be evident on CT (very large infarcts may show up earlier). CT is done immediately following the onset of symptoms to rule out hemorrhagic stroke and determine safety for thrombolytics.

**Blueprint Competency Being Tested:** 4.1b

53. Mr. Fever had an ischemic bowel requiring urgent total colectomy and ileostomy and TPN. One week following admission to ICU, his Alanine Aminotransferase (ALT) and his Aspartate Aminotransferase (AST) double, and his alkaline phosphatase and direct bilirubin increase 4 fold. His lipase and pancreatic amylase are mildly elevated and his ammonia is normal. These findings are most consistent with which complication?
- a. Hepatic ischemia
  - b. Biliary track disease
  - c. Pancreatitis
  - d. Hemolysis

**Rationale for Correct Response:**

b) AST and ALT are the two liver enzymes that best reflect hepatocyte disease. Bilirubin is a byproduct of red blood cell breakdown. Total bilirubin is the sum of the pre and post liver bilirubin. Pre liver bilirubin is protein bound and toxic to the brain (called indirect or unconjugated). It is conjugated (made water soluble) in the liver for excretion in the bile, feces and urine. Alkaline phosphatase is a liver enzyme that is manufactured near the biliary tree. Lipase and pancreatic amylase are pancreatic enzymes that can rise in pancreatitis, and ammonia is a byproduct of the deamination of proteins.

Acute hepatic failure due to ischemic insult is usually associated with extreme elevation in the AST/ALT (transaminases). End stage hepatic failure may be associated with very low levels if the hepatocytes are no longer able to manufacture these enzymes. While ALT is more specific to the liver, AST can be elevated for a number of reasons. Acute pancreatitis will usually present with elevated lipase and amylase, however, both can be elevated for other reasons, and may be normal at various phases in pancreatitis.

No single liver test will pinpoint a cause, and liver function tests can be elevated for non-hepatic reasons. The pattern of the elevation and the clinical picture is most important. AST is also found in red cells, muscle tissue, pancreas and kidneys, while alkaline phosphatase is also produced in bone, placenta (first trimester), kidney and intestines. Bilirubin can be elevated for many reasons (e.g., drugs, infection, critical illness, blood transfusion) that have nothing to do with hepatic function. If the bilirubin is due to an increase in red cell breakdown (e.g, hemolysis), the bilirubin elevation will be predominantly indirect or unconjugated hyperbilirubinemia (this scenario is predominantly direct hyperbilirubinemia).

The pattern of elevation that often influences investigative tests is the relationship between the AST/ALT and alkaline phosphatase elevation. If the AST/ALT is elevated > than the alkaline phosphatase elevation, a hepatic origin is suggested. If the alkaline phosphatase elevation is elevated greater than the degree of AST/ALT elevation, a cholestatic picture should be considered.

In this scenario, the patient would be NPO, and likely on TPN. These are two risk factors for biliary stasis (TPN delivers fat without stimulating bile secretion). The elevated alkaline phosphatase > transaminases would justify a biliary tree ultrasound.

**Blueprint Competency Being Tested:** 4.2a

54. Mrs. Volaro is admitted with a diagnosis of septic shock NYD. She received aggressive fluid resuscitation, is started on broad spectrum antibiotics and steroids, and is now on levophed at 15 mcg/min and vasopressin at 2.4 units/hr. Despite maintaining a MAP of 65 mmHg, her lactate rises from 4.5 to 8.8 and she develops new onset diarrhea. Which one of the following interventions would you anticipate?

- a. Repeat blood cultures
- b. Hepatic ultrasound
- c. CT abdomen
- d. Insertion of rectal tube

**Rationale for Correct Response:**

c) Rising lactate and new diarrhea suggests an acute abdomen or ischemic bowel. Urgent CT is warranted to rule out this lethal complication. There would likely be little benefit to repeated the blood cultures given the onset of broad spectrum antibiotics. The CT would be more valuable than a hepatic ultrasound. Rectal tube insertion should be avoided until the abdomen is investigated and perforated bowel is ruled out.

**Blueprint Competency Being Tested:** 3.5

55. Mrs. Farmer is started on neuromuscular blocking agents. Which one of the following interventions is a priority?
- Titrate sedation using a sedation scoring tool
  - Maintain eyes in a closed position
  - Use of oral hydration solutions
  - Administration of prn analgesia

**Rationale for Correct Response:**

b) The inability to blink or lubricate the eyes puts the cornea at risk for abrasion. Diligent eye care, including keeping the lids closed to maintain lubrication is essential. Sedation scoring tools are not useful as neuromuscular blockers mask motor activity; level of consciousness and symptoms are masked by the pharmacological paralysis. Patients on NMBs generally have excessive oral secretions, and analgesia should be administered by high dose continuous infusion.

**Blueprint Competency Being Tested:** 4.4e

56. Mr. Aikin is admitted with acute gallstone pancreatitis following ERCP. He develops ARDS and requires intubation and mechanical ventilation, with fluid resuscitation for systemic inflammation. He is experiencing nausea and vomiting. Which one of the following interventions would you anticipate?
- Early initiation of TPN
  - NPO with gastric drainage
  - Nasal-jejunal enteral feeding
  - Avoidance of narcotics

**Rationale for Correct Response:**

c) Early enteral feeding is recommended by the American Society of Parenteral and Enteral Nutrition (ASPEN) for patients with severe pancreatitis. TPN is only recommended if attempts at enteral feeding are unsuccessful. While initial feeding attempts can be made using a gastric feeding tube, patients who are critically ill with high gastric output (vomiting or NG suction) will usually require additional interventions. Nasal-jejunal feeding, early initiation of feeds before the onset of ileus, and administration of elemental (predigested) feeds are recommended strategies to promote early enteral feeding in pancreatitis.

Although narcotics can decrease peristalsis and gastric emptying, unresolved pain can increase gastric and pancreatic output, worsening the symptoms. Pain control with narcotics is an important part of the treatment.

\*Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Acute Pancreatitis. Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). McClave et al. *JPEN J Parenter Enteral Nutrition*. 33 (3): 277.

**Blueprint Competency Being Tested:** 1.1d

57. Mr. Singh is a 68 year old man who had an intraventricular hemorrhage. He has an external ventricular drain (EVD) that is open to drainage at 5 cmH<sub>2</sub>O above the reference level. It has been draining ~20 ml per hour for the past 24 hours. The waveform suddenly becomes dampened with a pressure reading of 8 mmHg, and there has been no CSF drainage during the past hour. How should these findings be interpreted?
- Lack of drainage is an expected finding
  - Clotting of the catheter should be suspected
  - The hydrocephalus has resolved
  - The drainage chamber should be raised

**Rationale for Correct Response:**

b) 5 cmH<sub>2</sub>O is equivalent to ~3.9 mmHg (bedside pressure). With the drainage chamber positioned at 5 cmH<sub>2</sub>O, a pressure gradient for CSF drainage would be present whenever the ICP  $\geq$  4 mmHg. In order for drainage to occur, the system must be patent and there must be CSF in the ventricle that can drain. In this scenario, a history of ventricular hemorrhage raises the potential for clotting, and the drainage has stopped abruptly. Despite a pressure gradient being present (8 mmHg), no drainage has occurred. The accuracy of the reading of 8 mmHg is also in question given the waveform quality. The damp waveform is also suggestive of a patency problem.

**Blueprint Competency Being Tested:** 4.2e

58. Christine is a 19 year old who suffers from anorexia and bulimia. She is admitted with failure to thrive, weighing 40 kg. Which one of the following interventions is a priority?
- Initiate central TPN while encouraging oral intake
  - Initiate tube feeding at a rate that matches daily energy requirements
  - Monitor and replace phosphate, magnesium and potassium
  - Administer loperamide prn if diarrhea develops

**Rationale for Correct Response:**

c) Severely malnourished patients are at risk for refeeding syndrome. During starvation, the reduced carbohydrate level causes insulin levels to fall. Low insulin levels increases glucagon levels, which favour the utilization of protein and fat stores for energy, and the loss of extracellular electrolytes such as phosphate, potassium and magnesium.

Upon initiation of feeding, insulin levels begin to rise. This causes a rapid return of electrolytes into the cells, and can lead to lethal reductions in serum phosphate, magnesium and potassium. Feeding should be gradually reintroduced, with the enteral route preferred. A patient who is this malnourished may continue to eat orally, but will need supplementation by feeding tube to meet her caloric requirements. Electrolytes must be monitored and corrected before starting feeding and until the patient's nutritional state improves. Antidiarrheal agents should not be initiated until infectious causes are ruled out (e.g., at least 2 C-diff cultures are negative). Antidiarrheals delay removal of toxins and could precipitate perforation of the colon in the setting of C-Diff colitis.

**Blueprint Competency Being Tested:** 4.3

59. Mr. Kieffer is admitted following an overdose of beta blockers. Which one of the following antidotes would you anticipate?
- a. Levothyroxine
  - b. Glucagon
  - c. Levophed
  - d. N-acetylcysteine Mucomyst

**Rationale for Correct Response:**

b) Beta blockade causes a decrease in the production of intracellular cyclic adenosine monophosphate (cAMP). This causes a variety of metabolic and cardiovascular effects, as a result of decreased catecholamine activity, including: bradycardia, decreased contractility and blood pressure and hypoglycemia. Beta blockers with the highest lipid concentration (such as propranolol) have a larger distribution and are better able to penetrate the central nervous system and cause CNS toxicity (including seizure and coma).

Glucagon is an accepted antidote for beta blocker and calcium blocker overdose. Glucagon will increase HR and contractility, independent of beta adrenergic receptors. Consequently, it may work where beta stimulating drugs such as epinephrine or isoproterenol may not. Administration can also be diagnostic. There is little evidence to support a benefit to charcoal, however, it may still be administered in conjunction with controlled gastric lavage to remove any undigested pills. Catecholamines and atropine may be considered to treat hypotension and bradycardia and benzodiazepines are the drug of choice for seizures. Cardiac pacing and magnesium may also be considered.

There is emerging interest based on case reports of survival following the administration of high dose lipid therapy (20% intralipid) for overdoses of drugs with a high lipid concentration with cardiac arrest (including beta blockers, bupivacaine and calcium blockers).

**Blueprint Competency Being Tested:** 4.4a

60. Following insertion of a nasogastric feeding tube, Mrs. Pinkerton is started on continuous enteral feeding infusion at 30 ml/hr. Three hours later, she has a residual volume of 100 ml. Which one of the following interventions would be the priority?
- Remove the feeding tube and replace with a nasal-jejunal tube
  - Position Mrs. Pinkerton on her left side
  - Initiate metoclopramide (Maxeran)
  - Administer a dose of pantoprazole (Pantoloc)

**Rationale for Correct Response:**

c) Although this residual represents 3 hours of feeding volume, a total volume of only 100 ml (< 4 ounces) may be insufficient to stimulate gastric emptying. Head of bed elevation, right sided positioning and use of a prokinetic (such as metoclopramide) should be initiated to facilitate gastric emptying. While the ideal placement for the initial feeding tube may be small bowel, it is more appropriate to initiate these simple strategies before putting the patient through a second tube insertion. If prokinetics and positioning are unsuccessful, the next step should be to consider a small bowel feeding tube and/or rule out any mechanical obstruction or ileus. Pantoloc decreases gastric acidity; it does not promote feeding.

**Blueprint Competency Being Tested:** 4.4a

61. Which one of the following interventions should be included in the care of a patient receiving Central TPN?
- Change lipid tubing every 72 hours
  - Change central line every 7 days
  - Weekly blood cultures
  - Routine liver function tests

**Rationale for Correct Response:**

d) Patients receiving TPN are at risk of developing fatty liver disease or cholestatic disease, as well as electrolyte or trace element deficiencies (including essential fatty acids). Liver function tests, coagulation and lipid profiles and protein and nutritional markers should be monitored routinely. A dietitian consult should be initiated whenever possible to ensure appropriate therapy monitoring.

The Center for Disease Control guidelines for the prevention of intravascular infections recommends changing IV tubing every 72-96 hours for stand infusions, however, with more frequent changes for lipids and blood tubing. Blood cultures are only indicated if there is a clinical indication (e.g., fever, elevated white count).

<http://www.cdc.gov/MMWR/PREVIEW/MMWRHTML/rr5110a1.htm>

**Blueprint Competency Being Tested:** 4.4c

62. Mrs. Clan develops a leak of gastric contents around her new gastrostomy tube site. Feeds are discontinued and she is started on a medication to decrease gastroenteropancreatic secretions. Which medication has been ordered to produce this effect?
- Pantoprazole (Pantoloc)
  - Octreotide (Sandostatin)
  - Metoclopramide (Maxeran)
  - Vasopressin

**Rationale for Correct Response:**

b) Octreotide inhibits pathologically increased secretion of peptides and serotonin produced within the gastroentero-pancreatic (GEP) endocrine system, and growth hormone. It can be used in pancreatitis or post pancreatic surgery to reduce secretions and prevent complications such as pancreatic fistula or abscess, or to reduce secretions in other gastric leak syndromes. It is also believed to reduce splanchnic blood flow primarily by inhibiting vasoactive gastrointestinal hormone secretion and exerting a direct vasomotor effect on splanchnic vessels, thus reducing portal blood flow. It can also be used in the emergency management of bleeding gastroesophageal varices in patients with cirrhosis.

**Blueprint Competency Being Tested:** 4.4d

63. Mr. Butler is admitted with bleeding from esophageal varices. He is intubated and ventilated for airway protection and to maintain sedation, and has a Minnesota Tube inserted to tamponade his varices. Which of the following should be included in the care of a patient with a Minnesota tube?
- The esophageal balloon must be inflated if the gastric balloon is deflated
  - The esophageal balloon should be inflated at all times
  - Traction is maintained through the use of weights on an overbed pulley
  - Airway obstruction can occur if the gastric balloon is inflated

**Rationale for Correct Response:**

c) The Minnesota tube has 4 lumens: an esophageal and gastric suction port and an esophageal and gastric balloon port. Inflation of the gastric balloon alone, along with upward traction to position the gastric balloon tightly into the esophogastric junction, may be sufficient to tamponade a bleeder.

Ideally, inflation of the gastric balloon should be done while measuring balloon pressure with a manometer. A baseline measurement should be taken prior to balloon inflation. Initially the balloon should be inflated with 100 cc of air, while listening for the sounds of gastric insufflation with a stethoscope. The balloon pressure should be rechecked after each additional 100 cc of air is added, to a maximum of 450 cc. The gastric balloon pressure should not exceed a 15 mmHg rise from baseline. The balloon is then “snugged” into position by the application of traction.

Traction is applied using the weight of a 500 ml IV bag. A rope is tied to the end of the Minnesota tube and pulled upward through a pulley on an overbed frame. The rope continues horizontally down the frame, with the 500 ml IV bag hanging from the end.



If bleeding cannot be controlled by the gastric balloon alone, the esophageal balloon may need to be inflated to provide additional compression of the bleeding varices. The esophageal balloon should be inflated to a maximum pressure of 25-40 mmHg.

Ideally, the physician should deflate the esophageal balloon every 2 hours for 10 minutes, to prevent esophageal necrosis. The balloon should never be left inflated for > 12 hours. One of the most serious complications is the upward migration of the Minnesota tube into the airway. This is most likely to occur if the gastric balloon is over inflated, or the esophageal balloon is inflated while the gastric balloon is deflated.

The mouth should be inspected every hour, and the tube repositioned from side to side to prevent oral mucosal damage. A pair of scissors should be kept at the bedside. All lumens of the tube can be cut to cause immediate tube deflation in the event of accidental airway obstruction from migration of the tube.

**Blueprint Competency Being Tested:** 4.4f

64. Mr. Gordinski is admitted with a diagnosis of hepatic encephalopathy secondary to cirrhosis. His ammonia level dropped to normal in the first 24 hours and he has had 2 spontaneous bowel movements. He remains in coma. Which one of the following interventions is a priority?
- a. Lactulose
  - b. N-acetylcysteine (Mucomyst)
  - c. Sodium Polystyrene (Kayexalate)
  - d. Glutamine supplements

**Rationale for Correct Response:**

a) Ammonia is produced by the bacterial degradation of the byproducts of protein metabolism. Hepatocytes convert ammonia to urea, making it water soluble for elimination in the urine. In liver failure, the loss of functioning hepatocytes reduces the ability to detoxify ammonia. If portal venous to systemic shunting occurs, ammonia may also be diverted away from the liver and into the systemic circulation without detoxification. Ammonia has a number of neurotoxicities.

Although some controversy exists regarding the role of ammonia in the development of encephalopathy (some patients have encephalopathy with normal ammonia levels, whereas, others have high ammonia levels without encephalopathy), lactulose administration is recommended for the treatment of hepatic encephalopathy. Lactulose inhibits the production of intestinal ammonia and aids in the elimination of ammonia producing bacteria. Lactulose should be given regardless of the ammonia level, until the patient is awake. Bowel movements that are not facilitated by lactulose administration may not have the same benefit.

**Blueprint Competency Being Tested: 5.1b**

65. Ms. Sibley is in a positive fluid balance with urine output < 30 ml/hr and significant peripheral edema. Labs are as follows:

Na 148 K 4.9 Cl 105 HCO<sub>3</sub> 23 Urea 16 mmol/L Creatinine 85 umol/L. Urine sodium is low, and serum and urine osmolality increased. Which one of the following interventions would you anticipate?

- a. Furosemide (Lasix)
- b. 0.45% normal saline
- c. 0.9 % normal saline
- d. Fluid restriction

**Rationale for Correct Response:**

c) The increased sodium, potassium and urea (with normal creatinine), concentrated blood and urine (increased serum and urine osmolality) and low urine sodium (sodium is reabsorbed from the urine in dehydration, reducing the amount of sodium in the urine) indicates that the patient is intravascularly dry. Rehydration should always be with isotonic or colloid solutions (such as 0.9% normal saline, ringers lactate or starch solutions) is indicated.

**Blueprint Competency Being Tested: 5.2**

66. Mr. Bright, 75 yrs old, has a history of Type II diabetes and chronic renal insufficiency. He is scheduled for a CT abdomen with contrast. Which one of the following interventions should be anticipated?

- a. Furosemide (Lasix)
- b. N-acetylcysteine (Mucomyst)
- c. Mannitol
- d. Low dose dopamine

**Rationale for Correct Response:**

b) Mucomyst is administered (usually 2 doses pre and 2 doses post IV contrast) to prevent IV contrast nephropathy. Prophylaxis is only indicated if IV contrast (not oral) is being used. It is postulated that mucomyst provides renal protection through oxygen radical scavenging properties, and by improving renal vascular tone. In addition to mucomyst, there is some evidence that prehydration may provide the best protection. Rehydration may also include sodium bicarbonate.

**Blueprint Competency Being Tested:** 5.3

67. Mr. Wilson undergoes an open repair of an abdominal aortic aneurysm. In the first 24 hours following surgery, his creatinine doubles and his urine output decreases to < 10 ml/hr. Which one of the following is the most likely cause of his acute kidney injury

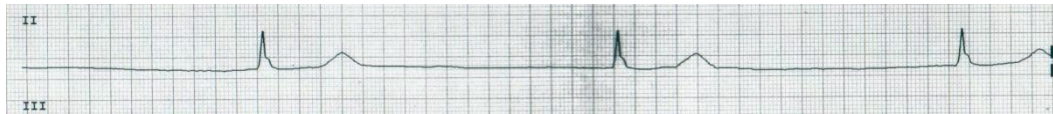
- a. Postrenal
- b. Intrarenal
- c. Prerenal
- d. Aneurysmal

**Rationale for Correct Response:**

c) Renal failure due to a decrease in blood flow to the kidney is referred to as prerenal cause for renal insufficiency. Following aneurysm repair, aortic cross clamping, hypovolemia/hypotension, renal artery involvement, atherosclerotic disease of the renal blood vessel and/or renal thrombosis are all possible causes for reduced renal blood flow. Prerenal is the most likely cause for the kidney injury.

**Blueprint Competency Being Tested:** 5.4

68. Ms. Lo is admitted with oliguric renal failure. She suddenly develops hypotension with the following rhythm:



Which one of the following interventions should be anticipated?

- a. Potassium bolus
- b. Magnesium Sulphate
- c. Insulin
- d. Amiodarone

**Rationale for Correct Response:**

c) This rhythm, in the setting of oliguric renal failure is typical of hyperkalemia. The treatment is insulin with glucose, sodium bicarbonate and calcium gluconate.

**Blueprint Competency Being Tested:** 5.5a

69. Mr. Yokobi is admitted with cardiogenic shock and oliguric acute kidney injury. Hemodynamics reveal the following: BP 105/60 (~70) Sinus rhythm (108) CI 1.8 (CO 2.4) CVP 23 PWP 25 SVRI 2088 (SVR 1566). Which one of the following interventions would you anticipate?

- a. Dopamine at 2 mcg/kg/min
- b. Captopril 6.5 mg q6h
- c. Metoprolol 25 mg BID
- d. Dobutamine at 5 mcg/kg/min

**Rationale for Correct Response:**

d) The acute kidney injury is most likely prerenal, due to the low cardiac output. Cardiac output is improved by optimizing heart rate and rhythm, preload, contractility and afterload. While beta blockers and ACE inhibitors are important interventions following myocardial infarction, the patient requires stabilization for the cardiogenic shock and renal failure prior to starting these medications (beta blockers decrease contractility and ACE inhibitors are contraindicated in oliguric renal failure).

The heart rate may come down by increasing the stroke volume. Since the intravascular volume is high, the next step would be to add an inotrope (such dobutamine). A loading dose could also be given; this dose is reduced to adjust for the renal insufficiency. Dopamine at 2 mcg/kg/min is a dopaminergic dose; there is no evidence that this will improve renal function and it is too low to provide inotropic support. Dopamine is also more likely to worsen the tachycardia.

**Blueprint Competency Being Tested:** 5.5c

70. Mrs. Clementine is on Continuous Renal Replacement and is receiving hemodiafiltration. Which one of the following interventions would increase clearance?
- a. Increased fluid removal
  - b. Use of citrate anticoagulation
  - c. Use of a larger filter
  - d. Reduction in the blood flow rate

**Rationale for Correct Response:**

c) Clearance (removal of waste solutes) is increased by use of a larger filter, higher flow rates of dialysate, blood flow or hemofiltration fluids. Post dilution hemofiltration provides better clearance than an equal volume of pre dilution hemofiltration. Increasing the fluid removal rate will increase water loss (ultrafiltration); it will not impact clearance. Citrate is a method for filter anticoagulation that is independent of clearance.

**Blueprint Competency Being Tested:** 6.1

71. Ms. Eaves has a TSH that is 39 (normal 0.2-4.2 mIU/L). T4 and T3 are both very low. Which one of the following problems is suggested by these findings?
- a. Hyperthyroidism
  - b. Hypothyroidism
  - c. Sick euthyroid of critical illness
  - d. Pituitary dysfunction

**Rationale for Correct Response:**

b) Thyroid Stimulating Hormone (TSH) is released from the pituitary, and stimulates the thyroid gland to produce T4 and T3 (in the presence of sufficient iodine). Most of the thyroid hormone produced is thyroxine (T4). T4 is converted to T3 which is the most biologically active form of the hormone.

In hypothyroidism, the thyroid gland is unable to make T4 and T3, therefore levels are low. The low T4 and T3 levels will stimulate the hypothalamus to release more Thyroid Releasing Hormone (TRH), which stimulates the pituitary to make more TSH. Despite the increased output of TSH, the thyroid gland is still unable to respond. This is classic hypothyroidism and is treated with the administration of T4 (levothyroxine).

During critical illness, patients often display a variety of thyroid abnormalities. Most frequently, they have a mild elevation in their TSH, and mild reduction in their T4 and T3. This is referred to as sick euthyroid (normal thyroid function during sickness). The TSH may be elevated, but rarely > 15. Thyroid function will return to normal following recovery from critical illness. There is controversy regarding the management of sick euthyroid, however, treatment is not usually recommended.

**Blueprint Competency Being Tested:** 6.2

72. Following a severe traumatic brain injury, Jamie's urine output increases to 300 ml/hr, BP decreases to 90/60 and HR increases to 144. His serum sodium is 155 mmol/L. Which one of the following interventions is the priority?
- a. Obtain urine and serum osmolalities
  - b. Change IV fluid to 0.45 % NaCl
  - c. Administer desmopressin (DDAVP)
  - d. Initiate levophed infusion

**Rationale for Correct Response:**

a) In the setting of acute traumatic brain injury, these findings could indicate Diabetes Insipidus. While this would be treated with DDAVP and fluid replacement, the diagnosis needs to be made first. This high output could be mobilization of resuscitation fluid and simply dehydration, in which case, DDAVP would not be indicated. Osmolalities will confirm the diagnosis.

Treatment of the hypovolemia is a priority, regardless of the underlying cause. Initial resuscitation during hypotension should always include isotonic solutions, even though conversion to lower sodium concentrations may be required to replace the water deficit during continued fluid replacement. Fluid is the priority for the treatment of hypovolemia, not vasopressors.

**Blueprint Competency Being Tested:** 6.2b

73. Mr. Veldman is admitted with decreased level of consciousness. His admission labs are: Blood glucose 56 mmol/L, Na 143 K 4.8 Cl 109 HCO<sub>3</sub> 22, ABGs PaO<sub>2</sub> 72 PCO<sub>2</sub> 45 pH 7.39 HCO<sub>3</sub> 23. Which one of the problems is indicated by these findings?
- a. Diabetic ketoacidosis
  - b. Glucagon overdose
  - c. Non-ketotic hyperosmolar coma
  - d. Adrenal crisis

**Rationale for Correct Response:**

c) Hyperglycemia in the absence of a metabolic acidosis and normal or near normal anion gap (AG =12: Normal is less than 12) is consistent with a non-ketotic hyperosmolar crisis. Anion gap = Na – (Cl + HCO<sub>3</sub>). DKA would include an anion gap metabolic acidosis.

**Blueprint Competency Being Tested:** 6.2c

74. Martha is admitted following a motor vehicle collision. Her past medical history includes daily prednisone for the treatment of systemic lupus. Despite fluid replacement therapy and initiation of levophed, her blood pressure remains low. Which one of the following interventions is the priority?
- Cosyntropin
  - Epinephrine
  - Hydrocortisone
  - Vasopressin

**Rationale for Correct Response:**

c) Chronic steroid use can cause adrenal suppression. During illness, trauma or other stressors, our body normally increases the output of our stress hormone cortisol. A stressor can induce sudden adrenal insufficiency in individuals who are on long term steroids and have suppressed adrenal function. Cortisol makes blood vessel responsive to catecholamines, both endogenous and exogenous. The failure to respond to levophed is consistent with adrenal insufficiency. All patients on long term steroids who undergo surgery, develop infection or undergo a significant injury need a “stress dose” of steroids. Hydrocortisone contains both glucocorticosteroids and minerocorticosteroids and has the fastest onset of action.

**Blueprint Competency Being Tested:** 6.2d

75. Ms. Oliviera is admitted with coma. She has a BP of 158/75 HR 52 (sinus) and requires intubation for level of consciousness and pulmonary edema. Her temperature is 34 (oral). Which of the following lab tests is the priority?
- TSH, T3, T4
  - Serum and urine osmolalities
  - Cosyntropin stimulation test
  - Serum renin and angiotensin levels

**Rationale for Correct Response:**

a) Mild hypertension, bradycardia, respiratory depression, coma and hypothermia are all consistent with hypothyroidism. It should be noted that most oral thermometers have a lower limit of 34; a temperature reading that is at or near the lowest possible reading should be verified with a low reading probe, as this temperature may be much lower. Hypothyroid coma is almost always precipitated by an event such as sepsis; investigation of the underlying cause for the hypothyroid coma should be part of the initial investigation and treatment.

**Blueprint Competency Being Tested:** 6.2d

76. Which one of the following pharmacological agents should be administered with levothyroxine for the treatment of myxedema coma?

- a. Insulin
- b. Glucagon
- c. Epinephrine
- d. Steroids

**Rationale for Correct Response:**

d) In the setting of coma due to hypothyroidism, steroids are also administered to cover the possibility of simultaneous adrenal insufficiency.

**Blueprint Competency Being Tested:** 63b

77. Mrs. Kang has been on steroids for the past 6 years to treat severe rheumatoid arthritis. Which one of the following problems would you anticipate?

- a. Hypercalcemia
- b. Hyperkalemia
- c. Hyperlipidemia
- d. Hypoglycemia

**Rationale for Correct Response:**

c) Prolonged steroid use causes Cushing's Syndrome. Cortisol is a catabolic hormone that favours the breakdown of fuel sources to create energy. Prolonged therapy with glucocorticosteroids causes hyperlipidemia (with atherosclerotic consequences, hypertension and coronary artery disease), protein breakdown (thin fragile skin, muscle wasting particularly in legs and arms), hyperglycemia (DMII), hypocalcemia, sodium and water retention with increased potassium loss in the urine (hypokalemia), fat distribution in back, shoulder and trunk, menstrual irregularities and mood/sleep disorders. Increased risk for infection is also an important problem.

**Blueprint Competency Being Tested:** 63c

78. Ms. Romansky suddenly develops a decrease in her level of consciousness, even though she has not received any additional sedatives or analgesics. She is on broad spectrum antibiotics, levophed, vasopressin, steroids and intensive insulin. She is being fed via a nasal gastric feeding tube. She develops gastric distention with residual volumes equal to 6 hours feeding volume. Which one of the following interventions is a priority?

- a. Change feeding tube to small bowel placement
- b. Obtain a blood glucose measurement
- c. Initiate a prokinetic agent
- d. Change feeds to elemental solution

**Rationale for Correct Response:**

b) The priority should be to rule out hypoglycemia as a potential cause for the neurological change. She is on insulin and has not been absorbing her feeds. Failure to absorb feeds should prompt a STAT blood glucose assessment.

**Blueprint Competency Being Tested:** 7.2

79. Which one of the following factors increases the risk for central line infection?

- a. Subclavian venous access
- b. Chlorhexidine skin prep
- c. Tunneled catheters
- d. TPN

**Rationale for Correct Response:**

d) The high glucose level and use of lipids in TPN can support bacterial or fungal growth. The Center for Disease Control Guidelines for the Prevention of Intravascular Catheter-Related Infections identifies subclavian access, chlorhexidine skin prep and use of tunneled catheters as preferred strategies.

**Blueprint Competency Being Tested:** 7.3

80. Mr. Vanderveen is admitted with alcoholic pancreatitis. He has a T 38.2 WBC 14,000 (with left shift and increased neutrophils). Following 4 litres of normal saline, his BP increases to 117/80 from 70/50, HR decreases from 144 to 92 and urine output increases from 10 to 60 ml/hr. He requires intubation for worsening hypoxemia. Which one of the following best explains these findings?

- a. Sepsis
- b. Severe sepsis
- c. Septic shock
- d. Systemic Inflammatory Response Syndrome

**Rationale for Correct Response:**



d) Severe pancreatitis causes systemic inflammation. Systemic Inflammatory Response Syndrome (SIRS) is characterized by increased vascular permeability, vasodilation, hypovolemia and hypotension. Pulmonary edema can also develop from increased pulmonary vascular permeability causes pulmonary shunting and Acute Lung Injury or ARDS. Organ dysfunction can develop as a result of intravascular volume deficit and distributive shock. SIRS is defined by the presence of 2 or more of the following findings:

- tachycardia
- tachypnea or respiratory alkalosis
- High or low temperature
- High or low white count (with bands >10% or a “left shift”)

Although infection can be a cause for SIRS (which is called “sepsis”), the SIRS in acute pancreatitis is usually due to the tissue injury from leaking pancreatic enzymes. Patients with pancreatitis can become infected and develop sepsis (e.g., pancreatic abscess, pneumonia), therefore, associated infections must always be considered. Sepsis associated with pancreatitis is typically associated with a higher WBC and temperature.

**Blueprint Competency Being Tested: 7.4**

81. Ms. Dorosz, 80 kg, drops her platelet count by >50% 10 days after starting subcutaneous heparin. She develops a swollen right calf and positive Homan’s sign. Which one of the following interventions would you anticipate?

- a. Change anticoagulant to dalteparin 15,000 units SC daily
- b. Administer protamine sulphate and discontinue heparin
- c. Initiate anticoagulation with fondaparinux
- d. Stop all anticoagulation and initiate pneumatic compression stockings

**Rationale for Correct Response:**

c) These findings are suspicious for the diagnosis of Heparin Induced Thrombocytopenia (HIT). One of the most serious complications associated with HIT is venous and/or arterial thromboembolism, and this patient has signs and symptoms of DVT. Once suspected, all heparin should be stopped, INCLUDING low molecular weight heparins (e.g., dalteparin) and a HIT screen drawn. When HIT is identified, anticoagulation with a non-heparin should be considered, but it is definitely indicated when thrombosis is confirmed or suspected. Fondaparinux is an example of an anticoagulant that can be used in the setting of HIT. Other anticoagulants that may be used when HIT is present include: hirudin (Iepirudin), argatroban or danaparoid. Pneumatic compression stockings would be contraindicated if DVT is suspected. Heparin should be stopped but protamine sulphate is not indicated.

**Blueprint Competency Being Tested:** 7.5b

82. Mr. Blewett is admitted with hypoxemic and hypercarbic respiratory arrest requiring intubation and ventilation. He has a RLL consolidation on xray, with copious purulent secretions. WBC is 24,000 T 39.2. BP 88/55 HR 136 and CVP 18 after 6 L of 0.9% normal saline. Urine output is 10 ml/hr. Which one of the following interventions is a priority?

- a. Levophed
- b. Dopamine
- c. Dobutamine
- d. Labetolol

**Rationale for Correct Response:**

a) These findings are consistent with septic shock (hypotension despite adequate intravascular volume) due to pneumonia. Hypotension persists despite adequate fluid replacement, indicating the need for vasoactive drugs. The best agent would be levophed, as it would produce vasoconstriction with less chance of worsening the tachycardia. Dopamine would probably worsen the tachycardia, whereas, the BP is too low to tolerate the vasodilating effect of dobutamine. Labetolol is a vasodilator that would worsen the hypotension.

**Blueprint Competency Being Tested:** 9.1a

83. Ms. Tam is recovering from a prolonged critical illness. She is having tracheostomy-mask trials each day. She is withdrawn and sad, and tells the nurse she no longer has any control of her life. Which one of the following interventions would best meet her needs?

- a. Initiate antidepressant therapy
- b. Administer sedation at bedtime
- c. Develop a collaborative plan of care
- d. Refer Mrs. Tam to a psychiatrist

**Rationale for Correct Response:**

c) All of these interventions may help improve her overall sense of well being, however, her expressed concern is her loss of control. Developing a plan of care collaboratively with Ms. Tam gives the patient control in her life.

**Blueprint Competency Being Tested:** 9.2a

84. Mr. Ferriere has been on home ventilation for several years with severe COPD. He was admitted for exacerbation of COPD due to pneumonia. At home, he varies his support between Pressure Control ventilation and spontaneous breathing. His pneumonia has now resolved and the plan is to return him to his baseline ventilation. He calls you to his bedside and asks you what his ventilator is set to because he feels short of breath. You tell him he is on Pressure Support, and he becomes very angry. He tells you that he told the respiratory therapist that he has tried Pressure Support in the past and he does not like it. When you speak to the respiratory therapist, she had placed the patient on PS to see if he noticed the difference. Which one of the following is an appropriate response?

- a. Encourage Mr. Ferriere to stay on the Pressure Support and give it a chance to work
- b. Have the respiratory therapists speak to Mr. Ferriere to explain her interventions
- c. Facilitate a meeting between you, the respiratory therapist and Mr. Ferriere to develop a plan for weaning
- d. Tell Mr. Ferriere that his lungs have changed and the previous mode might not work the same way

**Rationale for Correct Response:**

c) The patient knows his breathing better than anyone else and is experienced with his own ventilation requirements. The goal is to return him to his usual care, not try to wean him from the ventilator. The patient's previous experience and wishes for care should be respected. Changing the ventilator settings in a less than up front manner and against the patient's expressed wishes is not appropriate and will impact the patient's ability to trust the team. This patient needs to be included in his decision-making and care planning regarding this weaning, and the nurses should facilitate a meeting and advocate on the patient's behalf as required.

**Blueprint Competency Being Tested:** 9.2b

85. When using a Passy-Muir Valve (PMV), which one of the following interventions is appropriate?

- a. Ensure the cuff is always inflated
- b. Monitor for adequacy of exhalation
- c. Introduce the PMV as soon as the tracheostomy is performed
- d. Suction prn by passing the catheter through the centre of the PMV

**Rationale for Correct Response:**

b) The cuff must always be deflated when a PMV is in place. The PMV is a one-way valve that is open during inspiration and closed during exhalation. The patient can only exhale around the tube, enabling the patient to speak and facilitating easier swallowing during eating. There must be enough room between the trachea and the outer diameter of the tube to allow air flow during exhalation. Too large a tracheostomy tube, airway edema (such as immediately after tube insertion or tube exchange) or tracheal stenosis could limit exhaled air flow and volume, therefore the adequacy of exhalation must be assessed. Patients requiring high levels of support may also be unable to tolerate the loss of volume during cuff deflation. Suction catheters cannot be passed through a Passy-Muir valve. <http://www.passy-muir.com/pdfs/instructbklt.pdf>

**Blueprint Competency Being Tested:** 2.2c

86. Following an inferior wall infarction, Mrs. Kempster develops a sinus rhythm with Wenkebach phenomena. She develops episodes of symptomatic bradycardia. Which one of the following interventions would be the priority?

- a. Epinephrine
- b. Cardioversion
- c. Atropine
- d. Dopamine

**Rationale for Correct Response:**

c) Inferior wall infarction is most frequently the result of right coronary artery disease. Wenkebach is a pattern of blocking characterized by progressive prolongation of the PR interval, indicating that the intermittent block is within the AV node (block within the AV node is referred to as a Type I second degree block). AV nodal disease or ischemia reinforces the probability of right coronary artery disease. AV nodal ischemia following right coronary artery infarction is typically transient. The need for intervention is usually temporary. Atropine is an effective SA and AV node stimulant. Because this patient is most likely symptomatic from the slow HR, atropine may raise the HR effectively without adding unnecessary inotropic or vasoconstricting properties (that increase oxygen demand). While more potent agents or pacing may become necessary, atropine should be the first line agent for symptomatic bradycardia associated with SA or AV node dysfunction.

**Blueprint Competency Being Tested:** 9.5

87. Mrs. Singh has advanced cancer. She has been extubated for two days, with orders for no reintubation. She develops increasing dyspnea. Which one of the following agents would best manage these symptoms?

- a. Propofol (Diprivan)
- b. Fentanyl
- c. Midazolam (Versed)
- d. Gabapentin

**Rationale for Correct Response:**

b) Narcotics are the first line agent for the treatment of dyspnea. Gabapentin is for neurogenic pain.

**Blueprint Competency Being Tested:** 2.1f

88. You attempt to perform a pulmonary wedge pressure measurement, however, the catheter will not wedge. You identify the following waveform. Which one of the following interventions is appropriate?



- a. Withdraw catheter until a right atrial tracing appears
- b. Draw gases to assess location
- c. Avoid further balloon inflation
- d. Obtain a chest xray

**Rationale for Correct Response:**

a) The catheter tip is displaying a right ventricle waveform. The catheter requires withdrawal.

**Blueprint Competency Being Tested:** 2.4e

89. What is the appropriate intervention for the following arterial waveform during Intra Aortic Balloon Pumping (IABP)?



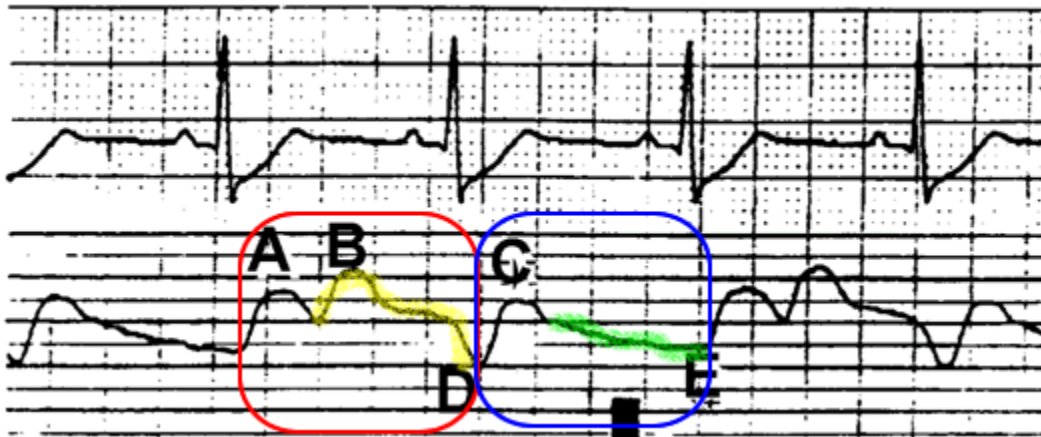
- a. Make the inflation begin earlier
- b. Make the inflation begin later
- c. Make the deflation begin earlier
- d. Make the deflation begin later

**Rationale for Correct Response:**

b) The arterial waveform in this question shows the pressure changes during intra-aortic balloon pumping with a ratio of 1:2 (the balloon inflates and deflates during every other cardiac cycle). The balloon is inflating before the dicrotic notch, indicating early inflation. Early inflation can cause premature closure of the aortic valve and premature termination of systole with backward regurgitation to the left ventricle. The inflation should be adjusted to make it begin a bit later.

The diagram below shows optimal balloon pumping with a 1:2 ratio. The red circle highlights the cardiac cycle when the balloon inflates (known as the augmented beat). The blue circle highlights the beat when the balloon does not inflate. The period of balloon inflation (or the diastolic period of the cycle) is highlighted in yellow. The diastolic period of the non-augmented beat is highlighted in green.

The IAB is inflated at the onset of diastole, raising the aortic pressure during diastole (B) until it is higher than the systolic pressure (A). This increased aortic pressure during diastole enhances coronary blood flow (90% of coronary blood flow occurs during diastole). Note that the arterial pressure suddenly increases at the point of the diastolic notch (closure of aortic valve). This rise in arterial pressure (B) is due to balloon inflation.



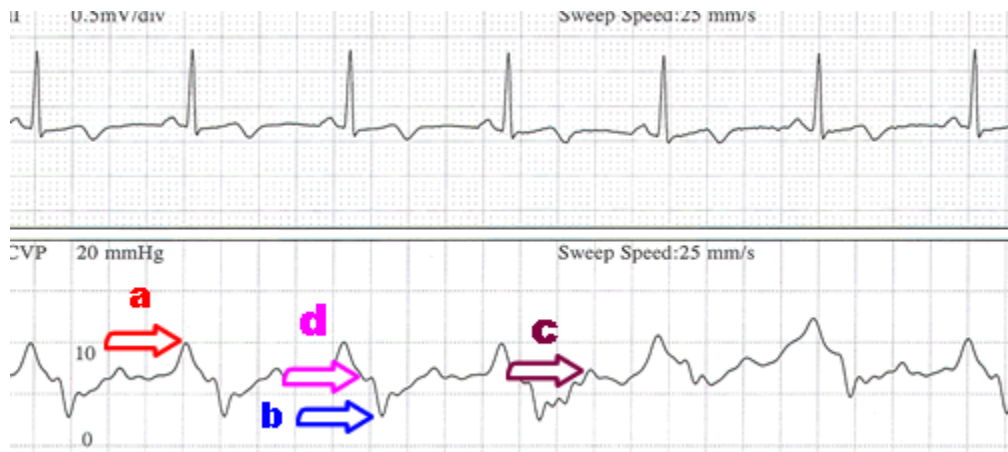
The balloon must be deflated before systole begins. If the balloon is inflated during systole, systolic ejection would be inhibited. Note that the arterial pressure falls rapidly after the peak diastolic pressure, falling below the normal end diastolic pressure. Timing of deflation to occur immediately before the next systole produces this drop in pressure below that of the normal end diastolic pressure to decrease the afterload for the next beat. Afterload reduction can be identified on this 1:2 waveform by noting that the arterial pressure at the end of balloon deflation (D) falls below that of the normal end diastolic pressure (E). The systolic pressure on the beat that follows balloon deflation is “helped” by the lower afterload. Note that the systolic pressure following balloon deflation (C) is less than the previous systolic pressure (A). This is referred to as the “assisted systolic pressure” (C).

Ideal timing should have the following characteristics:

- The balloon should inflate at the diastolic notch to produce a crisp “V”. A “U” or visible diastolic notch identifies late inflation. If the upstroke encroaches the systolic pressure (before the diastolic notch would appear), inflation is early (as in this example).
- Ideal augmentation will produce a peak augmentation pressure (also called peak diastolic pressure) that is higher than the systolic pressure ( $B > A$ ). If the diastolic pressure increases but does not exceed the systolic pressure, it could be due to a decrease in balloon volume, a balloon that is too low or only partially inflated or poor ventricular function.
- Ideal deflation is identified when the balloon end diastolic pressure is lower than the normal end diastolic pressure ( $D < E$ ) and the assisted systolic pressure is lower than the normal systolic pressure ( $C < A$ ). Late deflation is identified when  $D > E$  and the assisted pressure is lower than the normal systolic pressure due to impeded ejection by the inflated balloon. Early deflation is identified by a “U” or loss of “V” at the balloon end diastolic pressure. If deflation is late, afterload reduction is reduced or absent ( $D = E$ ).

**Blueprint Competency Being Tested:** 2.1g

90. Identify the ideal location for measuring right atrial pressure from the following right atrial waveform.



**Rationale for Correct Response:**

d) The end of diastole can be located just before the “C” wave, also referred to as the “pre C wave” point. It is identified in pink (d).

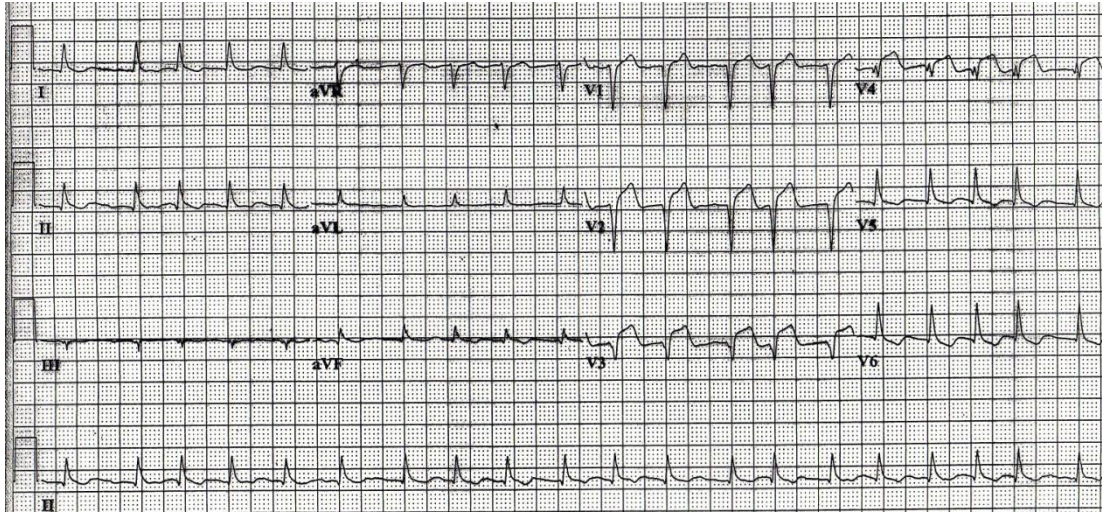
The C wave is the rise in the atrial pressure during isovolumetric contraction. Isovolumetric contraction is the period immediately after the tricuspid valve closes, but before the pulmonary valve opens. During this period, depolarization of the ventricle causes the ventricular pressure to increase until it overcomes the pulmonary artery pressure (the pressure change that is required to open the pulmonary valve). During isovolumetric contraction, the rising ventricular pressure causes the closed tricuspid valve to bulge upward into the atrium. This increases the atrial pressure, producing the “C” wave

The following waveform has labeled the right atrial pressure to identify the rise in pressure associated with atrial contraction (a wave), the rise in the atrial pressure during isovolumetric contraction (c wave) and the rise in the atrial pressure that occurs when the right atrium refills with blood during ventricular systole (v wave).



**Blueprint Competency Being Tested:** 2.1k

91. Mr. Sleaman is admitted with chest pain, hypotension and acute rise in CK and troponin. What does this ECG suggest?



- a. Inferior wall infarction
- b. Lateral wall infarction
- c. Anterior wall infarction
- d. Posterior wall infarction

**Rationale for Correct Response:**

c) Q waves and ST elevation are evident in V1-V4, consistent with a Q wave ST segment elevation MI in the anterior wall.

**Blueprint Competency Being Tested:** 2.4i

92. Mrs. Arubesque is admitted with cardiogenic shock following a myocardial infarction. She has the following findings:

HR 68 BP 80/55 CVP 24 SpO2 88%

Which one of the following interventions is the priority?

- a. Levophed
- b. Epinephrine
- c. Lasix
- d. Metoprolol



**Rationale for Correct Response:**

b) Epinephrine is the best option as it would increase BP and contractility. Levophed alone would increase afterload and heart work and could lower stroke volume. Although lasix may be indicated, the hypotension needs to be fixed first. Blood pressure is too low to start metoprolol.

**Blueprint Competency Being Tested:** 2.2d

93. Mr. Phillips underwent coronary bypass surgery. Four hours following admission to the critical care unit, his BP begins to fall, his HR rises to 130 and his urine output decreases to 35 ml/hr. His CVP increases to 22 and his PWP 18. The critical care nurse notifies the cardiovascular surgeon. Pending the surgeons arrival, which intervention is the priority?

- a. Milrinone
- b. Dobutamine
- c. Lasix
- d. Fluid

**Rationale for Correct Response:**

d) These findings (signs of low cardiac output, increased cardiac filling pressures with CVP > PWP, postoperative open heart surgery) suggest cardiac tamponade. The appropriate intervention is to contact the cardiac surgeon for definitive treatment (the patient may need his chest tube declotted if due to blocked flow, or may need to return to the operating room if due to bleeding). Pending the surgeons arrival, fluid should be the first intervention. Increased intravascular volume can temporarily maintain the cardiac output against the expanding pericardial/mediastinal pressure; hypovolemia or vasodilation can worsen the shock.

**Blueprint Competency Being Tested:** 3.1g

94. Identify the formula for minute volume.

- a. Tidal volume X respiratory rate
- b. Functional residual capacity – tidal volume
- c. Forced vital capacity X respiratory rate
- d. Cardiac Output X respiratory rate

**Rationale for Correct Response:**

a) Minute volume is the total amount of air exhaled in one minute and is calculated as the tidal volume X respiratory rate.

**Blueprint Competency Being Tested:** 3.1f

95. After successful completion of a spontaneous breathing trial, extubation is considered. Which one of the following findings would be a contraindication to extubation?
- a. FiO<sub>2</sub> 0.4
  - b. PEEP 5
  - c. GCS 4
  - d. Minute volume 10 L/min

**Rationale for Correct Response:**

c) A GCS of 4 indicates a severely depressed level of consciousness. A GCS of this level is typically associated with impaired ability to protect the airway.

**Blueprint Competency Being Tested:** 2.3b

96. Mrs. Andios is a Type II diabetic with a history of TIA and congestive heart failure. She is admitted to the critical care unit for monitoring following a Hartmann's procedure for colon cancer. Two hours post operatively, she develops new onset uncontrolled atrial fibrillation with hypotension. Which one of the following interventions is the priority?
- a. Lidocaine
  - b. Amiodarone
  - c. Coumadin
  - d. IV heparin

**Rationale for Correct Response:**

b) Conversion of this symptomatic rhythm is the priority. Lidocaine will not work on atrial arrhythmias. Although long term anticoagulation is indicated given her other comorbidities (DM II, TIA and CHF) if her atrial fibrillation persists, postoperative bleeding is a greater risk.

**Blueprint Competency Being Tested:** 1.2a

97. Mrs. Katanska had a thrombotic stroke 18 hours ago. She has the following findings:

HR 85  
BP 165/80 (MAP 80)  
CVP 13  
RR 25  
Temp 38.1

Which one of the following pharmacological agents is the priority?

- a. Antipyretic
- b. Anticonvulsant
- c. Antihypertensive
- d. Beta-blocker

**Rationale for Correct Response:**

a) Early intervention for fever is recommended following stroke. Fever is associated with worse outcome stroke. Hypertension is only treated when extreme, as the injured brain may need a higher cerebral perfusion pressure. Anticonvulsants are not indicated unless evidence of seizure.

**Blueprint Competency Being Tested:** 2.2e

98. Mrs. Benedict has a large anterior-lateral wall ST segment elevation myocardial infarction. She develops severe shortness of breath, orthopnea, pink frothy sputum and jugular venous distention. BP 160/95 HR 135 and RR 32. Which one of the following interventions is a priority?

- a. Dobutamine
- b. Metoprolol
- c. Lasix
- d. Digoxin

**Rationale for Correct Response:**

c) These findings suggest acute pulmonary edema secondary to left sided heart failure. Although beta blockade is a priority following myocardial infarction, the most urgent need is to manage the pulmonary edema with lasix.

**Blueprint Competency Being Tested:** 3.1h

99. Calculate the PaO<sub>2</sub>:FiO<sub>2</sub> ratio based on the following data:

FiO<sub>2</sub> 1.0 PEEP 10 PaO<sub>2</sub> 65 pH 7.34 PaCO<sub>2</sub> 45 SpO<sub>2</sub> 90%

- a. .90
- b. 20
- c. 65
- d. 35

**Rationale for Correct Response:**

c) PaO<sub>2</sub>:FiO<sub>2</sub> ratio in this example is 65 / 1.0 = 65.

**Blueprint Competency Being Tested:** 2.3a

100. Mr. Sinese is admitted with a Type B aortic dissection, distal to the left subclavian. Which one of the following interventions is the priority?

- a. Labetolol
- b. Metoprolol
- c. Milrinone
- d. Norepinephrine

**Rationale for Correct Response:**

a) Blood pressure control to prevent bleeding is the priority. Type B dissections are often managed medically.

**Blueprint Competency Being Tested:** 3.2a

101. Mrs. Chen has a diagnosis of asthma and is admitted with loud expiratory wheezes that are audible without a stethoscope. Three hours after starting salbutamol (Ventolin) by inhalation q 1 h and after IV methylprednisolone is started (Solumedrol), her wheezes have disappeared and her chest wall movement has decreased. She has the following findings:

RR is 35 SpO<sub>2</sub> 86% BP 160/95

Which one of the following interventions is the priority.

- a. Reduce the frequency of the ventolin
- b. Initiate spiriva
- c. Administer apresoline
- d. Prepare for intubation

**Rationale for Correct Response:**

d) Sudden cessation of wheezing and decreased chest movement are signs of severe airway obstruction. Intubation is a priority. Spiriva is a long acting bronchodilator (anticholinergic) and is not indicated for acute exacerbations. The hypertension is a response to the respiratory distress and should not be treated.

**Blueprint Competency Being Tested:** 1.2b

102. Darius is injured in a motor vehicle collision. He has a right cerebral contusion, small L subdural hematoma and decreased motor function in his left leg. His L great toe is downgoing, and his patellar and Achilles reflexes (knee and ankle jerk) are 0-1+. Which one of the following problems would explain his left leg weakness.
- a. Right cerebral injury
  - b. Left cerebral injury
  - c. Acute spinal cord injury
  - d. Peripheral nerve injury

**Rationale for Correct Response:**

d) He has a motor injury that is associated with decreased reflexes and downgoing toe on the affected side, suggesting a lower motor neuron (or peripheral) cause for his leg weakness. Brain or cord injuries are associated with motor weaknesses with increased reflexes and upgoing toe.

**Blueprint Competency Being Tested:** 3.2b

103. Mr. Sing is admitted to the critical care unit with a closed head injury following a fall from a ladder. He develops respiratory distress and has HR 144, RR 38, BP 60/40 and SpO<sub>2</sub> 74%. His peak airway pressures increase and his trachea deviates to the right side. Which one of the following interventions is the priority?
- a. Mannitol
  - b. Norepinephrine (Levophed)
  - c. Right sided chest tube
  - d. Left sided chest tube

**Rationale for Correct Response:**

d) These findings (hypoxemia, respiratory distress and hypotension), combined with the tracheal shift toward the right side, suggest a left sided tension hemothorax or pneumothorax.

**Blueprint Competency Being Tested:** 1.2d

104. Mrs. Sisko is admitted with atrial fibrillation and is treated with diltiazem, metoprolol and amiodarone. She is cardioverted to sinus rhythm 24 hours after admission, and develops R sided facial droop and right hand weakness 30 minutes later. Which one of the following explanations identifies the most likely cause of these findings.
- Right cerebral embolus
  - Right cerebral hemorrhage
  - Left cerebral hemorrhage
  - Left cerebral embolus

**Rationale for Correct Response:**

- d) Cardioversion for atrial fibrillation carries the risk of thrombotic embolus. The most likely journey would be via one of the carotid vessels to the corresponding middle cerebral artery. The timing and right sided facial and upper extremity symptoms, supports an embolus to the left middle cerebral artery (motor function is contralateral), causing ischemia/infarction to the left cerebral hemisphere.

**Blueprint Competency Being Tested:** 3.2c

105. Mrs. Watson sustains a fractured sternum and multiple fractures of right ribs #3-#6. She is on FiO<sub>2</sub> .5 PEEP 10 and Pressure Support (PS) 15 cmH<sub>2</sub>O. She becomes restless with paradoxical chest wall movement and her tidal volumes decrease to 250-300 cc. Which one of the following interventions is the priority?
- Analgesic
  - Sedative
  - Increase the PS
  - Increase the PEEP

**Rationale for Correct Response:**

- a) Pain control is a priority with flail chest. Inadequate pain control leads to chest wall splinting and decreased tidal volumes. The drop in tidal volume with increasing restlessness and paradoxical chest wall movement support the need for additional analgesia. Additional interventions may be required if the patient does not improve with analgesia.

**Blueprint Competency Being Tested:** 3.2e

106. Which one of the following findings is most suggestive of pulmonary embolus?
- Hypercarbia, hypoxemia and respiratory distress
  - Clear chest, severe hypoxemia, and respiratory alkalosis
  - Orthopnea, hemoptysis and pulmonary artery dilation
  - Cardiac enlargement, hypercarbia and increased minute ventilation

**Rationale for Correct Response:**

b) Pulmonary embolus is a problem of impaired perfusion in the setting of normal ventilation (creating a ventilation:perfusion mismatch). Because ventilated lung fields will appear black or “clear” on chest xray, pulmonary embolus is often associated with a normal chest xray, particularly if the pulmonary embolus is sudden. The chest xray is often most useful at ruling out other reasons for hypoxemia.

The hypoxemia associated with pulmonary embolus can be secondary to ventilation-perfusion mismatch, intrapulmonary shunts, reduced cardiac output and/or intracardiac shunt via a patent foramen ovale. Hypoxemia will trigger an increase in the minute ventilation. This can lead to over elimination of carbon dioxide (and respiratory alkalosis).

Pulmonary embolus is difficult to diagnose. It is often missed when present and over diagnosed when it is absent. The index of suspicion should be highest among patients with hypoxemia that fails to respond to oxygen or PEEP (because it is not due to a lack of oxygen in the alveoli), in the setting of a clear chest xray (or no other explanation for the hypoxemia). Hypoxemia with compensatory respiratory alkalosis is also an important marker of severe hypoxemia.

Rarely, pulmonary embolus can produce a pulmonary infarction. This may appear as a wedge shaped opacity in the distribution of the blood flow obstruction. The most common radiographic finding associated with pulmonary embolus (that is often absent) is pulmonary artery dilation and/or right ventricular dilation (cardiac enlargement).

Patients in the critical care unit pose important diagnostic challenges. For many of these patients, pulmonary embolus is a complication of another medical condition associated with hypoxemia and abnormal chest xray findings (e.g., pneumonia, pulmonary edema, pleural effusion or chronic pulmonary diseases). Consequently, many patients with pulmonary embolus will have an abnormal xray.

**Blueprint Competency Being Tested:** 1.3a

107. Mr. Liposki was admitted this morning with an acute C5-6 spinal cord injury due to an all terrain vehicle roll-over. He is currently ventilated and receiving prn analgesia. When planning his care, which one of the following interventions should be included in the plan?
- Strict maintenance of cervical, thoracic and lumbar spine alignment
  - Neurological testing of spinal cord function q 12 h
  - Early mobilization to trauma chair with cervical collar
  - Head of bed elevation to 45 degrees with cervical collar

**Rationale for Correct Response:**

a) CTL precautions must be maintained until the thoracic and lumbar spines have been cleared. Some of the current level of disability may be due to edema with potential for some recovery; good cord alignment promotes maximal recovery and reduces the chance that secondary injury (from instability, hypotension, hypoxia or hypercarbia) leads to higher level injury.

Multilevel injury can be present, and lower level injuries can be masked by the higher injury. For example, a thoracic level injury without cord injury could be present, and progress to spinal cord injury with inadequate spinal alignment. If some recovery from the cervical level injury occurs in this situation, the cervical recovery could be negated by the new and preventable thoracic level injury.

Neurological testing for spinal cord function should be q1h during the acute phase. This could identify worsening dysfunction that could indicate a need for urgent intervention. Movement to the trauma chair or head of bed elevation to 45 degrees would not promote thoracic-lumbar stabilization, and elevation of the head in the acute period could increase the risk for autonomic dysfunction due to neurogenic shock. Although early mobilization is an important goal, cord stability is the priority. Cervical collar with CTL precautions must be maintained at all times. Appropriate positioning includes reverse trendelenburg (45 degrees would not be possible; the degree elevation is limited by the potential for the patient to slide downward).

**Blueprint Competency Being Tested:** 1.3b

108. Mr. Bottwa sustained a C6 injury 14 years ago and has chronic narcotic use for neck pain. Two days ago, he was admitted with pneumonia. His blood pressure is 155/60 HR 55 and he has facial flushing and headache. Which one of the following interventions is the priority?
- a. Perform assisted cough
  - b. Administer antihypertensive agent
  - c. Assess bladder catheter
  - d. Administer analgesic

**Rationale for Correct Response:**

c) Hypertension, bradycardia, facial flushing and bounding headache are findings of autonomic dysreflexia. Autonomic dysreflexia is triggered by unrelieved stimulation of pain-temperature receptors, below the level of the spinal cord lesion. The release of catecholamines stimulates hypertension. The hypertension triggers inhibition (including vagal slowing of the heart and vasodilation). The vasodilatory messages can not travel below the level of the cord injury, therefore, vasoconstriction persists below the lesion (causing the hypertension) and vasodilation occurs above the lesion (facial flushing and bounding headache). The most common triggers are bladder or bowel distention due to inadequate evaluation. Although neck pain would be a potential source for painful stimulation, this trigger is above the level of the spinal cord lesion. Alleviation of the causative agent is the priority and will usually relieve the hypertension.



**Blueprint Competency Being Tested:** 1.4a

109. Mr. Dorias was admitted the previous evening following a hypertensive cerebral bleed. He is admitted in deep coma, with midline shift evident on CT. His best motor response is abnormal flexion and he frequently flexes his neck toward his shoulder during abnormal posturing episodes. During these episodes, his SBP increases to > 200 mmHg. Which one of the following interventions is a priority?
- Administer PRN hydralazine (Apresoline)
  - Reduce the frequency of neurological testing
  - Minimize the frequency of family visits
  - Apply a cervical spine collar

**Rationale for Correct Response:**

d) Neck alignment promotes cerebral venous drainage. Flexing of the neck toward the shoulder can decrease venous outflow and increase ICP. Stabilization of the neck in this example may help to reduce ICP.

The hypertension may be a sign of increased ICP or due to stimulation. The hypertensive episodes may be maintaining cerebral perfusion pressure. Treatment would only be considered if the hypertension is sustained and raised ICP as a cause has been ruled out. Neurological testing should continue on an hourly basis in an acute injury. There is no evidence that family visits are harmful; families should be educated regarding the plan of care to facilitate support of the plan during their visits.

**Blueprint Competency Being Tested:** 3.2f

110. Mrs. Talovsky developed idiopathic pulmonary hypertension following the birth of her second child 5 years earlier. She was admitted with cyanosis. She is mechanically ventilated with the following findings: SpO<sub>2</sub> 75%, HR 144, BP 105/60 and PAP 82/45. Which one of the following interventions is the priority?
- Prostacyclin (Flolan)
  - Norepinephrine (Levophed)
  - Increased PEEP
  - Epinephrine (Adrenalin)

**Rationale for Correct Response:**

a) Pulmonary vasoconstriction is believed to be the primary mechanism of pulmonary hypertension. Hypoxemia is a potent trigger of vasoconstriction, worsening the pulmonary hypertension. Right to left shunting of blood (due to high right to left pressure gradients) accounts for much of the hypoxemia. Prostacyclin is a potent pulmonary vasodilator with an ultra short half life. It is administered by a continuous infusion (chilled). Sildenafil citrate (Viagra) can also be used to promote pulmonary venous dilation.

While norepinephrine or epinephrine may help to raise systemic BP to maintain the systemic to pulmonary blood flow gradient, their use will also raise pulmonary artery pressures. PEEP will have minimal benefit since alveolar collapse is not the primary problem.

**Blueprint Competency Being Tested:** 3.2h

111. Ms. Kelder is admitted with status asthmaticus. Immediately following intubation, she is manually ventilated using a bag-mask. She becomes very difficult to ventilate, requiring increasing effort to inflate the lung with each manual breath. Which one of the following interventions is the priority?
- Connect to mechanical ventilator with Pressure Control mode
  - Initiate ventilation with High Frequency Oscillatory Ventilation (HFOV)
  - Disconnect the bag-mask valve and assist exhalation with manual chest pressure
  - Administer salbutamol (Ventolin) STAT via endotracheal tube

**Rationale for Correct Response:**

c) Asthma is associated with air trapping and hyperinflation. During manual ventilation, rapid rates or high tidal volumes can precipitate over distention. Disconnecting the bag-mask-valve apparatus with the application of gentle rib pressure may facilitate exhalation and lung deflation.

**Blueprint Competency Being Tested:** 1.4f

112. Mrs. Catalia, 45 years of age, had a clipping of a ruptured left middle cerebral artery aneurysm 5 days earlier. She had been obeying with her right side at previous assessments but is now only localizing. Her GCS has decreased from 12 (eye opening 3, verbal 3, motor 6) to 7 and a repeat CT is negative for new swelling or bleeding. Her BP is 145/84 (MAP 85), HR 80, CVP 13 and urine output 100 ml/hr. What intervention is the priority?
- Fluid bolus
  - Head of bed elevation
  - Mannitol bolus
  - Nifedipine q 4 h

**Rationale for Correct Response:**

a) Vasospasm (cerebral blood vessel narrowing) is a phenomena most commonly associated with subarachnoid hemorrhage. Arterial blood vessels are located in the subarachnoid space, therefore, a ruptured aneurysm is a common cause for subarachnoid hemorrhage (but not the only cause). The breakdown of subarachnoid blood and release of calcium has been implicated as the cause for cerebral vasospasm. The usual timeline is 4-11 days post bleed.

This patient has the appropriate timeline for vasospasm. Worsening level of consciousness could be due to decreased cerebral blood flow from the vasospasm, stroke, cerebral edema or rebleeding. CT ruled out edema or rebleeding, making vasospasm the most likely cause.

The treatment for vasospasm is to increase cerebral blood flow by raising the mean blood pressure with 3H therapy (hemodilution, hypervolemia and hypertensive therapy) and relaxing cerebral vessels with cerebral responsive calcium channel blockers (e.g., nimodipine). Cerebral blood flow can be enhanced by positioning the bed flat and avoiding fluctuations in blood pressure.

Mannitol is only indicated for cerebral edema. Administration to a patient with vasospasm could cause dehydration and worsening of vasospasm and ischemia.

**Blueprint Competency Being Tested:** 3.3c

113. Mr. Zelenick is on  $\text{FiO}_2$  .5 PEEP 10 and Pressure Control Ventilation (AC 18). Which one of the following alarms could be produced by biting on the endotracheal tube.
- High pressure
  - Low tidal volume
  - High minute volume
  - Auto PEEP

**Rationale for Correct Response:**

b) Biting on the tube would cause a drop in the tidal volume. A high pressure alarm would be typical if the patient was on volume ventilation.

**Blueprint Competency Being Tested:** 1.4g

114. Mrs. Sidiki experienced a cardiac arrest with a 15 minute downtime before return to spontaneous circulation. She has a GCS of 5 at admission, with a BP of 110/60, HR 118 on full ventilation. Which one of the following interventions is the priority?
- Phenytoin
  - Glucose
  - Hypothermia
  - Haldol

**Rationale for Correct Response:**

c) Mild therapeutic hypothermia, introduced immediately following a cardiac arrest (ideally prehospital), can improve neurological outcomes. Her neurological findings are most likely due to cerebral ischemia.

**Blueprint Competency Being Tested:** 1.4h

115. Mrs. Chin is in the critical care unit being treated for severe sepsis due to pneumonia. She is on  $\text{FiO}_2$  0.6 PC 32 AC 25 PEEP 18. She is on norepinephrine at 18 ug/min, vasopressin at 2 units per hour, hydrocortisone 100 mg q 8 h and insulin infusion at 8 units per hour. She suddenly has a tonic clonic generalized seizure. Which one of the following interventions is the priority?
- Phenytoin (Dilantin)
  - Magnesium Sulphate bolus
  - Hypertonic Saline administration
  - Blood sugar assessment

**Rationale for Correct Response:**

d) Hypoglycemia is an important cause for seizures. High index of suspicion must be maintained when using intensive insulin. If a blood sugar can be measured STAT, this is an appropriate action. If a glucometer is not immediately accessible, 50% dextrose should be administered empirically STAT. Hypoglycemia can be very harmful to the brain, whereas, the unnecessary administration of glucose if the blood sugar is adequate is considered less harmful.

Dilantin may be indicated if there is no reversible cause, but is not the first intervention (longer onset of action than benzodiazepines). Definite treatment for hypoglycemia and benzodiazepines for the rapid onset of anticonvulsant activity are first line agents for new seizure.

**Blueprint Competency Being Tested:** 1.4i

116. Mrs. Caplin is 18 hours post cardiac arrest and being treated with hypothermia. She remains non-responsive, with a BP of 100/55 (MAP 60), HR 85 (atrial fibrillation), CVP 12, T 33 urine output 35 ml/hr, SpO<sub>2</sub> 95% on FiO<sub>2</sub> .4 PEEP 5 and AC 18. Which one of the following interventions is a priority?
- a. Dopamine
  - b. Fluid bolus
  - c. Beta blocker
  - d. Increased PEEP

**Rationale for Correct Response:**

b) She is in a high risk period for cerebral edema secondary to her hypoxic insult. Edema can worsen during the initial 2-4 days. Preventing secondary injury by maintaining adequate cerebral perfusion pressure, and by preventing hypoxemia, hypercarbia and hypoglycemia is essential.

Her mean BP is low with a marginal urine output. Her HR is fast given her hypothermia. Her CVP is 12 while ventilated. A fluid bolus should be administered to identify whether volume deficit is the cause for the clinical findings. Correction of the marginal BP is important to ensure adequate cerebral perfusion (recommendations for cerebral protection include MAP > 80 mmHg). If intravascular volume is increased with no improvement in BP, inotropes and or vasoconstrictors may be required.

Although beta blockers are indicated following myocardial infarction, they may decrease contractility and worsen her cerebral perfusion given her marginal BP. Because of the myocardial depression associated with hypothermia, beta blockers are generally started after the period of hypothermia. She needs to have a stabilized BP before initiating beta blockers, with careful monitoring of cerebral perfusion.

Hypoxemia and hypercarbia should also be treated, however, an SpO<sub>2</sub> of 95% is adequate.

**Blueprint Competency Being Tested:** 3.3m

117. Mr. Evans has ARDS and is on the following ventilator settings:

FiO<sub>2</sub> 0.5 PEEP 12 AC 22 Volume Controlled ventilation with VT 450 cc.

Blood gases are: PaO<sub>2</sub> 64 PCO<sub>2</sub> 58 pH 7.22 HCO<sub>3</sub> 26.

Which one of the following interventions would be the priority?

- a. Increase the PEEP
- b. Increase the tidal volume
- c. Change to Pressure Control Ventilation
- d. Increase the AC rate

**Rationale for Correct Response:**

d) These gases reveal a respiratory acidosis, indicating that the minute volume is not sufficient to meet the CO<sub>2</sub> clearance needs.

Minute volume = TV X RR. In this example, the minute volume is 9.9 (plus any spontaneously triggered breaths). Interventions to increase the total minute ventilation are needed.

Increasing the tidal volume or increasing the AC rate would increase the minute volume. Because protective lung ventilation for ARDS includes restricting the tidal volume size, increasing the AC rate is the most appropriate action.

Although higher PEEP is recommended for the management of ARDS (to recruit additional alveoli and improve oxygenation), the PEEP is already increased. The current PaO<sub>2</sub> of 64 would be considered acceptable in the setting of protective lung ventilation and higher PEEP is not currently warranted.

PC is one method for determining when a breath is terminated, and it is often used in ARDS. The peak pressure and inspiratory time are set to limit the tidal volume size and protect against high inspiratory pressures. While this commonly used in many ICUs, conversion to PC in itself will not change the minute volume and blood gases (unless the tidal volume or AC are also changed).

**Blueprint Competency Being Tested:** 1.4j

118. Mrs. Vanelli develops witnessed onset of aphasia. One hour later, an urgent CT rules out cerebral hemorrhage. Vital signs are:

BP 156/84 (MAP 90)  
HR 105 (atrial fibrillation)  
RR 26  
Glucose 10.2  
T 36.8

What is the priority?

- a. TnK (Tenecteplase)
- b. tPA (Alteplase)
- c. Heparin
- d. Insulin

**Rationale for Correct Response:**

b) Thrombolysis with tPA is indicated for acute stroke with symptom onset < 3 hours (<4.5 hours for specific situations), in the absence of cerebral bleeding or severe hypertension. Currently, tPA is the thrombolytic of choice.

**Blueprint Competency Being Tested:** 2.2g

119. Two hours following open heart surgery for aortic valve replacement, Mr. Kiefer's BP increases from 110/60 to 145/90 despite analgesia. HR 75 and urine output 150 ml/hr. Which one of the following interventions is the priority?

- a. Antihypertensive
- b. Monitoring only
- c. Fluid bolus
- d. Anticoagulation

**Rationale for Correct Response:**

a) Mild hypertension is an important priority immediately following open heart surgery. Blood is returned following cardiopulmonary bypass via an aortic cannula. The cannulation site is particularly susceptible to dissection if the blood pressure becomes too high. Aortic valve replacement increases this risk. Anticoagulation is required if a mechanical valve is used, however, it is not started immediately postoperative due to the risk of bleeding.

**Blueprint Competency Being Tested:** 3.4

120. Mrs. Brown required full ventilation for 10 days. She is now hemodynamically stable with adequate blood gases on FiO<sub>2</sub> 0.4 and Pressure Support 16. Which one of the following interventions should be included in her plan of care?
- a. Mobilization
  - b. Anxiolytics
  - c. Prophylactic antibiotics
  - d. Saline instillation with suctioning

**Rationale for Correct Response:**

a) Liberation from the ventilator includes strategies to promote muscle rest and recovery (e.g., sleep, delirium management, adequate enteral nutrition, glycemic control), early mobilization (breathing trials, chair sitting, weight bearing and ambulation on ventilator), prevention of VAP (head of bed elevation, oral hygiene, use of EVAC tubes, avoidance of nasal gastric tubes, early liberation from ventilator), appropriate/minimal use of sedation.

There is no evidence to support the use of prophylactic antibiotics, rather, inappropriate use may lead to the emergence of antibiotic resistant organisms. Anxiolytics are only indicated if anxiety is impacting weaning. There is no evidence that routine saline instillation is beneficial; it may increase hypoxemia.

**Blueprint Competency Being Tested:** 1.1b

121. Steve has raised intracranial pressure and is receiving mannitol q 6 h for ICP > 20 mmHg. Which one of the following lab tests is the priority?
- a. Serum arginine vasopressin (AVP)
  - b. Urine specific gravity
  - c. Serum creatinine
  - d. Serum osmolality

**Rationale for Correct Response:**

d) Mannitol is given to promote osmotic diuresis and reduce cerebral edema. Repeated dosing can cause excessive volume contraction. Osmolality should be measured with regular mannitol dosing. A serum osmolality > 320 mmol/L can be harmful.