Hemodynamic Monitoring

1. HDL presentation

1.1 Hemodynamic Monitoring

1.2 The best monitor is:

(Multiple Choice, 10 points, unlimited attempts permitted)
1. **The best monitor is:**

   - a. ECG
   - b. Pulse oximetry
   - c. Temperature probe
   - d. Blood pressure
   - e. A vigilant physician

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. ECG</td>
</tr>
<tr>
<td></td>
<td>b. Pulse oximetry</td>
</tr>
<tr>
<td></td>
<td>c. Temperature probe</td>
</tr>
<tr>
<td></td>
<td>d. Blood pressure</td>
</tr>
<tr>
<td>X</td>
<td>e. A vigilant physician</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
Correct (Slide Layer)

1. The best monitor is:
   a. ECG
   b. Pulse oximetry
   c. Temperature
   d. Blood pressure
   e. A vital

Incorrect (Slide Layer)

1. The best monitor is:
   a. ECG
   b. Pulse oximetry
   c. Temperature
   d. Blood pressure
   e. A vital
1.3 V5 lead goes where?

(Multiple Choice, 10 points, unlimited attempts permitted)

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Right shoulder</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>b.</td>
</tr>
<tr>
<td>c.</td>
</tr>
<tr>
<td>d.</td>
</tr>
<tr>
<td>e.</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.

**Correct (Slide Layer)**
1.4 The dorsal pedis arterial blood pressure has a greater systolic blood pressure than the aortic blood pressure.

(True/False, 10 points, unlimited attempts permitted)
3. The dorsal pedis arterial blood pressure has a greater systolic blood pressure than the aortic blood pressure.

Correct Choice

| X | True |
|   | False |

Feedback when correct:

That’s right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.
Correct (Slide Layer)

3. The dorsal pedis arterial blood pressure has a greater systolic blood pressure than the aortic blood pressure.

- True
- False

Correct
That's right! You selected the correct response.

Continue

Incorrect (Slide Layer)

3. The dorsal pedis arterial blood pressure has a greater systolic blood pressure than the aortic blood pressure.

- True
- False

Incorrect
You did not select the correct response.

Continue
1.5 Which of the following is not true about the CVP waveform?

(Multiple Choice, 10 points, unlimited attempts permitted)

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Has an A wave</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>b. Has a C wave</td>
</tr>
<tr>
<td>c. Has a V wave</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.

**Correct (Slide Layer)**

4. Which of the following is not true about the CVP waveform?
   - a. Has an A wave
   - b. Has a C wave
   - c. Has a V wave
   - d. Has an X wave
   - e. Has a Y descent

   Correct
   That's right! You selected the correct response.
1.6 Which of the following is not a reason for elevated CVP?

(Multiple Choice, 10 points, unlimited attempts permitted)
5. Which of the following is not a reason for elevated CVP?

- a. Blood volume overload
- b. Left heart failure
- c. Pulmonary hypertension
- d. Tricuspid regurgitation
- e. All would lead to elevated CVP

X e. All would lead to elevated CVP

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
5. Which of the following is not a reason for elevated CVP?

- a. Blood volume overload
- b. Left heart failure
- c. Pulmonary edema
- d. Tricuspid regurgitation
- e. All of the above

**Correct (Slide Layer)**

That’s right! You selected the correct response.

**Incorrect (Slide Layer)**

You did not select the correct response.
Try Again (Slide Layer)

5. Which of the following is not a reason for elevated CVP?
   a. Blood volume overload
   b. Left heart failure
   c. Pulmonary edema
   d. Tricuspid regurgitation
   e. All will increase CVP

Incorrect
That is incorrect. Please try again.

1.7 Monitors

Monitors

“No monitor is therapeutic in itself but requires the skill and vigilance of a trained observer to interpret the information in the context of the ever-changing clinical picture.”

1.8 Monitoring Importance

Monitoring Importance

- Monitoring provides an early warning of adverse changes or trends before irreversible damage occurs
- Monitoring:
  - Reflects physiologic homeostasis
  - Allows prompt recognition of responses to therapeutic interventions
  - Allows prompt recognition of adverse changes
- What is the most important monitor?
  - Vigilance!


1.9 Monitors

Monitors

- Vigilant Physicians (Subjective Data)
  - Monitors - (Visual, Tactile, Auditory, Olfactory)

- Standard Monitoring Equipment (Objective Data)
  - Pulse Oximetry
  - Capnography
  - Body Temperature
  - ECG
  - Systemic Blood Pressure
1.10 Building Blocks of Monitoring

Building Blocks of Monitoring

“All monitoring builds on old-fashioned inspection, auscultation, and palpation.”


1.11 Monitoring that Requires No Instrumentation

Monitoring that Requires No Instrumentation

- Inspection
- Skin
- Nail Beds
- Mucous membranes
- Surgical field
- Bodily Movement
- Eyes
1.12 Monitoring that Requires No Instrumentation

Monitoring that Requires No Instrumentation

- **Inspection**
  - Skin (Is there normal capillary refill? Delayed return suggests abnormality in regional or systemic circulation)
- **Palpation**
  - Skin (Is the patient warm or cold and clammy?)
  - Pulse (Presence/Absence of pulse)
  - Skeletal muscle (Are muscles fasciculating?)
- **Percussion**
  - Gastric (Is there abdominal distension?)
- **Auscultation**
  - Chest (Listen for breath sounds over both lung field. Is there paradoxical breathing?)
  - Heart (Are sounds muffled, or murmurs present?)

1.13 Minimal Monitoring Standards

Minimal Monitoring Standards

- The American Society of Anesthesiologist (ASA) calls for standard monitors for all patients undergoing general anesthesia
  - Oxygenation (inspired gas and saturation of arterial blood (SpO₂))
  - Ventilation (capnography and clinical assessment)
  - Circulation (ECG, arterial blood pressure)
  - Temperature
1.14 Electrocardiogram (ECG)

**Electrocardiogram (ECG)**

- Provides information on
  - Cardiac arrhythmias
  - Myocardial ischemia/infarction
  - Electrolyte changes, particularly potassium
- ECG is *not* a measure of heart function
- ECG reflects only the electrical activities occurring in the heart


1.15 ECG 5-Lead Placement

**ECG 5-Lead Placement**

- “Snow on the Grass” → White ECG electrode to right should over green ECG electrode
- “Smoke over Fire” → Black ECG electrode to left should over red ECG electrode
- Brown ECG electrode at the V5 position (Left anterior axillary line between fourth and fifth intercostal space)

1.16 ECG

ECG

- Lead V5 is the most sensitive lead for detecting ischemia
- Lead II is the most sensitive lead for detecting arrhythmias
- P waves are best seen on Lead II
  - Best enables one to observe the cardiac rhythm

1.17 Pulse Oximetry

Pulse Oximetry

- Assess the oxygenation of blood
- Reduced (or deoxygenated) hemoglobin (Bluish)
- Oxygenated hemoglobin (Red)
- How it works?
  - A probe sends light impulses into a finger and collects the light that passes through it.
  - The unit estimates the proportion of oxyhemoglobin to reduced hemoglobin
- SpO2 - the saturation based on pulse oximetry
- SaO2 - the saturation obtained from direct arterial blood sample
1.18 Pulse oximetry (cont)

Pulse Oximetry (cont)

Correlation of SpO₂ to arterial partial pressure of oxygen (PaO₂)

<table>
<thead>
<tr>
<th>SpO₂</th>
<th>PaO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>100 mmHg or higher</td>
</tr>
<tr>
<td>90%</td>
<td>60 mmHg</td>
</tr>
<tr>
<td>80%</td>
<td>50 mmHg</td>
</tr>
<tr>
<td>60%</td>
<td>30 mmHg</td>
</tr>
</tbody>
</table>

1.19 The goal to monitor the ECG for the detection of myocardial ischemia is best accomplished utilizing lead ____.

(Multiple Choice, 10 points, unlimited attempts permitted)

6. The goal to monitor the ECG for the detection of myocardial ischemia is best accomplished utilizing lead ____?
   - a. AVL
   - b. II
   - c. V5
   - d. avF
   - e. III
Correct Choice

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. avL</td>
<td></td>
</tr>
<tr>
<td>b. II</td>
<td></td>
</tr>
<tr>
<td>c. V5</td>
<td></td>
</tr>
<tr>
<td>d. avF</td>
<td></td>
</tr>
<tr>
<td>e. III</td>
<td></td>
</tr>
</tbody>
</table>

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.

Correct (Slide Layer)

6. The goal to monitor the ECG for the detection of myocardial ischemia is best accomplished utilizing lead

   X

   a. avL
   b. II
   c. V5
   d. avF
   e. III

Correct
That's right! You selected the correct response.
1.20 You are called to the your patient's bedside because she is hemodynamic unstable. The patient is unresponsive and the noninvasive blood pressure cuff appears not to be working. You feel for a pulse and do
not identify a pulse. You observe the ECG and it has what appears to be some ECG complexes. This patient is having...

(Multiple Choice, 10 points, unlimited attempts permitted)

7. You are called to the your patient's bedside because she is hemodynamic unstable. The patient is unresponsive and the noninvasive blood pressure cuff appears not to be working. You feel for a pulse and do not identify a pulse. You observe the ECG and it has what appears to be some ECG complexes. This patient is having...

- a. atrial fibrillation
- b. asystole
- c. right bundle branch block
- d. left bundle branch block
- e. pulseless electrical activity

Correct Choice

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. atrial fibrillation</td>
</tr>
<tr>
<td></td>
<td>b. asystole</td>
</tr>
<tr>
<td></td>
<td>c. right bundle branch block</td>
</tr>
<tr>
<td></td>
<td>d. left bundle branch block</td>
</tr>
<tr>
<td>X</td>
<td>e. pulseless electrical activity</td>
</tr>
</tbody>
</table>

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.
Correct (Slide Layer)

7. You are called to the your patient's bedside because she is hemodynamic unstable. The patient is unresponsive and the noninvasive blood pressure cuff appears not to be working. You feel for a pulse and do not identify a pulse. You observe the ECG and it has what appears to be some ECG complexes. This patient is:

- a. atrial flutter
- b. asystole
- c. right bundle branch block
- d. left bundle branch block
- e. pulseless electrical activity

Correct: That’s right! You selected the correct response.

Incorrect (Slide Layer)

7. You are called to the your patient's bedside because she is hemodynamic unstable. The patient is unresponsive and the noninvasive blood pressure cuff appears not to be working. You feel for a pulse and do not identify a pulse. You observe the ECG and it has what appears to be some ECG complexes. This patient is:

- a. atrial flutter
- b. asystole
- c. right bundle branch block
- d. left bundle branch block
- e. pulseless electrical activity

Incorrect: You did not select the correct response.
1.21 Most cardiac arrhythmias are best picked up on interpreting lead?

(Multiple Choice, 10 points, unlimited attempts permitted)

Correct Choice

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. aVL</td>
</tr>
</tbody>
</table>
Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.

Correct (Slide Layer)
1.22 **Which of the following can NOT be true?**

*(Multiple Choice, 10 points, unlimited attempts permitted)*
9. Which of the following can NOT be true?

- a. SpO2 of 100% = mmHg 100%
- b. SpO2 of 99% = mmHg of 97%
- c. SpO2 of 100% = mmHg of 150%
- d. SpO2 of 100% = mmHg of 400%
- e. SpO2 of 100% = mmHg of 90%

Correct Choice

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. SpO2 of 100% = mmHg 100%</td>
</tr>
<tr>
<td>b. SpO2 of 99% = mmHg of 97%</td>
</tr>
<tr>
<td>c. SpO2 of 100% = mmHg of 150%</td>
</tr>
<tr>
<td>d. SpO2 of 100% = mmHg of 400%</td>
</tr>
<tr>
<td>X e. SpO2 of 100% = mmHg of 90%</td>
</tr>
</tbody>
</table>

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.
Correct (Slide Layer)

9. Which of the following can NOT be true?

- a. SpO₂ of 100% = mmHg 100%
- b. SpO₂ of 99% = mmHg of 97%
- c. SpO₂ of 100% = mmHg of 100%
- d. That's right! You selected the correct response.
- e. SpO₂ of 88% = mmHg of 87%

Incorrect (Slide Layer)

9. Which of the following can NOT be true?

- a. SpO₂ of 100% = mmHg 100%
- b. SpO₂ of 99% = mmHg of 97%
- c. SpO₂ of 100% = mmHg of 100%
- d. You did not select the correct response.
- e. SpO₂ of 88% = mmHg of 87%
1.23 Blood Pressure (BP) Monitoring

Blood Pressure (BP) Monitoring

- The lateral pressure exerted by the contained blood on the walls of the vessels is arterial pressure.
- Factors controlling blood pressure include:
  - Hormonal mechanisms (i.e. catecholamines, renin-angiotensin, antidiuretic hormone, atrial natriuretic peptide
  - Central & autonomic nervous function
  - Peripheral vascular resistance
  - Cardiac output
- BP monitoring is commonly performed:
  - *Indirectly* - noninvasive cuff around extremity
  - *Directly* - inserting catheter into artery

1.24 BP - Noninvasive Monitoring

Noninvasive Blood Pressure (NIBP) Monitoring

- Mechanical deformation from the blood pressure cuff of an artery leads to the creation of Korotkoff sounds result from turbulent flow
- The appearance of the first Korotkoff sound is the systolic blood pressure
- The disappearance of the Korotkoff sound signals the diastolic blood pressure.

1.25 Blood Pressure

Blood Pressure

- Systolic Blood Pressure (SBP)
  - Pressure which ejected blood will overcome to perfuse vessels distally
- Diastolic Blood Pressure (DBP)
  - Pressure under which the blood flow will be laminar
- Pulse Pressure = SBP - DBP
- Mean Arterial Blood Pressure (MAP)
  - Time weighted average of arterial pressures during a pulse cycle
  - \( MAP = \frac{[SBP + (2 \times DBP)]}{3} \)
1.26 **NIBP Bladder Cuff**

**NIBP Bladder Cuff**

- American Heart Association recommends:
  - Bladder width: approximately 40% of the circumference of the extremity
  - Bladder Length: sufficient to circle at least 60% of the extremity
- Falsely low estimates occur:
  - After quick deflation
  - When the extremity is above the heart
  - When cuffs are too large
- Falsely high estimates occur when:
  - Cuffs are applied too loosely
  - When the extremity is below heart level
  - When cuffs are too small


1.27 **Noninvasive Blood Pressure Monitoring Problems**

**NIBP Monitoring Problems**

- Hematomas results due to increase venous pressure after failure to deflate the cuff
- Delayed cuff deflation can results from shivering and tremors
- Ulnar neuropathy can occur due to compression of the ulnar nerve

1.28 **A falsely high blood pressure will occur from...**

(Multiple Choice, 10 points, unlimited attempts permitted)
10. A falsely high blood pressure will occur from...

- a. after quick deflation
- b. when the extremity is above the heart
- c. when cuffs are too large
- d. when the cuff is too small

Correct Choice

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. after quick deflation</td>
</tr>
<tr>
<td></td>
<td>b. when the extremity is above the heart</td>
</tr>
<tr>
<td></td>
<td>c. when cuffs are too large</td>
</tr>
<tr>
<td>X</td>
<td>d. when the cuff is too small</td>
</tr>
</tbody>
</table>

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.
Correct (Slide Layer)

10. A falsely high blood pressure will occur from...

- a. after quick deflation
- b. when the extremity is above the heart
- c. when...
- d. when...

Correct

That's right! You selected the correct response.

Continue

Incorrect (Slide Layer)

10. A falsely high blood pressure will occur from...

- a. after quick deflation
- b. when the extremity is above the heart
- c. when...
- d. when...

Incorrect

You did not select the correct response.

Continue
Try Again (Slide Layer)

10. A falsely high blood pressure will occur from...

- a. after quick deflation
- b. when the extremity is above the heart
- c. when...
  Incorrect
  That is incorrect. Please try again.
- d. when...

1.29 A falsely low blood pressure will occur from...
(Multiple Choice, 10 points, unlimited attempts permitted)

11. A falsely low blood pressure will occur from...

- a. cuffs are applied too loosely
- b. when the extremity is below heart level
- c. when cuffs are too small
- d. when the cuff is too large

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. cuffs are applied too loosely</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>b.</td>
</tr>
<tr>
<td>c.</td>
</tr>
<tr>
<td>X</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.

**Correct (Slide Layer)**
1.30 Which of the following is not true?

(Multiple Choice, 10 points, unlimited attempts permitted)
12. Which of the following is not true?

- a. The first Korotkoff sound is the systolic BP
- b. The last Korotkoff sound is the diastolic BP
- c. Korotkoff sounds reflect turbulent flow
- d. None are true
- e. All are true

**Correct Choice**

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>a. The first Korotkoff sound is the systolic BP</td>
</tr>
<tr>
<td></td>
<td>b. The last Korotkoff sound is the diastolic BP</td>
</tr>
<tr>
<td></td>
<td>c. Korotkoff sounds reflect turbulent flow</td>
</tr>
<tr>
<td></td>
<td>d. None are true</td>
</tr>
<tr>
<td>X</td>
<td>e. All are true</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
12. Which of the following is not true?

- a. The first Korotkoff sound is the systolic BP
- b. The last Korotkoff sound is the diastolic BP
- c. Korotkoff sound 2
- d. None
- e. All above

Correct (Slide Layer)

Incorrect (Slide Layer)
1.31 Invasive Monitors

Invasive Monitors

- Intra-arterial blood pressure
- Central venous pressure
- Pulmonary artery catheters (Swan-Ganz)
- Transesophageal echocardiography (TEE)
1.32 Intra-arterial Blood Pressure Indications

- Beat-to-beat monitoring
- Expected rapid changes in hemodynamic stability
- Induced hypotension, acute hypotension
- Reliable access for analysis of arterial blood gases, pH, and/or electrolytes
- Inability to achieve noninvasive monitoring
- Vasoactive drugs
- Sepsis

1.33 Systemic Blood Pressure Monitoring Sites

- Arterial Cannulation Sites
  - Aorta
  - Axillary artery
  - Brachial artery
  - Radial artery - most popular site due to presence of a collateral blood supply and accessibility
  - Ulnar artery
  - Femoral artery
  - Dorsalis pedis artery
1.34 Arterial Blood Pressure Measurement

Wave reflection distorts the arterial pressure waveform, leading to an exaggeration of systolic and pulse pressure, as a pulse moves peripherally through the arterial tree.

For example, dorsal pedis artery pressures are usually higher than aortic systolic pressure because of the former's more distal location (see Figure).

1.35 Changes in arterial blood pressure waveform configuration as a waveform moves peripherally
1.36 Arterial Pressure Waveform

- Rate of upstroke indicates contractility
- Rate of the downstroke indicates peripheral vascular resistance
- Dicrotic notch reflects the closure of the aortic valve
- The farther out the dicrotic notch the lower the SVR or peripheral vascular resistance

1.37 Complications of Intra-arterial BP Catheterization

- Hematoma
- Bleeding
- Vasospasm
- Arterial Thrombosis
- Distal Emboli
- Infection and Necrosis
- Air embolism
- Loss of digits
- Unintentional interarterial drug injection
- Pseudoaneurysm
- Damage to adjacent nerves

1.38 13. Which of the following is not an acceptable site for arterial blood pressure access?

(Multiple Choice, 10 points, unlimited attempts permitted)
13. Which of the following is not an acceptable site for arterial blood pressure access?

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Radial artery</td>
</tr>
<tr>
<td>B. Brachial artery</td>
</tr>
<tr>
<td>C. dorsal pedis artery</td>
</tr>
<tr>
<td>D. internal jugular</td>
</tr>
<tr>
<td>E. femoral artery</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.
13. Which of the following is not an acceptable site for arterial blood pressure access?

A. Radial artery
B. Brachial artery
C. dorsal pedal artery
D. internal carotid artery
E. femoral artery

Correct
That's right! You selected the correct response.

Incorrect
You did not select the correct response.
1.39 14. Match the following:

(Matching Drag-and-Drop, 10 points, unlimited attempts permitted)

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) easy access in low flow states, potential for retroperitoneal hemorrhage</td>
<td>Femoral artery</td>
</tr>
<tr>
<td>B) higher systolic pressure estimates</td>
<td>Dorsalis artery</td>
</tr>
<tr>
<td>C) preferred site for monitoring</td>
<td>Radial artery</td>
</tr>
<tr>
<td>D) inserting site at junction of the deltoid muscle and pectoralis</td>
<td>Axillary artery</td>
</tr>
<tr>
<td>E) median nerve damage is a potential hazard.</td>
<td>Brachial artery</td>
</tr>
<tr>
<td>F) primary source of hand blood flow.</td>
<td>Ulnar artery</td>
</tr>
</tbody>
</table>

A) Radial artery
B) Brachial artery
C) dorsalis artery
D) internal carotid
E) femoral artery
<table>
<thead>
<tr>
<th>retroperitoneal hemorrhage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B) higher systolic pressure estimates</td>
<td>Dorsalis artery</td>
</tr>
<tr>
<td>C) preferred site for monitoring</td>
<td>Radial artery</td>
</tr>
<tr>
<td>D) inserting site at junction of the deltoid muscle and pectoralis</td>
<td>Axillary artery</td>
</tr>
<tr>
<td>E) median nerve damage is a potential hazard.</td>
<td>Brachial artery</td>
</tr>
<tr>
<td>F) primary source of hand blood flow.</td>
<td>Ulnar artery</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.

**Correct (Slide Layer)**

14. Match the following:

A) easy access in low flow states, potential for retroperitoneal hemorrhage
   - Femoral artery

B) higher systolic pressure estimates
   - Dorsalis artery

C) preferred site for monitoring
   - Radial artery

D) inserting site at junction of the deltoid muscle and pectoralis
   - Axillary artery

E) median nerve damage is a potential hazard.
   - Brachial artery

F) primary source of hand blood flow.
   - Ulnar artery
Incorrect (Slide Layer)

14. Match the following:

1.40 Central Venous Access Indications

Central Venous Access Indications

- Monitoring central venous pressure (CVP)
- Rapid administration of fluid to treat hypovolemia and shock (i.e. acute hemorrhaging)
- Infusions of drugs
- Long-term IV Feeding (i.e. Hyperalimentation)
- Aspiration of air emboli
- Insertion of Transcutaneous pacing leads
- Venous Access in patients with poor peripheral veins
1.41 Internal Jugular (IJ) Central Venous Monitoring

Internal Jugular (IJ) Central Venous Monitoring

- Right IJ vein is the preferred site for cannulation
  - High success rate in both adults and children
  - Predictable anatomy
  - Accessible from the head of the operating table
- Left side IJ is less desirable because of potential damage to the
  - Thoracic duct
  - Challenge of placing catheter through the jugular-subclavian junction.

1.42 CVC Placement Sites

<table>
<thead>
<tr>
<th>CVC Placement Sites</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| R Internal jugular vein | Good landmarks  
Predictable anatomy  
Accessible from head of OR table | Carotid artery puncture  
Trauma to brachial plexus |
| L Internal jugular vein | Same as above                      | Same as above  
Thoracic duct damage         |
| Subclavian vein      | Good landmarks  
Remains patent despite hypovolemia  
Patient comfort when awake | Pneumothorax   |
| External jugular vein | Superficial location | Often difficult to thread catheter into the central circulation |
| Femoral vein         | Good landmarks  
Accessible in low flow state | Risk of local hematoma |
| Antecubital vein      | Safety                             | Often difficult to thread into the central vein |

1.43 CVC Contraindications

CVC Contraindications

- Anticoagulants
- Ipsilateral carotid endarterectomy
- Fungating tricuspid valve vegetations
- Renal cell tumor extension into the right atrium
- Contralateral Pneumothorax

1.44 CVP Waveform

CVP Waveform

- Central venous pressure parallels right atrial pressure, which is a major determinant of venous blood.
- Normal pressures might range from -2 to 12 mmHg in a spontaneously breathing patient.
- Pressures of 6 to 15 mmHg (or more with high peak inspiratory pressures) can be expected if the patient’s lung are being mechanically ventilated.
- The shape of the central venous waveform corresponds to the events of the cardiac contractions.
1.45 CVP Waveform

- The normal waveform consists of three peaks and two descents.
- The a-wave is atrial contraction (these are absent in atrial fibrillation).
- The c waves are due to tricuspid valve elevation during early ventricular contraction.
- The v-wave reflects venous return against a closed tricuspid valve.
- The two descents (x and y) are due to the downward displacement of the tricuspid valve during systole and tricuspid valve opening during diastole.

1.46 CVP Waveform

- Three peak (a,c, and v waves) and two descents (x,y) can be seen in a normal CVP waveform.
- If a waves are absent, the p wave is absent on ECG tracing.
- Large a waves are present when resistance to emptying of the right atrium is present (i.e. tricuspid stenosis or pulmonary hypertension).
- A large v wave may suggest tricuspid regurgitation.

1.47 Elevated CVP

Elevated CVP

- Tricuspid Stenosis
- Tricuspid Regurgitation
- Pulmonary Hypertension
- Mitral Stenosis
- Mitral Regurgitation
- LV Failure
- Volume Overload
- Cardiac Tamponade
- Arrhythmias
- Increased PVR (Anxiety, Pain)

1.48 Complications of CVC Placement

Complications of CVC Placement

- Arterial puncture
- Pneumothorax
- Chylothorax
- Tracheal Injury
- Cardiac Tamponade
- Arrhythmias
- Air embolus
- Thrombosis
- Infection

1.49 15. While evaluating the CVP waveform in a patient, you note that the a wave is not present. You conclude that this patient has

(Multiple Choice, 10 points, unlimited attempts permitted)
15. While evaluating the CVP waveform in a patient, you note that the 'a' wave is not present. You conclude that this patient has

- a) asystole
- b) right bundle branch block
- c) left bundle branch block
- d) atrial fibrillation
- e) ventricular fibrillation

**Feedback when correct:**

That’s right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
15. While evaluating the CVP waveform in a patient, you note that the a wave is not present. You conclude that this patient has

Correct (Slide Layer)

Incorrect (Slide Layer)
15. While evaluating the CVP waveform in a patient, you note that the a wave is not present. You conclude that this patient has

- A. infusing Vasopressors
- B. right atrial
- C. left heart failure
- D. atrial
- E. ventricular

16. Which of the following is NOT an indication of CVL placement?

(Multiple Choice, 10 points, unlimited attempts permitted)

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. infusing Vasopressors</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td><strong>B. Monitoring central venous pressure</strong></td>
</tr>
<tr>
<td><strong>C. Infusing hyperalimentation</strong></td>
</tr>
<tr>
<td><strong>D. Aspiration of fat emboli</strong></td>
</tr>
<tr>
<td><strong>E. Insertion of Transcutaneous pacing leads</strong></td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.

**Correct (Slide Layer)**

16. Which of the following is NOT an indication of CVL placement?

- [ ] A. Infusing Vasopressors
- [ ] B. Monitoring central venous pressure
- [ ] C. Infusing hyperalimentation
- [ ] D. Aspiration of fat emboli
- [ ] E. Insertion of Transcutaneous pacing leads

Correct
That's right! You selected the correct response.

Continue
16. Which of the following is NOT an indication of CVL placement?

- A. Infusing Vasopressors
- B. Managing Fluids
- C. Infusing Blood Products
- D. Aspirate
- E. Insertion

Incorrect

You did not select the correct response.

Try Again

That is incorrect. Please try again.

1.51 17. Which of the following is not a contraindication?

(Multiple Choice, 10 points, unlimited attempts permitted)
17. Which of the following is not a contraindication?

- A. Patient on Anticoagulants
- B. Ipsilateral carotid endarterectomy
- C. Contralateral Pneumothorax
- D. Fungating tricuspid valve vegetations
- E. all are contraindications

Correct Choice

A. Patient on Anticoagulants
B. Ipsilateral carotid endarterectomy
C. Contralateral Pneumothorax
D. Fungating tricuspid valve vegetations
X E. all are contraindications

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.
17. Which of the following is not a contraindication?

- A. Patient on Anticoagulants
- B. Ipsilateral foot fracture
- C. Contralateral foot fracture
- D. Fungus
- E. All are correct

**Correct (Slide Layer)**

**Incorrect (Slide Layer)**
17. Which of the following is not a contraindication?

A. Patient on Anticoagulants
B. Iuphalvenous Catheterization
C. Contamination
D. Fungal
E. All are

Incorrect
That is incorrect. Please try again.

Try Again

1.52 Pulmonary Artery Catheterization (PAC)

- Flow-directed, balloon-tipped catheter
- Allows for catheterization of right heart for measurement of pressures
- Pulmonary artery occlusion (wedge) reflects left atrial pressure
- Sampling mixed venous blood
- Thermistor at tip of catheter measures temperature of blood flowing past
1.53 Pulmonary Artery Catheterization

Pulmonary Artery Catheterization

- The effectiveness of pulmonary artery catheter (PAC) monitoring remains largely unproven in many groups of surgical patients.
- The American Society of Anesthesiology (ASA) concludes that the appropriateness of PAC depends on the combination of risks associated with the patient.
- Monitoring PAP and cardiac output in critically ill patients has been shown to provide cardiovascular information that is more accurate than that obtained by clinical assessment.
- These measurements prove particularly important in patients at high risk for hemodynamic instability (e.g., recent MI or TAAA).
- When PAOP occurs, there is no blood flow, the pressures can equilibrate between the distal end of the pulmonary artery catheter and the left atrium.


1.54 PAC Indications

PAC Indications

- Poor left ventricular function (EF < 40%)
- Assessment of intravascular fluid volume
- Valvular heart diseases
- Response to IV fluid infusion or administration of drugs (vasopressors, vasodilators, intropes)
- Recent myocardial infarction
- Massive trauma (shock, hemorrhage)
- Major vascular surgery (cross-clamping of the aorta, large fluid shifts)
1.55 Contraindications to PAC

Contraindications to PAC

- Relative
  - Surgical field
  - Left bundle branch block
  - Traumatized tissue
  - Coagulopathy
  - Mitral or aortic valvular stenosis
- Absolute
  - Pulmonary valve stenosis
  - Artificial or Prosthetic Right Sided Valves
  - Patient Refusal
  - Infection at the local site

1.56 PAC Waveform
1.57 Complications for PAC Placement

Complications for PAC Placement

- Dyshrhythmias
- Right ventricular damage
- Pulmonary artery rupture
- Pulmonary infarction
- Thrombosis
- Infection
- Intracardiac knot formation

1.58 Elevated PAP

Elevated PAP

- Pulmonary Hypertension
- Increase PVR (i.e. drugs, COPD)
- Left Heart Failure
- Mitral Stenosis
- Mitral Regurgitation
- Cardiac Tamponade
- Arrhythmias
1.59 PAC Used to Evaluate Hemodynamic Disorders

<table>
<thead>
<tr>
<th></th>
<th>CVP</th>
<th>PAOP</th>
<th>PAEDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypovolemia</td>
<td>Decreased</td>
<td>Decreased</td>
<td>PAEDP=PAOP</td>
</tr>
<tr>
<td>Left ventricular failure</td>
<td>Increased</td>
<td>Increased</td>
<td>PAEDP=PAOP</td>
</tr>
<tr>
<td>Right ventricular failure</td>
<td>Increased</td>
<td>No change</td>
<td>PAEDP&gt;PAOP</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>Increased</td>
<td>No change</td>
<td>PAEDP&gt;PAOP</td>
</tr>
<tr>
<td>Cardiac Tamponade</td>
<td>Increased</td>
<td>Increased</td>
<td>PAEDP=PAOP</td>
</tr>
</tbody>
</table>

1.60 18. Which of the following is a contraindication of pulmonary artery catheter?

(Multiple Choice, 10 points, unlimited attempts permitted)

18. Which of the following is a contraindication of pulmonary artery catheter?

- A. Pulmonary valve stenosis
- B. Artificial or Prosthetic Right Sided Valves
- C. Infection at the local site
- D. Patient refusal
- E. All are contraindications
<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. Pulmonary valve stenosis</td>
</tr>
<tr>
<td></td>
<td>B. Artificial or Prosthetic Right Sided Valves</td>
</tr>
<tr>
<td></td>
<td>C. Infection at the local site</td>
</tr>
<tr>
<td></td>
<td>D. Patient refusal</td>
</tr>
<tr>
<td></td>
<td>E. All are contraindications</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.

**Correct (Slide Layer)**

18. Which of the following is a contraindication of pulmonary artery catheter?

- A. Pulmonary valve stenosis
- B. Artificial or Prosthetic Right Sided Valves
- C. Infection at the local site
- D. Patient refusal
- E. All are contraindications

That's right! You selected the correct response.
19. Which of the following are the indications for consideration of placement of a pulmonary artery catheter.

(Multiple Choice, 10 points, unlimited attempts permitted)
19. Which of the following are the indications for consideration of placement of a pulmonary artery catheter.

- A) Myocardial infarction
- B) Cross-clamping of the aorta in thoracoabdominal aorta aneurysm replacement surgery
- C) Poor left ventricular function (EF 20-25%)
- D) Hemorrhage
- E) Assessment of intravascular fluid volume
- F) All of the above

Feedback when correct:
That’s right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.
19. Which of the following are the indications for consideration of placement of a pulmonary artery catheter.

A) Myocardial Ischemia
B) Congestive Heart Failure
C) Poor Ventilation
D) Hemodynamic instability
E) Assess
F) All of the above

Correct (Slide Layer)

Incorrect (Slide Layer)
Try Again (Slide Layer)

19. Which of the following are the indications for consideration of placement of a pulmonary artery catheter.

A) Myocardial ischemia
B) Congestive heart failure or imminent surgery
C) Poor response to initial therapy
D) Hemodynamic instability
E) Age
F) All of the above

1.62 Hemodynamic Variables

**Hemodynamic Variables**

- Calculating Systemic Vascular Resistance

Recall, \( V = I \times R \)

\[
SVR = \frac{(MAP - CVP) \times 80}{C.O.}
\]

Normally, \( SVR = 1200-1500 \text{ dynes}*\text{s}^*\text{cm}^2 \)
1.63 More Hemodynamic Variables

- Calculate Pulmonary Vascular Resistance (PVR)

\[
PVR = (MPAP - PAOP) * 80
\]
C. O.

Normally, PVR = 100-300 dynes*s*cm⁻¹

1.64 Transesophageal Echocardiography (TEE)

- Advantages over PAC
- Used to characterize cardiac valve morphology and function
- Determine regional wall motion abnormalities (myocardial ischemia)
- Assess cardiac output
- Adequacy of intravascular fluid volume
- Less invasive than PAC
1.65 Untitled Slide

Thank you for completing the content portion of this module. Next you must complete a 14 question quiz and score a minimum of an 80% to pass.

Please click Next to continue.

1.66 1. Match the following:

(Matching Drag-and-Drop, 10 points, 1 attempt permitted)
<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) Gold standard to document tracheal position of ETT, continuous</td>
<td>Capnography</td>
</tr>
<tr>
<td>B) Observe function, volume, structure, ischemia</td>
<td>Transesophageal echocardiography</td>
</tr>
<tr>
<td>C) High volume catheter useful for resuscitation</td>
<td>Central venous catheter</td>
</tr>
<tr>
<td>D) Inaccurate with carbon monoxide, severe anemia</td>
<td>Pulse oximetry</td>
</tr>
<tr>
<td>E) Mixed venous oxygen saturation, cardiac output, preload, right heart pressures</td>
<td>Pulmonary artery catheter</td>
</tr>
<tr>
<td>F) Thrill, Point of maximal impulse, rhythm and quality, pulse rate</td>
<td>Palpation</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.
1. Match the following:

A) Gold standard to document tracheal position of ETT, continuous

B) Observe for ischemia

C) High volume resuscitation

D) Inaccurate severe anemia

E) Mixed venous oxygen saturation, cardiac output, preload, right heart pressures

F) Thrill, Point of maximal impulse, rhythm and quality, pulse rate

Correct

Incorrect

That's right! You selected the correct response.

You did not select the correct response.

Continue

Continue

1.67 2. Match the following:

(Matching Drag-and-Drop, 10 points, 1 attempt permitted)
2. Match the following:

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Left ventricular stroke work index</td>
<td>SI * (MAP-PCWP) * 0.0136</td>
</tr>
<tr>
<td>B. Cardiac index (CI)</td>
<td>(HR * SV) / BSA</td>
</tr>
<tr>
<td>C. Cardiac output (CO)</td>
<td>HR * SV</td>
</tr>
<tr>
<td>Pulmonary vascular resistance</td>
<td>(MPAP-PCWP/CO) * 80</td>
</tr>
<tr>
<td>Stroke Index (SI)</td>
<td>CI / HR</td>
</tr>
<tr>
<td>Systematic vascular resistance</td>
<td>(MAP-CVP/CO) * 80</td>
</tr>
</tbody>
</table>

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.
Correct (Slide Layer)

2. Match the following:

- A. Left ventricular stroke work index: $SI \times (MAP-PCWP)^0.036$
- B. Cardiac index
- C. Cardiac output
- Pulmonary vascular resistance
- Stroke index (SI)
- Systemic vascular resistance: $(MAP-CVP/CO)^{0.80}$

Incorrect (Slide Layer)

2. Match the following:

- A. Left ventricular stroke work index: $SI \times (MAP-PCWP)^0.036$
- B. Cardiac index
- C. Cardiac output
- Pulmonary vascular resistance
- Stroke index (SI)
- Systemic vascular resistance: $(MAP-CVP/CO)^{0.80}$

1.68 3. A falsely low blood pressure will occur from?

(Multiple Choice, 10 points, 1 attempt permitted)
3. A falsely low blood pressure will occur from?

- A. cuffs are applied too loosely
- B. when the extremity is below heart level
- C. when cuffs are too small
- D. when the cuff is too large

Correct Choice

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. cuffs are applied too loosely</td>
</tr>
<tr>
<td></td>
<td>B. when the extremity is below heart level</td>
</tr>
<tr>
<td></td>
<td>C. when cuffs are too small</td>
</tr>
<tr>
<td>X</td>
<td>D. when the cuff is too large</td>
</tr>
</tbody>
</table>

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.
3. A falsely low blood pressure will occur from?

- A. cuffs are applied too loosely
- B. when the extremity is below heart level
- C. when...
- D. when...

Correct (Slide Layer)

Incorrect (Slide Layer)

1.69 4. The best monitor is:

(Multiple Choice, 10 points, 1 attempt permitted)
4. The best monitor is:

- A. ECG
- B. Pulse Oximetry
- C. Temperature probe
- D. Blood Pressure
- E. A Vigilant Physician

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. ECG</td>
<td></td>
</tr>
<tr>
<td>B. Pulse Oximetry</td>
<td></td>
</tr>
<tr>
<td>C. Temperature probe</td>
<td></td>
</tr>
<tr>
<td>D. Blood Pressure</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>E. A Vigilant Physician</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.
1.70 5. V5 lead goes where?

(Multiple Choice, 10 points, 1 attempt permitted)
5. V5 lead goes where?

- A. Right shoulder
- B. Left Shoulder
- C. Right anterior axillary line between fourth and fifth intercostal space
- D. Left anterior axillary line between fourth and fifth intercostal space
- E. Left Lower limb

Correct Choice

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Right shoulder</td>
</tr>
<tr>
<td>B. Left Shoulder</td>
</tr>
<tr>
<td>C. Right anterior axillary line between fourth and fifth intercostal space</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>D. Left anterior axillary line between fourth and fifth intercostal space</td>
</tr>
<tr>
<td>E. Left Lower limb</td>
</tr>
</tbody>
</table>

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.
1.71 6. The dorsal pedis arterial blood pressure has a greater systolic blood pressure than the aortic blood pressure.

(True/False, 10 points, 1 attempt permitted)
6. The dorsal pedis arterial blood pressure has a greater systolic blood pressure than the aortic blood pressure.

<table>
<thead>
<tr>
<th>Correct Choice</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>True</td>
</tr>
<tr>
<td></td>
<td>False</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That’s right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
1.72 7. Which of the following is not true about the CVP waveform?

*(Multiple Choice, 10 points, 1 attempt permitted)*
**7. Which of the following is not true about the CVP waveform?**

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>has a A wave</td>
</tr>
<tr>
<td>B.</td>
<td>has a C wave</td>
</tr>
<tr>
<td>C.</td>
<td>has a V wave</td>
</tr>
<tr>
<td>D.</td>
<td>has a X wave</td>
</tr>
<tr>
<td>E.</td>
<td>has a Y descent</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
1.73 8. Which of the following is not a reason for elevated CVP?

(Multiple Choice, 10 points, 1 attempt permitted)
8. Which of the following is not a reason for elevated CVP?

- A. Blood volume overload
- B. Left heart failure
- C. Pulmonary hypertension
- D. Tricuspid regurgitation
- E. All would lead to elevated CVP

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Blood volume overload</td>
</tr>
<tr>
<td>B. Left heart failure</td>
</tr>
<tr>
<td>C. Pulmonary hypertension</td>
</tr>
<tr>
<td>D. Tricuspid regurgitation</td>
</tr>
<tr>
<td>X E. All would lead to elevated CVP</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.
1.74 9. Which of the following is not true?

(Multiple Choice, 10 points, 1 attempt permitted)
9. Which of the following is not true?

- A. the first Korotkoff sound is the diastolic BP
- B. the last Korotkoff sound is the systolic BP
- C. Korotkoff sounds reflect laminar flow
- D. None are true
- E. All are true

Correct Choice

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. the first Korotkoff sound is the diastolic BP</td>
</tr>
<tr>
<td>B. the last Korotkoff sound is the systolic BP</td>
</tr>
<tr>
<td>C. Korotkoff sounds reflect laminar flow</td>
</tr>
<tr>
<td>X</td>
</tr>
<tr>
<td>D. None are true</td>
</tr>
<tr>
<td>E. All are true</td>
</tr>
</tbody>
</table>

Feedback when correct:
That's right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.
1.75 10. Which of the following is not an acceptable site for arterial blood pressure access?

(Multiple Choice, 10 points, 1 attempt permitted)
10. Which of the following is not an acceptable site for arterial blood pressure access?

- A. Radial artery
- B. Brachial artery after radial attempt
- C. Dorsal pedis artery
- D. Ulnar artery after radial attempt
- E. Femoral artery after dorsal pedis attempt

Correct Choice

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Radial artery</td>
</tr>
<tr>
<td>B.</td>
<td>Brachial artery after radial attempt</td>
</tr>
<tr>
<td>C.</td>
<td>Dorsal pedis artery</td>
</tr>
<tr>
<td>X</td>
<td>D. Ulnar artery after radial attempt</td>
</tr>
<tr>
<td></td>
<td>E. Femoral artery after dorsal pedis attempt</td>
</tr>
</tbody>
</table>

**Feedback when correct:**
That's right! You selected the correct response.

**Feedback when incorrect:**
You did not select the correct response.
10. Which of the following is not an acceptable site for arterial blood pressure access?

A. Radial artery  
B. Brachial artery  
C. Dorsalis pedis  
D. Ulnar  
E. Femoral

Correct (Slide Layer)

Incorrect (Slide Layer)

1.76 11. Arterial catheters are advantageous because they are low risk, allow easy access to arterial blood, and allow beat-to-beat blood pressure.

(True/False, 10 points, 1 attempt permitted)
11. Arterial catheters are advantageous because they are low risk, allow easy access to arterial blood, and allow beat-to-beat blood pressure.

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>X True</td>
</tr>
<tr>
<td>False</td>
</tr>
</tbody>
</table>

Feedback when correct:
That’s right! You selected the correct response.

Feedback when incorrect:
You did not select the correct response.
11. Arterial catheters are advantageous because they are low risk, allow easy access to arterial blood, and allow beat-to-beat blood pressure.

**Correct (Slide Layer)**

1.77 12. **Pulmonary artery catheter can help?**

*(Multiple Choice, 10 points, 1 attempt permitted)*
12. Pulmonary artery catheter can help?

<table>
<thead>
<tr>
<th>Correct Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. sample arterial blood</td>
</tr>
<tr>
<td>B. measure arterial blood pressure</td>
</tr>
<tr>
<td>C. measure continuous cardiac output</td>
</tr>
<tr>
<td>D. measure left ventricular pressure</td>
</tr>
<tr>
<td>E. all of the above</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
1.78 13. Which of the following is an absolute indication of CVL placement?

(Multiple Choice, 10 points, 1 attempt permitted)
13. Which of the following is an absolute indication of CVL placement?

- A. Infusing Vasopressors
- B. Monitoring arterial oxygen content
- C. Infusing large volumes of crystalloid
- D. Aspiration of fat emboli
- E. Measuring CVP

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A. Infusing Vasopressors</td>
</tr>
<tr>
<td></td>
<td>B. Monitoring arterial oxygen content</td>
</tr>
<tr>
<td></td>
<td>C. Infusing large volumes of crystalloid</td>
</tr>
<tr>
<td></td>
<td>D. Aspiration of fat emboli</td>
</tr>
<tr>
<td>X</td>
<td>E. Measuring CVP</td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
1.79 14. Most cardiac arrhythmias are best picked up on interpreting lead?

(Multiple Choice, 10 points, 1 attempt permitted)
14. Most cardiac arrhythmias are best picked up on interpreting lead?

<table>
<thead>
<tr>
<th>Correct</th>
<th>Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. aVL</td>
<td></td>
</tr>
<tr>
<td>B. I</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>C. II</td>
</tr>
<tr>
<td>D. IIII</td>
<td></td>
</tr>
<tr>
<td>E. V</td>
<td></td>
</tr>
</tbody>
</table>

**Feedback when correct:**

That's right! You selected the correct response.

**Feedback when incorrect:**

You did not select the correct response.
14. Most cardiac arrhythmias are best picked up on interpreting lead?

A. aVL
B. I
C. II
D. III
E. V

Correct
That's right! You selected the correct response.

Incorrect
You did not select the correct response.

1.80 Results Slide

(Results Slide, 0 points, 1 attempt permitted)
<table>
<thead>
<tr>
<th>Results for</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.66 1. Match the following:</td>
</tr>
<tr>
<td>1.67 2. Match the following:</td>
</tr>
<tr>
<td>1.68 3. A falsely low blood pressure will occur from?</td>
</tr>
<tr>
<td>1.69 4. The best monitor is:</td>
</tr>
<tr>
<td>1.70 5. V5 lead goes where?</td>
</tr>
<tr>
<td>1.71 6. The dorsal pedis arterial blood pressure has a greater systolic blood pressure then the aortic blood pressure.</td>
</tr>
<tr>
<td>1.72 7. Which of the following is not true about the CVP waveform?</td>
</tr>
<tr>
<td>1.73 8. Which of the following is not a reason for elevated CVP?</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>1.74</td>
</tr>
<tr>
<td>1.75</td>
</tr>
<tr>
<td>1.76</td>
</tr>
<tr>
<td>1.77</td>
</tr>
<tr>
<td>1.78</td>
</tr>
<tr>
<td>1.79</td>
</tr>
</tbody>
</table>

Result slide properties

**Passing Score**

80%

**Success (Slide Layer)**

- **Your Score:** (Your score percentage)
- **Passing Score:** (Score percentage required to pass)
- **Result:** Congratulations, you passed.

Published by Articulate® Storyline  www.articulate.com
Failure (Slide Layer)

Results

Your Score:

Passing Score:

Result:

You did not pass.

Retry Quiz  Exit Module