

# The Kaji Review

Emergency Medicine Clinical Review Book

*1st Edition*

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# **The Kaji Review**

Welcome to the Kaji Review. This book is intended for students, residents, and senior physicians alike. Although formatted as a question book, the Kaji Review is really an evidence based clinical case book to advance your bedside knowledge with 744 questions.

We hope you will use this question book to improve clinical care and encourage lifelong learning. Content pulls heavily from textbooks and LLSA readings. Topics are focused on emergency care but also cover outpatient and inpatient medical and surgical topics. Sometimes questions will have more than one correct answer, just like our patients. Don't worry, we will give you a hint on those.

Often the explanations include textbook references, evidence based guidelines, online resources, and specific details of clinical research. If we could find a full text or appropriate video or illustration we included links. Questions are grouped by section so you can focus on specific topics and dive deeply into relevant clinical content.

We hope you enjoy the challenge and increase your fund of knowledge!

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# Cardiology

**#1**

**Inappropriate shocks occur in 20 to 25% of those with an AICD in place. The most common cause of an inappropriate shock is:**

- A. Lead fracture
- B. Loud electrical noise
- C. Atrial Fibrillation
- D. Inappropriate sensing
- E. Sudden body movements



**#1**

**Answer: C.**

The incidence of inappropriate ICD firing is reported to occur in 20 - 25% of patients, with the main cause being atrial fibrillation. The reported percentages for inappropriate shocks are:

- A. Atrial fibrillation (44%)
- B. Supraventricular tachycardia (36%)
- C. Abnormal sensing (20%)

Other less common causes included electrical noise, inappropriate sensing, and ICD malfunction, such as lead fracture. Patients with supraventricular tachycardias (SVT) often experience more than one discharge. Dual chamber devices can reduce the frequency of inappropriate shocks, in which an atrial sensing lead can differentiate atrial tachycardia vs atrial flutter or fibrillation. Other settings, such as antitachycardia pacing, help to further discriminate atrial from ventricular dysrhythmias. Alternatives to decrease inappropriate shocks and atrial dysrhythmias include antiarrhythmic drugs and catheter ablation.

*References:*

- Daubert, et al. Inappropriate Implantable Cardioverter Defibrillator Shocks in MADIT II. 2008:1357–65. [full text](#)
- Mitchell AR. Effect of atrial antitachycardia pacing treatments in patients with an atrial defibrillator: randomised study comparing subthreshold and nominal pacing outputs. Heart. 2002 May;87(5):433-7. [full text](#)

#2

**Which of the following patients/conditions has the lowest risk of bacterial endocarditis?**

- A. Patient with a prosthetic heart valve
- B. Patient with a complex cyanotic congenital heart defect
- C. Patient who has had a systemic-to-pulmonary shunt
- D. Patient with an isolated atrial septal defect
- E. Patient with a previous episode of endocarditis

#2

**Answer: D.**

Patients with cardiac lesions that produce turbulent blood flow are predisposed to bacterial endocarditis since there is greater risk of endothelial damage and vegetation formation. Cardiac conditions carrying the greatest risk are:

1. Ventricular septal defects
2. Aortic valvular stenosis
3. Tetralogy of Fallot
4. Single ventricular states
5. Prosthetic valves
6. Cardiac shunting procedures

Atrial septal defects carry a low risk for endocarditis since atrial flow is much lower than ventricular flow and valvular flow. This decreases the risk of endothelial and valvular damage.

*Reference:*

- Rosen's Emergency Medicine 8th edition. 2013. Chapter 83: Infective Endocarditis and Valvular Heart Disease. 1106 - 1112

#3

**Which of the following strategies has NOT been associated with shorter door-to-balloon times?**

- A. Prehospital ECG and activation of catheterization laboratory en route
- B. Emergency department activation of the catheterization laboratory without routine cardiology consultation
- C. Prompt feedback from data monitoring
- D. Establishing a single call system to activate the entire catheterization laboratory team
- E. Establishment of the expectation that the catheterization team members arrive within 60 to 90 minutes after being paged

#3

**Answer: E.**

Establishing an expectation that team members arrive within 20-30 minutes after being paged is one of the strategies that has been associated with shorter door-to-balloon times. Other strategies include the following:

1. Prehospital ECG and activation of the catheterization laboratory en route
2. Direct transfer to the catheterization laboratory by emergency medical services using prehospital ECGs
3. Establishing emergency department guidelines and protocols for rapidly obtaining ECGs in triage
4. ED activation of catheterization laboratory without cardiology consultation
5. Single call activation of the catheterization laboratory
6. Prompt data feedback
7. Commitment from senior management and administration

*Reference:*

- LLSA 2009: Brahmajee K, et al. Time to treatment in primary percutaneous intervention. N Eng J Med. 2007; 357:1631-1638. [full text](#)

# 4

Regarding acute myocardial infarction, when patients with normal and non-diagnostic electrocardiograms were compared with patients who had diagnostic electrocardiograms, patients with normal and non-diagnostic electrocardiograms had an in-hospital mortality that was:

- A. Lower
- B. Higher
- C. The same

# 4

**Answer: A.**

Welch et al. examined the in-hospital mortality among patients with AMI who have normal or nonspecific initial ECGs compared to patients with diagnostic ECGs. The study was multicenter and involved 391,208 patients with acute myocardial infarction who had an ECG that was normal (n = 30,759), nonspecific (n = 137,574), or diagnostic (n = 222,875). Diagnostic ECGs were defined as ST-segment elevation or depression and/or left bundle-branch block. They demonstrated in-hospital mortality rates of 5.7% (normal ECG), 8.7% (nonspecific ECG), and 11.5% (diagnostic ECG) and rates of the composite of mortality and life-threatening adverse events of 19.2% (normal ECG), 27.5% (nonspecific ECG), and 34.9% (diagnostic ECG).

After adjusting for other predictor variables, the odds of mortality for the normal ECG group was 0.59 (95% confidence interval [CI], 0.56-0.63;  $P < .001$ ) and for the nonspecific group was 0.70 (95% CI, 0.68-0.72;  $P < .001$ ), compared with the diagnostic ECG group. In this cohort, patients with normal or nonspecific ECGs had a lower in-hospital mortality than those with diagnostic ECGs.

*Reference:*

- LLSA 2006: Welch RD et al. Prognostic value of a normal or nonspecific initial ECG in acute myocardial infarction. JAMA. 2001; 286: 1977-1984. [full text](#)

#5

Acute symptoms of myocardial infarction (AMI) or prodromal symptoms occurring 1 month prior to the MI in women include all EXCEPT:

- A. Fatigue
- B. Shortness of breath
- C. Weakness
- D. Loss of consciousness
- E. Sleep disturbances



# 5

**Answer: D.**

**The most frequent prodromal symptoms experienced by women more than 1 month before AMI were:**

- Fatigue (70.7%)
- Sleep disturbance (47.8%)
- Shortness of breath (42.1%).

Only 29.7% reported chest discomfort, a classic symptom in men.

**The most frequent acute symptoms in women were:**

- Shortness of breath (57.9%)
- Weakness (54.8%)
- Fatigue (42.9%)

Acute chest pain was absent in 43%.

*Reference:*

- LLSA 2006: McSweeney JC et al. Women's early warning symptoms of acute myocardial infarction. *Circulation*. 2003; 108: 2619 -2623. [full text](#)

# 6

Which of the following is the LEAST helpful feature for increasing the probability that heart failure is the etiology of dyspnea?

- A. Past history of heart failure
- B. Paroxysmal nocturnal dyspnea
- C. The sign of a third heart sound
- D. The sign of a fourth heart sound
- E. Electrocardiogram demonstrating atrial fibrillation

# 6

**Answer: D.**

Wang et al. assessed history and physical as well as diagnostic tests as methods for determining the usefulness of diagnosing heart failure. Below are the [likelihood ratios](#) of the various diagnostic characteristics and tests.

**Positive predictors:**

**Past history of heart failure:**

- Positive LR = 5.8; 95% CI, 4.1-8.0

**Symptom of paroxysmal nocturnal dyspnea**

- Positive LR = 2.6; 95% CI, 1.5-4.5

**Sign of the third heart sound (S3) gallop**

- Positive LR = 11; 95% CI, 4.9-25.0

**Pulmonary venous congestion on X-ray**

- Positive LR = 12.0; 95% CI, 6.8-21.0

**Electrocardiogram showing atrial fibrillation**

- Positive LR = 3.8; 95% CI, 1.7-8.8

**Negative predictors:**

**Absence of a past history of heart failure**

- Negative LR = 0.45; 95% CI, 0.38-0.53

**Absence of dyspnea on exertion**

- Negative LR = 0.48; 95% CI, 0.35-0.67

**Absence of rales**

- Negative LR = 0.51; 95% CI, 0.37-0.70

**Absence of a cardiomegaly on chest radiograph**

- Negative LR = 0.33; 95% CI, 0.23-0.48

**Absence of electrocardiogram abnormality**

- Negative LR = 0.64; 95% CI, 0.47-0.88

**Serum B-type natriuretic peptide <100 pg/mL**

- Negative LR = 0.11; 95% CI, 0.07-0.16

The authors conclude that for dyspneic adult emergency department patients, a directed history, physical examination, chest radiography, and electrocardiography should be performed. If the diagnosis of heart failure is still uncertain, a serum BNP level may be helpful.

*Reference:*

- LLSA 2007: Wang CS, et al. Does this Dyspneic patient in the emergency department have congestive heart failure? JAMA. 2005; 294:1944-1956. [full text](#)

#7

Studies had shown that nesiritide improved symptoms in patients with acutely decompensated heart failure compared with placebo and possibly appeared to be safer than dobutamine. When comparing nesiritide with standard diuretic and vasodilator therapies, nesiritide may:

- A. Improve creatinine clearance
- B. Be associated with an increased risk of 30-day death
- C. Be associated with a decreased risk of 30-day death
- D. None of the above

#7

**Answer: B.**

Sackner-Bernstein et al. performed a meta-analysis of trials evaluating nesiritide for the treatment of decompensated heart failure. Death within 30 days tended to occur more often among patients randomized to nesiritide therapy (35 [7.2%] of 485 vs 15 [4.0%] of 377 patients; risk ratio, 1.74; 95% CI, 0.97-3.12).

Compared with diuretic and vasodilator therapy, nesiritide may be associated with an increased risk of death after treatment for acutely decompensated heart failure.

*Reference:*

- LLSA 2007: Sackner-Bernstein JD, et al. Short-term risk of death after treatment with Nesiritide for decompensated heart failure. JAMA. 2005; 293: 1900-1905. [full text](#)

#8

A 60 year old male who has an ICD in place presents in cardiac arrest. All of the following are appropriate management steps, EXCEPT:

- A. Focus on treating potentially reversible causes of electromechanical dissociation (EMD) and Ventricular Fibrillation (VF)/Ventricular Tachycardia (VT)
- B. Generally follow ACLS protocols.
- C. Place the defibrillator pads directly over the device
- D. Perform chest compressions in the standard fashion
- E. After successful resuscitation, you should focus on the causes of ICD failure (electrolyte imbalance, myocardial ischemia or infarction, drug effects) that may be treated without ICD reprogramming or surgery.

#8

**Answer: C.**

The most common causes of sudden death in patients with ICDs are:

- Electromechanical dissociation (EMD) after ICD conversion of VF or VT (29%)
- Defibrillator failure (25%) -VT or VF that was not terminated by the ICD shocks
- EMD not involving VF or VT (16%)
- Recurrent VF after successfully defibrillation (13%).

When treating the patient with an ICD in cardiac arrest, emphasis should be placed on external counter shocks and correcting all potentially reversible causes. Resuscitation should follow ACLS protocols. Most ICDs analyze and shock VF or VT within 30 seconds, so it should be assumed that a patient who presents in VF or VT has ICD failure. The external defibrillator pads should not be placed directly over the device, but rather, should be positioned anteroposteriorly.

*Reference:*

- Mitchell LB et al. Sudden death in patients with implantable cardioverter defibrillators: the importance of post-shock electromechanical dissociation. J Am Coll Cardiol. 2002; Apr 17;39(8):1323-8. [full text](#)



#9

**Which of the following statements about pacemakers is true?**

- A. The absence of ST segment elevations and T wave changes in a patient with a pacemaker rules out ischemia and infarction.
- B. Right ventricular pacemakers produce a right bundle branch block.
- C. Using Sgarbossa's Criteria on a paced patient or patient with a LBBB has poor sensitivity but high specificity for the diagnosis of STEMI.
- D. High voltage electrical machinery has no risk to altering pacemaker function
- E. The most common cause of failure to capture (the absence of ventricular or atrial depolarization after a pacemaker spike) is due to hyperkalemia.

#9

**Answer: C.**

Right ventricular pacemakers produce a left bundle branch (LBBB) pattern of depolarization, and thus, the ECG diagnosis of myocardial ischemia and infarction may be difficult. The [Sgarbossa Criteria](#) has low sensitivity but high specificity in evaluating a patient with a LBBB. In general, everyday electrical utilities and computers will not interfere with a pacemaker, although high voltage industrial machinery may offer some interference risk. The most common cause of non-capture is pacemaker lead dislodgment, which typically occurs within a few weeks of implantation. Other mechanical causes include insulation breaks and lead fractures.

*References:*

- Klimczak A, et al. Electrocardiographic diagnosis of acute coronary syndromes in patients with left bundle branch block or paced rhythm. *Cardiol J* 2007; 14(2) 207-13. [full text](#)
- Shlipak MG et al. Should the electrocardiogram be used to guide therapy for patients with left bundle-branch block and suspected myocardial infarction? *JAMA*. 1999; 281(8):714. [full text](#)

**#10**

**In the patient with an acute myocardial infarction and cardiogenic shock, which of the following constitutes optimal therapy?**

- A. Ensure adequate ventilation and oxygenation
- B. Treat emergent arrhythmias
- C. Administer aspirin if not aspirin allergic
- D. Arrange for emergent PCI
- E. All of the above

**# 10**

**Answer: E.**

All of the above would be indicated, and consideration should be given for inotropic agents. Evidence from randomized trials suggests that emergent revascularization improves mortality rates at 6 months and one year.

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 78: Acute Coronary Syndrome. 997-1033

**# 11**

**What is the only post-return of spontaneous circulation intervention that has been shown to improve survival and functional outcome of comatose cardiac arrest survivors?**

- A. Transvenous pacing
- B. Transcutaneous pacing
- C. Intra-aortic balloon counterpulsation
- D. Induced hypothermia
- E. Inotropic agents

# 11

**Answer: D.**

Therapeutic hypothermia has been shown to improve survival and functional outcome in prospective randomized controlled trials. Although there are no absolute contraindications to hypothermia, relative contraindications include

1. Persistent dysrhythmias
2. Uncontrolled hemorrhage
3. Preexisting coagulopathy
4. Pregnancy
5. Drug overdose or status epilepticus causing coma
6. Terminal illness and a do-not-resuscitate order

Patients who have received thrombolytics can still undergo hypothermia protocol. Recent evidence also suggests that traditional (32-34°C) cooling may be no better than 36°C. The main benefit from cooling may be the result of preventing fever.

*References:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 83: Brain Resuscitation. 84-86
- Nielsen, N et al. Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest. The New England Journal of Medicine. 2013; 369(23):2197-2206. [full text](#)

**# 12**

**Which of the following statements are FALSE regarding the combined administration of epinephrine and vasopressin in cardiac arrest?**

- A. Animal studies suggest a benefit of combining vasopressin and epinephrine in cardiac arrest.
- B. Human studies demonstrate no significant difference in survival to hospital admission.
- C. Human studies demonstrate a significant benefit in return of spontaneous circulation.
- D. Human studies demonstrate no significant difference in survival to hospital discharge.
- E. Human studies demonstrate no significant difference in good neurologic recovery at the time of hospital discharge.

# 12

**Answer: C.**

Despite animal studies suggesting a benefit of combining vasopressin and epinephrine in cardiac arrest, this has never been confirmed in human studies. In a multicenter double-blind placebo-controlled trial of 2,894 patients in France (up to two doses of 1 mg of epinephrine either alone or combined with 40 IU of vasopressin), there was no difference in any of the primary or secondary outcomes, including survival to hospital admission or discharge, return of spontaneous circulation, or in neurologic recovery at the time of hospital discharge. That being said, there has also not been a mortality benefit demonstrated from epinephrine in cardiac arrest, although it increases the rate of return of spontaneous circulation.

*References:*

- Gueugniaud PY et al. Vasopressin and epinephrine vs. epinephrine alone in cardiopulmonary resuscitation. N Engl J Med. 2008; 359: 21. [full text](#)
- Hagihara A et al. Prehospital epinephrine use and survival among patients with out-of-hospital cardiac arrest. JAMA. 2012 Mar 21;307(11):1161-8. [full text](#)



**#13**

**Regarding the San Francisco Syncope Rules (SFSR), which of the following is FALSE?**

- A. The rule is based on five predictor variables.
- B. One predictor variable is a history of CHF
- C. One predictor variable is a hematocrit below 30%
- D. Other predictor variables include an abnormal EKG, SBP < 90 and shortness of breath
- E. The SFSR has been validated in multiple settings and populations

# 13

**Answer: E.**

Birnbaum et al. performed a prospective validation trial of the San Francisco syncope rule with 713 patients. The SFSR predicted only 45 of 61 who had a “serious seven day outcome” and was falsely positive in 278 patients without a serious outcome. Overall sensitivity was 74% and specificity was 57%. The 16 serious outcomes not predicted by the rule included one death, 8 ventricular arrhythmias, three strokes, and one SAH. Needless to say, the rule was not validated.

San Francisco Syncope Rule Criteria:

1. Congestive Heart Failure
2. Hematocrit < 30%
3. ECG abnormality
4. Shortness of breath
5. Systolic BP < 90 mmHg at triage

*References:*

- Birnbaum A et al. Failure to validate the San Francisco syncope rule in an independent emergency department population. *Ann Emerg Med* 2008; 52: 151.
- MD Calc <http://www.mdcalc.com/san-francisco-syncope-rule-to-predict-serious-outcomes/>

**#14**

**A 58 year old male with dilated ischemic cardiomyopathy presents with dyspnea at rest and on exertion, and orthopnea. The X-rays demonstrate pulmonary edema, the ECG is unchanged from a previous ECG, and the pulse oximetry is 92% on a non-rebreather mask. After administration of nitrates, what is the best next step in management?**

- A. Endotracheal intubation
- B. Digoxin
- C. Nesiritide
- D. Noninvasive ventilation
- E. Albuterol nebulizer treatments

**# 14**

**Answer: D.**

In a systematic review of fifteen trials, noninvasive ventilation significantly reduced the mortality rate by nearly 45% compared with conventional therapy (risk ratio [RR], 0.55; 95% confidence interval [CI], 0.40-0.78;  $P = .72$  for heterogeneity). The results were significant for continuous positive airway pressure, CPAP, (RR, 0.53; 95% CI, 0.35-0.81) but not for bilevel noninvasive pressure support ventilation, NIPSV, (RR, 0.60; 95% CI, 0.34-1.05), although there were fewer studies in the NIPSV group.

Both modalities showed a significant decrease in the intubation rates compared with conventional therapy. Although the level of evidence is higher for CPAP, there are no significant differences in clinical outcomes when comparing CPAP vs NIPSV.

*Reference:*

- LLSA 2009: Masip J, Roque M et al. Noninvasive ventilation in acute cardiogenic pulmonary edema: systematic review and meta-analysis. JAMA. 2005 Dec 28;294(24):3124-30. [full text](#)

# 15

A 57 yo male patient is found to have a Type B aortic dissection by CT and is still complaining of severe chest pain. While awaiting evaluation by the vascular surgery service, which of the following would be the LEAST appropriate early treatments you could provide this patient with a BP of 190/100 and a HR of 100 bpm:

- A. Opioids
- B. Esmolol alone
- C. Nitroprusside alone
- D. Esmolol and Nitroprusside
- E. Labetalol

# 15

**Answer: C.**

Early therapy for aortic dissection is directed towards two goals:

1. Reduction of blood pressure
2. Decrease the rate of rise of the arterial pulse ( $dP/dt$ ) to diminish shearing forces.

First line therapy is the use of beta-blockers. Esmolol or labetalol can be administered as boluses and then maintained as an infusion. Target heart rate of 60 bpm and SBP 100-120 mmHg. Opioids should be administered in adequate amounts for pain control and to decrease sympathetic tone. Nitroprusside is a potent preload and afterload reducing agent that causes vasodilatation and arteriolar dilatation. Because vasodilators like nitroprusside can increase heart rate and therefore increase  $dP/dt$  (increasing shearing force), a beta blocker should be started before or in conjunction with nitroprusside.

*References:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 85: Aortic Dissection. 1127-1128
- EmCrit - Aortic Dissection <http://emcrit.org/podcasts/aortic-dissection/>
- Kodama K et al. Tight heart rate control reduces secondary adverse events in patients with type B acute aortic dissection. Circulation. 2008 Sep 30;118(14 Suppl):S167-70. [full text](#)

**#16**

**Which of the following is NOT consistent with Dressler's syndrome?**

- A. Fever
- B. Pleuritis and pleural effusion
- C. Leukocytosis
- D. Friction rub
- E. Mediastinitis

**#16**

**Answer: E.**

Dressler's syndrome is characterized by chest pain, fever, and pleural effusions. It is thought to be an immunologic reaction that occurs 2 to 6 weeks post MI. Aspirin or indomethacin is standard therapy. An acute pericarditis 2-7 days following transmural MIs can also occur. It is manifested by low grade fever and a transient friction rub that is generally short-lived and disappears with 1-3 days of initiating aspirin treatment.

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 82: Pericardial and Myocardial. 1093.



**#17**

**Regarding pericardial disease, which of the following statements are FALSE:**

- A. Most cases of pericarditis are idiopathic.
- B. Classic symptoms of pericarditis include chest pain, pericardial friction rub and ECG abnormalities including electrical alternans.
- C. Pericardial effusions of less than 200cc usually will not produce cardiomegaly on chest X-ray.
- D. Cardiac tamponade is the result of compression of the myocardium and increased pericardial pressure leading to decreased cardiac output.
- E. Ventricular dysrhythmias are common in pericardial disease.

**#17**

**Answer: E.**

Pericarditis has multiple causes that include, infectious, post procedural, metabolic, neoplastic, and systemic connective tissue disorders. Ventricular dysrhythmias should not be caused by pericarditis. If they do occur in a patient diagnosed with pericarditis, the patient either has a concomitant myocarditis or intrinsic cardiac disease.

Patients with pericarditis generally recover fully after 3 weeks. The ECG will evolve over that time. The ECG stages are:

1. Diffuse ST segment elevation with possibility for concurrent PR depression
2. ST and PR segments become isoelectric and T wave flattening occurs
3. Deep symmetric T wave inversions
4. Normalization of T waves

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 82: Pericardial and Myocardial. 1091-1093.

**#18**

**Vasodilatory agents would be the LEAST appropriate initial therapy in which of the following patients with chronic valvular disease?**

- A. Patient with chronic mitral and aortic insufficiency with a BP of 150/87 and CHF
- B. Patient with mitral stenosis, BP of 137/70 and pink sputum
- C. Patient with critical aortic stenosis with a BP of 120/45 and chest pain
- D. Patient with mitral insufficiency with a BP of 180/90 and CHF

**#18**

**Answer: C.**

Chronic valvular disease is commonly associated with CHF (most commonly mitral insufficiency and aortic stenosis). Patients with decompensated aortic stenosis have a fixed lesion and without adequate preload, they will become hypotensive. Generally vasodilators such as nitroglycerine should be avoided.

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 82: Pericardial and Myocardial Disease. 1078-1079.

**#19**

**Regarding pericardial disease, which of the following is FALSE?**

- A. ECG changes associated with pericarditis include ST elevation in all leads, except avR and V1.
- B. To help distinguish the ST elevation of pericarditis from repolarization abnormality, take the ST elevation/T wave amplitude ratio. If the ratio is  $< 0.25$ , then it is more likely to be pericarditis, rather than early repolarization.
- C. Patients may complain of retrosternal pain radiating to the trapezius ridge with pericarditis, which is improved with sitting forward.
- D. The American College of Cardiology (ACC) and AHA recommend an echocardiogram to rule out associated pericardial effusion in patients suspected of having pericarditis.
- E. Consider admission for patients with pericarditis, particularly if they are immunocompromised, on warfarin, have an associated effusion, or have had significant chest trauma.

# 19

**Answer: B.**

The major clinical manifestations of acute pericarditis include:

1. Chest pain,
2. Pericardial friction rub
3. ECG changes — new diffuse ST elevation or PR depression
4. Pericardial effusion

Absence of pericardial effusion does not exclude pericarditis. The normal early repolarization variant is often confused with acute pericarditis. It is characterized by ST elevation of the J point, which represents the junction between the end of the QRS complex (termination of depolarization) and the beginning of the ST segment (onset of ventricular repolarization). As a result, there is elevation of the ST segment itself, which maintains its normal configuration. ST elevation is most often present in the mid to lateral chest leads (V3-V6), although many leads can be involved.

Two findings that strongly favor pericarditis are PR depression and evolution of the ST and T changes, neither of which is seen in early repolarization. There can also be ST depression and PR elevation in leads aVR and V1.

In a prospective study, the most reliable distinguishing feature was the ratio of ST elevation to T wave amplitude in lead V6. If the ratio exceeds 0.25, acute pericarditis was present (positive and negative predictive values were both 100%).

**Image:** [ST-Twave Ratio](#)

*References:*

- Ginzton LE, Laks MM. The differential diagnosis of acute pericarditis from the normal variant: new electrocardiographic criteria. *Circulation*. 1982. May;65(5):1004-1009. [full text](#)
- Spodick DH. Differential characteristics of the electrocardiogram in early repolarization and acute pericarditis. *N Engl J Med*. 1976. Sep;295(10):523-526

# 20

Which of the following statements regarding B-type Natriuretic Peptide (BNP) is FALSE?

- A. Normal BNP levels increase with age
- B. Normal BNP levels are higher in women
- C. BNP levels are more accurate in obese patients
- D. BNP levels are elevated in renal failure

# 20

**Answer: C.**

Normal plasma BNP values increase with age and are higher in women than men. Obese patients tend to have lower plasma BNP while patients with renal failure have elevated BNP.

*References:*

- Mehra MR et al. Obesity and suppressed B-type natriuretic peptide levels in heart failure. J Am Coll Cardiol. 2004; 43:1590. [full text](#)
- Redfield MM et al. Plasma brain natriuretic peptide concentration: impact of age and gender. J Am Coll Cardiol. 2002; 40:976. [full text](#)



**# 21**

**Regarding hypertension in the ED, which of the following statements are true?**

**(choose all that apply)**

- A. ED blood pressure readings are accurate and reliable for screening asymptomatic patients for hypertension, but it is recommended that 2 separate measurements are obtained.
- B. In addition to the history and physical examination, screening for target organ damage in an asymptomatic patient may include urinalysis, serum creatinine level, ECG, and chest radiography.
- C. There is no published evidence demonstrating improved patient outcomes or decreased mortality or morbidity with acute management of asymptomatic elevated blood pressure in the ED.
- D. When ED treatment for asymptomatic hypertension is initiated, blood pressure management should attempt to gradually lower blood pressure and should not be expected to be normalized during the initial ED visit.

# 21

**Answer: A-D.**

Much practice variation exists regarding the appropriate treatment of patients found to have asymptomatic hypertension in the ED. The ACEP clinical policy provides guidance to the provider but ultimately suggests that workup and therapy should be individualized. If there is concern for end organ dysfunction consider obtaining an ECG and measuring the creatine. The patient without symptoms can have gradual blood pressure lowering as an outpatient with decisions to start a new antihypertensive or adjustment of current medications individualized to the patient. There are not specific target blood pressures that need to be achieved prior to patient discharge.

*References:*

- Wolf SJ et al. Clinical policy: critical issues in the evaluation and management of adult patients in the emergency department with asymptomatic elevated blood pressure. Ann Emerg Med. 2013 Jul;62(1): 59-68. [full text](#)
- Decker WW et al. Clinical policy: critical issues in the evaluation and management of adult patients with asymptomatic hypertension in the emergency department. Ann Emerg Med. 2006 Mar;47(3): 237-49. [full text](#)

# 22

**In the management of acute cardiogenic pulmonary edema with noninvasive ventilation, which of the following were NOT found on meta-analysis?**

- A. There was a statistically significant decrease in mortality for patients receiving CPAP.
- B. There was a statistically significant decrease in mortality for patients receiving noninvasive pressure support ventilation (BIPAP).
- C. There was a statistically significant decrease in “need to intubate” for patients receiving CPAP or noninvasive pressure support ventilation (BIPAP).
- D. There were no statistically significant differences in mortality when comparing CPAP to noninvasive pressure support ventilation (BIPAP).
- E. There was no statistically significant difference in “need to intubate” for patients receiving CPAP versus noninvasive pressure support ventilation (BIPAP).

# 22

**Answer: B.**

In the meta-analysis performed by Masip et al., comparing noninvasive ventilation to conventional oxygen therapy in patients with acute pulmonary edema, noninvasive ventilation significantly reduced the mortality rate by nearly 45% compared with conventional therapy (risk ratio [RR], 0.55; 95% CI, 0.40-0.78).

The results were significant for CPAP but not for bilevel ventilation (NIPSV), although there were fewer studies in the NIPSV group. Both modalities showed a significant decrease in the "need to intubate" rate compared with conventional therapy. There were no differences in intubation rates or mortality rates in the analysis of studies comparing the 2 non-invasive techniques. Noninvasive ventilation should be used in all patients without contraindications who are in significant respiratory distress from pulmonary edema. Although the level of evidence is higher for CPAP, there are no significant differences in clinical outcomes when comparing CPAP vs NIPSV.

*Reference:*

- LLSA 2009: Masip J et al. Noninvasive ventilation in acute cardiogenic pulmonary edema. Systematic review and meta-analysis. JAMA. 2005; 294: 3124-3130. [full text](#)

#23

In a meta-analysis, which of the following was NOT found to be a sensitive indicator for the diagnosis of cardiac tamponade secondary to a pericardial effusion?

- A. Muffled or distant heart sounds
- B. Pulsus paradoxus greater than 10 mm
- C. Elevated jugular venous pressure
- D. Tachycardia
- E. Dyspnea

# 23

**Answer: A.**

Five features occur in the majority of patients with tamponade. Each has the following sensitivities:

1. Dyspnea (sensitivity range, 87%-89%)
2. Tachycardia (pooled sensitivity, 77%; 95% CI, 69%-85%)
3. Pulsus paradoxus (pooled sensitivity, 82%; 95% CI, 72%-92%)
4. Elevated jugular venous pressure (pooled sensitivity, 76%; 95% CI, 62%-90%)
5. Cardiomegaly on chest radiograph (pooled sensitivity, 89%; 95% CI, 73%-100%)

One study indicated that the presence of pulsus paradoxus greater than 10 mm Hg in a patient with a pericardial effusion increases the likelihood of tamponade (likelihood ratio, 3.3; 95% CI, 1.8-6.3), while a pulsus paradoxus of 10 mm Hg or less greatly lowers the likelihood (likelihood ratio, 0.03; 95% CI, 0.01-0.24).

**Video: Pulsus Paradoxus** <http://youtu.be/jTsjCZ9QxW8>

*Reference:*

- LLSA 2009: Roy CL et al. Does this patient with a pericardial effusion have cardiac tamponade? JAMA. 2007; 297:1810-1818. [full text](#)

#24

A patient presents with active chest pain and a 12-lead ECG listed in the choices below. Which of the following according to the ACCF/AHA would NOT meet the criteria for a STEMI?

- A. A man with  $\geq 1$ mm ST-segment elevation in lead II, III, and AVF
- B.  $\geq 1$ mm ST-segment elevation in lead V4-V6
- C.  $\geq 2$  mm ST segment elevation in V1-V3
- D. A woman with 1 mm ST segment elevation in V2 and V3

# 24

**Answer: D.**

According to the 2013 ACCF / AHA Guideline for the Management of ST-Elevation Myocardial Infarction and the Universal Definition of Myocardial Infarction, STEMI is defined as new ST elevation at the J point in at least 2 contiguous leads of:

- 2 mm (0.2 mV) in leads V2-V3 (Men)
- 1.5 mm (0.15 mV) in leads V2–V3 (Women)
- or 1 mm (0.1mV) in other contiguous chest leads or the limb leads

There are many alternative causes of ST elevations besides for acute infarction, which will be discussed in question 27.

*Reference:*

- ACCF / AHA 2013 ACCF / AHA Guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation / American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2013 Jan 29;61(4):e78-140. [full text](#)



# 25

To help in assessing the likelihood that a given patient with chest pain and a baseline LBBB is having a STEMI, the Sgarbossa criteria can be used. Which of the following is NOT a Sgarbossa Criteria?

(choose all that apply)

- A. ST-segment elevation  $\geq 1$  mm in a lead with an upward QRS complex (5 points)
- B. ST-segment depression  $\geq 1$  mm in V1, V2, V3 (3 points)
- C. ST-segment elevation  $\geq 5$  mm in a lead with downward QRS complex (2 points)
- D. ST-segment elevation  $\geq 1$  mm in a lead with downward QRS complex (2 points)
- E. Similar to the general AHA STEMI criteria, the Sgarbossa criteria need to be found in contiguous leads.

# 25

**Answer: D and E.**

Unlike the general AHA STEMI criteria, the Sgarbossa criteria need not be found in contiguous leads. In leads with downward QRS complexes, there must be  $\geq 5$  mm ST segment elevation to meet the Sgarbossa criteria.

The criteria are:

1. ST-segment elevation  $\geq 1$  mm in a lead with an upward QRS complex (5 points)
2. ST-segment depression  $\geq 1$  mm in V1, V2, V3 (3 points)
3. ST-segment elevation  $\geq 5$  mm in a lead with downward QRS complex (2 points)

Criterion (1) is more indicative of STEMI than is criterion (2), and the more criteria that are met, the more likely that a STEMI has occurred.

Sgarbossa criteria are poorly sensitive, but highly specific. A score of 5 to 10 indicates an 88 to 100% probability of acute MI. However, with 0 points, there is still a 16% chance of a STEMI.

*References:*

- Sgarbossa E. et al. Electrocardiographic diagnosis of evolving acute myocardial infarction in the presence of left bundle-branch block. GUSTO-1 (Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries) Investigators. NEJM. 1996. 334(8):481-7. [full text](#)
- Shlipak MG et al. Should the electrocardiogram be used to guide therapy for patients with left bundle-branch block and suspected myocardial infarction? JAMA. 1999;281(8):714. [full text](#)

#26

You are seeing a patient in whom you suspect a patent foramen ovale (PFO). True statements about this entity include which of the following statements?

(choose all that apply)

- A. PFO is the most common type of atrial septal defect
- B. Up to 30% of adults have a PFO
- C. The clinical importance of a PFO lies in its association with paradoxical embolism and stroke.
- D. The development of Eisenmenger physiology is accompanied by signs of right ventricular failure in addition to pulmonary hypertension.

# 26

**Answer: B, C, and D.**

A PFO may occur in 30% of adults but should not be confused with an atrial septal defect since there is no missing septal tissue. Right to left atrial shunting does not generally occur unless the right atrial pressure exceeds the left atrial pressure. Usually the left atrial pressure is greater. However during a valsalva or straining, the right atrial pressure will increase and potentially allow shunting to occur. A PFO can give rise to paradoxical embolization when a venous thrombosis passes across the PFO to the left atria and subsequently enters the arterial circulation. This phenomenon is more likely a complication in children. Eisenmenger syndrome is right ventricular failure due to pulmonary hypertension which leads to further hypoxia. Eisenmenger syndrome in the setting of an isolated PFO without septal defects is rare, due to the low degree of shunted blood.

*Reference:*

- Hara H et al. Patent foramen ovale: current pathology, pathophysiology, and clinical status. J Am Coll Cardiol. 2005; 46:1768. [full text](#)

# 27

Causes of ST-segment elevation other than ST-segment myocardial infarction include which of the following?

(choose all that apply)

- A. Pericarditis
- B. Ventricular aneurysm
- C. Hyperkalemia
- D. Brugada syndrome
- E. Hypothermia

# 27

**Answer: A-E.**

Causes of ST elevation other than acute infarction include:

- Prinzmetal's pattern
- Takotsubo cardiomyopathy
- Post-MI (ventricular aneurysm pattern)
- Acute pericarditis
- Normal "early repolarization variants"
- Left ventricular hypertrophy or left bundle branch block (only V1-V2 or V3)
- Myocarditis (may look like myocardial infarction or pericarditis)
- Brugada patterns (V1-V3 with right bundle branch block-appearing morphology)
- Myocardial tumor
- Myocardial trauma
- Hyperkalemia
- Hypothermia (J wave/Osborn wave)
- Vasospasm (cocaine or sympathomimetic induced)

*Reference:*

- Wang K, et al. ST-segment elevation in conditions other than acute myocardial infarction. N Engl J Med. 2003. Nov 27;349(22):2128-35. [full text](#)

#28

Regarding cardiac arrest, which of the following statements is FALSE?

- A. The majority of cardiac arrest occur out-of-hospital.
- B. Early bystander CPR affects survival outcome
- C. The AHA recommends mouth-to-mouth ventilation interspersed with chest compression for bystander CPR
- D. Bystanders should perform "hands only" CPR and abstain from mouth to mouth

#28

**Answer: C**

The vast majority of cardiac arrests occur out of hospital, with survival significantly improved if bystander CPR is initiated. One of the major impediments to bystander CPR was the requirement for mouth-to-mouth ventilation. In 2008 the American Heart Association changed their recommendation to "hands only" or continuous chest compression cardiopulmonary resuscitation (CPR) for untrained lay people. Although Hallstrom et al. did not find a statistically significant difference, survival to hospital discharge was better among patients who received compression only CPR compared to patients who received compression, plus mouth to mouth ventilation.

*References:*

- Ramaraj R, et al. Rationale for continuous chest compression cardiopulmonary resuscitation. Heart. 2009 Dec;95(24):1978-82
- Hallstrom A, et al. Cardiopulmonary Resuscitation by Chest Compression Alone or with Mouth-to-Mouth Ventilation. N Engl J Med. 2000; 342:1546-1553 [full text](#)



# 29

A 51 year old male is brought into the ED after a cardiac arrest. After chest compressions, defibrillation, and epinephrine, the patient has return of spontaneous circulation (ROSC). He is intubated and unresponsive with intermittent decorticate posturing. You plan to initiate therapeutic hypothermia. True statements about this include which of the following?

(choose all that apply)

- A. If the patient develops an arrhythmia during the cooling process, the cooling should be interrupted.
- B. For the protocol, the AHA recommends cooling to 32 to 34°C for 12-24 hours.
- C. Patients who are comatose prior to cardiac arrest should be excluded from therapeutic hypothermia.
- D. Therapeutic hypothermia should not interfere with coronary perfusion, and primary coronary intervention is indicated if the patient has a ST-segment elevation myocardial infarction.
- E. Patients should be sedated and paralyzed so that they stop shivering.

# 29

**Answer: B - E.**

Cooling should not be interrupted if the patient develops arrhythmias. The AHA currently recommends cooling to 32 to 34 °C for 12 -24 hours for unconscious adult patients with spontaneous circulation after out-of-hospital cardiac arrest when the initial rhythm was ventricular fibrillation or ventricular tachycardia. Targeted temperature management to 36°C may offer the same benefit as traditional cooling to 33°C and should be based on hospital policies. Institutional cooling policies may also differ regarding cooling of patients with rhythms that were not ventricular fibrillation or ventricular tachycardia.

Sedatives and analgesics should be given to facilitate mechanical ventilation. Intermediate length paralytics such as vecuronium or cisatracurium can decrease shivering, which will allow for greater temperature control and also decrease the patients' stress response and work of breathing. Treatment of suspected underlying acute coronary syndromes with percutaneous coronary intervention or thrombolytics can occur during therapeutic hypothermia, if indicated.

*Reference:*

- Scirica BM. Therapeutic hypothermia after cardiac arrest. *Circulation*. 2013 Jan 15;127(2):244-50 [full text](#)

# 30

Regarding the induction of therapeutic hypothermia (TH), which of the following statements is true?

- A. Thrombolytics must not be given during therapeutic hypothermia due to the associated coagulopathy.
- B. The patient is most unstable during the rewarming phase (rather than induction or maintenance) of therapeutic hypothermia.
- C. When inducing hypothermia, 32-34 °C should be maintained over a 12-24 hour period.
- D. The most common rhythm seen with therapeutic hypothermia is sinus bradycardia.
- E. When measuring a standard blood gas in a hypothermic patient, the reported pH is overestimated.

# 30

**Answer: C and D.**

The most common cardiac rhythm seen with TH is sinus bradycardia. Current AHA guidelines recommend TH with a goal temperature of 32°C to 34°C for 12 to 24 hours in patients successfully resuscitated after cardiac arrest.

Thrombolytics and PCI may be initiated during TH despite the associated coagulopathy. The patient is most unstable during the induction phase, and induction should be performed as rapidly as possible. There may be a mortality increase as high as 20% for every hour delay in cooling.

The blood gas is rewarmed to 37 °C in order to be analyzed. This results in:

- The reported PO<sub>2</sub> being overestimated by 5 mm Hg for every 1°C below 37°C
- The reported PCO<sub>2</sub> being overestimated by 2 mm Hg for every 1°C below 37°C
- The reported pH being underestimated by 0.012 points for every 1°C below 37°C

*References:*

- Polderman KH. Mechanisms of action, physiological effects, and complications of hypothermia. Crit Care Med. 2009 Jul;37(7 Suppl):S186-202. [full text](#)
- Scirica BM. Therapeutic hypothermia after cardiac arrest. Circulation. 2013 Jan 15;127(2):244-50. [full text](#)

**# 31**

**Regarding myocarditis, which of the following statements is FALSE?**

- A. Myocarditis may present with a wide range of symptoms, ranging from mild dyspnea or chest pain that resolves without specific therapy to cardiogenic shock and death.
- B. The most serious long term complication of myocarditis is dilated cardiomyopathy..
- C. Drug-hypersensitivity reactions are the most common cause of myocarditis.
- D. Most people with myocarditis who present with acute dilated cardiomyopathy have relatively mild disease that resolves with few short-term sequelae.

# 31

**Answer: C.**

Dilated cardiomyopathy with heart failure is the major long-term complication of myocarditis. Infectious etiologies are the most common causes of myocarditis. Other possible causes include autoimmune diseases, medications, and toxins. Reported viral outbreaks of myocarditis include Coxsackievirus B and Parvovirus B19.

Commonly, acute myocarditis may be diagnosed as an unexplained nonischemic dilated cardiomyopathy with worsening symptoms and even decompensation. Other presentations include new onset atrial or ventricular dysrhythmias, heart block, or acute myocardial infarctions. Presenting symptoms are usually non-specific but involve worsening dyspnea, palpitations, chest pain and syncope. Myocarditis can also commonly exist with a concomitant pericarditis.

*Reference:*

- LLSA 2011: Cooper LT. Myocarditis. N Engl J Med. 2009 Apr 9;360(15):1526-38. [full text](#)

# 32

**Regarding cocaine induced chest pain, which of the following statements is true?**

- A. Cocaine was the second most commonly used illicit drug in the United States, second to marijuana, but has now been surpassed by prescription drug abuse.
- B. Cocaine causes myocardial ischemia by increasing myocardial oxygen demand, decreasing oxygen supply via vasoconstriction and inducing a prothrombotic state.
- C. The presence of chest pain has excellent value for discriminating an ischemic from nonischemic cause in these patients.
- D. Ischemia is the only entity that causes chest pain in a cocaine abuser.

# 32

**Answer: A and B.**

The most frequent symptom among cocaine users is chest pain. The quality of the pain is often pressure-like but can have a multitude of other qualities. The chest pain alone has little value in determining ischemic vs benign causes in the setting of cocaine use. The pain may also be manifestations of a pneumothorax, arrhythmia, or aortic dissection, caused by the cocaine use. Another less common complication includes an acute pulmonary syndrome called "crack lung". The syndrome involves hypoxemia, hemoptysis, respiratory failure, and diffuse pulmonary infiltrates and occurs after inhalation of freebase cocaine.

Prescription drug abuse is increasing in the United States and has surpassed cocaine use according to the 2012 National Survey on Drug Use and Health, with only marijuana being abused more frequently.

There are four major mechanisms for cocaine induced myocardial ischemia:

- An increase in myocardial oxygen demand from the increased heart rate, blood pressure and contractility
- Decreased cardiac oxygen supply via vasoconstriction and vasospasm
- Induction of a prothrombotic state by stimulating platelet activation and altering the balance between procoagulant and anticoagulant factors
- Accelerated atherosclerosis

*References:*

- LLSA 2011: McCord J et al. Management of Cocaine-associated chest pain and myocardial infarction. *Circulation*. 2008; 117:1897-1907. [full text](#)
- U.S. Department of Health and Human Services. Results from the 2012 National Survey on Drug Use and Health: Summary of National Findings. [full text](#)



# 33

**True or False: Cocaine can be detected in the urine 20 days after chronic use on routine urine drug screens.**

A. True

B. False

# 33

**Answer: A**

Qualitative detection of the cocaine metabolite benzoylecgonine in the urine is the most commonly used laboratory method for drug screening. Cocaine use is detected as positive when the level of benzoylecgonine is above a standard cut-off value (usually 300 ng/mL). It can be detected in the urine on average from 24 to 48 hours after use. In long-term users, benzoylecgonine has been detected as great as 22 days after last ingestion. This highlights the poor utility of a urine drug screen in the ED for determining if cocaine is causing related chest pain.

*Reference:*

- LLSA 2011. McCord J et al. Management of Cocaine-associated chest pain and myocardial infarction. *Circulation*. 2008; 117:1897-1907. [full text](#)

# 34

Regarding cocaine-induced chest pain, which of the following are true?

(choose all that apply)

- A. Unlike patients with ACS unrelated to cocaine use, cocaine users should be provided with intravenous benzodiazepines as early management.
- B. Dobutamine echocardiography is contraindicated in a patient who presents with cocaine-induced chest pain.
- C. Hypertension and tachycardia should not be the focus of immediate therapy.
- D. The ACC/AHA ST-segment-elevation MI guidelines state, "Beta-blockers should be administered to patients with STEMI precipitated by cocaine use."
- E. Labetalol has substantial benefits over other beta-blockers in treating cocaine induced hypertension.

# 34

**Answer: A and C.**

Treatment of cocaine-chest pain is similar to acute coronary syndrome (ACS) treatment, with only a few modifications. Although there are ACC/AHA recommendations, the evidence is not based on randomized placebo-controlled trials. Early aspirin therapy is recommended since there is greater platelet activation in the setting of cocaine use.

Unlike with ACS, intravenous benzodiazepines (diazepam or lorazepam) relieve chest pain and have beneficial anxiolytic and hemodynamic effects. Treating the underlying anxiety and agitation with a benzodiazepine often decreases the tachycardia and hypertension. However, treatment should not focus on resolution of the hypertension, and should instead be titrated to patient's symptom relief.

If there is a need for emergent correction of hypertension, agents such as sodium nitroprusside, nitroglycerin, or intravenous phentolamine are recommended. The ACC/AHA ST-segment-elevation MI guidelines state that beta-blockers should be avoided due to the risk of coronary spasm and propranolol is contraindicated. The unopposed alpha adrenergic effects introduced by a beta-blockade has uncertain clinical effects, and the benefits of a mixed alpha and beta blocker, such as labetalol, is theoretical.

Risk stratification in patients with possible ACS or cocaine induced chest pain is still encouraged. There are no contraindications to performing a dobutamine stress test.

*Reference:*

- LLSA 2011. McCord J et al. Management of Cocaine-associated chest pain and myocardial infarction. Circulation. 2008; 117:1897-1907. [full text](#)

# 35

**True statements about multifocal atrial tachycardia (MFAT) include which of the following statements?**

- A. It is a subset of atrial tachycardia.
- B. It has more than two foci of impulse formation.
- C. On the ECG, at least three distinctly different P waves with varying PR RR, and PP intervals exist.
- D. It is often associated with pulmonary disease and hypoxia.
- E. All of the above

# 35

**Answer: E.**

MFAT is highly associated with pulmonary disease such as COPD. It can also originate from a reentrant focus, and it can be due to electrolyte and acid-base disturbances, drug toxicity, fever, and hypoxia. Note that MFAT often resolves when hypoxia is resolved or with correction of the underlying primary disturbance. MFAT is often confused with atrial fibrillation because both are irregular.

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 79: Dysrhythmias. 1050-1051.

# 36

A 35 year old female with a history of hyperthyroidism on propranolol presents with an intentional overdose of this medication. All of the following are common initial clinical presentations of a propranolol overdose EXCEPT?

- A. Bradycardia
- B. Bronchospasm and wheezing
- C. Hypotension
- D. Unconsciousness

# 36

**Answer: B.**

Patients with beta-blocker overdoses present most often with profound bradycardia, followed by hypotension and altered mental status. Propranolol is highly lipophilic and causes the most CNS depressant effects of all the beta-blockers. In nonselective and selective beta-blockers, bronchospasm is rarely a complication.

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 152: Cardiovascular Drugs. 1987-1989



# 37

Regarding left main coronary artery occlusion (LMCO), which of the following statements is true?

- A.  $\geq 0.5$ mm ST elevation in lead aVL is consistent with acute LMCO.
- B.  $\geq 0.5$ mm ST elevation in lead aVR is consistent with acute LMCO.
- C. Acute LMCO is fatal unless there is adequate perfusion from right-sided collaterals.
- D. None of the above
- E. All of the above

# 37

**Answer: B.**

≥ 0.5 mm ST elevation in aVR is consistent with acute LMCO, especially when the degree of ST-elevation in aVR is greater than lead V1, and ST depression is also present in the inferior leads. These ECG findings have >75% sensitivity and specificity for LMCO.

*Reference:*

- LLSA 2013: Rokos IC, et al. Appropriate cardiac cath lab activation: optimizing electrocardiogram interpretation and clinical decision making for acute ST-elevation myocardial infarction. Am Heart J. 2010; 160:995-1003. [full text](#)

# 38

Regarding treatment of patients resuscitated from sudden cardiac arrest, which of the following statements is true?

- A. The number need to treat (NNT) with therapeutic hypothermia to improve rate of cerebral recovery is approximately 100.
- B. The target hypothermia temperature is 37°C.
- C. Baseline abnormal neurologic status immediately after ROSC precludes early cath lab activation
- D. The patient should be cooled for 72 hours.
- E. The patient should be rewarmed over 8 hours after the initial 24hr cooling.

# 38

**Answer: E.**

The NNT is approximately 6 for therapeutic hypothermia. Neurologic status after return of spontaneous circulation (ROSC) should not determine need for cardiac catheterization. Prognostication on neurologic outcome should not occur until at least 72 hours after rewarming. Although the best hypothermia protocol has yet to be definitively proven, current evidence suggests two potentially equivalent options. Cooling as early as possible (pre-arrival to cath lab) to a target temperature of:

- 33 °C and maintenance of 33 degrees for 24 hours
- 36°C and maintenance of 36 degrees for 24 hours

After 24 hours of cooling, the patient should then be rewarmed over 8 hours (0.5 degrees per hour) back to normothermia.

*References:*

- TheNNT.com - Mild Therapeutic Hypothermia for Neuroprotection Following Cardiopulmonary Resuscitation (CPR) <http://www.thennt.com/nnt/hypothermia-for-neuroprotection-after-cardiac-arrest/>
- Nielsen N et al. Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest. N Engl J Med. 2013. 369(23):2197-2206. [full text](#)

# 39

**A patient with long-standing CHF, taking amiodarone presents to the ED due to ICD firing. Interrogation of his ICD shows that he had an episode of ventricular fibrillation for 15 seconds when the firing occurred. What should be done with this patient?**

- A. No need for any evaluation since this was an appropriate shock
- B. If the device fires repeatedly in the ED in the absence of a detectable dysrhythmia, then a bolus of amiodarone is indicated.
- C. Admit the patient for monitoring

**# 39**

**Answer: C.**

Ideally, these patients should be seen in the ED by cardiology. Almost all patients with a shockable event should be admitted for monitoring and observation. Although the ICD acted appropriately, titration of medications may be needed. Deactivation of an inappropriately firing ICD can occur in the ED but the patient should have cardiac resuscitation equipment at bedside in case of a future dysrhythmia. Amiodarone will not affect an inappropriately firing ICD.

*Reference:*

- Roberts and Hedges' Clinical Procedures in Emergency Medicine. 6th edition. 2013. Chapter: 13 Assessment of Implantable Devices. 248-262.

# 40

You are seeing a patient who presents with chest pain and shortness of breath. The chest X-ray demonstrates air in the pericardial space. Possible risk factors for a pneumopericardium include which of the following?

- A. Esophageal diverticulum
- B. Asthma
- C. Barotrauma from positive-pressure ventilation
- D. Cocaine inhalation from a positive pressure device
- E. All of the above

**# 40**

**Answer: E.**

Pneumopericardium is caused by a connection between the pericardium and the pleural, bronchi, or GI tract. Gas producing bacteria can also cause the phenomenon. Fistulization with the GI tract can occur from GI malignancy (specifically esophagus or stomach), peptic ulcer disease, or esophageal diverticula. Barotrauma, asthma, rapid increase in intrathoracic pressure (Valsalva) and drug inhalation can also cause pneumopericardium.

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 82: Pericardial and Myocardial Disease. 1097-1098.



**# 41**

**Pacemaker malfunction can be separated into broad categories:**

- **Failure to capture**
- **Undersensing**
- **Oversensing**
- **Inappropriate rate**

**True or False: Battery depletion can lead to all of these problems.**

A. True

B. False

**# 41**

**Answer: B. False.**

Battery depletion can lead to failure to capture and an inappropriate rate. Causes of undersensing can be due to lead displacement, inadequate endocardial lead contact, low-voltage intracardiac p-waves or QRS complexes, and lead fracture. Oversensing is due to sensing extracardiac signals and T wave sensing.

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 80: Implantable Cardiac Devices. 1068-1071

# 42

True statements about post-cardiac arrest management include which of the following?

(choose all that apply)

- A. Arterial hyperoxia (PaO<sub>2</sub> >300 mm Hg) may be beneficial.
- B. Hypoxia should be avoided.
- C. Hypocarbica should be avoided.
- D. Hyperventilation should be initiated.

# 42

**Answer: B and C.**

Hyperoxia is independently associated with increased in-hospital mortality. Often 100% oxygen is used for resuscitation but should be rapidly titrated down to the minimum needed for an arterial saturation of 94%. Hyperventilation should be avoided because it produces hypocarbia, causing cerebral vasoconstriction and decreases cerebral perfusion. Additionally, hyperventilation can cause auto-PEEP, and decrease cardiac output.

*Reference:*

- Stub D et al. Post Cardiac arrest syndrome. A review of therapeutic strategies. *Circulation*. 2011; 12: 1428-1435. [full text](#)

# 43

Regarding therapeutic hypothermia (TH) in the post-ROSC management, which of the following is true?

- A. Of all cooling mechanisms, the General Electric device has been demonstrated to be the most effective.
- B. Possible adverse effects of TH include electrolyte imbalances and altered coagulation profile.
- C. TH increases the heart rate and decreases the systemic vascular resistance.
- D. Prehospital induction of TH has been found to be more beneficial when compared with cooling patients on arrival to the hospital.

# 43

**Answer: B.**

There has not been a demonstrated benefit from using one particular cooling device over any other device in regard to mortality or morbidity. Prehospital cooling has also not been shown to offer a clinical mortality benefit when compared to in-hospital cooling. TH decreases heart rate, and bradycardia is the most common dysrhythmia. There is also an increase in systemic vascular resistance. Hypothermia can cause electrolyte changes, diuresis, hypovolemia, and coagulopathies.

*Reference:*

- Stub D et al. Post Cardiac arrest syndrome. A review of therapeutic strategies. *Circulation*. 2011; 12: 1428-1435. [full text](#)

**# 44**

**Which of the following is a predictor of poor prognosis after cardiac arrest.**

- A. Patient comorbidities
- B. Arrest details, such as initial rhythm, time to ROSC, absence of bystander CPR, and maximal end-tidal CO<sub>2</sub>
- C. Both of the above
- D. Neither of the above

**# 44**

**Answer: C.**

All the above factors are associated with patient outcome but none can definitively predict if care should be withdrawn. Absent pupillary and corneal reflexes at day 3 after rewarming are predictors of very poor prognosis. Neurologic prognostication should be delayed until 3 days after rewarming.

*Reference:*

- Stub D et al. Post Cardiac arrest syndrome. A review of therapeutic strategies. Circulation. 2011; 12: 1428-1435. [full text](#)



# 45

**Hospital-based strategies to decrease time to treatment in primary percutaneous coronary intervention should include all of the following EXCEPT:**

- A. "Facilitated PCI" – transferring patients to a hospital capable of PCI after a half dose or full dose of a thrombolytic is administered
- B. Prehospital ECG and activation
- C. ED activation of the catheterization laboratory
- D. Establishment of the expectation that the PCI team can arrive within 20-30 minutes of activation
- E. Routine data monitoring with prompt feedback

# 45

**Answer: A.**

Attempts are always ongoing to improve door to balloon time. A strategy named “Facilitated PCI” referred to treatment with a fibrinolytic and a glycoprotein IIb/IIIa receptor blockers followed by PCI.

However, clinical trials were not able to demonstrate improved patient centered outcomes with facilitated PCI. In fact, there may actually be increased mortality. For rural areas and long transport times, there may be local protocols for facilitated PCI, but it is not a widespread recommendation. There may in fact be harm, if a full-dose fibrinolytic is administered prior to transfer.

*Reference:*

- Nallamothu BK, et al. Time to treatment in primary percutaneous coronary intervention. N Engl J Med. 2007; 357: 1631-1648. [full text](#)

**# 46**

**Regarding myocarditis, which of the following statements is true?**

**(choose all that apply)**

- A. The sensitivity of the electrocardiogram for myocarditis is high and there are always associated signs of pericarditis.
- B. Cardiac MRI is being used with increasing frequency as a diagnostic test in suspected acute myocarditis.
- C. All patients with suspected myocarditis should undergo an endomyocardial biopsy, since this is the gold standard for diagnosis.
- D. The mainstay of therapy for acute myocarditis is supportive therapy for left ventricular dysfunction.
- E. In patients with acute myocarditis, therapy for arrhythmias is also supportive, since arrhythmias usually resolve after the acute phase of the disease.

# 46

**Answer: B, D, and E.**

In acute myocarditis, patients most often have ECGs with sinus tachycardia and nonspecific ST-segment and T-wave abnormalities. Patients can often be misdiagnosed with a STEMI. Since myocarditis and pericarditis frequently coexist, ECG findings consistent with pericarditis, such as PR depression, may also be present. Overall, the sensitivity of the electrocardiogram for myocarditis is low (47%).

Treatment of heart failure should follow standard care, with preload and afterload reduction and optimization of contractility. Supportive care is also employed for new onset arrhythmias but may require cardioverter-defibrillator implantation.

Endomyocardial biopsy may be an option in patients in whom the etiology of the myocarditis from other infiltrative diseases such as amyloidosis must be made. However, cardiac MRI is used more often as a non-invasive diagnostic modality.

*Reference:*

- LLSA 2011: Cooper LT. Myocarditis. N Engl J Med. 2009 Apr 9;360(15):1526-38. [full text](#)

# Critical Care

**#1**

**Regarding propofol administration for conscious sedation, which of the following is FALSE?**

- A. An absolute contraindication to its use is an allergy to egg or soy-based products.
- B. One known adverse side effect is hypotension.
- C. It is an analgesic.
- D. It is a sedative.
- E. It causes amnesia.

**#1**

**Answer: C.**

Propofol is a sedative amnestic without analgesic properties. The amnesia lasts an average of 15 minutes in adults who have received 1 mg/kg of propofol followed by 0.5 mg/kg until sedated. Onset of sedation is approximately 30 seconds after the initial bolus. The major side effect of propofol is hypotension, as well as apnea. The hypotensive effects are more profound in patients with depleted intravascular volumes.

*Reference:*

- LLSA 2009: Miner JR, Burton JH. Clinical Practice Advisory: Emergency department procedural sedation with propofol. *Ann Emerg Med.* 2007; 50: 182-187. [full text](#)

#2

**In patients with septic shock, hydrocortisone appears to:**

- A. Improve survival in all patients with septic shock
- B. Improve survival in patients who do not have a response to corticotropin
- C. Hasten reversal of shock in patients in whom shock was reversed
- D. Decrease the recurrence of sepsis and septic shock and fewer episodes of superinfection
- E. Improve patient survival in those with hemorrhagic shock.



#2

**Answer: C.**

Hydrocortisone is widely used in patients with septic shock even though a survival benefit has been reported only in patients who remained hypotensive after fluid and vasopressor resuscitation and whose plasma cortisol levels did not rise appropriately after the administration of corticotropin.

In the the multicenter, randomized, double-blind, placebo-controlled CORTICUS trial by Sprung et, 251 patients received 50 mg of intravenous hydrocortisone and 248 patients received placebo every 6 hours for 5 days; the dose was then tapered during a 6-day period.

The primary outcome was death at 28 days in patients who did not have a response to a corticotropin test. Of the 499 patients in the study, 233 (46.7%) did not have a response to corticotropin (125 in the hydrocortisone group and 108 in the placebo group). At 28 days, there was no significant difference in mortality between patients in the two study groups who did not have a response to corticotropin (39.2% in the hydrocortisone group and 36.1% in the placebo group,  $P=0.69$ ) or between those who had a response to corticotropin (28.8% in the hydrocortisone group and 28.7% in the placebo group).

**Death at 28 days occurred in 86 patients from the hydrocortisone group (34.3%) and 78 in the placebo group (31.5%).**

**However, shock was reversed more quickly than in the placebo group but at the expense of a greater number of superinfections that resulted in new sepsis.** There was no improvement in overall survival with patients who received hydrocortisone, although in those who had recovery from shock, hydrocortisone increased the speed of recovery.

*Reference:*

- Sprung CL et al. Hydrocortisone therapy for patients with septic shock. N Engl J Med. 2008; 358: 111-124. [full text](#)

#3

**Which of the following patients will desaturate to less than 90% oxygen saturation most quickly during rapid sequence intubation without pre-oxygenation?**

- A. Healthy young adult
- B. Morbidly obese pregnant female at 39 weeks gestation
- C. Pregnant female at 39 weeks gestation
- D. Normal, healthy infant
- E. Normal, healthy child

#3

**Answer: B.**

Any patient who may require endotracheal intubation should be given adequate preoxygenation to allow for “nitrogen washout” of the lungs. A healthy 70 kg adult can maintain oxygen saturation above 90% for eight minutes. Young children typically fall below the 90% threshold in less than four minutes. The oxygen saturation of adults with severe illness or obesity and pregnant women nearing the end of their third trimester, fall below 90% in less than three minutes.

Preoxygenation provides a longer period before clinically significant desaturation occurs, regardless of the patient's condition. Although the duration of time before desaturation varies significantly, “nitrogen washout” can be achieved with the patient taking eight vital capacity (ie, maximal) breaths. Passive oxygenation with nasal cannula during the procedure may also increase the time period before desaturation occurs.

*Reference:*

- Rosen's Emergency Medicine 8th edition. 2013. Chapter: 1 - Airway. 13-14.

# 4

You decide to use succinylcholine to intubate a patient. True statements about succinylcholine include all of the following, EXCEPT:

- A. It is contraindicated in a patient who sustained a 40% TBSA burn 30 minutes prior to arrival.
- B. Onset of action is 45 to 60 seconds
- C. Duration of action is 6-10 minutes
- D. It may be administered intramuscularly, but when given via that route, the dose should be doubled
- E. The dose is 1.5 – 2 mg/kg IV

# 4

**Answer: A.**

Succinylcholine is a neuromuscular blocking agent (1.5-2 mg/kg IV or 3-4 mg/kg IM), that acts by directly depolarizing the neuromuscular junction. It has a rapid rate of onset for paralysis (45 to 60 seconds) and brief duration of action (6 to 10 minutes). Since succinylcholine is a depolarizing agent, in conditions where there is upregulation of receptors in the neuromuscular junction, there can be transient increases in potassium, causing hyperkalemia. Thus, succinylcholine should be avoided in patients with established conditions (longer than 5 days) that cause upregulation of receptors at the neuromuscular junction, for example:

- Spinal cord injury
- Stroke
- Denervating disease such as multiple sclerosis
- Major burns
- Myopathy
- Rhabdomyolysis
- History of malignant hyperthermia

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 1: Airway. 13-14.

#5

**Regarding the use of hydrocortisone in septic shock patients, which of the following was found?**

- A. Mortality was significantly reduced in patients who received steroids
- B. Mortality was only reduced in patients who had a positive corticotropin test
- C. Mortality was only reduced in patients who had a negative corticotropin test
- D. Shock was reversed more quickly in the steroid group, when compared to the placebo group
- E. There were fewer episodes of superinfection in the steroid group

# 5

**Answer: D**

In summary, the use of hydrocortisone did not decrease mortality in a general population of patients with septic shock, even though the drug hastened reversal of shock. This lack of improvement may be related to an increased incidence of superinfection and new septic episodes. No benefit was seen in a subgroup of patients who had had no response to corticotropin, as was shown previously for patients with severe septic shock. This finding may be related to methodologic issues surrounding the accurate diagnosis of adrenal insufficiency in critically ill patients or to decreased prognostic importance of this phenomenon in less severe shock. On the basis of these findings, hydrocortisone is not recommended as general adjuvant therapy for septic shock that is fluid or vasopressor-responsive. Corticotropin testing is also not recommended for determining which patients should receive hydrocortisone therapy. At the expense of increasing the risk for infection, hydrocortisone may have a role among patients who are treated early after the onset of septic shock who remain hypotensive despite the administration of high-dose vasopressors.

*Reference:*

- LLSA 2010: Sprung CL et al. Hydrocortisone therapy for patients with septic shock. N Engl J Med. 2008; 358: 111-124. [full text](#)

# 6

**You are just about to intubate someone, and you are considering the use of succinylcholine. Consider using a nondepolarizing agent in which of the following conditions?**

- A. Personal history of malignant hyperthermia
- B. Burn over 72 hours
- C. Rhabdomyolysis
- D. Stroke greater than 72 hours
- E. Hyperkalemia
- F. All of the Above



# 6

**Answer: F.**

A nondepolarizing neuromuscular blocking agent should be considered when performing RSI on patients with the following conditions:

1. Malignant hyperthermia
2. History (personal or family)
3. Neuromuscular disease
4. Muscular dystrophy
5. Stroke over 72 hours old
6. Rhabdomyolysis
7. Burn over 72 hours old
8. Significant hyperkalemia (eg, suggested by characteristic changes on an electrocardiogram).

*Reference:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 1: Airway. 13-14.

#7

**Noninvasive ventilation (NIV) is a modality of ventilatory support without endotracheal intubation and sedation that has demonstrated to be useful in several forms of respiratory failure. Regarding NIV for the treatment of cardiogenic pulmonary edema, which of the following statements is FALSE?**

- A. Continuous positive airway pressure (CPAP) may be performed with an oxygen source connected to a tight-fitting face mask with an expiratory valve to maintain constant positive pressure.
- B. Bilevel noninvasive pressure support ventilation (NIPSV) is more complex, requires a ventilator to provide 2 levels of pressure: one to assist patients with inspiratory positive airway pressure (IPAP) and the other, like CPAP, to maintain expiratory positive pressure (EPAP).
- C. A quantitative systematic review of existing literature demonstrated that NIV reduces intubation rate and mortality in patients with acute pulmonary edema.
- D. NIPSV is clearly superior to CPAP in terms of its impact on mortality and intubation rates for pulmonary edema.
- E. Noninvasive ventilation has recently been categorized as class IIa, level of evidence A, in the guidelines on the diagnosis and treatment for acute heart failure by the European Society of Cardiology.

#7

**Answer: D.**

Masip et al. performed a systematic review and quantitative analysis of the short-term effect of noninvasive ventilation on major clinical outcomes in acute cardiogenic pulmonary edema. They selected fifteen trials. Overall, noninvasive ventilation significantly reduced the mortality rate by nearly 45% compared with conventional therapy (risk ratio [RR], 0.55; 95% [CI], 0.40-0.78).

The results were significant for CPAP (RR, 0.53; 95% CI, 0.35-0.81) but not for noninvasive pressure support ventilation (NIPSV) (RR, 0.60; 95% CI, 0.34-1.05), although there were fewer studies in the latter.

Both modalities showed a significant decrease in the "need to intubate" rate compared with conventional therapy: CPAP (RR, 0.40; 95% CI, 0.27-0.58), NIPSV (RR, 0.48; 95% CI, 0.30-0.76), and together (RR, 0.43; 95% CI, 0.32-0.57).

There were no differences in intubation or mortality rates in the analysis of studies comparing the 2 techniques.

*Reference:*

- LLSA 2009: Masip J et al. Noninvasive ventilation in acute cardiogenic pulmonary edema. JAMA. 2005; 294:3124-3130. [full text](#)

#8

**True or False: The available evidence suggests that etomidate suppresses adrenal function.**

A. True

B. False

#8

**Answer: A.**

True. According to this systematic review of 20 studies, pooled mean cortisol levels were lower in elective surgical patients induced with etomidate compared with those induced with other agents between 1 and 4 hours post induction. However, none of the studies showed a statistically significant effect on mortality, and no studies to date have been powered to detect a difference in hospital, ventilator, or ICU length of stay.

*Reference*

- LLSA 2010: Hohl CM, et al. The effect of a bolus dose of etomidate on cortisol levels, mortality, and health services utilization: a systematic review. *Ann Emerg Med.* 2010; 56:105-113.

#9

**You are treating a patient with septic shock, and after performing aggressive fluid resuscitation, consider escalating to vasopressor therapy. You are debating between dopamine vs. norepinephrine to restore and maintain blood pressure. Regarding these two vasopressors in the treatment of shock, which of the following is FALSE?**

- A. Both of these agents influence alpha-adrenergic and beta-adrenergic receptors, but to different degrees.
- B. There is no significant difference between the two vasopressors in rate of all-cause death at 29 days, 6 months, or 12 months.
- C. Patients who are treated with norepinephrine are more likely to have an arrhythmia.
- D. Patients with cardiogenic shock have a higher rate of death if treated with dopamine when compared to those who are treated with norepinephrine.
- E. Dopamine is a less potent vasopressor than norepinephrine.

#9

**Answer: C.**

In a multicenter, randomized trial, performed by DeBacker et al., patients with shock were randomized to receive either dopamine or norepinephrine. The primary outcome variable was death. The trial included 1679 patients, and there was no significant between-group difference in mortality at 28 days (52.5% in the dopamine group and 48.5% in the norepinephrine group; odds ratio with dopamine, 1.17; 95% confidence interval, 0.97 to 1.42; P=0.10). However, there were more arrhythmic events among the patients treated with dopamine than among those treated with norepinephrine (207 events [24.1%] vs. 102 events [12.4%], P<0.001).

A subgroup analysis showed that dopamine, as compared with norepinephrine, was associated with a higher mortality among the 280 patients with cardiogenic shock but not among the 1044 patients with septic shock or the 263 with hypovolemic shock.

*Reference:*

- LLSA 2012: DeBacker D et al. Comparison of dopamine and norepinephrine in the treatment of shock. N Engl J Med. 2010; 362:779-789. [full text](#)

**#10**

**You are about to perform rapid sequence intubation, and you ask the nurse to order up etomidate. The medical student who is "shadowing" you asks if etomidate increases mortality. You state that:**

**(choose all that apply)**

- A. Etomidate inhibits cortisol production by blocking 11-beta hydroxylase but has not been shown to affect mortality
- B. Etomidate is the most widely used induction agent in North America and appears safe even though it does transiently suppress adrenal function.
- C. A review of the literature demonstrated an overwhelming effect on increasing hospital length of stay when etomidate was used for induction
- D. Multiple studies have shown a significant effect on increased ventilator days when etomidate was used for induction.
- E. A review of the literature showed a statistically significant difference in mortality, favoring the use of etomidate.



**#10**

**Answer: A and B.**

In a systematic review by Hohl CM et al., pooled mean cortisol levels were lower in elective surgical patients induced with etomidate compared with those induced with other agents between 1 and 4 hours post induction. The differences varied from 6.1 microg/dL (95% CI, 2.4 to 9.9 microg/dL) to 16.4 microg/dL (95% CI, 9.7 to 23.1 microg/dL).

Two studies in critically ill patients reported significantly different cortisol levels up to 7 hours post induction. None of the studies demonstrated (pooled estimate odds ratio 1.14; 95% CI 0.81 to 1.60) a statistically significant effect on mortality. Only one study reported longer ventilator, ICU, and hospital lengths of stay in patients intubated with etomidate. The available evidence suggests that etomidate suppresses adrenal function transiently without demonstrating a significant effect on mortality. However, no studies to date have been powered to detect a difference in hospital, ventilator, or ICU length of stay or in mortality.

*Reference:*

- LLSA 2012: Hohl CM, et al. The effect of a bolus dose of etomidate on cortisol levels, mortality, and health services utilization: a systematic review. *Ann Emerg Med.* 2010; 56: 105-113. [full text](#)

**# 11**

**In a study comparing etomidate and ketamine for RSI in acutely ill patients, which of the following was true?**

- A. Ketamine led to greater difficulty in intubation.
- B. Etomidate led to higher 28 day mortality.
- C. Ketamine led to longer duration of catecholamine weaning.
- D. Length of stay was longer with etomidate.
- E. None of the above

# 11

**Answer: E.**

In a randomized, controlled, single-blind trial by Jabre et al, 655 patients who needed sedation for emergency intubation were prospectively enrolled from 12 emergency medical services or emergency departments and 65 intensive care units in France. Patients were randomly assigned to receive 0.3 mg/kg of etomidate (n=328) or 2 mg/kg of ketamine (n=327) for intubation. The primary endpoint was the maximum score of the sequential organ failure assessment (SOFA) during the first 3 days in the intensive care unit. The mean maximum SOFA score between the two groups did not differ significantly (10.3 [SD 3.7] for etomidate vs 9.6 [3.9] for ketamine; mean difference 0.7 [95% CI 0.0-1.4], p=0.056). Intubation conditions did not differ significantly between the two groups (median intubation difficulty score 1 [IQR 0-3] in both groups; p=0.70). The percentage of patients with adrenal insufficiency was significantly higher in the etomidate group than in the ketamine group (OR 6.7, 3.5-12.7). There were no serious adverse events with either study drug, and there were no differences in mortality, duration of catecholamine weaning, or length of stay.

#### *Reference*

- LLSA 2012: Jabre P, et al. Etomidate versus Ketamine for rapid sequence intubation in acutely ill patients: a multicentre randomized controlled trial. Lancet. 2009; 374: 293-300. [full text](#)

**#12**

**You are about to intubate a morbidly obese patient. True statements about managing the airway in obese patients include which of the following statements?**

- A. Obese patients have lower pH of gastric contents.
- B. Obese patients have greater total lung capacity and vital capacity.
- C. Airway resistance is decreased in obesity.
- D. Etomidate should be dosed according to lean body mass.
- E. Ketamine should be dosed according to total body weight.

**# 12**

**Answer: A.**

Obese patients have a higher incidence of GERD and have lower gastric pH, which puts them at risk for lung injury after aspiration. Obese patients may undergo oxygen desaturation to 90% within 3 minutes compared to 6 minutes in normal weight patients. In patients with BMI greater than 60, the time to desaturation may be less than one minute. Obesity causes diminished total lung capacity and vital capacity from decreased chest wall compliance and increased abdominal cavity contents. Airway resistance is also increased in obesity, and they have a higher incidence of hypoxemia and hypercapnia. Etomidate is lipophilic and theoretically should be administered according to total body weight. Ketamine should be dosed according to lean body mass, by adding 20% to the ideal body weight.

*Reference:*

- LLSA 2012: Dagin J, Medson R. Emergency department management of the airway in obese adults. Ann Emerg Med. 2010;56:95-104.

**#13**

**True statements about airway management in the obese patient include:**

**(choose all that apply)**

- A. Noninvasive positive pressure ventilation is not well-tolerated by the obese
- B. The patient's head should be elevated 25 degrees (ramped position)
- C. Succinylcholine should be administered based upon total body weight
- D. Rocuronium should be administered based upon total body weight
- E. Video laryngoscopy has been shown to improve visualization of the larynx and reduce the time to tracheal intubation in obese patients undergoing elective surgery.

# 13

**Answer: B, C, and E.**

In the morbidly obese patient, the head and shoulders should be elevated above the chest such that the external auditory canal is parallel with the sternal notch to optimize the laryngoscopic view.

Multiple folded blankets placed under the head, shoulders, and neck may be required to achieve the so-called ramped position. Application of 100% oxygen with pressure support before tracheal intubation increases the duration of non-hypoxic apnea by 1 minute in obese patients undergoing elective surgery (decreases atelectasis and increases functional residual capacity).

When succinylcholine is administered according to ideal body weight, poorer laryngoscopic views and incomplete neuromuscular paralysis are achieved compared with dosing based on total body weight. Inadequate sedation and muscle relaxation may predispose to aspiration. Succinylcholine should be dosed according to TOTAL body weight. Nondepolarizing neuromuscular agents, such as rocuronium should be dosed according to IDEAL body weight.

*References:*

- LLSA 2012: Dagin J, Medson R. Emergency department management of the airway in obese adults. *Ann Emerg Med.* 2010;56:95-104.
- Meyhoff CS et al. Should dosing of rocuronium in obese patients be based on ideal or corrected body weight? *Anesth Analg.* 2009 Sep;109(3):787-92
- Airway Cam - Ear Sternal Notch <http://www.airwaycam.com/Ear-Sternal-Notch-Positioning.html>

**#14.**

**When comparing etomidate versus ketamine for rapid sequence intubation in acutely ill patients, which of the following statements is true?**

- A. Etomidate is the sedative-hypnotic drug that is used most frequently in rapid sequence intubation.
- B. A single bolus of etomidate is associated with a significant increase in morbidity and mortality compared with ketamine in patients admitted to the intensive care unit.
- C. Etomidate affects the adrenal axis, and according to one study, more than 4/5 of etomidate recipients had adrenal insufficiency and were non-responders to the ACTH stimulation test.
- D. No patients given ketamine in an RCT of ketamine versus etomidate developed adrenal insufficiency.
- E. Serious adverse events are more common in the etomidate group.



# 14

**Answer: A and C.**

According to a randomized controlled trial by Jabre et al. with 655 patients, the percentage of patients with adrenal insufficiency was significantly higher in the etomidate group than in the ketamine group (OR 6.5, 95%CI 3.5-12.7), but there were no serious adverse events with either study drug. Statement C is true, and **about half of patients given ketamine also had adrenal insufficiency**. This emphasizes that critical illness per se affects adrenal function. These authors emphasize that ketamine is a safe and valuable alternative to etomidate for endotracheal intubation in critically ill patients, and should be considered in those with sepsis.

*Reference:*

- LLSA 2012: Jabre P, et al. Etomidate versus ketamine for rapid sequence intubation in acutely ill patients: a multicentre randomized controlled trial. *Lancet*. 2009; 374: 293-300.

**#15**

**With respect to proper positioning of the morbidly obese patient for laryngoscopy and intubation, which of the following statements is true?**

- A. The head and shoulders should be made parallel to the chest
- B. The head and shoulders should be lower than the chest
- C. The “sniffing” position is the optimal position
- D. The head and shoulders should be elevated above the chest
- E. None of the above

# 15

**Answer: D.**

Repositioning the morbidly obese patient after failed attempts can be difficult and time consuming, and proper positioning should be achieved before any attempts at laryngoscopy. In the morbidly obese patient, the head and shoulders should be elevated above the chest such that the external auditory canal is parallel with the sternal notch to optimize view during laryngoscopy. Multiple folded blankets placed under the head, shoulders, and neck may be required to achieve the so-called ramped position, which improves laryngoscopic view over the standard “sniffing” position in obese patients. The ramped position may also improve mask ventilation and provide easy access to the neck for application of cricoid pressure and attempts at a surgical airway.

*References:*

- LLSA 2012: Dargin J and Medzon R. Emergency Department Management of the airway in obese adults. *Ann Emerg Med.* 2010; 56:95-104.
- Airway Cam - Ear Sternal Notch <http://www.airwaycam.com/Ear-Sternal-Notch-Positioning.html>

**#16**

**When confirming endotracheal intubation in the morbidly obese patient, which of the following statements is true?**

- A. Pulse oximetry may be inaccurate because of poor light-wave transmission through increased soft tissue in the fingers.
- B. Condensation in the endotracheal may be less effective in morbidly obese patients.
- C. Interpretation of chest radiography can prove challenging as well, owing to poor penetration of radiographs through excess soft tissue.
- D. All of the above
- E. None of the above

**#16**

**Answer: D.**

All of the statements are true. Reliance on indirect clinical tests alone, such as chest and gastric auscultation, chest excursions, endotracheal tube condensation, and oxygen saturations to detect esophageal tracheal intubation contributes to hypoxemia, regurgitation, aspiration, and cardiovascular complications during emergency airway management. Obesity may further diminish the utility of clinical findings to confirm endotracheal tube placement. End tidal CO<sub>2</sub> detection should be used in all intubated patients.

*Reference:*

- LLSA 2012: Dargin J and Medzon R. Emergency Department Management of the airway in obese adults. *Ann Emerg Med.* 2010; 56:95-104.

**#17**

**When comparing dopamine versus norepinephrine in the treatment of shock, which of the following statements is true?**

- A. In a multicenter RCT comparing dopamine vs. norepinephrine as the initial vasopressor in the treatment of shock, there was a significant benefit of norepinephrine in the rate of death at 28 days.
- B. Dopamine was associated with more arrhythmic events.
- C. In a subgroup analysis of patients with septic shock, patients in this particular group had a lower mortality when treated with norepinephrine.
- D. None of the above
- E. All of the above

#17

**Answer: B.**

Although there was no significant difference in the rate of death between patients with shock who were treated with dopamine as the first-line vasopressor agent and those who were treated with norepinephrine, the use of dopamine was associated with more arrhythmic events, and these events were severe enough to require withdrawal from the study. In addition, dopamine was associated with a significant increase in the rate of death in the predefined subgroup of patients with cardiogenic shock, even though one might expect cardiac output to be better maintained with dopamine than with norepinephrine.

*Reference:*

- DeBacker D, et al. Comparison of dopamine and norepinephrine in the treatment of shock. N Engl J Med. 2010; 362:779-789. [full text](#)

**#18**

**True or False: In severe obstructive airway disease, the inspiratory to expiratory ratio (I:E) should be about 1:1.**

A. True

B. False



#18

**Answer: B.**

Exhalation times must be prolonged or dangerous breath-stacking occurs. I:E ratios should be 1:5 or less to promote full exhalation. Because respiratory frequency is the single greatest determinant of expiratory time, tachypnea is the greatest enemy of asthmatics on positive pressure ventilation.

*Reference:*

- LLSA 2013: Manthous CA. avoiding circulatory complications during endotracheal intubation and initiation of positive pressure ventilation. J of Emerg Med. 2010; 38:622-631. [full text](#)

**#19**

**According to the landmark ARDSnet study, which of the following strategies is indicated to prevent worsening lung injury?**

- A. Tidal volumes of 10 ml/kg.
- B. Plateau pressure to be maintained at >45 cm
- C. Increase PEEP to achieve >90% oxygen saturation
- D. Maintain patient-ventilator synchrony

**# 19**

**Answer: C and D.**

Tidal volumes should be 6 ml/kg. The plateau pressure should be checked and maintained less than 30 cm H<sub>2</sub>O Hg. Tidal volumes may need to be decreased to ensure safe plateau pressures. Patient-ventilator synchrony should be maintained because positive end expiratory pressure (PEEP) is less useful in settings of over-breathing, coughing, and ventilator dyssynchrony.

*Reference:*

- LLSA 2013: Manthous CA. avoiding circulatory complications during endotracheal intubation and initiation of positive pressure ventilation. J of Emerg Med. 2010; 38:622-631. [full text](#)

#20

You have just intubated a patient with severe asthma.

True or False: A higher peak airway pressure may be tolerated as long as tidal volumes are titrated to yield a plateau pressure < 30cm H<sub>2</sub>O.

A. True

B. False

# 20

**Answer: A.**

Hypoventilation is a risk of severe obstruction because ventilators are often programmed to stop tidal volume deliveries after exceeding a certain peak airway pressure (commonly 40-60 cm H<sub>2</sub>O). In severe asthma, when peak airway pressure reflects resistance of the upper airways, the ventilator may truncate breaths to dangerously low volumes, barely sufficient to ventilate the dead space. So, the allowable peak airway pressures must be set higher, so long as plateau pressure is maintained < 30 cm H<sub>2</sub>O.

*Reference:*

- LLSA 2013: Manthous CA. Avoiding circulatory complications during endotracheal intubation and initiation of positive pressure ventilation. J Emerg Med. 2010; 5:622-631. [full text](#)

**#21**

**True or False: National guidelines suggest no more than three ETI attempts before either inviting more skilled personnel or employing "difficult airway" adjuncts.**

A. True

B. False

**#21**

**Answer: A.**

True. Note that BVM should only be interrupted for at most, 30 seconds and the maximum oxygen saturation should be achieved prior to each attempt. Vital signs should be monitored carefully for bradycardia, excessive tachycardia, hypotension and desaturation, which should prompt return to BVM even if 30 seconds has not elapsed.

*Reference:*

- LLSA 2013: Manthous CA. Avoiding circulatory complications during endotracheal intubation and initiation of positive pressure ventilation. J Emerg Med. 2010; 5:622-631. [full text](#)

# 22

**More than 25% of patients develop transient hypotension after emergent ETI and positive pressure ventilation. Some of the ways in which this can be attenuated include which of the following?**

- A. Begin volume resuscitation – in all but obviously hypervolemic patients during ETI, especially when patients are very catecholamine driven before ETI.
- B. Ensure that a pure vasoconstrictor, such as phenylephrine, is rapidly available, in case fluid resuscitation is insufficient to fill the vascular system until the patient awakes.
- C. Ventilate with tidal volumes of 6-8 mL/kg of ideal body weight.
- D. All of the above



# 22

**Answer: D**

One other consideration would be to attempt ETI with intermittent doses rather than bolus doses of sedatives. For example 1-2 mg of midazolam or lorazepam or 0.3 mg/kg of propofol every 5-10 minutes if the patient's clinical status allows. Other agents such as ketamine provide an adjunctive catecholamine release for further hemodynamic stability. Using small incremental doses will prevent overdosing that could potentially induce hypotension. Also beginning with fairly low ventilator settings will allow for titration to prevent rapid increases in intrathoracic pressure which could limit venous return.

*Reference:*

- LLSA 2013: Manthous CA. Avoiding circulatory complications during endotracheal intubation and initiation of positive pressure ventilation. J Emerg Med. 2010; 5:622-631. [full text](#)

#23

You are seeing a patient who has anaphylactic shock secondary to a nut allergy. Her only medication is metoprolol. You have already administered antihistamines, corticosteroids, epinephrine, large volumes of crystalloid, but despite this, the patient remains hypotensive and continues to wheeze, while developing bradycardia. What other adjunctive therapy would be the best choice to administer?

- A. Prayer
- B. Glucagon
- C. Atropine
- D. Isoproterenol

# 23

**Answer: B.**

Although prayer may be useful, no randomized trials have assessed its effects. Glucagon, can have positive inotropic and chronotropic cardiac effects mediated independently of alpha and beta-receptors. Administration may be helpful in patients who are receiving beta-blockers and who do not respond to epinephrine and antihistamines. Glucagon is thought to effect positive inotropism by augmenting cAMP synthesis through a non-adrenergic pathway. The initial dose is 1mg for adults and 0.5 mg for children, and side effects include nausea, vomiting, hypokalemia, and hyperglycemia. Atropine and isoproterenol, can also be used as second-line therapy.

*References:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 119: Allergy, Hypersensitivity, Angioedema, and Anaphylaxis. 1551- 1555.
- Momeni M. Anaphylactic shock in a beta-blocked child: usefulness of isoproterenol. Paediatr Anaesth. 2007 Sep;17(9):897-9.

# 24

**You are about to intubate a patient with respiratory failure in the ED. What are the reasons for providing preoxygenation before tracheal intubation?**

- A. To extend the duration of safe apnea.
- B. To bring the patient's saturation as close to 100% as possible.
- C. To denitrogenate the residual capacity of the lungs and thereby maximize oxygen storage in the lungs.
- D. To maximally oxygenate the bloodstream.
- E. All of the above.

**# 24**

**Answer: E.**

Preoxygenation extends the duration of safe apnea and is recommended for every ED intubation. Achieving 100% oxygen saturation and denitrogenating the residual capacity of the lungs is the primary goal. Although denitrogenating and oxygenating the blood adds little to the duration of safe apnea, because oxygen is poorly soluble in the blood and the bloodstream is a comparatively small oxygen reservoir compared with the lungs, it may add 5% to oxygen reserves.

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med.* 2012; 59: 165-175. [full text](#)

# 25

**What is the best source of high FIO<sub>2</sub> for preoxygenation?**

- A. 100% facemask
- B. 10 liters/minute via nasal cannula
- C. 6 liters/minute of nasal cannula and a nebulizer
- D. 100% facemask with an oxygen reservoir (standardly available nonrebreather in the ED)
- E. Bag-valve-mask held over the patient's face

# 25

**Answer: D.**

The 100% face mask with an oxygen reservoir (standardly available nonrebreather in the ED) lacks one way valves and only provides 60-70% FIO<sub>2</sub> when standard 15L/minute oxygen flows through the device. There are true non-rebreather masks with one-way valves that are usually unavailable in the ED. Using a greater O<sub>2</sub> flow than 15L/minute with the standard ED non-rebreathers can achieve a similar 90% inhaled FIO<sub>2</sub> and are the preferred means of preoxygenation. Bag Valve Masks lacking one way inhalation and exhalation ports are inadequate when preoxygenating unless there is a tight seal and active ventilatory assistance.

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. Ann Emerg Med. 2012; 59: 165-175. [full text](#)

**#26**

**For what period of time should the patient receive preoxygenation?**

- A. 3 minutes' worth of tidal volume breathing with a high FIO<sub>2</sub> source
- B. 8 vital capacity breaths with maximal inhalation and exhalation
- C. Either of the above



# 26

**Answer: C.**

Ideally, patients should receive preoxygenation until they denitrogenate the functional residual capacity (FRC) of their lungs to achieve greater than 90% end-tidal oxygen level, which is rarely measured in the ED. Thus, 3 minutes worth of tidal volume breathing is an acceptable alternative. Patients can also take 8 vital capacity breaths if they are not well enough to cooperate.

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med.* 2012; 59: 165-175.

# 27

**Can increasing mean airway pressure augment preoxygenation?**

A. Yes

B. No

C. There is no evidence to support using noninvasive positive pressure ventilation.

# 27

**Answer: A.**

CPAP masks, noninvasive positive-pressure ventilation, or PEEP valves on a bag-valve mask device should be considered for preoxygenation and ventilation during intubation at the stage of muscle relaxation. This is important in patients who cannot achieve saturations greater than 93 to 95% with high FiO<sub>2</sub>.

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med.* 2012; 59: 165-175. [full text](#)

**#28**

**In what position should the patient receive preoxygenation?**

- A. Supine positioning
- B. Sitting upright
- C. 20 to 25 degree head-up position

#28

**Answer: C.**

Patients should receive preoxygenation in a head-elevated position, and reverse trendelenburg may be used for patients who are immobilized (c-spine precautions). An additional benefit of head elevation is better laryngeal views during intubation.

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med.* 2012; 59: 165-175. [full text](#)

**#29**

**How long will it take for the critically ill patient to desaturate after preoxygenation?**

- A. 2 minutes if the patient was otherwise healthy and was breathing room air.
- B. 10 minutes if the patient was otherwise healthy and was breathing a high FiO<sub>2</sub> level.
- C. 5 minutes in an obese adult breathing a high FiO<sub>2</sub>.
- D. It is impossible to predict.

# 29

**Answer: D.**

Although traditional teaching has stated that if the patient is otherwise healthy and was breathing room air, they have 1 minute of safe apnea time, 8 minutes if they were breathing a high FiO<sub>2</sub> percentage, and 2.7 minutes if they are obese. However in the ED due to the possible effects of shunting, increased metabolic demand, anemia, volume depletion, and decreased cardiac output, the critically ill may experience much shorter times to desaturation. One paper has estimated that time to desaturation down to 85% may be as short as 23 seconds in a critically ill adult vs. 502 seconds in a healthy adult. It is therefore impossible to predict the time to desaturation, making adequate preoxygenation imperative.

*References:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med.* 2012; 59: 165-175. [full text](#)
- Benumof JL, Dagg R, Benumof R. Critical hemoglobin desaturation will occur before return to an unparalyzed state following 1 mg/kg intravenous succinylcholine. *Anesthesiology.* 1997;87:979-982

**# 30**

**True or False: A nasal cannula set at 15 L/minute is the most readily available means of providing apneic oxygenation during ED tracheal intubation.**

A. True

B. False



# 30

**Answer: A.**

True. In passive oxygenation, alveoli take oxygen even without diaphragmatic movements or lung expansion. In the ED, the easiest and readily available device is the nasal cannula. The decreased oxygen demands of the apneic state will allow this device to fill the pharynx and allow a steady state of oxygenation to the alveoli while the patient is sedated and paralyzed. The nasal canal can also be applied under a 100% non-rebreather mask for increased preoxygenation.

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med* 2012; 59: 165-175. [full text](#)

**# 31**

**What is the benefit of providing manual ventilation during the apneic period?**

**(choose all that apply)**

- A. PaCO<sub>2</sub> increases 8 to 16 mm Hg in the first minute of apnea and then 3 mm Hg per minute, so by ventilating, you may prevent hypercarbia and acidemia.
- B. Ventilation during the onset phase of muscle relaxation can create alveolar distension and lengthen the duration of safe apnea during tracheal intubation efforts.
- C. Increases venous return and improves blood pressure.
- D. All of the above.

# 31

**Answer: A and B.**

The risk/benefit of active ventilation during the onset phase of muscle relaxation must be carefully assessed in each patient. In patients at low risk for desaturation ( $> 95\%$   $O_2$  sat), manual ventilation is not necessary. Those at higher risk of desaturation (91-95%  $O_2$  sat) may benefit from positive pressure ventilation. In hypoxemic patients, low-pressure, low volume, low rate ventilation will be required. Regarding choice A, it is unclear if this degree of  $PaCO_2$  increase will have a clinical effect except in severe metabolic acidosis and salicylate toxicity. These patients require ventilation to match their pre-intubation respiratory rate to decrease  $CO_2$  and prevent cardiovascular collapse. Also in patients with elevated intracranial pressure, hyperventilation (as a temporizing measure) can prevent the cerebral vasodilation caused by increasing  $CO_2$ .

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med.* 2012; 59: 165-175. [full text](#)

# 32

**Which paralytic agent may be preferred in patients at high risk of desaturation during airway management?**

A. Succinylcholine

B. Rocuronium

C. Vecuronium

D. Pancuronium

# 32

**Answer: B.**

Paralytic choice may also play a role in the time to desaturation. The fasciculation caused by succinylcholine (a depolarizing neuromuscular blocker) may increase oxygen use. An operating room study comparing succinylcholine to rocuronium demonstrated that the time to desaturation to 95% was 242 seconds in patients receiving succinylcholine versus 378 seconds in the rocuronium group. Thus, in patients at high risk of desaturation, rocuronium may provide a longer duration of safe apnea than succinylcholine.

*Reference:*

- Weingart SD, Levitan RM. Preoxygenation and prevention of desaturation during emergency airway management. *Ann Emerg Med.* 2012; 59: 165-175. [full text](#)

# 33

**When etomidate was used in the Sprung CL et al. study of hydrocortisone therapy for patients with septic shock, it was found that:**

- A. A single dose of etomidate inhibited the metabolism of corticosteroids for 24 hours in patients who were critically ill.
- B. An association between etomidate and the likelihood of adrenal suppression was found.
- C. Both of the above
- D. Neither of the above

# 33

**Answer: C**

The use of etomidate for induction of anesthesia in this study (26% of patients) was similar to that in the Annane study (24%). Etomidate has a low profile of cardiovascular complications, but a single dose can inhibit the metabolism of corticosteroids for at least 24 hours in patients who are critically ill. An association between etomidate and the likelihood of adrenal hyporesponsiveness was also found in this study.

*References:*

- Sprung CL et al. Hydrocortisone therapy for patients with septic shock. N Engl J Med. 2008; 358:111-124 [full text](#)
- Annane D, et al. Effect of treatment with low doses of hydrocortisone and fludrocortisone on mortality in patients with septic shock. Journal of the American Medical Association. 2002. 288(7):862-871. [full text](#)

**# 34**

**The '2" in the 3-3-2 Rule refers to:**

- A. The distance between the patient's incisor teeth
- B. The distance between the thyroid notch and the floor of the mouth
- C. The distance between the thyroid notch and the chin
- D. The distance between the hyoid bone and the chin
- E. The distance between the floor of the mouth and the nose



# 34

**Answer: B.**

The mnemonic LEMON (Look externally, evaluate 3-3-2 rule, Mallampati, Obstruction, Neck Mobility) is helpful in judging the potential for intubation difficulty. External characteristics that may predict difficulty with intubation include significant maxillofacial trauma, limited mouth opening, and anatomical variation such as a receding chin, overbite, or as a short neck. The 3-3-2 rule evaluated the alignment of the pharyngeal, laryngeal, and oral axes.

- The distance between the patient's incisor teeth should be at least three finger breadths.
- The distance between the hyoid bone and the chin should be at least 3 finger breadths
- The distance between the thyroid notch and the floor of the mouth should be at least 2 finger breadths.

*References:*

- Rosen's Emergency Medicine - Concepts and Clinical Practice. 8th edition. 2013. Chapter 1: Airway. 1-5
- WikEM - Difficult Airway Algorithm [http://wikem.org/wiki/Difficult\\_Airway\\_Algorithm](http://wikem.org/wiki/Difficult_Airway_Algorithm)

# 35

**When evaluating patients for hypovolemia, which of the following is the most helpful sign?**

- A. Postural tachycardia and the inability to stand from postural dizziness
- B. Supine hypotension
- C. Supine tachycardia
- D. Delayed capillary refill
- E. Poor skin turgor

# 35

**Answer: A.**

When clinically evaluating patients for hypovolemia, postural tachycardia and the inability to stand from postural dizziness add to diagnostic decision making while supine hypotension, supine tachycardia, capillary refill, and skin turgor have no proven diagnostic role. Vital signs and orthostatic vitals are insensitive measurements for detecting hypovolemia. The exception is postural lightheadedness, which should increase the clinical suspicion for hypovolemia. Orthostatic vital signs are normal in most hypovolemic and dehydrated patients according to the literature.

Unless a patient has significant volume loss exceeding 1,000 mL of blood, supine hypotension is also insensitive. Physical examination markers traditionally thought to be associated with dehydration (eg, dry membranes, sunken eyes) appear to be helpful when multiple positive findings are present, but their absence cannot rule out dehydration.

Sinert et al. conclude that there should be a low threshold for ordering confirmatory laboratory tests (BUN, creatinine, and metabolic panel) in the evaluation of the hypovolemic patient. Inferior vena cava ultrasound was not addressed in this review but may also aid in diagnostic evaluation.

*Reference:*

- LLSA 2007: Sinert R, et al. Clinical assessment of hypovolemia. Ann of Emerg Med. 2005; 45: 327-329.  
[full text](#)