

## Cardiovascular Block

### 2020 CSIE ICE Facilitator Guide

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### ICE Student Online “Virtual” Case

#### **Lecture Notes you might find helpful (see week 4 of Cardiovascular block):**

- "ECG and Ischemic Heart Disease" (1 lecture by Dr. Costa), May 7
- "Ischemic Heart Disease" (1 lecture by Drs. Wilson and Tong), May 7
- "Pharmacology- Antianginals" (1 lecture by Dr. Trzeciakowski), May 8

#### **REQUIRED READING:**

To access some of the resources below, please make sure to login to the library's website first, in order for the links to load.

#### **Links and Review Articles:**

Antman et al. The TIMI risk score for unstable angina/non-ST elevation MI: A method for prognostication and therapeutic decision-making. JAMA 2000 Aug 16;284(7):835-42. [TIMI Risk Score - JAMA 2000](#)

[ONLINE TIMI SCORE Calculator](#)

ASCVD Risk Calculator (Visit <http://tools.acc.org/ASCVD-Risk-Estimator/> or [2013 ACC/AHA Guideline on the Assessment of Cardiovascular Risk Calculator](#)).

[Canto et al. Atypical presentations among Medicare beneficiaries with unstable angina pectoris. American Journal of Cardiology 2002, v90 p248-253](#)

**OPTIONAL READING:**

*Additional Suggested Background Review Material. Please note, the following suggested reading is long, therefore use as a reference to read/review portions as you see fit:*

*AHA Guidelines with table references:*

[2013 ACC/AHA Guideline on the Assessment of Cardiovascular Risk \(Circulation 2014;129\[sup\]:s49-s73\)](#)

*2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction (Circulation 2013: v127 e362) ; <http://circ.ahajournals.org/content/127/4/e362>*

[2014 AHA/ACC Guideline for the Management of Patients with Non-ST-Elevation Acute Coronary Syndrome \(Circulation 2014;130e:344-e426\)](#)

[AHA/ACCF Secondary Prevention and Risk Reduction Therapy for Patients with Coronary and other Atherosclerotic Vascular Disease:2011 Update \(Circulation 2011;124:2458-2473\)](#)

**Note that some of the information presented in this case supports summarized information from:**

**First Aid for the USMLE Step 1 2017: pages 282, 290, 293-296 and 304-306**

Learning Objectives

Will be listed within each Part below

----- Part A (Information below available on Friday) -----

**Learning Objectives for Part A**

1. Create an appropriate differential diagnosis for cardiac and non-cardiac chest pain.
2. List and describe the risk factors of ischemic heart disease.
3. Describe how clinical risk scores are used to predict coronary artery disease outcomes.
4. Discuss appropriate evaluation of a patient with coronary artery disease risk factors and symptoms.

**Chief Complaint:** “I would like a second opinion about the ‘spells’ I’m having”

**History of Present Illness:**

Mrs. Jones is a 54-year-old African American woman who is very active and runs a house-cleaning service. About one year ago, she developed what she calls “spells”. To her, a spell consists of suddenly not feeling well with panic, a feeling of being unable to breathe enough air, palpitations, sweating, and neck discomfort. At first, these spells occurred during strenuous activity or during heated discussion. As time has progressed, her spells have occurred more frequently with less association with activity.

She was previously diagnosed with panic attacks. She was treated with clonazepam, which did help to some extent, but not satisfactorily. Lately, these spells now occur while she is at rest. The frequency of these has increased to about 2-3 times per week. Each spell lasts about 5-10 minutes. Her dosage of clonazepam was increased recently, and therapy with sertraline was started. However, she believes there is something very wrong. Thus, she came in to seek a second opinion.

**Past Medical History:**

1. Hypertension
2. Gastroesophageal reflux
3. Anxiety with panic attacks

**Past Surgical History:**

1. Total abdominal hysterectomy and bilateral salpingo-oophorectomy for prolapse of uterus

**Allergies:**

No known drug allergies

**Medications:**

1. Amlodipine 10 mg daily
2. Omeprazole 20 mg daily
3. Clonazepam 2 mg twice per day
4. Sertraline 50 mg daily

**Social History:**

1. Active smoker, 1 pack/day, for 34 years
2. Social alcohol use, about 1-2 beers per week
3. No illicit drug use
4. Married, and runs a busy cleaning service

**Family History:**

1. Father died from myocardial infarction in his early 50s
2. A brother received a coronary artery stent in his early 40s
3. Mother is still alive at age 72 with hypertension and type 2 diabetes mellitus

### **Review of Systems:**

Pertinent positives and negatives as reported in the History of Present Illness. All organ systems are reviewed and are otherwise negative.

### **Physical Examination:**

**Vital signs:** Temperature is 98.2°F (36.8°C), heart rate 86/min, blood pressure 148/85 mmHg, weight 135 lb., Height 5'7", oxygen saturation is 99% on room air

General: The patient is upbeat, animated, overall well-appearing, and in no acute distress. She appears her stated age. She is thin.

HEENT: PERRLA, mucus membranes are moist, sclera non-icteric, neck supple. No lymphadenopathy, no carotid bruit.

Pulmonary: Clear to auscultation bilaterally. No wheezes, rales, or rhonchi. Equal lung expansion. Non-labored breathing.

Cardiovascular: Regular rate and rhythm with occasional irregularity, normal S1 and S2. No murmurs, rubs, or gallops are appreciated. +2 peripheral pulses.

Abdominal: Soft, non-tender, and non-distended with active bowel sounds and no organomegaly. No abdominal bruit.

Skin: No visible or palpable lesions.

Musculoskeletal: Well developed with 5/5 strength in the upper and lower extremities.

Neurological: Cranial nerves II-XII intact with no dysdiadochokinesia. Romberg negative. All reflexes are elicited and are 2/4.

Psychiatric: Mood and affect are appropriate, mildly anxious. She has good judgment and insight.

### **Laboratory Evaluation and ECG**

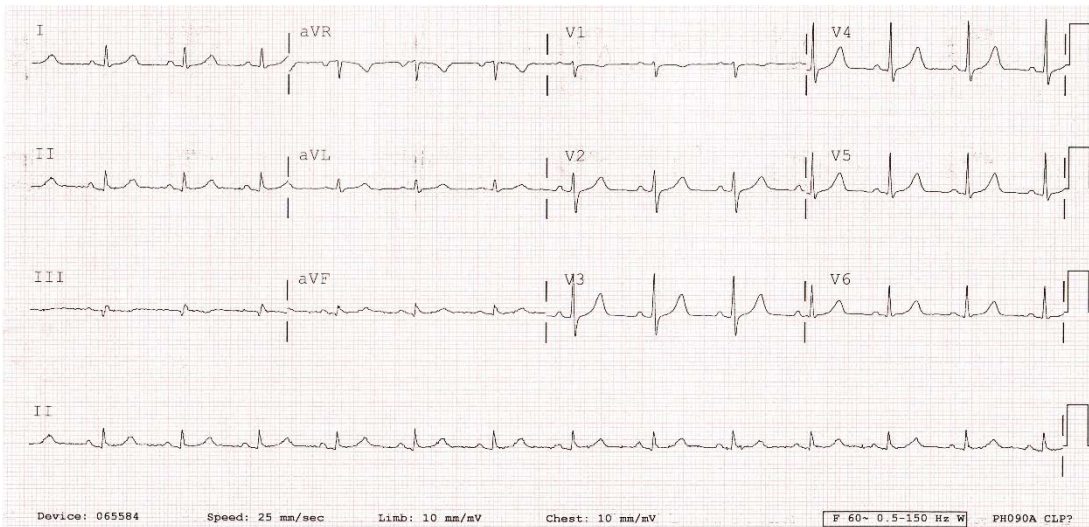
Lipid profile:

HDL: 40 mg/dL

LDL: 155 mg/dL (directly measured)

Triglycerides: 120 mg/dL

In-office at rest ECG:



**Question 1:** What medical condition could these “spells” (not feeling well with panic, unable to breathe, palpitations, sweating, and neck discomfort) represent? Make a differential diagnosis by organ system. The patient is already being treated for possible anxiety. Name at least one non-cardiac diagnosis for each of the organ systems below (examples provided in **BOLD**).

Organ System	Diagnosis
<b>Neuro/Psych</b>	<b>Panic attacks, partial-complex seizures</b>
Endocrinology	<b>Hyperthyroidism</b>
Hematology	<b>Anemia</b>
Pulmonology	<b>Lung disease (COPD, asthma, interstitial lung disease)</b>
<b>Vascular</b>	<b>Hypotension</b>
<b>Oncologic</b>	<b>Pheochromocytoma, carcinoid syndrome (both uncommon)</b>

**Question 2:** What cardiac diagnoses are you considering (Name at least 3)?

Cardiac differential diagnoses include:

- Ischemia
- Vasospasm
- Mitral valve prolapse
- Paroxysmal atrial fibrillation, other arrhythmia

**Question 3:** What risk factors does this patient have for coronary artery disease? Review the patient’s H&P and the following resources and calculate the patient’s TIMI Risk score. *Note: The patient’s TIMI risk score was used to assess if*

Mrs. Jones needs to be transferred to the ED or not when you are seeing her in the clinic. Patient's TIMI risk score for unstable angina is 1 due to existence of at least 3 risk factors for coronary artery disease.

[TIMI Risk Score Article - JAMA 2000](#)

[ONLINE TIMI SCORE](#)

**Question 4:** What does this score tell you about this patient's risk (%) of experiencing a major ischemic event within the next 14 days?

With **TIMI score =1**, she only has **5% or less chance of experiencing a major ischemic event within the next 14 days.**

### TIMI RISK SCORE for UA / NSTEMI

HISTORICAL	POINTS	RISK OF CARDIAC EVENTS (% BY 14 DAYS IN TIMI 11B)*		
		Risk Score	Death or MI	Death, MI or Urgent Revasc
Age ≥ 65	1			
≥ 3 CAD risk factors (FHx, HTN, ↑ chol, DM, active smoker)	1			
Known CAD (stenosis ≥ 50%)	1			
ASA use in past 7 days	1			
<b>PRESENTATION</b>				
Recent (≤ 24H) severe angina	1			
↑ cardiac markers	1			
ST deviation ≥ 0.5mm	1			
<b>RISK SCORE=Total Points (0-7)</b>				

\*Entry criteria: UA or NSTEMI defined as ischemic pain at rest within past 24H, with evidence of CAD (ST segment deviation or +marker)

For more info go to [www.timi.org](http://www.timi.org)

Antman et al JAMA 2000;284:835-842

### CASE DISCUSSION:

Based on the TIMI Risk Score, she is low risk. As such, she does not need to be hospitalized for her coronary disease diagnosis work-up. However, further diagnostic test should be done within 2 weeks. Conversely, if one still suspects severe unstable angina with impending myocardial necrosis and feels the need to check for troponin, then this needs to be done in a telemetrically monitored setting (e.g. ED, chest pain unit, or hospital).

**Question 5:** Calculate the patients ASCVD Risk (Visit <http://tools.acc.org/ASCVD-Risk-Estimator/> or [2013 ACC/AHA Guideline on the Assessment of Cardiovascular Risk Calculator](#)). What is her calculated 10-year atherosclerotic cardiovascular (ASCVD) risk (%)? You will need to have a value for the total cholesterol, which is calculated as follows: total cholesterol = LDL + HDL + (triglycerides/5).

Without taking into account her family history, the **calculated 10-year atherosclerotic cardiovascular disease (ASCVD) risk is 21.5%**.

**NOTE:** The ASCVD estimation does NOT account for family history; therefore, one will need to adjust % risk to a higher number due to positive family history of CAD (Father died of MI at early 50s and brother needing revascularization at early 40s). Thus, she has high probability of having or developing coronary artery disease. If all diagnostics are negative for coronary artery disease, she still needs high intensity statin therapy.

**Question 6:** What is (are) the next step(s) in evaluating the patient? To evaluate for each of the conditions below name one laboratory study that needs to be done (see example in **BOLD**)?

Medical Condition	Laboratory Test
Anemia	<b>Complete blood count (CBC)</b>
Diabetes	Fasting glucose, HgbA1c
Renal Dysfunction	Complete metabolic profile, U/A
Coagulopathy	PTT, PT/INR

**Question 7:** What other tests, in addition to blood studies, should be done?

An **imaging stress test** needs to be done since she has symptoms consistent with unstable angina. Her angina equivalents have increased in frequency and now can occur at rest to strongly suggest presence of unstable angina.

----- Part B (Information below available after Part A is complete) -----

**Learning Objectives for Part B**

1. Identify ECG changes in acute myocardial ischemia. Describe how such changes in different ECG leads correlate with the location of the lesion, based upon coronary arterial anatomy.
2. Discuss appropriate evaluation of a patient with a positive stress test.
3. List disorders within the spectrum of ischemic heart disease that need immediate attention, including unstable angina, non-ST elevation myocardial infarction, and ST-elevation myocardial infarction.
4. Describe therapeutic interventions for active ischemia, including anti-coagulation, anti-platelet, revascularization, and adjunctive medical therapy.

**CASE CONTINUATION:**

An **imaging stress test** needs to be done since Mrs. Jones has symptoms consistent with unstable angina. Her angina equivalents have increased in frequency and now can occur at rest to strongly suggest presence of unstable angina.

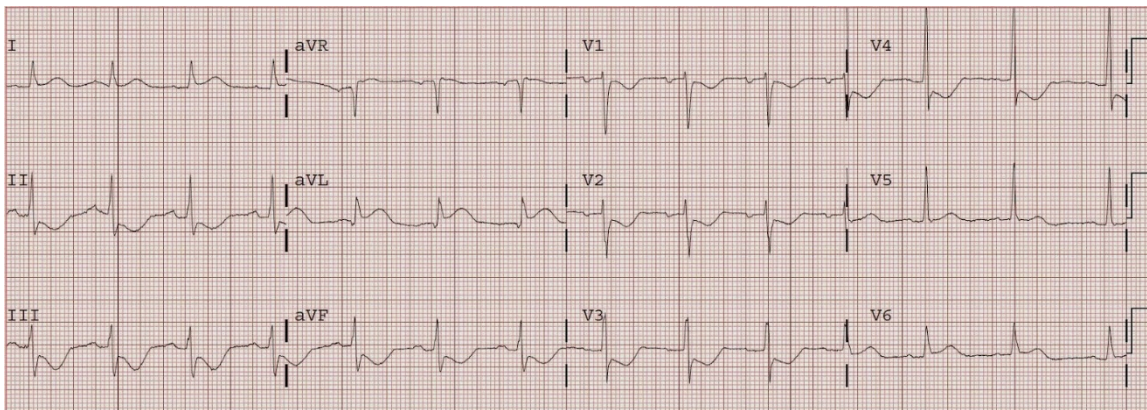
**Types of Stress test:**

- Exercise only ECGs are less accurate in women.
- Exercise stress echocardiography allows one to directly visualize active ischemia causing dysfunction.
- Perfusion imaging allows one to see reduced blood flow to ischemic region.

**\*\*Exercise stress echocardiography is a bit more specific but Exercise perfusion imaging is a bit more sensitive.**

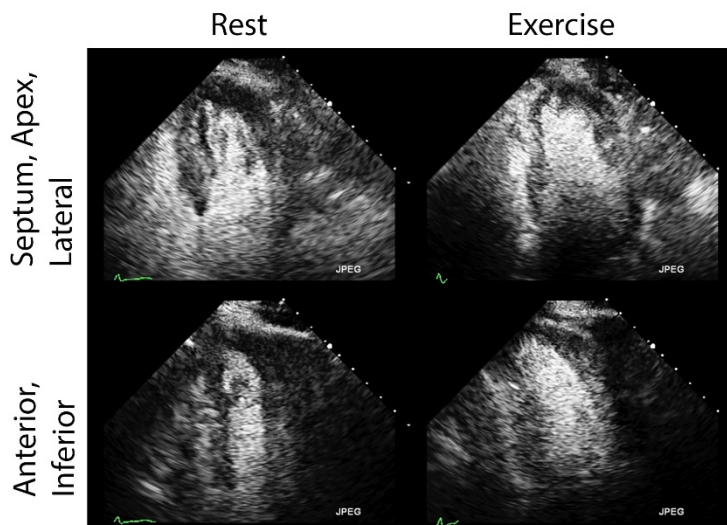
**Studies: An exercise stress echocardiogram is performed.**

ECG was normal at rest. ECG immediately following exercise stress showed the following:



Her ECG returns normal after 10 minutes of rest.

Echocardiogram: Exercise-caused dilation of left ventricle and decrease in ejection fraction (EF).



Apical 4-chamber and apical 2-chamber views of the heart at end systole.

(Note significant dilation with exercise).

Results:



Exercise ECG suggests ischemia: significant ST depression in II, III, aVF, V1-V4. Exercise Echocardiography also suggests ischemia: normal ejection fraction (EF) 60% and ventricular size (LVEDD 4.4 cm) at rest, but significant dilation of left ventricle and decrease in EF during exercise.

**Question 8:** Finding Q waves or ST changes in a 12-lead ECG correlates with which coronary artery supplying that area?

Leads	Coronary artery supply
II, III, aVF	RCA or right coronary artery
V1-V4	LAD or left anterior descending coronary artery
V6-AVL	LEFT Circumflex coronary artery

The ST depressions in II-III-aVF suggest right coronary artery stenosis. ST depressions in V1-V4 suggest left anterior descending artery stenosis. Transient ST elevations in V6 & aVL suggest that there is critical stenosis in left circumflex artery.

**CASE CONTINUATION:**

The patient's stress test is positive. What is the next step? The patient is started on several medications.

**Question 9:** Mrs. Jones is prescribed the following medications. For each medication provided below, list the mechanism of action (see example in **BOLD**)?

Drug	Mechanism of action
<b>Nitroglycerine - as needed for severe symptoms and given instruction to seek emergency care (e.g. call 911) if single dose of nitroglycerine does not relieve her symptoms.</b>	<b>Venodilation to decrease preload, dilate epicardial coronary arteries, and recruit coronary collaterals. Furthermore, they attenuate platelet aggregation</b>
Aspirin	Antiplatelet therapy
Beta-blocker	Relieve angina by decreasing myocardial oxygen demand by reducing heart rate, blood pressure, and contractility
High intensity statin	LDL reduction

**NOTE:** An angiotensin-converting enzyme inhibitors (ACE-I) should not be given for patients who will be undergoing catheterization with possible intervention shortly after to reduce the risk of contrast induced nephropathy. However, post-procedure they should be started as a secondary preventative therapy.

**Question 10:** What is the next diagnostic procedure in the evaluation of this patient with unstable angina?

She will need **catheterization with coronary angiogram**. She essentially follows the pathway of unstable angina with low risk in the 2014 AHA/ACC Guideline for the Management of Patients with Non-ST-Elevation Acute Coronary Syndrome (Circulation 2014;130e:344-e426).

----- Part C (Information below available after Part B is complete) -----

### Learning Objectives for Part C

1. Discuss approaches to counseling a patient to modify risk factors for coronary artery disease.
2. Review resources available to patients who wish to modify their risk factors for coronary artery disease.
3. List secondary interventions for patients who have had a coronary event that will prevent and/or reduce the likelihood of future cardiac events.

### **CASE CONTINUATION:**

Mrs. Jones undergoes a cardiac catheterization procedure.

### **Cardiac Catheterization Procedure Results:**

#### **Stenosis:**

Long 90% at proximal left anterior descending artery.

Very long 90% at proximal left circumflex artery.

85% at proximal right coronary artery.

90% at the ostial of ramus intermedius.

**Question 11:** What are the modifiable risk factors for coronary artery disease and what counseling would you provide Mrs. Jones to target her modifiable risk factors (**Name at least 3**)?

- **Smoking cessation-** She needs to **stop smoking**
- **Cholesterol reduction (diet, exercise, statins)**
- **Blood pressure reduction: heart healthy diet, exercise, BP meds**
- **Actively preventing development of diabetes**
- Follow **regular aerobic exercise routine** (e.g. walking 5-times per week of 30 minutes each).
- She needs to understand that her bypass can easily become stenotic; therefore, she has to take secondary prevention measures.

As you counsel Mrs. Jones, also consider recommending several community and national resources to help her achieve these goals, such as:

- **American Heart Association ([www.heart.org](http://www.heart.org))**
- National Heart, Lung and Blood Institute (<http://www.nhlbi.nih.gov/>)
- CDC - ([https://www.cdc.gov/tobacco/quit\\_smoking/how\\_to\\_quit/index.htm](https://www.cdc.gov/tobacco/quit_smoking/how_to_quit/index.htm)).
- Patients may also contact a local support group through their hospital, which may provide nutrition consults, support groups for healthy eating and weight loss, smoking cessation, etc.

#### **PATIENT UPDATE:**

Mrs. Jones received coronary artery bypass grafts (left internal mammary to left anterior descending, vein graft to dominant obtuse marginal branch of left circumflex, vein graft to ramus intermedius, vein graft to right coronary artery). She recovered well post-surgery with normal cardiac function seen on echocardiogram. Her spells completely went away, as these were cardiac pain equivalents. Her secondary prevention medications include the following:

- **Aspirin**
- **Beta-blocker**
- **ACE-I or ARB**
- **High intensity statins**

#### **What you have learned in this case ....**

You were introduced to Mrs. Jones, a 54-year-old African-American woman that has been having “spells” for 1 year, which have recently increased in frequency. Treatment with anxiolytics has been minimally helpful. She is a smoker and has a family history of early MI in her father, at age 50. Utilizing a systems based differential, you identified several potential non-cardiac (hyperthyroidism, anemia, COPD, etc.) and cardiac (ischemia, vasospasm, mitral valve prolapse, paroxysmal atrial fibrillation, other arrhythmia) causes for her spells. In further evaluating her cardiac risk factors you calculated her TIMI and ASCVD risk scores. Based on these calculated risk scores, she underwent basic lab testing to evaluate for diabetes, renal dysfunction, and coagulopathy. She also underwent a stress test which was positive (ST depressions in II-III-aVF suggest right coronary artery stenosis. ST depressions in V1-V4 suggest left anterior descending artery stenosis. Transient ST elevations in V6 & aVL suggest that there is critical stenosis in left circumflex artery. Decrease in EF and ventricular dilation seen by stress echocardiography strongly suggests severe multi-vessel coronary artery disease). Pharmacologic therapies were started including nitroglycerine (vasodilation), aspirin (antiplatelet effect), beta-blocker (reduced myocardial oxygen demand) and high intensity statin therapy (lipid reduction). Ultimately she was found to have multi-vessel disease on cardiac catheterization and therefore underwent coronary artery bypass grafting (CABG). An ACE-I was added to her preventive medications and modifiable risk factors (smoking cessation, heart-healthy diet, cholesterol reduction, blood pressure reduction, and diabetes prevention) were targeted interventions to reduce the risk of recurrent disease. Available patient resources such as the American Heart Association were identified for patient education.

**STUDENTS IN THE MAROON SUBGROUPS:** Please prepare a 4-5 sentence summary (~ 30 seconds to 1 minute) of this entire clinical case. This is often asked of students to do in the clinical setting after performing a full H&P. You will each present your summary at the live session.

#### **Student Expectations**

- Students are expected to arrive on time, in professional dress, white coat and badge.
- Students are expected to actively participate, show professional behavior such as appropriate listening skills and refraining from disrupting the session (please see the [student evaluation](#) rubric for more details).

- Students are expected to have prepared for the live session by reviewing the online “virtual” case and answering all the questions within each part, as well as reviewing the suggested lectures, and completing the required reading (see page 1-2, above) to prepare them for the live session.

### ICE Assessment

- The CSIE ICE comprises of 3.0% of the overall block grade in the following way:
  - o 1.5% for completing all the questions from Parts A, B, C of the online “virtual” case
  - o 1.5% for the student evaluation form (provided by you as the facilitator)

## Live Session Facilitator Guide

General Timeline:

**8:00-8:30 am** - Facilitator Meeting with Content Expert to answer questions

**8:30-10:20 am** - Meet with your group

**10:20-10:30 am** - Release students, complete student evaluations and CME forms

**10:30-11:00 am** - Faculty debriefing

Recommended timeline for the group activities

- **Get started (5 minutes)**
- **Activity 1 (20 minutes):** Online Virtual Case Summary Presentation and Debriefing
- **Activity 2 (50-60 minutes):** Practice Clinical Cases
- **Activity 3 (20 minutes):** High Yield Cardiovascular Content

### Get started (Start at 8:30 am: 5-10 minutes)

- Start the live session by introducing yourself.
- Meet the students and let them introduce themselves.
- Take this time to check attendance utilizing the provided student roster with their pictures/names. This will help in completing the student evaluation form for grading.
- If you are familiar with the students, take a few minutes to check in on them and how they are doing.
- Let the pre-designated student/students connect the computer to the AV system to log on and bring up the google doc forms to be used in the session

### **Activity 1 – Online “Virtual” Case Summary and Debriefing (Start no later than 8:40 am: 20 minutes)**

#### PART 1 – Online Virtual Case Summary (10 minutes)

Objective: To concisely present a clinical case, which is often done during rounds in the clinical setting.

Instructions:

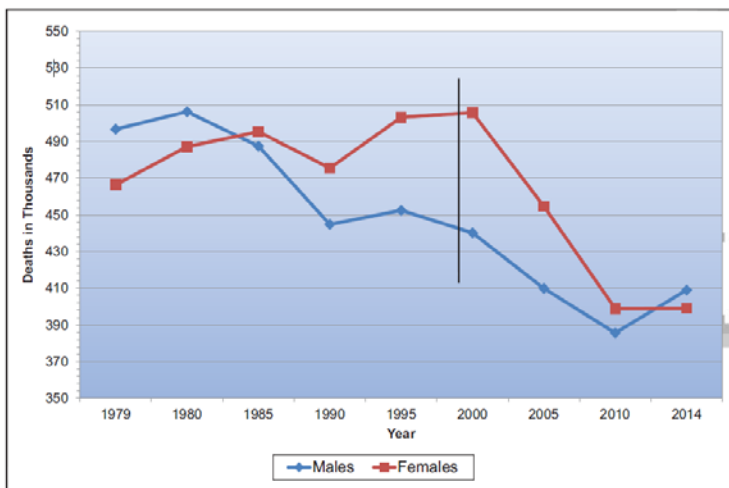
- Ask each student in the “maroon” group a **4-5 sentence summary (~ 30 seconds to 1 minute) of this entire clinical case**. This is often asked of students to do in the clinical setting after performing a full H&P. The summary should at least include the following:
  - Presenting symptoms
  - Important (pertinent) history and physical exam findings
  - Pertinent laboratory and other diagnostic test findings
  - Diagnosis
  - Treatment
  - Outcome
- **Example Summary:** Mrs. Jones, a 54-year-old African American woman, experienced unstable angina symptoms that were mistaken for panic attacks. Race, smoking history, hypertension, cholesterol, and strong family history suggested high risk for CAD. Stress echocardiography suggested severe ischemia and coronary angiography showed severe 4-vessel disease, and therefore she underwent coronary artery bypass grafting (CABG).

**PART 2 – Online Virtual Case Debriefing (10 minutes)**

**Objective:** Review, debrief, and reinforce the contents of the online virtual case. Emphasize important epidemiological findings of cardiovascular disease within different patient population groups.

**Instructions:**

- This is a brief review of the student online “virtual” case. Consider just opening it up to specific student questions rather than going through the entire case or every question. If there are no questions, please reinforce the points below. If there are questions, please ask the “AV student” to bring up the case on eCampus (PDF) so you can review their question. The answers are in your Facilitator Guide PDF document (see also paper copy in your maroon folder).
- Reinforce some of the salient epidemiological findings of cardiovascular disease with the group:
  - Women are just as likely to perish from cardiovascular disease as men.
  - African Americans have a higher prevalence of cardiovascular disease.
  - Women with ongoing ischemia will typically present with a different set of symptoms than the classic description for men.



**Chart 13-19. Cardiovascular disease (CVD) mortality trends for males and females (United States: 1979–2014).**

CVD excludes congenital cardiovascular defects (*International Classification of Diseases, 10th Revision [ICD-10] codes I00–I99*). The overall comparability for cardiovascular disease between the *International Classification of Diseases, 9th Revision (1979–1998)* and *ICD-10 (1999–2013)* is 0.9962. No comparability ratios were applied. Source: National Center for Health Statistics and National Heart, Lung, and Blood Institute.

CLINICAL STATEMENTS AND GUIDELINES

**Table 13-1. Cardiovascular Diseases**

Population Group	Prevalence, 2011–2014: Age ≥20 y	Mortality, 2014: All Ages*	Hospital Discharge, 2010: All Ages	Cost, 2012–2013
Both sexes	92 100 000 (36.6%)	807 775	5 802 000	\$316.1 Billion
Males	44 300 000 (37.4%)	408 747 (50.6%)†	3 021 000	...
Females	47 800 000 (35.9%)	399 028 (49.4%)†	2 781 000	...
NH white males	37.7%	320 859	...	...
NH white females	35.1%	316 843	...	...
NH black males	46.0%	49 210	...	...
NH black females	47.7%	48 573	...	...
Hispanic males	31.3%	24 875	...	...
Hispanic females	33.3%	21 571	...	...
NH Asian males	31.0%	9784‡	...	...
NH Asian females	27.0%	9147‡	...	...
NH American Indian/Alaska Native	...	4054	...	...

Ellipses (...) indicate data not available; and NH, non-Hispanic.

\*Mortality for Hispanic, American Indian or Alaska Native, and Asian and Pacific Islander people should be interpreted with caution because of inconsistencies in reporting Hispanic origin or race on the death certificate compared with censuses, surveys, and birth certificates. Studies have shown underreporting on death certificates of American Indian or Alaska Native, Asian and Pacific Islander, and Hispanic decedents, as well as undercounts of these groups in censuses.

†These percentages represent the portion of total cardiovascular disease mortality that is attributable to males vs females.

‡Includes Chinese, Filipino, Hawaiian, Japanese, and other Asian or Pacific Islander.

Sources: Prevalence: National Health and Nutrition Examination Survey 2011 to 2014, National Center for Health Statistics (NCHS) and National Heart, Lung, and Blood Institute (NHLBI). Percentages for racial/ethnic groups are age adjusted for Americans ≥20 years of age. Age-specific percentages are extrapolated to the 2014 US population estimates. Mortality: Centers for Disease Control and Prevention/NCHS, 2014 Mortality Multiple Cause-of-Death—United States. These data represent underlying cause of death only for *International Classification of Diseases, 10th Revision* codes I00 to I99 (diseases of the circulatory system). Mortality for NH Asians includes Pacific Islanders. Hospital discharges: National Hospital Discharge Survey, NCHS. Data include those inpatients discharged alive, dead, or of unknown status. Cost: NHLBI. Data include estimated direct and indirect costs for 2012 to 2013 (annual average).

**Activity 2 – Clinical Cases (Start no later than 9:00 am: 50-60 minutes)**

**Objective:** Apply a consistent strategy that translates clinical findings, ECG findings, laboratory, and radiology results to effectively identify and treat emergent arrhythmias, acute coronary syndromes, and congestive heart failure (Bonus cases).

**Instructions:**

- 1) Divide into 4 groups of similar size.
- 2) Each group will work on **one case plus a Bonus case** (All groups will have the same bonus case).
- 3) Project **Activity 2 Handouts A-D** in google docs.
  - a. Group 1: activity handout A, group 2: activity handout B, group 3: activity handout C etc.
- 4) Each group will have access to the “Resource folder” in google docs with supplemental handouts. This contains algorithms and helpful tools for reading ECGs and CXRs.
- 5) Allow them 15-20 minutes to work through the cases and answer the provided questions. Encourage them to use online resources.
- 6) Rotate and guide them if they are struggling using the answers provided below.
- 7) Regroup after 15-20 minutes and go through answers allowing all four groups to present their case (e.g.: group A presents case 1, group B presents case 2, group C presents case 3; group D presents case 4).

8) Discuss the bonus case as a large group; call on each group to answer questions; highlight any key points.

**Group A Cases (Case 1 plus Bonus case below):**

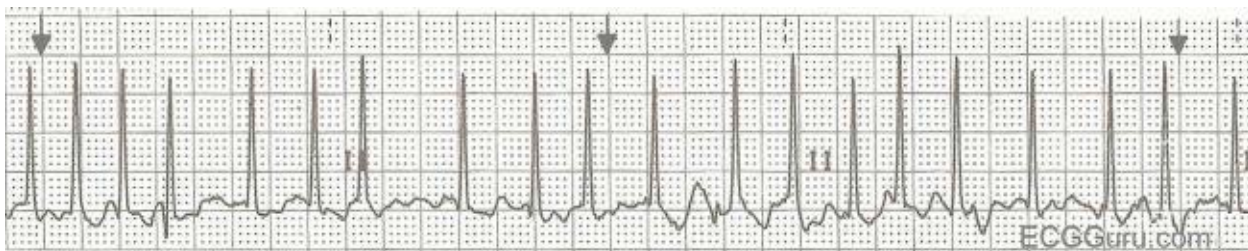
**Case 1**

Mrs. Wanda Smith is a 76-year-old woman who is evaluated in the emergency department for dizziness, shortness of breath, and palpitations that began acutely 1 hour ago. She has a history of hypertension and heart failure with preserved ejection fraction. Medications are hydrochlorothiazide, lisinopril, and aspirin.

On physical examination, she is afebrile, blood pressure is 80/60 mm Hg, heart rate is 155/min, and respiratory rate is 30/min. Oxygen saturation is 80% on 40% oxygen by face mask. Cardiac auscultation reveals an irregularly irregular rhythm and tachycardia. Crackles are heard bilaterally one-third up in the lower lung fields.

*(case modified from MKSAP 16, question Cardiology question 10)*

Rhythm Strip:



**Case 1 Questions:**

- 1) List key information in the case you find important as you evaluate the patient (i.e. problem list). Use proper medical terminology if applicable, (e.g. O2 saturation of 80% on 40% oxygen = hypoxemia).
  - Elderly – 76 year old
  - Dizziness, SOB, with palpitations
  - Began Acutely – 1 hour
  - Hypotension – 80/60
  - Tachycardia – 155
  - Tachypnea – 30
  - Hypoxemia - O2 sat 80% on 40% oxygen (Room air 21%)
  - Irregularly irregular rhythm
  - Crackles bilaterally
  
- 2) Is the patient stable or unstable? Explain why?
 

The fact that the patient is tachycardic with hypotension and hypoxemia means they are in shock and are unstable.
  
- 3) Read the rhythm strip provided. What is the rate? Intervals (narrow or wide complex)? Rhythm?
 

Rate - Approximately 150/min – Tachycardia.  
 Intervals - Narrow complex.  
 Rhythm - Irregular

For assistance in reading ECGs see the following link: [Thaler MS. The only ECG book you'll ever need. In: Seigafuse S, eds. 8<sup>th</sup> ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2015.](#)

4) What is the likely diagnosis?

**Atrial Fibrillation with rapid ventricular response**

5) How would you emergently treat this patient (remember – stable versus unstable)?

**Direct electric cardioversion (synchronized) because the patient is unstable.** This is an important distinction in initial management of patients with atrial fibrillation with RVR. This patient will likely also require anticoagulation short term. Additional workup (echocardiogram, review of history and physical) will be needed to determine the underlying cause.

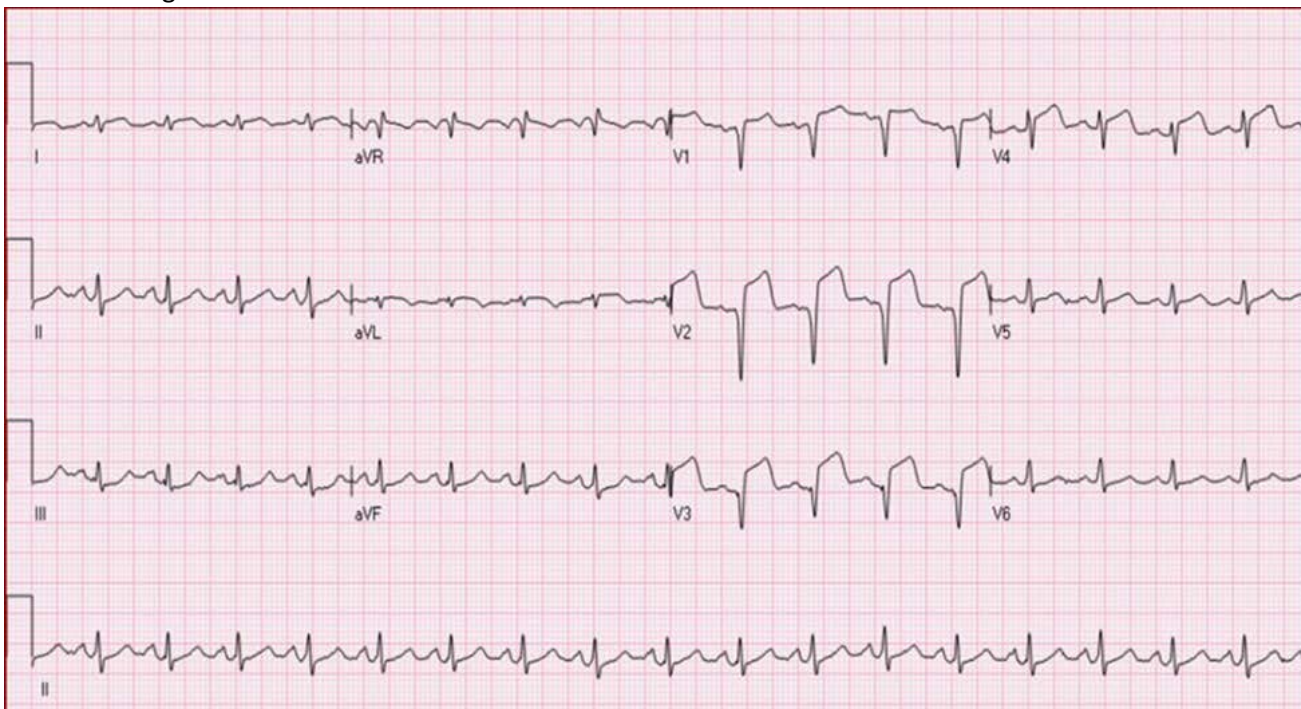
### Group B Cases (Case 2 plus Bonus case below)

#### Case 2

Mr. Troy Vincent is a very fit 21-year-old African American man, who develops severe mid-substernal chest pains and shortness of breath while doing bench presses at the gym. He assumes this is due to muscle strain and takes Ibuprofen. However, his chest pain and shortness of breath did not dissipate, and he was not able to sleep prompting a visit to the emergency department at 4:00 am. He admits to a prior history of cocaine use. However, he said that he has not been using cocaine recently.

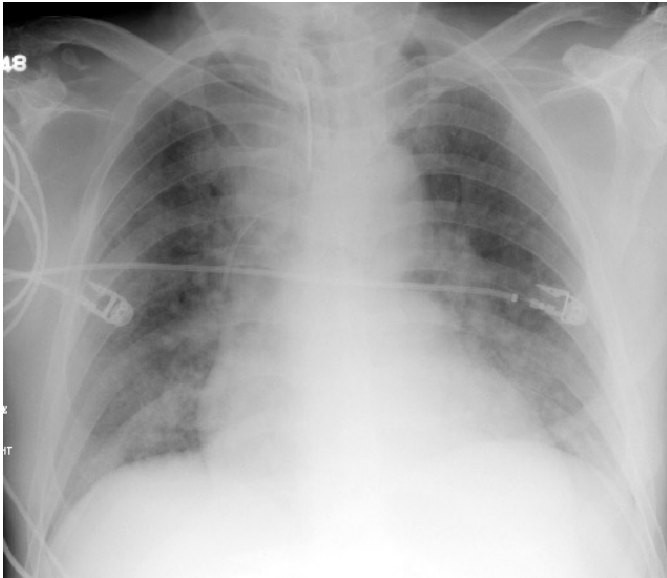
On physical exam, his temperature is 99.0°F (37.2°C), heart rate 116/min, respiratory rate is 40/min, blood pressure is 86/60 mmHg, oxygen saturation is 94% on 4-liters by nasal cannula. Jugular venous pressure (JVP) is elevated at 14 cm. Cardiac auscultation reveals tachycardia, S1/S2, 2/6 holosystolic murmur at the apex, no discernable gallops, and no obvious rubs. Lung auscultation reveals distinct inspiratory crackles in the lower half bilaterally. Lower extremities are cool to the touch, and the dorsalis pedis pulses are barely palpable.

Electrocardiogram:





Chest Radiograph:



**Case 2 Questions:**

- 1) List key information in the case you find important as you evaluate the patient (i.e. problem list). Use proper medical terminology if applicable.
  - Symptoms:
    - Chest pain at rest
    - Shortness of breath
  - Signs:
    - Tachycardia – HR 116
    - Tachypnea – RR 40
    - Hypotension 86/60 (Shock)
    - Hypoxemia
    - Signs of heart failure
      - Pulmonary edema by exam and CXR
      - Poor perfusion
  - History: Cocaine use in the past
- 2) Is the patient stable or unstable? Explain why?  
 Unstable as evidenced by shock state with tachycardia, hypotension, hypoxia, poor perfusions and weak pulses.
- 3) Read the ECG provided. While it is important to do a complete and consistent reading each time you look at an ECG, for this case focus on signs of coronary artery disease. (Q waves, ST-segment changes, T-wave changes).  
 ST segment elevations V1-V4

For assistance in reading ECGs see the following link: [Thaler MS. The only ECG book you'll ever need. In: Seigafuse S, eds. 8<sup>th</sup> ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins; 2015.](#)

- 4) What is the working diagnosis?

The patient has an ST-elevation myocardial infarction.

NOTE: Labs not made available to student to discourage over dependence on labs. It is important for them to learn to synthesize critical diagnosis using real time physical exam and test. ECG and CXR only take a few minutes to perform. Waiting for laboratory results is too long. Most STEMI cases labs are not available.

5) How would you emergently treat this patient (remember – stable versus unstable)?

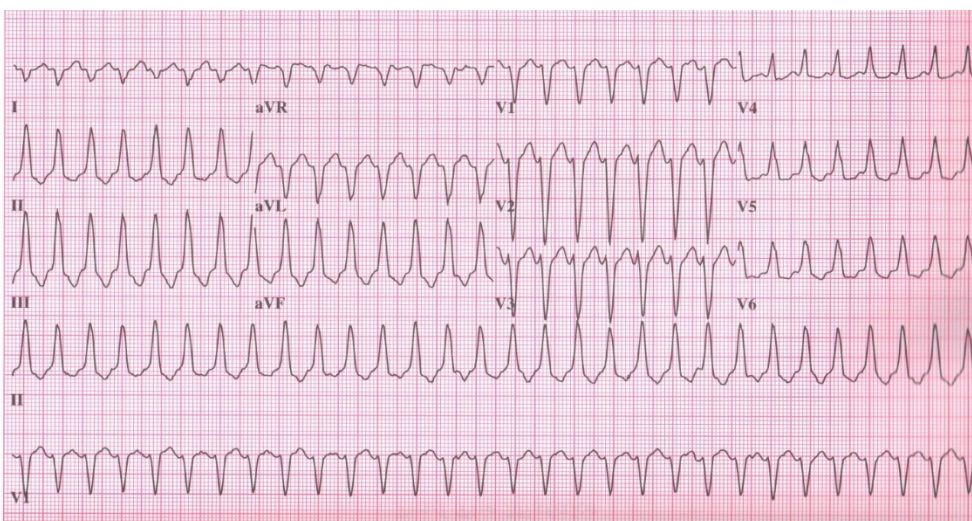
**He needs immediate catheterization/coronary angiography with the intent of intervention. The duration from the time the patient enters the emergency department to the time that the balloon opens the culprit stenotic lesion needs to be less than 90 minutes.**

**Group C Cases (Case 3 plus Bonus case below)**

**Case 3**

Tiffany Chan is a 24-year-old woman who arrives at the emergency department with a 30-minute history of palpitations and feeling weak. She gave birth to her first baby via vaginal delivery about 2 weeks ago. Since then, she has been feeling progressively fatigued. About 30 minutes ago, she felt an abrupt onset of palpitations. Shortly afterwards, she felt so weak that she sought emergency care.

On physical exam, she is afebrile, heart rate is 150/min and blood pressure is 82/60 mmHg. Cardiac exam reveals: jugular venous pulsation at 13 cm of H<sub>2</sub>O and appearance of cannon A-waves. Point of maximal impulse (PMI) is inferiorly and laterally displaced to the 7<sup>th</sup> intercostal space near the mid-axillary line, (+) right ventricular heave, tachycardia, regular rhythm, unable to appreciate gallop due to rapid rate. There is a 2/6 systolic murmur at the left lower sternal border, and a 2/6 systolic murmur lateral to the mid-clavicular line just below her left breast. Her ECG reveals:



**Case 3 Questions:**

1) List key information in the case you find important as you evaluate the patient (i.e. problem list). Use proper medical terminology if applicable, (e.g. BP 82/60 mmHg= hypotension).

- Young – 24 years old
- Palpitations and weakness
- Acute onset
- Recent pregnancy/birth – 2 weeks ago
- Preceding progressive fatigue since delivery
- Tachycardia – HR 150
- Hypotension – 82/60
- Cannon A waves
- PMI displaced inferiorly and laterally to 7<sup>th</sup> intercostal space
- Right ventricular heave
- 2/6 systolic murmur

2) Is the patient stable or unstable? Explain why?

The patient is unstable because of the tachycardia and hypotension indicative of shock.

3) Read the ECG provided. What is the rate? Intervals (narrow or wide complex)? Rhythm?

- Rate Approximately 150.
- Interval - Wide complex.
- Rhythm - Regular

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4) What is the likely diagnosis? How do the Cannon-A waves fit with this diagnosis? What is the significance of her recent pregnancy?

Diagnosis: ventricular tachycardia

- Lasts > 30 seconds by history = sustained tachycardia
- Cannon-A waves suggesting ventricular tachycardia (right atrium is contracting against a closed tricuspid valve during ventricular systole to physically show A-V disassociation)
- Peripartum cardiomyopathy

5) How would you emergently treat this patient (remember – stable versus unstable)?

**Direct current (synchronized) cardioversion because patient is unstable**

After successful cardioversion she will need an antiarrhythmic (i.e. amiodarone) due to a high probability of reoccurrence, since she most likely has peripartum cardiomyopathy. Additional workup (echocardiogram, electrolytes) will be needed. Placement in the ICU with Cardiology consultation (Electrophysiology and Heart Failure) for guidance of appropriate treatments will be needed. Chance of recovery is only about 50%, and she should avoid pregnancy due to combination of her cardiac condition and teratogenicity of the medications.

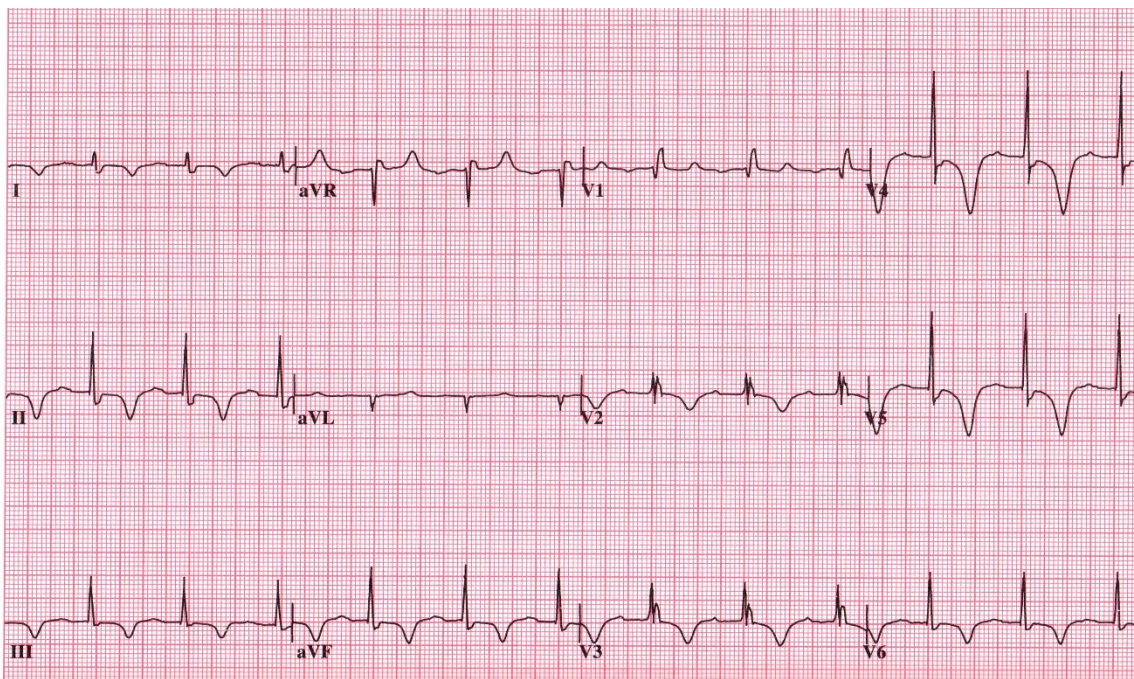
**Group D Cases (Case 4 plus Bonus case below)**

**Case 4**

Mr. Juan Pena is a 67-year-old Hispanic man with a history of hypertension and type 2 diabetes mellitus, who has experienced unprovoked episodes of shortness of breath for the past 3 days. He suddenly developed mid sub-sternum chest pressure about 12 hours ago. He states that the chest pressure worsened with activity, such as walking. He soon thereafter developed progressive shortness of breath and fatigue. His friend called 911 due to his appearance, as he was sweaty, gasping for air, weak and in distress at work. In route to the emergency department, he received nitroglycerine 0.4 mg three times and metoprolol 5 mg IV twice, due to his chest pressure and pain and an ECG was done. Blood for laboratory analysis was sent upon arrival. His outpatient medications included aspirin, metformin, glipizide, and simvastatin.

On physical exam you note an obese, man who appears in distress while reclining with head of the bed elevated at 45 degrees. He only can speak in short broken sentences between breaths. His temperature is 99.0°F (37.2°C), heart rate is 80/min, respiratory rate is 38/min, blood pressure is 84/62 mmHg, and oxygen saturation is 94% on 4-liters by nasal cannula. Jugular venous pressure (JVP) is elevated at the angle of jaw. Cardiac exam reveals tachycardia, S1/S2, S3 gallop, and 3/6 holosystolic murmur at apex with loud radiation to the left axilla, but no obvious rubs. Lung exam reveals crackles in lower half bilaterally. Extremities are cool to the touch, 1 cm pitting edema is present from the ankle to half-way up the knee, and dorsalis pedis pulses are barely palpable.

See ECG obtained during transport below.



**Laboratory Values:**

Cardiac troponin is 12 ng/mL (which is above 99% of upper limit of normal being 0.1).

**Complete blood count (CBC):**

White blood cell (WBC) count: 12,000/mm<sup>3</sup>

Hemoglobin: 13 g/dL

Platelet count: 237,000/mm<sup>3</sup>

Serum Chemistry:

Sodium: 140 mEq/L

Potassium: 4.2 mEq/L

BUN: 28 mg/dL

Creatinine: 1.1 mg/dL

Glucose: 210 mg/dL

**Case 4 Questions:**

- 1) List key information in the case you find important as you evaluate the patient (i.e. problem list). Use proper medical terminology if applicable.
  - Elderly – 67 years old
  - Chest Pain
  - Dyspnea
  - Hypotension/Shock
  - Tachypnea
  - Hypoxemia
  - Increased JVP
  - Holosystolic murmur
  - Crackles to lung bases
  - Poor perfusion – cool extremities
  - Edema
  - Weak pulses

- 2) Is the patient stable or unstable? Explain why?

Unstable as evidenced by shock state with hypotension, hypoxia, poor perfusion and weak pulses.

- 3) Read the ECG provided. While it is important to do a complete and consistent reading each time you look at an ECG, for this case focus on signs of coronary artery disease (Q waves, ST-segment changes, and T-wave changes)  
Multi-lead T-wave inversions (I, II, III, AVF, V2-V6)

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- 4) What is the likely diagnosis? Is the patient high risk? (*hint: calculate TIMI or GRACE risk score*)

The patient has Non-ST segment elevation myocardial infarction (NSTEMI) due to combination of elevated troponin, concerning ECG with deep inverted T-waves, and clinical findings of chest pressure with CAD equivalent, dyspnea and diaphoresis.

Risk stratification:

- The patient is very high risk, as seen by signs of heart failure and most likely worsening mitral regurgitation. At this point, no other risk assessment is needed. However, students can calculate TIMI or GRACE risk scores.

- His TIMI score is 7 (CAD equivalent, age>65, positive troponin, CAD equivalent, ST deviation, ongoing use of aspirin, and recurring chest pains give the maximum score with 40.9% chance of mortality, MI, or severe ischemia requiring revascularization all within 14 days).
- His GRACE risk score is 228 (Killip class-4, SBP 84, HR 80, age 67, creatinine 1.1, ST-changes, positive troponin). This equates to very high risk of 29-36% in-hospital mortality.

5) How would you treat this patient (remember – stable versus unstable)?

**NSTEMI with high risk stratification requires catheterization/coronary angiogram with intent for revascularization within 2 hours.**

**Need to ensure that patient has defibrillator pads already in place and connected to defibrillator given these patients can easily deteriorate into ventricular fibrillation.**

Adjunctive medical therapy:

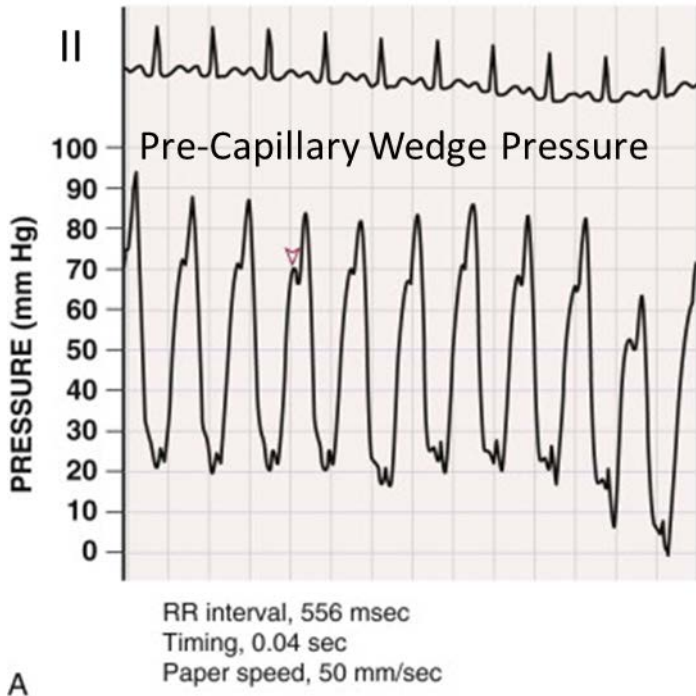
- This patient will need to be anticoagulated (unfractionated heparin, bivalirudin).
- The patient will need anti-platelet therapy of aspirin (162-325 mg) before catheterization.
- Will need to coordinate with catheterization team regarding when to give clopidogrel, prasugrel, or ticagrelor.

**Bonus Case (Note: same bonus case for all groups)**

Mr. Bill Shaw is a 57-year-old Caucasian man in the ICU on the ventilator and balloon pump after a witnessed cardiac arrest with CPR/AED on the scene 3 days ago. He subsequently underwent emergent catheterization with a drug-eluting stent for an occluded proximal left circumflex artery. After initial improvement with weaning off the balloon pump and ventilator, the ICU nurse pages the on-call physician because Mr. Shaw is now suddenly hypoxic.

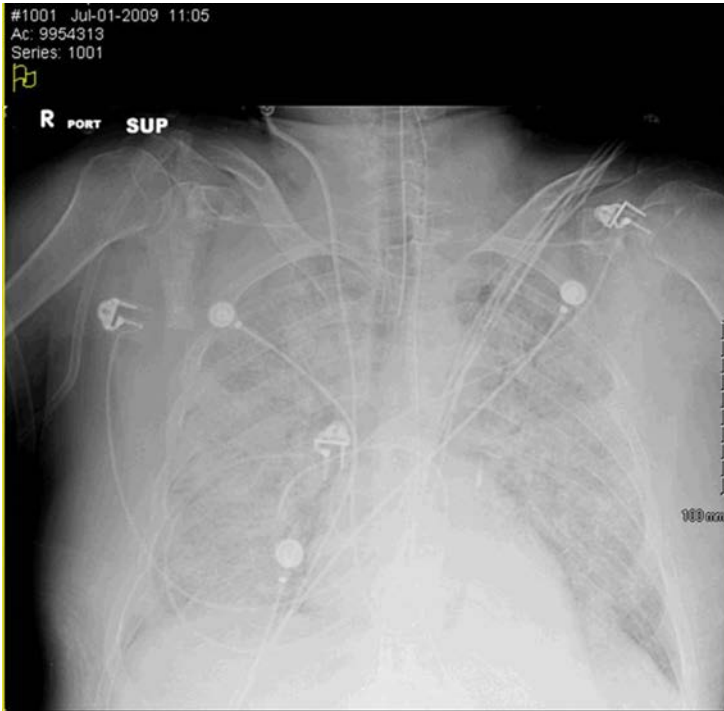
After an urgent physical exam, the patient is intubated and sedated. His temperature is 98.6°F (37.0°C), heart rate is 105/min, blood pressure is 95/65 mmHg, O2 sat is 70% while the ventilator FIO2=100%, and respiratory rate is 36/min (patient is over breathing the ventilator setting of 16). Cardiac exam shows tachycardia with loud 3/6 holosystolic murmur (while balloon pump paused). Lung exam reveals diffuse bilateral crackles. Extremities are warm with good pulses and no edema.

**Swan-Ganz (Pulmonary Artery Catheter):**



The precapillary wedge pressure is measured with a balloon inflated at the distal small branch of pulmonary artery. Thus, it represents the left atrial pressure provided that there is no stenosis in pulmonary veins feeding the left atrium.

**CXR:**



**Bonus case Questions:**

- 1) List key information in the case you find important as you evaluate the patient (i.e. problem list). Use proper medical terminology if applicable.
  - Witnessed cardiac arrest
  - CPR and AED on scene
  - Acute MI
  - S/P Cardiac catheterization with stent placement
  - On balloon pump (weaning)
  - Acute worsening after initial improvement
  - Marked hypoxia
  - On Ventilator
  - Tachypnea
  - Loud holosystolic murmur
  - Crackles on lung exam
  - Extremely high V-waves seen at pre-capillary wedge pressure wave form
  - Pulmonary edema on CXR
  
- 2) Is the patient stable or unstable? Explain why?
  - Unstable due being critically ill with acute respiratory distress while on ventilator.



- 3) The pre-capillary wedge pressure (PCWP) on the Swan-Ganz catheter shows very prominent V-waves and the CXR shows diffuse pulmonary edema. What do these findings tell you?

V-waves:

V-waves produced by increased blood volume entering the atria during the period of rapid atrial filling during the cardiac cycle. This is the most frequent right atrial wave abnormality and is most commonly caused by tricuspid or mitral insufficiency (regurgitation).

The precapillary wedge pressure is measured with a balloon inflated at the distal small branch of pulmonary artery. Thus, it represents the left atrial pressure provided that there is no stenosis in pulmonary veins feeding the left atrium. In this case, the ruptured papillary muscle leads to sudden mitral valve incompetence which allows LV systolic pressure to push blood back through the left atrium and pulmonary circulation resulting in the prominent v-waves.

Pulmonary edema:

The sudden increase in luminal pressures and volumes due to the LV pushing blood backwards into the pulmonary circulation simultaneously with the RV pushing forward into the pulmonary circulation causes severe and intractable pulmonary edema.

- 4) What is the likely diagnosis?

Papillary muscle rupture as a mechanical complication of the MI.

IMPORTANT LEARNING POINTS TO SHARE:

- The posterior papillary muscle is more likely to rupture due to being supplied by only one vessel, usually a branch of the left circumflex artery. Frequency of the main artery that supplies branches to the posterior papillary muscle consists of LCx > RCA > both > LAD.
- The rupture typically occurs 3-5 days after MI as the cellular reparative process has degraded matrix without laying down sufficient connective tissue to sustain the strain.
- LVEF increases with rupture because it is now emptying into a very low pressure left atrium; however forward stroke volume to the aorta will significantly decrease to cause shock.

- 5) How would you emergently treat this patient (remember – stable versus unstable)?

- **Emergent surgery to replace mitral valve.**
- Patient must be stabilized until time of surgery by maximizing forward flow. This includes: increase balloon pump support (ensure there is 1:1 augmentation), add maximum tolerable vasodilation (e.g. IV nitroprusside), consider inotropic support (e.g. dobutamine; however, need to avoid vasoconstricting medication because it will worsen MR), consider diuretics. One can also maximize ventilator settings (e.g., increase PEEP).
- 70% chance of survival.
- Most survivors do well providing LV has not been too badly damaged by the MI.

### Activity 3 – Cardiac “Jeopardy” (Start by 10:00 am: 20 minutes)

Objective: To review high yield information related to the cardiovascular system including anatomy, physiology, pathology, and pharmacology through a jeopardy like game session.

Instructions:

- 1) Divide into Maroon and White Teams.
- 2) Let each Team work on their respective Maroon or White Activity 3 Handout.
- 3) The handouts will be identical with categories and questions of variable difficulty (see table below).
- 4) Allow each Team to work as a group to come up with as many answers as they can within 10 minutes! (You may want to time them).
- 5) They need to record their answers in their respective activity handout google doc.
- 6) **They must fill the easy, then moderate, then hard questions within a category (they cannot jump to hard questions), but they can do all the easy questions in all categories, then medium then hard.**
- 7) After 10 minutes, let the 2 teams bring up their handouts on the screen and alternate between the teams to see if they came up with the correct answer for each question.
- 8) Assign the points (or volunteer a student from each team) based on the difficulty of questions.
- 9) Tally up total number of points for each team.
- 10) Winning team is the one with the most points.
- 11) Prize is bragging rights!

*Adjust times depending if you have more or less time!*

Pts	Anatomy	Physiology	Pathology	Pharmacology
100	Q: Which arteries provide a majority of the perfusion of the heart during diastole?  A: Coronary Arteries	Q: Stroke volume times Heart rate (SV x HR =) provides which useful cardiac physiologic parameter?  A: Cardiac output	Q: What heart valve may be involved with bacterial endocarditis associated with IV drug abuse?  A: Tricuspid valve	Q: Which medication is used to treat acute angina?  A: Nitroglycerine
100	Q: Which artery branches off the left main coronary artery and supplies blood to the front of the left side of the heart?  A: LAD	Q: Which curve demonstrates that the force of contraction is proportional to the initial length of cardiac muscle fiber (Preload)?  A: Starling Curve	Q: Which cardiac marker rises after 4 hours and is elevated for 7-10 days, and is more specific than other protein markers for MI?  A: Troponin	Q: Name a loop diuretic used to treat congestive heart failure:  A: Furosemide
100	Q: Which heart valve normally has 3 three cusps or leaflets (bicuspid in 1-2 %)?  A: Aortic valve	Q: What must exist for blood flow to overcome vascular resistance?  A: Difference in pressure or pressure gradient ( $\Delta P > 0$ )	Q: Which condition is also known as variant angina, angina inversa, or coronary vessel spasm?  A: Prinzmetal's angina	Q: What drug should be administered immediately on recognition of MI signs and symptoms?  A: Aspirin
200	Q: Which structure consists of the internal jugular vein, the common carotid artery, and the vagus nerve?  A: Carotid Sheath	Q: What equals systolic pressure minus diastolic pressure, and is proportional to the stroke volume?  A: Pulse Pressure	Q: What condition presents with tearing chest pain radiating to back and has mediastinal widening on CXR?  A: Aortic Dissection	Q: What class of medications can be used for treating hypertension, angina, arrhythmias, Prinzmetal's angina, and Raynaud's?  A: Calcium channel blockers
200	Q: Which artery supplies the inferior portion of the left ventricle through the posterior descending artery 80% of the time?  A: Right Coronary	Q: What calculation using systolic BP and diastolic BP is a surrogate marker for blood flow?  A: Mean Arterial Pressure (MAP)	Q: Which condition causes calcification in the media of radial/ulnar arteries? Hint: causes "pipestem" arteries on x-ray  A: Medial calcific sclerosis (Monckeberg)	Q: Quinidine, Procainamide, and Disopyramide are in what class of antiarrhythmics?  A: Class Ia

<b>200</b>	Q: Which layer of the heart or pericardium serves the dual purpose of lining the pericardium and forming the outermost wall of the heart? A: <b>visceral pericardium (epicardium)</b>	Q: What occurs in ventricular myocytes and Purkinje fibers in 4 phases? A: <b>Ventricular action potential</b>	Q: Which cardiac condition is associated with Aschoff bodies and Antitschkow's cells? A: <b>Rheumatic heart disease</b>	Q: What class of antiarrhythmics may cause impotence, exacerbation of asthma, and mask signs of hypoglycemia? A: <b>Beta blockers</b>
<b>400</b>	Q: Enlargement of this cardiac chamber can cause dysphagia or hoarseness and is the most posterior part of the heart. A: <b>Left Atrium</b>	Q: Arterioles account for most of this physiologic parameter? A: <b>Total peripheral resistance</b>	Q: What are 6 types of emboli? A: <b>FAT BAT - Fat, Air, Thrombus, Bacteria, Amniotic fluid, Tumor</b>	Q: What anti-hypertensive drug increases cGMP leading to smooth muscle relaxation? A: <b>Hydralazine</b>
<b>400</b>	Q: What venous system carries blood directly from the intestines to the liver for processing rather than directly into the inferior vena cava? A: <b>Hepatic portal system</b>	Q: What is the pulse finding in severe cardiac tamponade, asthma, OSA, pericarditis and croup? A: <b>Pulsus paradoxus</b>	Q: What condition causes an idiopathic segmental thrombosis vasculitis of the small and medium peripheral arteries and veins? A: <b>Buerger's disease</b>	Q: What drug class lowers hepatic cholesterol levels by inhibiting synthesis of mevalonate? A: <b>HMG CoA reductase inhibitors</b>
<b>400</b>	Q: What carries part of the right bundle branch of the AV bundle to the anterior papillary muscle? A: <b>Moderator band</b>	Q: Progressive lengthening of the PR interval until a beat is dropped describes what condition? A: <b>2<sup>nd</sup> Degree heart block Mobitz Type 1</b>	Q: What condition occurs due to granulomatous thickening of aortic arch and/or proximal great vessels? A: <b>Takayasu's arteritis</b>	Q: What cardiac drug can cause cyanide toxicity? A: <b>Nitroprusside</b>

### Student Evaluation Form (10 minutes)

Instructions: Release the students at 10:20. Complete the provided student evaluation form and place back in the brown envelope.

**PLEASE ENSURE THAT ALL COMPLETED FILLED-IN STUDENT EVALUATION FORMS ARE IN THE BROWN ENVELOPE BEFORE YOU LEAVE THE ROOM**

**Thank you for your time with the students and for supporting the CSIE!**