Must-Know Topics in Cardiology

- Stable angina pectoris
- Acute coronary syndrome
  - Unstable angina
  - Non-STEMI
  - STEMI
- Heart failure
  - Systolic
  - Diastolic
- Cardiomyopathies
  - Dilated
  - Hypertrophic
  - Restrictive
  - “Ischemic”
- Myocarditis
- Pericarditis
- Aortic dissection
- Hypertension
  - Essential
  - Secondary causes
- Valvular diseases
  - Aortic stenosis
  - Mitral regurgitation
  - Endocarditis
- Arrhythmias
  - Tachyarrhythmias
  - Bradyarrhythmias

Note: STEMI = ST segment elevation myocardial infarction

Tools of the Cardiologists

- History: Dyspnea, orthopnea, paroxysmal nocturnal dyspnea (PND), edema, weight gain, abdominal fullness, nocturia, syncope, chest pain, and palpitations
- Exam: JVD, edema, murmurs, extra heart sounds (S3/S4), displaced PMI (point of maximal intensity), BP differential between extremities, and pulsus paradoxus
- Tests
  - CXR (chest X-ray), EKG and Echocardiography
  - Stress tests
  - Cardiac catheterization

Labs:
- Cardiac biomarkers
- Brain natriuretic peptide (proBNP)
- Lipid profile

Interventions

Pharmacotherapy: Aspirin, beta-blockers (BB), ACE inhibitors, angiotensin II receptor blockers (ARBs), diuretics, nitrates, calcium channel blockers (CCBs), direct acting vasodilators, pressors, and Lytics

Procedures: Angiography, Right heart (Swan-Ganz) catheterization, percutaneous transluminal coronary angioplasty (PTCA), intra-aortic balloon pump (IABP)

Surgery: Valvuloplasty and coronary artery bypass graft surgery (CABG)

Notes:

Cardiology: Case 1

A 72 year-old male smoker with poorly controlled diabetes mellitus (DM2) is resented with worsening fatigue and dyspnea over the past year.

What are some potential causes of his dyspnea?
**Approach to Dyspnea**
- Pathophysiology: Impaired O2 delivery
  - Cardiac (↓ CO and pulmonary edema)
    - CHF
    - Ischemia
    - Valvular disease
    - Arrhythmia
  - Lungs (↓ Hb saturation)
    - Alveolar
    - Airway
    - Interstitial
    - Pleural
    - Vascular
  - Anemia (↓ O2 carrying capacity)
  - Neurological

**Cardiology: Case 1 Continued…**
Initially, he experienced difficulty breathing only with exertion, but recently he has experienced dyspnea at rest and admits to supporting himself with two pillows at night to help with breathing. He further claims that he experiences PND (paroxysmal nocturnal dyspnea).

How does this additional information affect your differential?

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**Cardiology: Case 1 Continued…**
Examination reveals distended neck veins, bibasilar pulmonary crackles, pitting edema of the ankles and cardiomegaly on CXR. Results of Echocardiography shows ejection fraction (EF) of 65%. The patient has no valvular abnormalities. Lab indicates increased BNP.

What does this additional information tell you?

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What is your diagnosis?

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Why does this patient have an increased BNP?

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**Note:** Congestive heart failure is a clinical diagnosis!

**Common Etiologies of Diastolic Failure**
- Ischemic heart disease
- Longstanding hypertension (HTN)
- Restrictive cardiomyopathy
- Constrictive pericarditis
- Aortic stenosis with a normal LVEF

What is the most common cause of systolic and diastolic heart failure?

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What is the second most common cause of systolic and diastolic heart failure?

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**Note on Diastolic Heart Failure:**

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**Common Causes of CHF Exacerbation**
- Dietary non-adherence
- Medication non-compliance
- Viral UTI

_______________________________________

2. Step/Level II CK/CE Preparation; Dr. Thomas Brown, Northwestern Medical Review
www.northwesternmedicalreview.com
Screening Tests
- History
- Exam
- CXR
- BNP
- Echo
- Right heart catheterization (Swan-Ganz): Confirms diastolic HF (elevated LVEDP) but it is rarely done

Patient Management
- Lifestyle modifications
  - Low sodium diet
  - Daily weights
  - Smoking cessation
  - Aggressive BP control
- Pharmacotherapeutic options
  - Loop diuretics
  - ACE inhibitors
  - ARBs
  - Beta blockers
  - Aldosterone antagonists

Summary of Important Concepts
- Approach to dyspnea
- Pathophysiology of heart failure
- Presentation and diagnosis of diastolic failure
- Methods of screening for heart failure
- Initial management
- Pharmacotherapy
- Preventative measures
Helpful (Optional) Procedure-related Information on Cardiology

What is the procedure for computed tomography angiography (CTA)?

What are major uses of CTA?

What is intra-aortic balloon pump (IABP) and what is its function?

What are a few indications for IABP?

What are the top contra-indications for IABP?

About CTA
- Computed tomography angiography (CTA) uses x-rays to visualize blood flow in arterial and venous vessels.
- The scan is performed simultaneously with a high speed contrast media injection using a technique called Bolus Tracking.
- Compared to catheter angiography, which involves placing a sizable catheter and injecting contrast material into a large artery or vein, CTA is a much less invasive and more patient-friendly procedure.

Note: The contrast material is injected into a small peripheral vein by using a small needle or cannula.

Common Uses of CTA
- Examination of the pulmonary arteries to rule out pulmonary embolism.
- Visualization of blood flow in the renal arteries in patients with high blood pressure and those suspected of having kidney disorders.
- Identification of aneurysms in the aorta and other major blood vessels.
- Identification of dissection in the aorta or its major branches.
- Identification of intracranial small aneurysms or arteriovenous malformation.
- Detection of atherosclerotic diseases, narrowing and obstruction of arteries.
- Detection of thrombosis in veins
- Examination of arteries in the brain in patients who complain of headache, dizziness, ringing in the ears or fainting.
- Examination of cranial arteries in patients who have had accidents (e.g. car accident) and in patients with cranial tumor.

About Intra-aortic Balloon Pump (IABP)
- IABP is a mechanical device that decreases myocardial oxygen demand while at the same time increases cardiac output and as a result coronary blood flow and myocardial oxygen delivery.
- It consists of a cylindrical balloon that sits in the aorta and counter-pulsates.
- It actively deflates in systole and increases forward blood flow by reducing afterload, and actively inflate in diastole and increases blood flow to the coronary arteries.
- The balloon is inflated during diastole by a computer-controlled, ECG linked mechanism. This controls the flow of helium from a cylinder into and out of the balloon. Helium is used because its low viscosity allows it to travel quickly through the long connecting tubes.

Major Indications for IABP
- Cardiogenic shock
- Reversible cardiac mechanical defects that often complicate infarction (acute mitral regurgitation and septal perforation)
- Unstable angina pectoris
• Post cardiothoracic surgery and weaning patients from cardiopulmonary bypass after continued preoperative injury to myocardial tissue.
• Preoperative use for high-risk patients such as those with unstable angina with stenosis greater than 70% of main coronary artery, and in cases of ventricular dysfunction with an ejection fraction of less than 35%.
• Percutaneous coronary angioplasty

**Absolute Contraindications for IABP**
• Aortic valve insufficiency
• Aortic dissection
• Severe aortoiliac occlusive diseases

What is the common usage of the term “angioplasty”?

Although pulmonary arterial pressure can be estimated on the basis of echocardiography, what procedure will provide the most accurate measurement of pressure of pulmonary artery occlusion pressure (PAOP) or pulmonary vascular resistance (PVR)?

What does pulmonary capillary wedge pressure measure?

What is the diagnostic value of PCWP?

What are the main three veins used for inserting the Swan-Ganz?

What cardiovascular functions and parameters are measured by the Swan-Ganz procedure?

What is the mechanism and procedure of the Swan-Ganz?

How does Swan-Ganz estimate the cardiac output?

What is the normal pulmonary artery pressure?

What is the normal right atrial pressure?

What is the normal left atrial pressure?
**Answers to the Previous Questions**

**Angioplasty** is the mechanical widening of a narrowed or totally obstructed blood vessel and it includes all manners of vascular interventions typically performed to reestablish or promote flow in a vessel.

**Right-sided catheterization** with a Swan-Ganz catheter can measure the cardiac output and provides a more definite assessment of the PAOP and PVR.

**Pulmonary capillary wedge pressure (PCWP)** is measured by inserting a Swan-Ganz catheter into a branch of pulmonary artery. It provides an indirect estimate of the left atrial pressure (LAP).

PCWP measurement is important in diagnosing severity of left ventricular failure and quantifies the degree of mitral stenosis. Note that aortic stenosis and regurgitation and mitral regurgitation also elevate LAP.

The main three veins used for inserting the Swan-Ganz are the internal jugular, subclavian and femoral veins.

A Swan-Ganz measures pulmonary arterial pressures, right atrial pressures, left atrial pressure, and reproduces left ventricular end-diastolic pressure. It helps to evaluate cardiac function by assessing the effectiveness of right and left pumping of the heart and provides a quantitative measurement of cardiac output by allowing for sampling of mixed arterial-venous oxygen levels.

From the venous entry site, the catheter is threaded, often with the aid of fluoroscopy (an X-ray source and fluorescent screen) through the right atrium and right ventricle into the pulmonary artery. Commonly used catheters have two lumens and they are equipped with an inflatable balloon at their tips for positioning into one of the branches of the pulmonary artery with the aid of blood flow. Inflation of the balloon causes the catheter to "wedge" in the pulmonary blood vessel. The wedged catheter then provides a measurement of the pressure in the left atrium or Left Ventricular End Diastolic Pressure.

Note that the balloon is a little behind the tip (front opening or port) of the catheter. It has another opening/port a few centimeters behind the balloon. These two openings are attached to pressure transducers. When balloon is placed in the pulmonary branch the front port measures the pulmonary artery pressure, and the back port, the right atrial pressure. When the balloon is inflated, the pressure recorded by the front port rapidly drops and reaches to about the same value as the pressure of the left atrium.

Swan-Ganz is also used to measure cardiac output. Presently catheters have several openings along their length to allow administration of drugs directly into the atrium to monitor the effect of the drugs on the heart.

Additionally they have a small thermistor or temperature probe a little behind the tip.

To estimate cardiac function in terms of dilution of the temperature either cold or room temperature saline is injected into the right atrium via the Swan-Ganz catheter. Temperature dilution technique is based on the assumption that after injection of a quantity of a prescribed saline with a particular temperature into the circulation, the downstream temperature changes in direct relationship to the cardiac output. For instance with high cardiac output, the cold temperature rapidly dissipates at downstream location.

Note: Another method, for evaluating cardiac output would be by gas dilution technique. A pulmonary artery catheter delivers a biocompatible gas such as oxygen. A mixed venous blood gas level is then measured at the pulmonary artery using a gas sensor. The gas sensor uses oximetry to measure mixed venous oxygen saturation. Again, the rate of dilution of the gas is correlated with the blood flow at downstream positions.

The normal pulmonary artery pressure is 25/10 mmHg

The normal right atrial pressure is 0-3 mmHg

The normal left atrial pressure is 6 to 10 mmHg