12 Lead ECG Part 2 – AMI, Hypertrophy, Wolff-Parkinson White, & Non Invasive Testing

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Agenda

ECG Interpretation Tools for AMI and hypertrophy

Practice 12 Lead ECGs

Wolff-Parkinson White

Hypertrophic Cardiomyopathy

Non-invasive cardiovascular testing
Objectives

1. Identify abnormal findings associated with various pathologies.
2. Discuss medication and diet considerations for non-invasive testing.
3. Discuss the management of heart failure patients.
Cardiovascular Disease (CVD) Facts

36.9% of Americans (1 in 3) have cardiovascular disease.

785,000 will have a new coronary (heart) event; 470,000 a recurrent attack.
- One every 25 seconds.

It is the leading cause of death for both women and men (1 of every 6) in the U.S
- One person dies every 39 seconds.

33.5% of US adults have hypertension (high blood pressure).
- Only 2 of 3 are controlled to goal levels.

Despite decades of progress, 21.2% of men and 17.5% of women continue to smoke.
# What is Normal in the 12 Lead

<table>
<thead>
<tr>
<th>LEAD</th>
<th>NORMAL WAVEFORM</th>
<th>USUAL DEFLECTION</th>
<th>AREA OF HEART IT VIEWS</th>
<th>CORONARY ARTERY INVOLVED</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td><img src="image" alt="I" /></td>
<td>Positive</td>
<td>Lateral, atrial rhythms</td>
<td>Circumflex</td>
</tr>
<tr>
<td>II</td>
<td><img src="image" alt="II" /></td>
<td>Positive</td>
<td>Inferior, SA node, atrial rhythms</td>
<td>RCA</td>
</tr>
<tr>
<td>III</td>
<td><img src="image" alt="III" /></td>
<td>Usually positive, can be equiphasic</td>
<td>Inferior</td>
<td>RCA</td>
</tr>
<tr>
<td>AVR</td>
<td><img src="image" alt="AVR" /></td>
<td>Negative</td>
<td>No specific</td>
<td>None</td>
</tr>
<tr>
<td>AVL</td>
<td><img src="image" alt="AVL" /></td>
<td>Equiphasic</td>
<td>Lateral</td>
<td>Circumflex</td>
</tr>
<tr>
<td>AVF</td>
<td><img src="image" alt="AVF" /></td>
<td>Positive</td>
<td>Inferior</td>
<td>RCA</td>
</tr>
<tr>
<td>V1</td>
<td><img src="image" alt="V1" /></td>
<td>Negative</td>
<td>Anterior septal, ST segment, BBB</td>
<td>LAD</td>
</tr>
<tr>
<td>V2</td>
<td><img src="image" alt="V2" /></td>
<td>Mainly negative</td>
<td>Anteroseptal</td>
<td>LAD</td>
</tr>
<tr>
<td>V3</td>
<td><img src="image" alt="V3" /></td>
<td>Equiphasic</td>
<td>Anterior</td>
<td>LAD</td>
</tr>
<tr>
<td>V4</td>
<td><img src="image" alt="V4" /></td>
<td>Equiphasic, becoming more positive</td>
<td>Anterior</td>
<td>LAD</td>
</tr>
<tr>
<td>V5</td>
<td><img src="image" alt="V5" /></td>
<td>Positive</td>
<td>Lateral</td>
<td>Circumflex</td>
</tr>
<tr>
<td>V6</td>
<td><img src="image" alt="V6" /></td>
<td>Positive</td>
<td>Lateral</td>
<td>Circumflex</td>
</tr>
<tr>
<td>Wall</td>
<td>Leads</td>
<td>Coronary Artery</td>
<td>Reciprocal changes</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>------------------------</td>
<td>----------------------------------</td>
<td>-------------------</td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>V1, V2, V3, V4</td>
<td>LAD branch of LCA</td>
<td>II, III, aVF</td>
<td></td>
</tr>
<tr>
<td>Inferior</td>
<td>II, III, aVF</td>
<td>RCA</td>
<td>I, aVL</td>
<td></td>
</tr>
<tr>
<td>Lateral</td>
<td>I, aVL, V5, V6</td>
<td>Circumflex branch of LCA</td>
<td>V1, V3</td>
<td></td>
</tr>
<tr>
<td>Posterior</td>
<td>V1, V2 (ST depression, tall R waves)</td>
<td>RCA, Circumflex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apical</td>
<td>V3, V4, V5, V6</td>
<td>LAD, RCA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anteriolateral</td>
<td>I, aVL, V1, V2, V3, V4, V5, V6</td>
<td>LAD, Circumflex</td>
<td>II, III, aVF</td>
<td></td>
</tr>
<tr>
<td>Septal</td>
<td>V1, V2</td>
<td>LAD</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Acute injury is occurring. Heart attack is happening now.
Infarction  Significant Q Waves

Q waves develop over 4 to 24 hours and remain for life.

Significant Q waves are 25–33% of the R wave. Q > 0.038 seconds
Ischemia  Inverted T waves

Supply and Demand problem.
<table>
<thead>
<tr>
<th>Axis</th>
<th>Lead I</th>
<th>Lead II</th>
<th>Lead III</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal 0-90</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>aVF positive</td>
</tr>
<tr>
<td>Physiologic Left Axis 0--40</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>aVF negative</td>
</tr>
<tr>
<td>Pathological Left Axis -40 to -90</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>Anterior Hemiblock</td>
</tr>
<tr>
<td>Right Axis 90-180</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>aVF positive Posterior Hemiblock</td>
</tr>
<tr>
<td>Extreme Right Axis No Man’s Land</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>![Waveform]</td>
<td>aVF negative Ventricular in origin</td>
</tr>
</tbody>
</table>
# Types of MI

## Type 1
- Spontaneous MI related to ischemia due to a primary coronary event such as plaque erosion and/or rupture, fissuring, or dissection.
- Non ST Elevation MI or ST Elevation MI

## Type 2
- MI secondary to ischemia due to either increased oxygen demand or decreased supply.
  - Coronary artery spasm, coronary embolism, anemia, arrhythmias, hypertension, or hypotension
  - Respiratory distress, renal failure, sepsis

## Type 3
- Sudden unexpected cardiac death, including cardiac arrest, often with symptoms suggestive of MI.
- Accompanied by presumably new ST elevation or new LBBB
- Evidence of fresh thrombus in the coronary artery by angiography

## Type 4
- MI associated with coronary angioplasty or stent.

## Type 5
- MI associated with coronary artery bypass grafting (CABG)
STEMI Reperfusion Strategy

Door-to-needle goal of 30 minutes  Thrombolytic (fibrinolysis) therapy

- TNKase (tenecteplase)
- Activase (t-PA, alteplase)
- Retavase (r-PA, reteplase)
- Streptokinase (Streptase)

Door-to-Balloon (D2B) within 90 minutes

- Angioplasty
  - PTCA – Percutaneous Transluminal Coronary Angioplasty
- Coronary artery stents
- Atherectomy Percutaneous Coronary Intervention
AMI Guideline Management

During hospitalization

- Aspirin within 24 hours before or after arrival
- Smoking (tobacco) cessation advice/counseling

At Discharge

- Aspirin
- Beta-Blocker
- Statin
- ACE-I or ARB therapy for left ventricular systolic dysfunction, EF (ejection fraction) ≤ 40%
Patient Safety Indicators

1. Mortality
2. Readmission with 30 days
3. Patient Satisfaction
Right Atrial Hypertrophy

tall p waves
Right Atrial Hypertrophy

Lung disease
- COPD
Pulmonary Emboli
Pulmonary Hypertension

Tall, peaked P-waves
- II, III, aVF

Causes
What will see
Left Atrial Hypertrophy
Left Atrial Hypertrophy

**Causes**

- Hypertension
- Left atrial enlargement
  - Pulmonary edema

**What will see**

- Broad or notched P–waves
- Prolonged P wave (>0.12)
- V1 broad trough
- I, II, & V4-V6 notched
Right Ventricular Hypertrophy

qR & tall R in V1

deep S in V6
Right Ventricular Hypertrophy

**Causes**
- Increased right ventricular mass
  - Pulmonary stenosis
  - Primary pulmonary hypertension
  - Diastolic overload
  - Atrial septal defect

**What will see**
- Right axis deviation
  - Tall “R” waves in right precordial leads
    - V1 most sensitive
  - Deep “S” waves in left precordial leads
    - V6
Left Ventricular Hypertrophy

tall R in V6 and deep S in V1
Left Ventricular Hypertrophy

Increased LV muscle mass
- Hypertension
- Cardiomegaly
- Cardiomyopathy
- Valvular regurgitation
- Aortic stenosis

Left axis deviation

Measure
V1 or V2 Deepest “S” wave
PLUS
V5 or V6 Tallest “R” wave

#mm add up > 35 mm
Heart Failure Epidemiology

<table>
<thead>
<tr>
<th>Lifetime Risk</th>
<th>Prevalence</th>
<th>Incidence</th>
<th>Mortality</th>
<th>Hospital Discharges</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% of Americans ≥ 40 years</td>
<td>~5.7 million</td>
<td>Over 650,000 annually</td>
<td>50% within 5 years 1 yr ~ 30%</td>
<td>&gt; 1,000,000 annually</td>
<td>&gt; $40 billion annually</td>
</tr>
</tbody>
</table>

- 1 month readmission rate of 25%
  - 50% at 6 months
- Over half of the total cost of HF care in the US is spent on hospitalizations.
## Definition of Heart Failure

<table>
<thead>
<tr>
<th>Classifications</th>
<th>Ejection Fraction</th>
<th>Description</th>
</tr>
</thead>
</table>
| Heart Failure with Reduced Ejection Fraction (HFrEF) | ≤ 40%             | • Systolic HF  
• Reduced Left Ventricle contractility  
• Diminished ejection fraction |
| Heart Failure with Preserved Ejection Fraction (HFpEF) | ≥ 50%             | • Diastolic HF  
• Stiffing of the ventricle  
• Problem with ventricular filling or relaxation |
| HFpEF Borderline                                     | 41 to 49%         | • Borderline or intermediate group                                          |
| HFpEF Improved                                       | > 40%             | • Previously had HFrEF                                                      |
Causes for elevated BNP (Natriuretic Peptide) Levels

Cardiac
- Heart Failure, including right ventricle syndromes
- Acute coronary syndrome
- Heart muscle disease, including left ventricular hypertrophy
- Valvular heart disease
- Pericardial disease
- Atrial fibrillation
- Myocarditis
- Cardiac surgery
- Cardioversion

Noncardiac
- Advancing age
- Anemia
- Renal failure
- Pulmonary causes; obstructive sleep apnea, severe pneumonia, pulmonary HTN
- Critical illness
- Bacterial sepsis
- Severe burns
- Toxic-metabolic insults
Biomarkers for Heart Failure

- Galectin - 3
- ST 2
- Interleukin 6
- Procalcitonin
Pharmacologic Therapy for Heart Failure

- Diuresis
- ACE inhibitor or ARB
- Beta blocker

- Aldosterone antagonist
  - Spironolactone

- Hydralazine/nitrate
  - Hydralazine and isosorbide dinitrate

- Chronic anticoagulation for permanent or persistent atrial fibrillation
- Statins no benefit in solely HF
  - Omega 3 supplementation is reasonable
- Calcium Channel Blockers are not recommended in HFrEF
- Digoxin mixed reviews
- Avoid NSAIDs
Beta Blockers

- Reduce catecholamine levels
- Decrease myocardial ischemia and limit infarct size
- Reduce myocardial workload and oxygen demand
- Reduce heart rate and blood pressure
- Reduce supraventricular and malignant ventricular arrhythmias

Only three BBs have been shown in studies to be beneficial in heart failure.

Metoprolol – Lopressor, Toprol XL
Carvedilol – Coreg
Bisoprolol - Zebeta
Renin-Angiotensin-Aldosterone System

- Decrease in renal perfusion (juxtaglomerular apparatus)
  - Renin
  - Angiotensinogen → Angiotensin I → Angiotensin II
  - Lungs
  - Surface of pulmonary and renal endothelium: ACE
  - Kidney

- Sympathetic activity
- Tubular Na⁺ Cl⁻ reabsorption and K⁺ excretion, H₂O retention
  - Adrenal gland: cortex
  - Aldosterone secretion
  - Arteriolar vasoconstriction, increase in blood pressure
  - Pituitary gland: posterior lobe
  - ADH secretion
  - Collecting duct: H₂O absorption

Legend:
- Blue: Secretion from an organ
- Green: Stimulatory signal
- Red: Inhibitory signal
- Orange: Reaction
- Purple: Active transport
- Gray: Passive transport

Water and salt retention. Effective circulating volume increases. Perfusion of the juxtaglomerular apparatus increases.
ACE-I & ARBs

ACE-I
Lisinopril – Prinivil, Zesteril
Benazepril – Lotensin
Captopril – Capoten
Ramipril - Altace
Enalapril – Vasotec
Fosinopril – Monopril

Adverse effect – cough, angioedema, hyperkalemia
Watch renal function.

ARB
Losartan – Cozaar
Valsartan - Diovan
Irbesartan – Avapro

Tend not to have as many adverse effects.
New medications for HF

Ivabradine (Corlanor)
- 5 mg BID increasing to 7.5 mg BID with meals
- Adverse effects: Bradycardia, visual disturbances
  - More about funny channel blockers @
    http://circres.ahajournals.org/content/106/3/434.full.pdf+
    html

Sacubitril/valsartan (Entresto)
- Film-coated tablets (sacubitril/valsartan): 24/26 mg; 49/51 mg; 97/103 mg BID
- Adverse effects: Hypotension, angioedema, hyperkalemia
Nonpharmacological Interventions

- Nutritional supplements
  - For HFrEF patients

- Exercise training or regular physical activity

- Sodium restriction is reasonable
  - 2000-3000 mg daily, avoid potassium-based salt substitutes

- Daily weight monitoring

- Daily fluid limitation
  - 2 liters per day

- Education focused on self-care
  - Smoking cessation, weight reduction, discontinue alcohol use, vaccination
  - Manage co-morbidities – diabetes, high blood pressure, atrial fibrillation
Life Vest & Cardiac Devices

- **Zoll Life Vest**
  - Often prelude to an implantable device
  - Non-invasive and continuous monitor
  - 98% first shock success rate

- **Implantable Cardioverter Defibrillator**

- **Cardiac Synchronization Therapy- CRT**
  - Biventricular pacing
  - 3 leads – right atrium, right ventricle, left ventricle
CRT - BiVentricular Pacing

EF \leq 35\% \text{, Wide QRS} > 10 \text{ ms. Very complex algorithm.}
Surgical Therapies for HF

- Percutaneous Coronary Intervention
- Coronary revascularization (CABG)
- Transcatheter aortic valve replacement (TAVR)
- Aortic valvuloplasty
- Aortic valve replacement
- Mitral valve repair or replacement
Heart Failure Guideline Management

Medical management more complex.

- Ejection Fraction (EF%) must be documented.
  - New or documentation of known

- Discharged on
  - Specific Beta Blocker
  - ACE-I or ARB therapy for left ventricular systolic dysfunction, EF (ejection fraction) ≤40%

- Educated on
  - Daily weights
  - Fluid limitations
  - Diet
  - Signs and symptoms
  - Follow up appointment
Patient Safety Indicators

1. Mortality
2. Readmission with 30 days
3. Patient Satisfaction
Sinus impulses bypass the AV node via an accessory pathway (AP) conduction.

- Uncommon - ~2 per 1,000 in the general population
- Can be right-sided, left-sided, anterior, or posterior – and sometimes more than a single AP.
- A very fast atrial fibrillation (250-300) – think WPW.
Accessory Pathway

Normal electrical pathways

Abnormal electrical pathway in Wolff-Parkinson-White syndrome
WPW

Three key signs:

- Delta wave which may be positive or negative
- QRS widening
- Short PR interval
WPW
Treatment and Management

**Acutely**
- Adenosine
- Consult cardiology

**Long Term**
- Catheter ablation
- Flecainide (Tambocor)
- Sotalol (Betapace)
Hypertrophic Cardiomyopathy

Normal

Hypertrophic cardiomyopathy

Dilated cardiomyopathy

- Arch of aorta
- Left atrium
- Aortic valve
- Mitral valve
- Left ventricle
- Right atrium
- Tricuspid valve
- Right ventricle
- Ventricular septum
- Small left ventricle
- Thickened ventricular septum
HCM

- Left ventricular hypertrophy in the absence of hypertension or aortic stenosis
  - Previous called hypertrophic obstructive cardiomyopathy (HOCM), idiopathic hypertrophic subaortic stenosis (IHSS)
- Common inherited cardiac disorder
  - Primarily autosomal dominant, over 150 mutations
- ~1 in 500 people
- Number one cause of sudden cardiac death in young athletes
HCM ECG Features

• Deep T-wave inversions
  ○ Particularly in the precordial and high-lateral leads

• Deep, narrow septal Q-waves (dagger-like)
  ○ Most prominent in leads I and aVL

• Left atrial enlargement

• Signs of WPW

• Dysrhythmias: atrial fibrillation, SVT, VT

http://lifeinthefastlane.com/ecg-library/hcm/
HCM
HCM
Treatment and Management

Medication
- Usual heart failure regimen
- Don’t over diurese

Surgical
- Cardiac Transplant
- Septal myomectomy
- Alcohol septal ablation
Cardiovascular Non-Invasive Testing

4 Steps

1. Decide level
2. Choose test
3. Address medications
4. Change diet
## Decide Level – Low, Very Low Risk

<table>
<thead>
<tr>
<th>Risk Factors</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Negative troponin x 2</strong> And <strong>Diagnostic ECG</strong></td>
<td><strong>Low Risk</strong></td>
</tr>
<tr>
<td>□ Dyslipidemia</td>
<td>□ &gt; 3 risk factors</td>
</tr>
<tr>
<td>□ HTN</td>
<td>□ ECG, stress (exercise only)</td>
</tr>
<tr>
<td>□ Smoking</td>
<td></td>
</tr>
<tr>
<td><strong>And</strong></td>
<td><strong>Very Low Risk</strong></td>
</tr>
<tr>
<td>□ Male &gt; 40 years</td>
<td>□ &lt; 3 risk factors</td>
</tr>
<tr>
<td>□ Female &gt; 45 years</td>
<td><strong>Outpatient Stress test and follow up within 7 days</strong></td>
</tr>
<tr>
<td>□ Positive Family Hx</td>
<td></td>
</tr>
<tr>
<td>First degree relatives before age 55 for male and 60 for female.</td>
<td>Date/Time appointment:</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

No additional information is gathered from imaging.
Decide Level – Moderate, High Risk

Moderate – High Risk
- History of CAD
- Diabetes mellitus
- Heart Failure
- Continuous typical chest pain
- *ECG changes from baseline
- Non diagnostic ECG changes
  - LBBB
  - New arrhythmia
  - Early repolarization
  - Atrial fib
- Unable to exercise

Morning
- CV myocardial perfusion imaging (MPI)
- Stress Echo

After Noon and on weekends
- Stress Echo
Choose test

- What is the clinical picture?
  - If you think is ischemic, go ahead with nuclear or stress echo study.

- What is the day of the week and time of day?*

- Can the patient exercise?

- Conditions that affect choice
  - Severe aortic stenosis
  - Glaucoma
  - Pregnancy or breastfeeding
  - Arrhythmias
  - Systemic or pulmonary HTN
  - Asthma, emphysema or COPD
  - Recent AMI or HF exacerbation
  - Had a negative test within the past 6 months with NO intervention**
  - NPO time
  - Caffeine intake

* Conditions that affect choice include:
- Severe aortic stenosis
- Glaucoma
- Pregnancy or breastfeeding
- Arrhythmias
- Systemic or pulmonary HTN
- Asthma, emphysema or COPD
- Recent AMI or HF exacerbation
- Had a negative test within the past 6 months with NO intervention**
- NPO time
- Caffeine intake
Exercise Stress Test

Exercise
- Treadmill
- Arm bike

Basic exercise test
- Order **ECG Stress (Exercise only)** ★ or Stress Treadmill ECG
  - Bruce or Modified Bruce protocol
  - Increase speed and incline over 15 minutes
  - Goal is heart rate at least 85% higher
- Monitoring for ECG changes, S/S, and clinical response
Stress Echo

Procedure
- Echo
- Stress
- Stop – Drop – Rollover
  - Immediately repeat echo
- Compare

Stress
- Exercise on treadmill
- Dobutamine

Order Echo, Stress Drug (if cannot walk) or Echo, Stress Exercise w/o contrast

Will need
- RN to administer dobutamine
- Cardiac Sonographer
- Physician
- ECG Tech

May need imaging enhancer for elevated BMI patients
- Definity
Old terminology – thallium test, adenosine thallium

Pharmacology agent
- Lexiscan
- Dobutamine
- Adenosine

Order CV myocardium perfusion scan rest/stress

Procedure
- Inject with radioactive tracer
- Small glass of water and wait 15-20 minutes
- Scan – with arms above head
- Stress with exercise or pharmacologic agent
- More water and 15-20 minute wait
- Rescan
Monitoring During the Test

ECG changes
- ST elevation or depression

Arrhythmias
- Supraventricular tachycardia (SVT)
- Ventricular tachycardia or fibrillation

Hypotension or Hypertension

Bronchospasm, flash pulmonary edema

Angina
Viability Study

TI 201 used

Sequence

- Inject
- Immediately scan
- Wait 3 hours
- Rescan
- Wait 24 hours
- Rescan

Detects viable ischemic myocardium
1\textsuperscript{st} injection pyrophosphate (PYP) – a tin derivative
Wait 20-30 minutes
2\textsuperscript{nd} injection with radioactive tracer
Scan

Evaluating ejection fraction (EF\%) 
Looking at blood flow, not myocardium
Nursing Considerations

Will be *slightly* radioactive for the next 12-24 hours

- *Limit Time* to exposure
- *Increase Distance* from the patient - one step away

Increase fluid intake

- Help flush out

Universal Precautions

- Isotope is excreted in urine
Common Questions

Can I hold my baby / grandchildren / pet afterwards?
- Yes, but limit time.
- Quick hug then down to decrease exposure

When can I eat?
- Cardiologist to give order.
- OPs can usually eat unless was really positive.

Can I get on / back on the plane?
- Yes, but ask the physician for a letter to avoid problems if the isotope sets off TSA sensors.
Address Medications

- Beta Blockers
  - BB don’t allow HR increase
  - Hold minimum of that morning.
  - Up to 48 hours
  - Occasionally may leave on BB to see the effect of the BB.

- Insulin and BP medications
Address Medications

Vasodilators
- Hold minimum of 12 hours, best if up to 48 hours.
  - Aggrenox
  - Persantine (dipyridamole)
  - Nitrates – Imdur, ntg patches or gtt, Ismo,
  - Calcium channel blockers

Theophylline
- Reverses test
- Slobid, Theo-dur, theophylline sprinkles, aminophylline

Erectile Dysfunction
- Cialis, Viagra
Change Diet

NPO

- Minimum of 4 hours.
  - Best if NPO after midnight.
- Risk of vomiting
- Radioactive agent will collect in the stomach with food.
  - Interferes with visualization of heart.
NO Caffeine

- Caffeine is a vasoconstrictor. Will cause a false negative.
- Stop for 24 hours before test
- Medications with caffeine
  - Aspirin products with caffeine – Excedrin, Anacin, Vivarin, Norgesic,
  - NoDoz, Midol
- Chocolates, including candies, frosting, cookies, pies, cocoa, or chocolate mild
- Coffee or tea – brewed, instant, iced or decaffeinated
- Colas or soft drinks with caffeine, including those labeled “caffeine-free.”
  - Energy Crystal Light, Energy Vitamin water
  - Energy drinks
- Guarana seeds
Other

- MPIs will take a minimum of TWO hours.
- Patent peripheral saline lock or CVC access.
- Wear loose fitting slacks or pants. Bras ok for women.
- Wear comfortable shoes if walking.

- Outpatient to Inpatient admissions do occur.
References


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