Comprehensive Cardiology: Matters of the Heart Class II

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Overview

- Quick review of last week’s concepts
- Finish up intro to arrhythmias
- Conduction disorders
- Myocardial infarction
- Intro to Heart Failure
A look inside the heart

- Atria (upper chambers)
- Ventricles (lower chambers)
- Divided by the septum
Valves

Held in place by chordae tendinae aka "heart strings"
Coronary Arteries

- Branch from the Aorta into left and Right
- Right: Right coronary Artery (RCA)
- Left: Left Main (LM), splits into Left Circumflex (LCX) and the Left Anterior Descending (LAD)
The heart’s electrical route

- **Sinoatrial (SA) Node**: The heart’s pacemaker
  - Intrinsic rate: 60-100 bpm
- **Internodal Pathways**
- **Atrioventricular (AV) Node**: Gate keeper/backup pacemaker
  - Intrinsic rate: 40-60 bpm
- **Bundle of His**
- **Left and Right Bundle Branches**
- **Purkinje Fibres**
  - Intrinsic rate: 20-40 bpm
The ECG

- Single unit represents a heart beat
- Recorded on grid paper
- Height = amplitude
  - Measured in mVolts
- Length = time
  - Large square represents 0.20 seconds
  - Small square represents 0.04 seconds
Depolarization and Repolarization

- Depolarization = contraction
- Repolarization = relaxation

Movement captured on the ECG as changes in the waveform from the isoelectric (flat) line
What is an arrhythmia?

Variation of the normal heart rhythm

Person may have symptoms or not

Symptoms and ECG readings depend on where the arrhythmia originates
Common Arrhythmias - Atria

- Atrial fibrillation/ Flutter
- Sick Sinus Syndrome
  - Rapid switches between tachy and brady
  - Presents as syncope
Other Common Arrhythmias

- AV Blocks
  - Type I, II 1st or 2nd degree, III
- SVT- Supraventricular Tachycardia
Deadly arrhythmias: VT and VF

- **Ventricular tachycardia**: wide complex QRS
  - Fast but regular
  - Person may still have a pulse

- **Ventricular fibrillation**
  - Fast and irregular
  - No pulse
  - Lethal

Figure 1
Pulseless Electrical Activity and Asystole

- Person is considered to be clinically dead
- No pulse for either rhythm
Epidemiology

Most type of arrhythmia is atrial fibrillation.

40,000 Canadians die every year from sudden cardiac death.

Projected to be the greatest cause of death for Canadians by 2020.
Causes of arrhythmias - cardiac factors

- Damage to the heart from an MI
- Valvular disorders
- Cardiomyopathy
- Congenital Heart Disease
- High Blood pressure
Causes of arrhythmias- outside factors

- Alcohol
- Caffeine
- Smoking
- Drugs and Supplements
- Stress
- Thyroid issues
- Kidney disease
- Sleep Apnea
Signs and Symptoms

- Palpitations
- Light headedness/fainting
- Dizziness
- Fatigue
- Chest pain
- Shortness of breath
- Sweating

- No symptoms at all!

Symptoms:

Bradycardia.
- Fatigue
- Dizziness
- Lightheadedness
- Fainting or near-fainting spells
- In extreme cases, cardiac arrest may occur.

Tachycardia.
- Dizziness
- Lightheadedness
- Rapid heartbeat or "palpitations"
- Angina (chest pain)
- Shortness of breath
- Unconsciousness
Diagnostic procedures

- Cardiac exam
- ECG - 12 lead, holter monitor
- Exercise Stress Test
- Electrophysiology Study (EPS)
Electrophysiology Study (EPS)

- Done via catheterization under fluoroscopy
- Insertion at wrist, groin, or neck
- Stimulation of different parts of the heart to see electrical pathways inside the heart
Treatment for arrhythmias - Rx

- Antiarrhythmics
  - Bradyarrhythmias - atropine
  - Tachyarrhythmias - Sodium channel blockers
- Digoxin
- Betablockers
- Calcium Channel Blockers - vasodilators
- Blood thinners
Cardioversion

“RESETTING” OF THE HEART’S ELECTRICAL SYSTEM

LOWER ELECTRICAL LEVELS THAN DEFIBRILLATION

USED MOST COMMONLY FOR ATRIAL ARRYTHMIAS

HIGH SUCCESS RATE

Irregular heart rhythm (before cardioversion)

Normal heart rhythm (after cardioversion)

Cardioversion pads placed on chest and back

Intravenous line (IV)
Treatment for arrhythmias - Ablation

- Can be done as part of an EPS
- Destroy accessory electrical pathways by scarring heart muscle tissue
- **Not** for all arrhythmias
  - SVT, Atrial fib/flutter
- Last resort option after Rx and cardioversion
Treatment for Arrythmias: ICD & Pacemakers

- ICD - Internal Cardiac Defibrillator vs. Cardiac Pacemaker
- Newer devices have both functions
- Several ways to implant the pacemaker
  - Transvenous
  - Thoracotomy or subxiphoid
  - Sternotomy
- Single lead vs multi-lead
Pacemakers & ICD’s

https://www.youtube.com/watch?v=SMXBR_YFocs
Pacemaker follow-up/maintenance

- Last 5-15 years
- Be sure to carry a pacemaker card on you at all times
- Avoid prolonged exposure to devices that transmit electromagnetic pulses/waves
  - Medical equipment
  - Security scanners
  - Cellphones
Arrhythmia Summary

- Arrhythmias are becoming an increasing problem.
- Not everyone who has an arrhythmia is symptomatic.
- ECG’s tell practitioners what kind of arrhythmia the patient has.
- Several treatment options available with varying levels of invasiveness.
- Pacemakers are not needed for all arrhythmias- single lead vs multilead.
Coronary Artery Disease and Acute Coronary Syndrome
Coronary Artery Disease

- Angina
- Acute Coronary Syndrome
  - N-STEMI vs. STEMI
Pathogenesis

- Narrowing of coronary arteries related to age or other factors
- Build up of plaque
- Decrease of blood flow to the heart muscle itself
Angina

- Aka Angina Pectoris
- Stable: triggered by exercise, relieved by medication
- Unstable: can occur during inactivity, not relieved with medication
- Printzmetal: coronary artery spasm
Signs and Symptoms

- Classic: Chest pain
- Jaw pain
- Left arm pain
- Shortness of breath
- Nausea
- Back pain

- Symptoms different in women than in men:
  
  [YouTube Video](https://www.youtube.com/watch?v=JlI487D1gTA)
Diagnosis

- Nuclear stress test - stable angina
- Bloodwork: Troponin, Myocytes
  - UA vs MI
- ECG: ST segment elevation
  - N-STEMI vs STEMI
- Angiography
12 Lead ECG

- Lead = view of the heart
- Bipolar vs unipolar leads
- Different leads of the ECG indicate there is a blockage in different places
N-STEMI vs STEMI

**N-STEMI**
- ST Depression
- T Inversion

**STEMI**
- ST Elevation

**Normal ECG**
- ST Segment
Diagnosis through 12 lead ECG

- Inferior: II, III, AVF
- Anterior: V1-V4 (Septal V1-2)
- Lateral: I, AVL, V5, V6
Angiography

- Allows visualization of blockages in the coronary arteries
- Catheter inserted into wrist or groin- fed up to coronary arteries through the aorta
- Dye injected into different vessels to look for blockages
- If blockages are accessible from this view, angiography will be performed
Treatment

- Medical and Lifestyle Management
- Angioplasty and Stent insertion
- Coronary Artery Bypass Grafting
Medical Management

- Thrombolytics: Clot busting drugs
- Aspirin
- Anti-platelet agent
- Beta-blocker
- Anti-hypertensive
- Cholesterol Lowering medication
Lifestyle factors

- Modifiable risk factors play an important role in patient recovery:
  - Reduce salt and saturated fat intake
  - Routine light exercise and resistance training
  - Quit smoking
  - Manage stress
Angioplasty

- During angiography: opening of a blocked vessel
- Fresh clot: can be aspirated
- Hardened vessels: diamond drill may be used
- Balloon used to inflate a stent inside the affected artery

Video:

https://www.youtube.com/watch?v=gVMi4j6v1E4
Coronary Artery Bypass

- If blockages are not accessible via angioplasty or vessels are too heavily calcified
- Arteries/veins are grafted onto the aorta to bypass the blockages
  - Venous vs arterial grafts
- Most invasive procedure: mid sternotomy required
- Most grafts will need to be replaced after 10 years
Complications - Myocardial Infarction

- If a myocardial infarction is not treated in a timely and effective method, heart tissue death will result.
- Arrhythmias
- Weakened heart muscle - heart failure
- Mental Health conditions
Summary of CAD

- Narrowing of the coronary arteries
- Modifiable and non-modifiable risk factors
- Symptoms are different in men and women
- Angina - Stable, unstable, prinzmetal
- STEMI vs N-STEMI
- Treatment/management depends on the location
- Lifestyle modifications are important in order to avoid reinfarction
Heart Failure

- Inability for the heart to pump blood effectively
- Cardiac Output = Stroke Volume x Heart Rate
- Heart tries to compensate in order to maintain appropriate cardiac output
  - Heart stretches to try and hold more blood
  - Heart becomes more muscular to try and pump harder
  - Heart pumps faster to try and get more blood out
  - Vessels narrow their diameter
Causes of Heart Failure

- Coronary Artery Disease
- Hypertension
- Valvular Disorders
- Cardiomyopathy
- Congenital Disorders
Left vs Right Sided

- **Left sided heart failure**
  - Systolic vs diastolic
  - Generally precedes RHF
  - Symptoms seen in the ‘L’ungs

- **Right sided**
  - Symptoms seen in the ‘R’est of the body
Left sided Heart Failure symptoms:

- Paroxysmal Nocturnal Dyspnea
- Elevated Pulmonary Capillary Wedge Pressure
- Pulmonary Congestion
  - Cough
  - Crackles
  - Wheezes
  - Blood-Tinged Sputum
  - Tachypnea
- Restlessness
- Confusion
- Orthopnea
- Tachycardia
- Exertional Dyspnea
- Fatigue
- Cyanosis
Right sided Heart Failure Symptoms

**Right Sided Heart Failure (Cor Pulmonale)**

- Fatigue
- ↑ Peripheral Venous Pressure
- Ascites
- Enlarged Liver & Spleen
- May be secondary to chronic pulmonary problems
- Distended Jugular Veins
- Anorexia & Complaints of GI Distress
- Weight Gain
- Dependent Edema

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Pulmonary Edema

- Fluid in the lungs
- Accumulates over time, but can be acute as well
  - Flash pulmonary edema
- Lungs sound wet - difficulty breathing
- Can be deadly if left untreated
Diagnosing Heart Failure

- Cardiac Exam
- Blood tests - Troponin
- Chest X-Ray
- Cardiac Stress Test
- Echo
- ECG
- CT/ MRI
Next week

- Heart Failure continued
- Cardiomyopathies
- Valvular Disorders