EMC 451 Advanced ECG Interpretation

AV and Bundle Branch Blocks

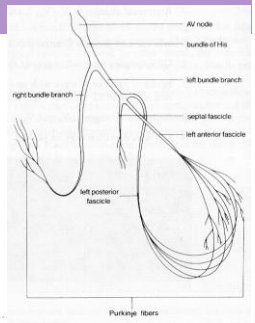
Unit Objectives

Upon completion of this unit, the student will be able to:

- Describe the normal ventricular conduction system.
- Recognize the ECG changes associated with 1 , 2 , and 3 AV block.
- Discuss the clinical significance of 1 , 2 , and 3 AV block.
- List the instances of AV block when pacemaker insertion is necessary.
- List the instances of AV block when the use of atropine is contraindicated.
- Recognize the ECG changes of RBBB.
- Discuss the clinical significance of RBBB.
- Recognize the ECG changes of LBBB.
- Discuss the clinical significance of LBBB.

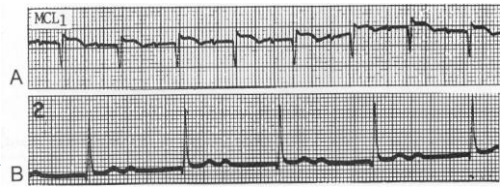
Review of Ventricular Conduction System

Structure	Arterial Blood Supply
AV Node	RCA
Proximal Bundle of His	RCA
Distal Bundle of His	LAD
Proximal Bundle Branches	LAD
RBB	LAD
Left Anterior Fascicle	LAD
Left Posterior Fascicle	LAD and RCA



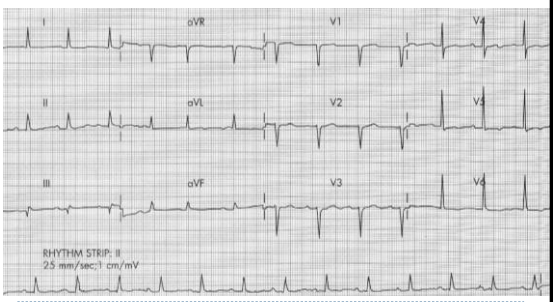
Atrioventricular Blocks

- First Degree AV Block
  - Not really a block
  - Delay in conduction through either the AV node or His bundle.
  - PR interval > 0.20 seconds
  - PR interval usually < 0.40 but may be up to .60 seconds
  - Rarely, PR intervals as long as 1.0 seconds (5 large boxes) have been recorded



Atrioventricular Blocks

- First Degree AV Block continued



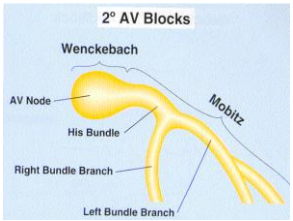
AV Blocks continued

- First Degree AV Block continued
  - Clinical Significance
    - Common finding in normal hearts (3% incidence)
    - Occurs in up to 13% of patients with AMI
    - May be an early sign of degenerative disease of the conduction system
    - May be transient sign of myocarditis or drug toxicity
    - Clinical significance is not a function of the amount of PR interval prolongation
    - Rarely requires treatment.

AV Blocks continued

Second Degree AV Block Type I (Wenkebach)

- Almost always due to a block within the AV node
- Increasing PR interval until a beat is dropped
- Sequence repeats itself, but the ratio of conducted to non-conducted beats does not have to remain constant
- The block may be intermittent
- R-R interval progressively shortens within each group of conducted beats



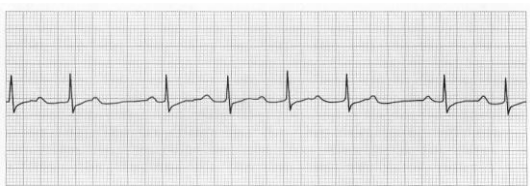
AV Blocks continued

Second Degree AV Block Type I (Wenkebach) continued

- QRS complexes are narrow unless there is an associated BBB
- Clinical Significance
  - Usually does not progress to more advanced conduction problem
  - Commonly associated with digitalis toxicity, inferior wall MI, RV MI, and acute myocarditis
  - May also be a normal finding in trained athletes
  - If complete heart block develops because of inferior wall MI, the escape mechanism is junctional and does not always necessitate pacemaker insertion.

AV Blocks continued

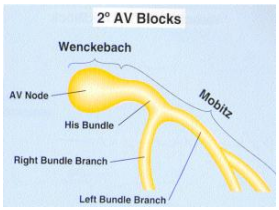
Second Degree AV Block Type I (Wenkebach) continued



AV Blocks continued

Second Degree AV Block Type II

- Usually due to a block below the AV node, within or below the His bundle
- Almost always associated with RBBB
- No lengthening of PR interval, or shortening of RR interval, as with Wenkebach
- P waves conducted at 2:1-4:1 ratios commonly, but higher ratios are possible
- P to R conduction ratios may vary
- QRS complexes usually broad. The complete block of one bundle causes the QRS to be broad, while the intermittent block of the other bundle causes the dropped beats.



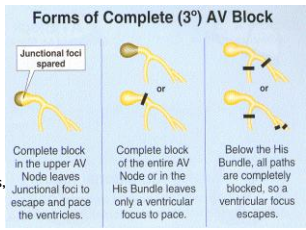
AV Blocks continued

- **Clinical Significance**
  - Not as common as Type I AV block, and is more serious.
  - Denotes disease in lower portions of the conduction system.
  - Often associated with Stokes-Adams syncope and deteriorates into complete AV block.
  - Associated with anteroseptal MI and chronic fibrotic disease of the conduction system.
  - Indicates a high risk patient when associated with anteroseptal MI.
  - When complete heart block develops, the escape mechanism is slow and of ventricular origin.
  - Atropine is rarely effective in improving ventricular rate, thus requireing pacemaker insertion.
  - Impossible to differentiate Type II with 2:1 conduction from Wenkebach with 12 lead EKG.

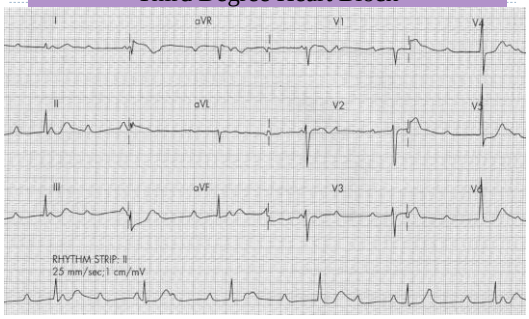
AV Blocks continued

Third Degree Heart Block

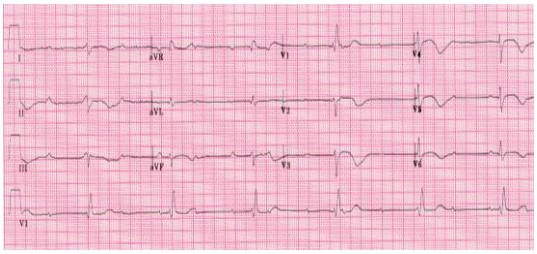
- No atrial impulses are conducted
- Block may be located in the AV node, His bundle, or bilateral BBB
- If block in upper AV node, junctional escape rhythm ensues, otherwise, escape rhythm is ventricular and QRS is wide.



AV Blocks continued
Third Degree Heart Block



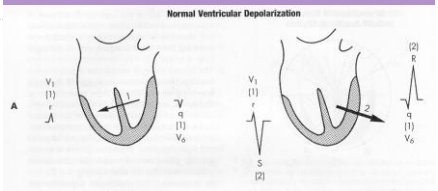
AV Blocks continued
Third Degree Heart Block



AV Blocks continued
Clinical Significance of 3rd Degree Heart Block

- Rate and dependability of the escape rhythm is related to the level of the lesion.
- An escape at the top of the His bundle has a rate of about 55 bpm, is relatively dependable, and may not require pacemaker insertion. This type of 3rd degree block is associated with inferior MI.
- Lower level lesions produce wide QRS complexes, slower rates, less dependable escape rhythms, and require pacemaker insertion. These are usually associated with anterior MI.
- AV dissociation loses "atrial kick," reducing cardiac output that may result in syncope or angina.
- If the block is below the AV node, increased SA firing with atropine, exercise, or catecholamines would compound the block. If the block is at the AV node, increased SA firing and AV conduction speed would improve the block.

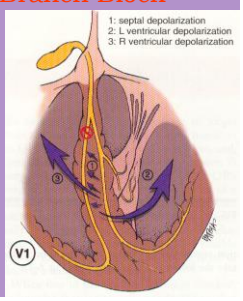
Normal Ventricular Conduction



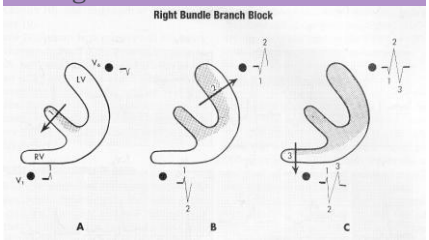
- Normally, the left side of the septum is first stimulated by a branch of the left bundle, producing a small positive r wave in V_1.
- The second phase is simultaneous depolarization of the left and right ventricles. The left ventricle, being larger, is electrically dominant, producing a deep S wave in V_1.

Right Bundle Branch Block

- Phase 1 and 2 ventricular depolarization continue as normal, but depolarization of the right ventricle is delayed, producing a phase 3 depolarization.
- Phase 3 depolarization is directed to the right, producing a wide, positive R' wave in V_1.

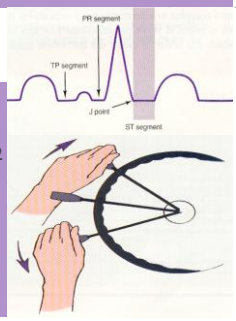


Right Bundle Branch Block



Right Bundle Branch Block

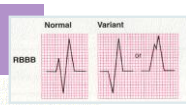
- Simpler Method to Diagnose RBBB
  - QRS is wide (≥ 0.12 seconds)
  - Terminal force of QRS complex in V_1 is positive (up on the turn signal)

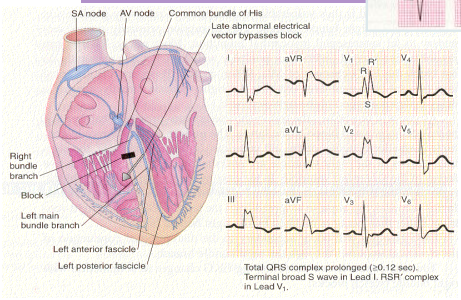


Right Bundle Branch Block and T Wave Changes

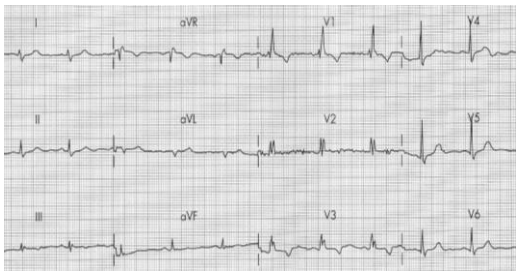
- Because ventricular depolarization is abnormal, so are the T waves. The T wave is expected to be opposite in polarity to the terminal component of the QRS complex in the right precordial leads. This is known as secondary T wave changes and is a normal consequence of BBB.
- If the polarity of the T wave is the same as that of the terminal component of the QRS complex, myocardial disease is suspected.
- T wave changes in leads other than V_1 are primary T wave changes and are not the result of RBBB.

Right Bundle Branch Block





Right Bundle Branch Block

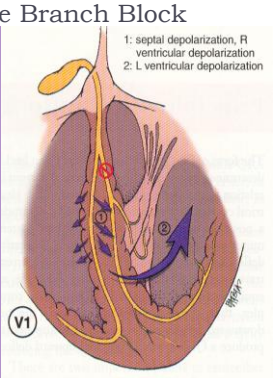


Right Bundle Branch Block

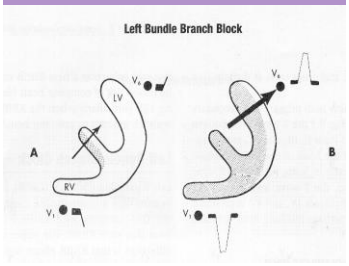
- Clinical Significance
  - May be caused by a number of factors, including COPD, atrial septal defect, pulmonary hypertension, pulmonary stenosis, pulmonary embolism, anterior wall MI, inferior wall MI, and degenerative changes of the conduction system.
  - When associated with anterior wall infarction, new onset RBBB indicates a risk for complete heart block, especially when accompanied by left anterior or posterior hemiblock.
  - When associated with anterior wall MI, mortality is high because it signifies an occlusion in the proximal LAD. Even without complete heart block, mortality is high because of extensive myocardial damage and pump failure.
  - Normally, RBB does not require treatment.

Left Bundle Branch Block

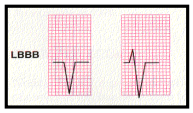
- Normally, the septum depolarizes from left to right. But in the presence of LBBB, the septum depolarizes from right to left.
- Results from either total occlusion of left main branch or a simultaneous block in both anterior and posterior fascicles.
- The normal septal r wave in V_1 is lost, and the total time for left ventricular depolarization is prolonged.
- A QS pattern is produced in V_1.
- Axis is normal or deviated to the left.



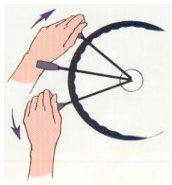
Left Bundle Branch Block



Left Bundle Branch Block



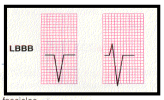
- Simpler Method to Diagnose LBBB
  - QRS is wide (≥ 0.12 seconds)
  - Terminal force of QRS complex in V_1 is negative (down on the turn signal)

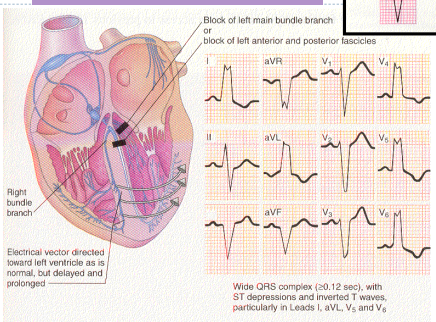


Left Bundle Branch Block

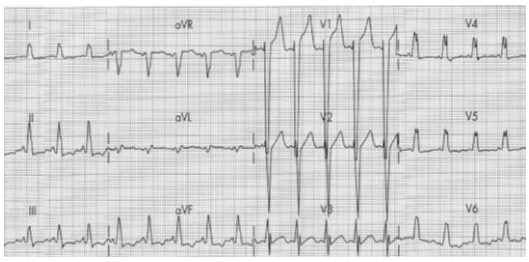
- Because ventricular depolarization is abnormal, so are the T waves. The T wave is expected to be opposite in polarity to the terminal component of the QRS complex in the **left** precordial leads($V_5 - V_6$). This is known as secondary T wave changes and is a normal consequence of BBB.
- If the polarity of the T wave is the same as that of the terminal component of the QRS complex, myocardial disease is suspected.
- T wave changes in leads other than $V_5 - V_6$ are primary T wave changes and are not the result of LBBB

Left Bundle Branch Block





Left Bundle Branch Block



- Clinical Significance
  - Usually a sign of organic heart disease (ischemic LCA disease, chronic hypertensive heart disease, calcification of the mitral valve, aortic stenosis or regurgitation, and cardiomyopathy)
  - Most patients with LBBB have underlying LVH and impaired LV function.
  - Degenerative changes in the conduction system may lead to LBBB, particularly in the elderly.
  - LBBB may be the first clue to 4 previously undiagnosed pathologies: CAD, valvular heart disease, hypertensive heart disease, and cardiomyopathy.
  - It is very difficult to diagnose AMI in the setting of LBBB.