Dysrhythmia Recognition
    Basics in practice
    Nursing Skills 221

Section 1: Fundamentals of the Cardiac Conduction system

Leads: The human body runs on electrical activity so the understanding of this is important to remembering.

- Resting cells also known as polarized, carry a positive charge
- Shifting of electrolytes reverses the charge to negative, this process is depolarization
- Repolarization is the resting phase when the cells are turning back to positive on cell wall.

Three basic “Laws of Electrocardiography”

1. A positive (upward) deflection will be recorded by any lead if depolarization spreads toward the positive pole of that lead.

2. A negative (downward) deflection will be recorded if depolarization spreads toward the negative pole (or away from the positive pole) of any lead.

3. If the depolarization path is directed at right angles (perpendicular) to any leads, a small biphasic (RS or QR) deflection will be recorder.
Standard Limb Leads: Leads I, II, & III and they record frontal plan activity. These are bipolar leads. **Which means that each of these leads has two electrodes which record the electrical potential of the heart?**

I. Positive electrode is on the left arm and the negative electrode is on the right arm. **The important thing to observe is that the direction of depolarization moves generally toward the positive electrode.** Thus you see a positive or upright deflection.

II. Records the difference of potential between the left leg and the right arm. The left leg is positive and the right arm electrode is negative. **Notice the direction of depolarization moves generally toward the positive electrode.** Therefore, the QRS is positive or upright.

III. Records the difference of potential between the left leg and the left arm. **Lead III, the left leg electrode is positive** and the left arm electrode becomes negative. The direction of depolarization moves between the positive and the negative electrodes. Thus, we can expect that the QRS will appear partly positive and partly negative (biphasic).
The Augmented Leads: aVR, aVL, and aVF are designed to increase the amplitude of the deflection by 50%. The leads are unipolar in nature (one electrode on the body) and record electrical potential from both the right and left arms and the left leg.

**aVR** stands for *augmented voltage right arm*

Faces the heart from the right shoulder. The important thing to notice is that the direction of depolarization moves toward the negative electrode. Thus, the QRS is directed negatively.

**aVL** stands for *augmented voltage left arm*.

Faces the heart form the left shoulder and is oriented to the left ventricle. The left arm electrode is positive. The negative electrode extends in an imaginary direction between the right arm and left leg electrodes. The important thing to notice is that the direction of depolarization moves more or less perpendicular to the positive and negative electrodes. Thus the wave is neither extremely positive nor negative (biphasic).

**aVF** stands for *augmented voltage foot*.

The left leg electrode is positive the negative electrode extends in an imaginary direction between the right arm and left arm electrodes. The important point to notice is that the direction of depolarization moves principally toward the positive electrode. Thus, the wave is positive.
Precordial Leads

There are six chest or precordial leads that are identified by the letter V – V1, V2, V3, V4, V5, & V6. The V leads record electrical potential in the horizontal plain and provides six views for the hearts activity. There is a **single positive electrode which is moved to all six positions on the chest wall.**

V1 is located over the 4\textsuperscript{th} intercostal space to the right of the sternal border.

**Mostly negative deflection**

V2 is located over the 4\textsuperscript{th} intercostal space to the left of the sternal border

**Mostly negative deflection**

V3 is located between V2 and V4

**Mostly biphasic more**

V4 is located at the 5\textsuperscript{th} intercostal space on the midclavicular line.

**Mostly positive deflection**

V5 is located at the 5\textsuperscript{th} intercostal space on the anterior auxiliary line.

**Mostly positive deflection**

V6 is located at the 5\textsuperscript{th} intercostal space on the midauxiliary line.

**Mostly positive deflection**

Since the left ventricle is the most important heart chamber, the various leads are designed to look at its surfaces.

- Leads I and aVL look at the lateral surface of the left ventricle (high lateral)
- Leads II, III and aVF look at the inferior surface of the left ventricle
- Leads V1, V2, V3 look at the anteroseptal surface of the left ventricle
- Leads V5 and V6 look at the apical surface of the left ventricle (low lateral)
- There are no leads that view the posterior region of the left ventricle directly. Must look for reciprocal changes
The Conduction system

The electric impulse normally originates in the sinoatrial node (SA) and travels across the heart to initiate myocardial muscle depolarization.

- Sinoatrial (SA) node
- Intranodal Pathways
- Atrio-ventricular (AV) node
- Right and left bundle branches
- Purkinje fibers

P-wave

Atrial excitation begins at in SA node and spreads through the right and left atria. Indicated by a P wave, normally upright in leads I, II, aVF, and V3-V6. P waves are inverted in leads aVR and aVL.

The P wave represents depolarization of both the right and left atria. Normal P wave is not over 0.11 seconds

P-R interval

Is the time for the electrical excitation to pass from the SA node to the AV junction in the upper ventricle.

PR intervals normally range is 0.12 – 0.20 seconds and includes SA excitation and AV Pause
1. pause to increase filling of ventricle
2. pause slow heart rate usually between 160 – 220 bpm

P-R segment:

Is from the end of the P wave to the beginning of the R/Q wave. This represents the AV pause
QRS Complex:
- Represent **depolarization of the ventricular** muscle
- The first downward (negative) deflection is the **Q wave**
- The first upward (positive wave or deflection is the **R wave**
- If a negative deflection follows an R wave, it is labeled an **S wave**.
- Usually measured of **0.04 – 0.11 seconds**

ST segment and T wave:
- ST segment (**straight line between the S wave and T wave**) represents the early phase of ventricular muscle recovery.
  - Usually identified as isoelectric, or above or below isoelectric line
- The T wave is the **recovery phase (repolarization)** after ventricular activation

QT Interval
- Represents the depolarization and repolarization of the ventricle
- Starts with the Q wave and goes till the end of the T wave.
- Measures from 0.32 to .40 seconds, should be less than **50%** of R to R time

U Wave
- Represents repolarization of Purkinje fibers. May also be seen in:
  - Hypokalemia
  - Hypertension or heart disease

PP interval signifies atrial rhythm and rate
RR interval signifies ventricular rate and rhythm
TP interval is isoelectric period
J point signifies the start of the T wave, & end of the S wave, usually indicated by thickening of the line
Paper Time

- EKG recording paper is run at a standard speed of 25 mm per second to standardize the measurement of the various electrical events.
- EKG paper is subdivided both horizontally and vertically with 1 mm and 5 mm (dark lines) spaced lines. The vertical lines represent time intervals. Thus denotes time:
  - Each small square represents 0.04 seconds
  - 5 small boxes make a Large (dark line) box. This represents 0.20 seconds
  - 15 large boxes = 3 seconds

Calculating Heart Rate:

1. Count the number of cardiac cycles within a 6 second strip and multiply by 10. Used with irregular rates.
2. Count the number of small boxes (0.04 seconds) between 2 successive R waves and divide by the constant 1500. Ex: 1500 / 15 = 100 beats per minutes. Used with regular rhythms.
3. Count the number of large boxes (0.2 seconds) between 2 successive QRS complexes and divide by the constant 300. EX: 300 / 3 = 100 beats per minutes. Used with regular rhythms.
4. For a quick count of a regular rhythm, select a QRS complex (R wave) that coincides with a thick line. Count the number of small lines between 2 successive R waves, the lines will be represented by the following order of rates: 300, 150, 100, 75, 60, 50, 42, 37, 33, 30…
Interpreting dysrhythmias

1. Determine if the rhythm is regular
   a. Regular or irregular
   b. Compare R-R & P-P intervals for entire strip

2. Determine the heart rate
   a. Irregular rates should be counted for 1 minute
   b. Determine both Atrial and Ventricular rates

3. Evaluate the P activity
   a. Are there P waves?
   b. Are they uniform across the strip (measurement)?
   c. Do all the P waves look alike across the strip
   d. Is the P-P interval regular?
   e. If actual atrial wave forms are difficult to identify, does the base line appear chaotic.
   f. Measure PR interval, is it consistent (.12-.2)

4. Evaluate the ventricular activity
   a. Are the QRS’s or normal duration (less than 0.12 seconds)
   b. What are the ventricles doing (look of lines)

5. Evaluate the relationship between atrial and ventricular activity
   a. Is each P wave producing a QRS
   b. Are there P waves that are not followed by QRS complexes
   c. Is the PR interval of all conducted beats constant, does it vary or is there no established relationship

What are Dysrhythmias?

1. Disorders of the formation and/or conduction of electrical impulses in the heart.
2. May/Can/Will cause disturbances of heart rate and/or heart rhythm
3. May be evidenced by changes in hemodynamics
4. Diagnosed by analyzing electrocardiogram or telemetry
Rhythms

Sinus Rhythms

Normal Sinus Rhythm (NSR)
- Rate between 60 and 100 beats per minute
- Regular rhythm
- P waves are uniform with normal measurements
- The QRS complexes are all of normal configuration and duration
- Each P wave produces a QRS. The P-R interval is normal and consistent across the strip (so, atrial activity is related to ventricular activity)

Sinus Bradycardia
- Rate less than 60 beats per minute
- Regular rhythm
- P waves are uniform with normal measurements
- The QRS complexes are all of normal configuration and duration
- Each P wave produces a QRS. The P-R interval is normal and consistent across the strip (so, atrial activity is related to ventricular activity)

Sinus Arrhythmia
- The heart rate falls between 60 and 100 beats per minute
- The rhythm is irregular (only slightly irregular) with respiratory function
- P waves are uniform with normal measurements
- The QRS complexes are all of normal configuration and duration
- Each P wave produces a QRS. The P-R interval is normal and consistent across the strip (so, atrial activity is related to ventricular activity)
Sinus Tachycardia

- The rate is over 100 beats per minute and less than 140/160 beats per minute
- Regular rhythm
- P waves are uniform with normal measurements
- The QRS complexes are all of normal configuration and duration
- Each P wave produces a QRS. The P-R interval is normal and consistent across the strip

Atrial Dysrhythmias

Premature Atrial Contractions (PAC’s)

- The heart rate is usually between 60 and 100 beats per minute but may also occur in bradycardia and tachycardia
- The rhythm is irregular
- P waves are uniform with normal measurements except in premature beat
  1. Early complex has unique P wave configuration
- The QRS complexes are all of normal configuration and duration
- Each P wave produces a QRS. The P-R interval is normal and consistent across the strip except in premature beats.
- Conduction:
  1. A normal QRS follow the abnormal P wave. There is a slight pause or delay before the next normal beat. This pause tends to partly compensate for the prematurity.
- Misc data: Occurs in Pulmonary disease, right heart disease, and myocardial infarction.
  1. Drugs like epinephrine, digitalis, coffee, tea, alcohol, tobacco or emotional distress or fatigue may increase frequency.
Atrial Tachycardia

- Rate between 160 and 220 beats per minute
- Rhythm is usually regular
- P waves are uniform with normal measurements
  1. may be buried in the QRS complexes or T waves and not visible; or may be similar to the contour of sinus P waves
- The QRS complexes may be normal configuration and duration, but can/may be widened
- Each P wave produces a QRS. The P-R interval is normal and consistent across strip.
- Conduction: A ventricular complex follows each P wave by the same interval
- Misc data:
  - Paroxysmal atrial tachycardia = short burst or runs of atrial tachycardia referred to as PAT
    - Also called supraventricular = implies that the rhythm originates above the level of the ventricles.
    - Associated with coronary artery disease, valvular disease (rheumatic mitral disease).
    - May be precipitated by emotional stress, drug actions of digitalis or quinidine, coffee, tea, tobacco, & alcohol.
    - Increased rate = increased oxygen demand and consumption of the cardiac muscle which may cause ischemia of the myocardium and may precipitate an anginal attack (chest pain).
Atrial Flutter

- Rate varies:
  - Controlled is rate below 100
  - Uncontrolled is rate above 100
- Rhythm varies may be regular or irregular, usually **regular rapid atrial impulses occurring at a rate of 220 – 350 per minute.**
- F (flutter) waves appear as saw-toothed waves
  - Atrial rate may be 220 – 350
  - AV node incapable of conduction more than 220 beats
  - No isoelectric line is visible
- QRS are usually narrow with a rate between 60 to 150
- Conduction: usually ½, 1/3, or ¼ of the flutter (atrial) impulses will be conducted to the ventricles.
- Misc. data: *Physiologic block:* protective mechanism so rate rarely goes above 220

Atrial Fibrillation

- Rate varies
  - Controlled rates below 100
  - Uncontrolled rates above 100
- Rhythm irregular – irregular
- No P wave, there are bizarre and irregular deflection
  - No coordinated activation process in the atria
- QRS may be narrow or wide depending on site of initiation.
  - QRS rate varies
- Conduction: Bizarre
  - Most of the atrial impulses which reach the AV node are blocked. Those impulse that pass through the AV node are normally conducted
- Misc. data:
  - Associated the **hyperthyroidism, rheumatic heart disease, cardio-respiratory disease, hypertensive heart disease, arteriosclerotic heart disease, myocardial infarction, surgery, infection**
Junctional Dysrhythmias

Junctional Rhythm

- Usually regular rhythm
- The pacemaker impulse formation is usually slower than the sinus node (40-60 beats per minute).
- Occurs secondary to failure or disruption of the sinus pacemaker (escape rhythms)
- P waves are usually inverted or upside down in leads II, III, and aVF.
- P waves may occur before, during or after the QRS
- The QRS complexes occur regularly are uniform in appearance, and normally measure less than 0.12 seconds.

Premature Junctional Complexes

- The premature beat interrupts the underlying rhythm
- An inverted P wave may occur before, during or after the QRS complex of the premature beat.
- The QRS of the premature beat is usually similar to the QRS complexes in the underlying rhythm
Ventricular Dysrhythmias

Premature Ventricular Contractions
- Occur prematurely, interrupting the underlying rhythm
- There may be a P wave following the QRS, usually **P wave is absent**
- QRS complexes are wide and bizarre in appearance, measuring 0.12 seconds or greater
  - T wave in opposite direction of QRS
  - Multi-focal will look different than other PVC’s
- **May be a compensatory pause following the premature beat**

Ventricular Tachycardia
- Rate is usually rapid, between 140 – 200 beats per minute
- The P wave are absent
  - P waves usually buried in the QRS complexes, thus obscure
- The QRS complexes are wide and bizarre
- The ventricles are directly stimulated by an ectopic ventricular focus firing repeatedly or through a reentry process. This action is independent of atrial activity
- The ventricular rhythm is basically regular
- **Life threatening rhythm treatment must be immediate**
  - **CPR**
  - **ACLS**
- Fusion or capture beats may be evident
  - Fusion beat is an abnormal beat produced by a double stimulation. A sinus impulse is conducted normally through the atria, and at the same time an ectopic ventricular focus fires (PVC) initiating depolarization of the lower part of the ventricles. A collision occurs
Ventricular Fibrillation
- Chaotic, uncoordinated ventricular depolarization
- Total irregularity of electrical activity, NO PQRST can be seen and the base line appears to wander
- **Life threatening rhythm treatment must be immediate:**
  - CPR
  - Defibrillation

Idioventricular Rhythm (Ventricular Escape Rhythm)
- When heart rate slows the fastest distal pacemaker will take over, SA node 60 – 100 bpm, junctional 40-60 bpm, ventricular 20-40 bpm.
- Rate usually slow usually 20 to 40 bpm
  - May accelerated in response to catecholamines
- Rhythm regular
- No P wave, may be buried in QRS or T waves
- QRS wide and bizarre, usually T wave in opposite direction of QRS

Ventricular Asystole
- Rate undetectable
- Rhythm undetectable
- P waves absent
- QRS absent
- **Life Threatening rhythm**
  - CPR
  - ACLS
Heart Blocks

First degree heart block
- Rate varies
- Rhythm usually regular
- P wave upright, **PR interval longer than 0.20 seconds**
- QRS usually normal
- Misc. data:
  - Most frequently associated with coronary artery disease, digitalis administration and all types of acute myocardial infarction

Second Degree AV Block

Mobitz Type I – Wenckebach
- Progressive prolongation of the PR interval until a P wave is finally blocked (not conducted), look for **group beating**
- Varied rate
- Irregular rhythm
- QRS may be normal or wide, depending on electrical pathway used
- Misc data:
  - Most frequently associated with acute inferior wall myocardial infarction, 2\textsuperscript{nd} to ischemic damage of the AV node, also digitalis toxicity

Mobitz Type II
- Usually originates below the level of the bundle of his, indicating severe injury
- Irregular rate
- P wave usually normal, **PR interval normal and constant in conducted beats except for the blocked QRS**
- QRS may be thin or wide depending on ventricular damage
- All 2:1 blocks are considered Type II until proven otherwise
Complete Heart Block
- The atrial and ventricular rates are different, the atrial activity is independent of or dissociated from, ventricular activity (AV dissociation)
- The atrial rate (P waves) is faster. No sinus impulses are conducted through to the ventricles.
- The ventricular rate (QRS complexes) is slow and regular.
- The QRS complexes may be narrow (less than 0.12 seconds) or wide (0.12 seconds or greater)
  - Junctional Escape rhythms have narrow ORS complexes
  - Ventricular escape rhythms have wide QRS complexes
- The PR interval is never constant

Right Bundle Branch Block (RBBB)
- QRS measures 0.12 seconds or greater
- Wide and slurred S waves in lead I, V5 and V6
- rsR (M pattern) in V1 and V2 (wide and positive)
- PQRST relationship is normal
- Secondary ST and T wave changes

Left Bundle Branch Block (LBBB)
- QRS measures 0.12 seconds or greater
- QRS is wide and may be notched, the T wave usually inscribed in the opposite direction to the R wave in most leads
- W or V pattern seen in leads V1 and V2
  - The QRS in lead V1 will appear wide and negative
- M pattern (rsR) seen in leads V5 and V6
- Secondary St and T wave changes
Artifact
1. Electrical signal which appears on the tracing and which originates from sources other than the heart.
2. To monitor your client effectively, you will need to be able to recognize artifact when it appears, distinguish it from a client’s rhythm, and take appropriate steps to minimize the artifact.

Sixty-cycle Interference
- Wide, fuzzy baseline which makes atrial activity difficult to recognize.
  i. Good tracing should have a narrow, distinct baseline.
- Usually caused by a faulty electrode contact which is from:
  i. Inadequate skin preparation techniques,
  ii. dried electrode gel
  iii. defective wires in client cable

Motion Artifact
- Is the most troublesome and confusing type of artifact, even for the experts
  a. May mimic any rhythm
- Ask for help, get a consult and a second opinion
- Discuss with physician if present
- Must always assess the client, and ask about the treatment of the electrode (is there taping of the leads or scratching) all assessment needs to be completed rapidly
- Clients are treated for life threatening rhythms that they do not have
  a. Must always check ABC’s, checking pulse will clarify motion artifact
  b. Shifting baselines usually occur with change of position, brushing teeth, taps on electrode
  c. **Treat the client, not the monitor**
Artifact produced by electrical equipment
- Originates from signals produced by electrical equipment in the monitoring area.
- Appears as little “blips” on the monitor tracing
- Two types of electrical equipment,
  - Pacemakers
  - Pain control devices (TENS)

Off the monitor
- Looks like Asystole needs immediate action
  - Reattach any disconnected wires
  - Check to see that the cable is attached to the monitor
  - Check electrode patches for intactness and replace any loose patches. Making certain that an ample amount of gel is present.
  - Check the wires with a lead tester for breakage and replace if necessary
  - Check for a effective cable by replacing the cable
  - Check the amplitude setting to see if the amplitude is set correctly
**Clues for identifying artifact**

1. Baselines should be fine, narrow lines
2. QRS complexes must be followed by T waves.
   - Whenever ventricular depolarization occurs, ventricular repolarization must follow.
   - Also, there cannot be T waves which are not preceded by QRS complexes.
   - If you see a T wave in the middle of nowhere or a QRS complex not followed by a T wave, chances are this is artifact.
3. A change in supraventricular rhythm, e.g., atrial flutter to sinus rhythm or vice versa, is usually accompanied by a change in ventricular rate.
4. Cells in the heart cannot be depolarized by two impulses simultaneously. They must repolarize after the first impulse before they can be depolarized by a second. If you see portions of your client’s QRS complexes superimposed on a run of ventricular tachycardia, the V tach is probably artifact.
5. P waves should have an established rhythm and logical configuration. P waves do not usually appear out of nowhere, except sometimes in digitalis toxicity or sick sinus syndrome. If P waves occur early in the cardiac cycle, there should be a pause before the next P wave is seen.
6. Clients rarely go from a normal rhythm to a straight line rhythm. Usually, they are off the monitor because of a disconnected electrode or patch. However, **ALWAYS** check the client.
Nursing interventions

1. Monitoring and managing the dysrhythmias
   a. Rapid response and evaluation to all calls or concerns
   b. Increases legal responsibility
      i. More frequent monitoring

2. Monitoring and maintaining equipment
   a. Frequent maintenance of leads and equipment
   b. Proper placement and maintenance of electrodes

3. Minimizing anxiety
   a. Explore routine of frequent monitoring

4. Teaching self care
   a. How to maintain electrodes
   b. Answer all questions about equipment