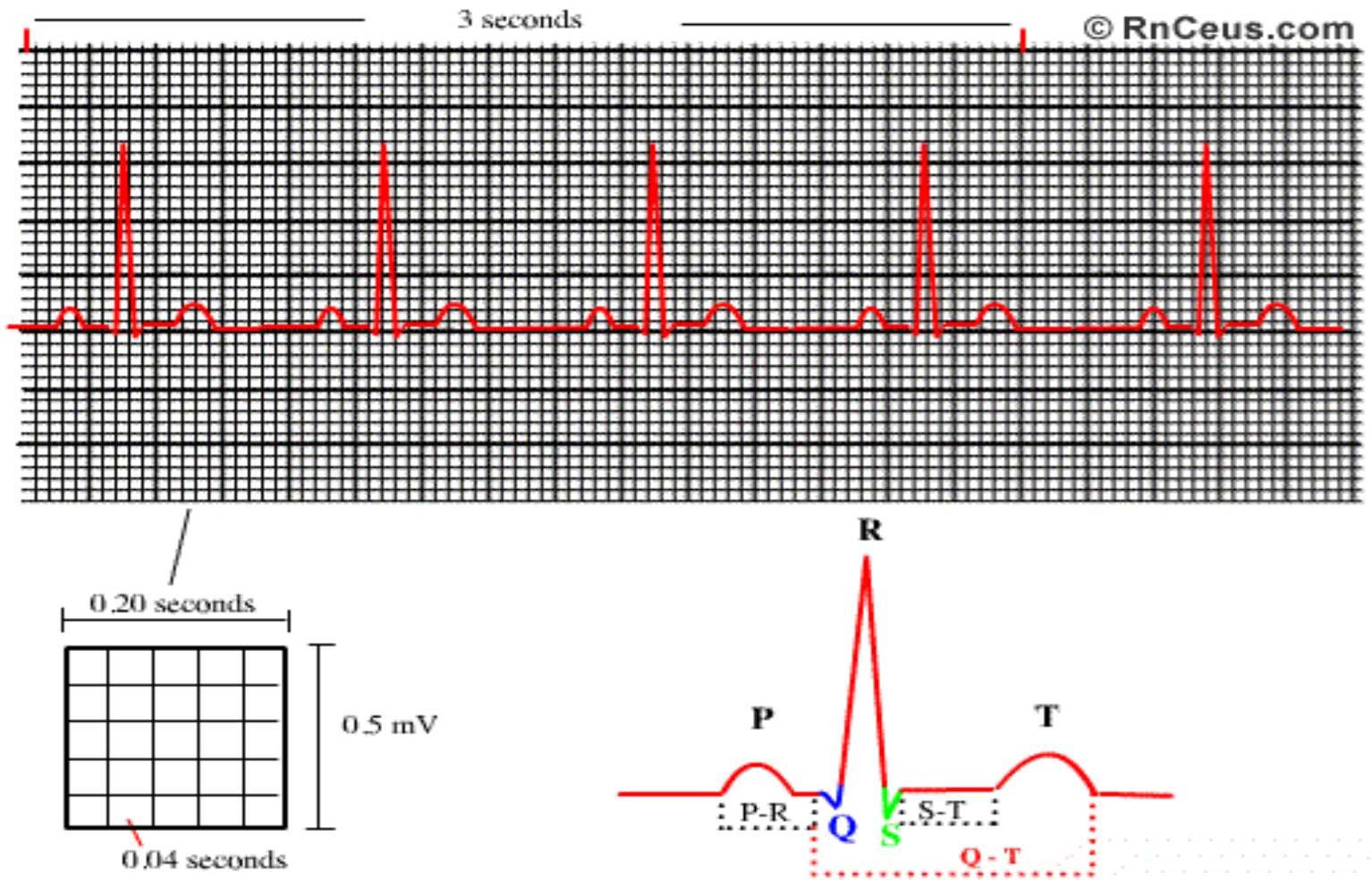
Eight Steps to ECG Interpretation and Analysis

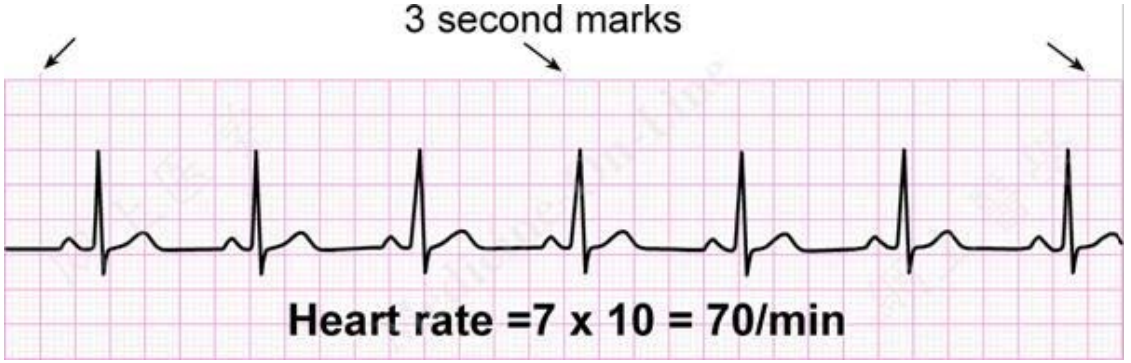
Interpreting an ECG Strip



Step 1: Determine the HR

- Count # of QRS in 1 minute

- HR calculation methods:
  - 6-second count method
  - HR calculator ruler
  - R-R interval method
  - Rule of 300

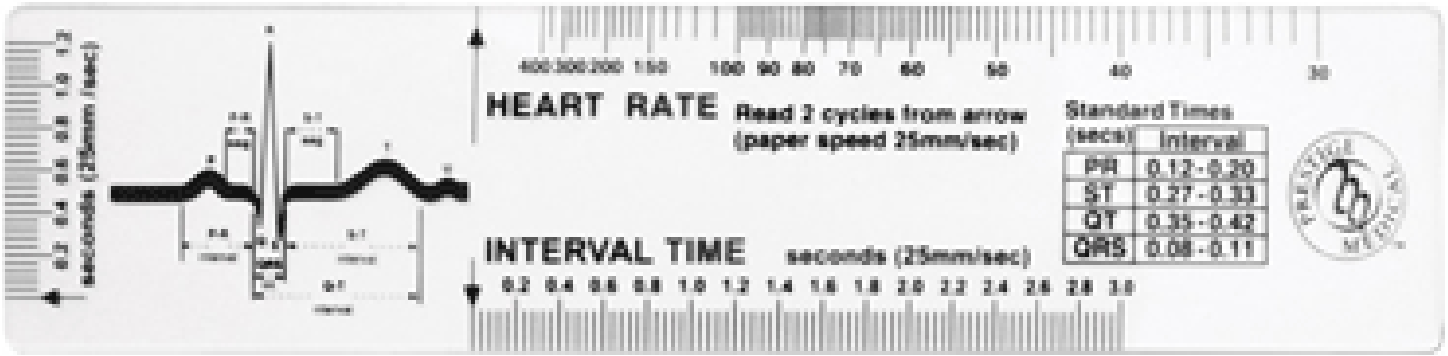


The 6-Second Count Method

- Simplest, fastest, and most common method
- Least accurate method
- Count # of QRS in 6 second strip and multiply by 10
- Example:
  - 8 QRS complexes in a 6-second interval
    - 8 x 10 = 80 bpm

HR Calculator Ruler Method

- Can determine HR rapidly and accurately
- Most accurate when rhythm is regular
- Follow directions printed on ruler



R-R Interval Method

- Rhythm must be regular to be accurate
- May be used 4 different ways:
  - Method 1: Measure distance in seconds between peaks of 2 consecutive R waves and divide this number into 60
    - Example: Distance between peaks of 2 consecutive R waves is 0.56 second.
      - 60/0.56 = 107 bpm
  - Method 2: Count the large squares between peaks of 2 consecutive R waves and divide this number into 300
    - Example: There are 2.5 large squares between peaks of 2 consecutive R waves
      - 300/2.5 = 120 bpm

R-R Interval Method

- Method 3: Count the small squares between peaks of 2 consecutive R waves and divide this number into 1500
  - Example: There are 19 small squares between peaks of 2 consecutive R waves
    - 1500/19 = 78.9 bpm (rounded off = 79 bpm)
- Method 4: Count the small squares between peaks of 2 consecutive R waves and, using a rate conversion table, convert the number of small squares into the rate
  - Example: There are 17 small squares between peaks of 2 consecutive R waves
    - HR = 88 bpm

R-R Interval Method

0.04-sec spaces	HR/Min	0.04-sec spaces	HR/Min
5	300	14	107
6	250	15	100
7	214	16	94
8	188	17	88
9	167	18	84
10	150	19	79
11	136	20	75
12	125	21	72
13	115	22	68

HR Conversion Table

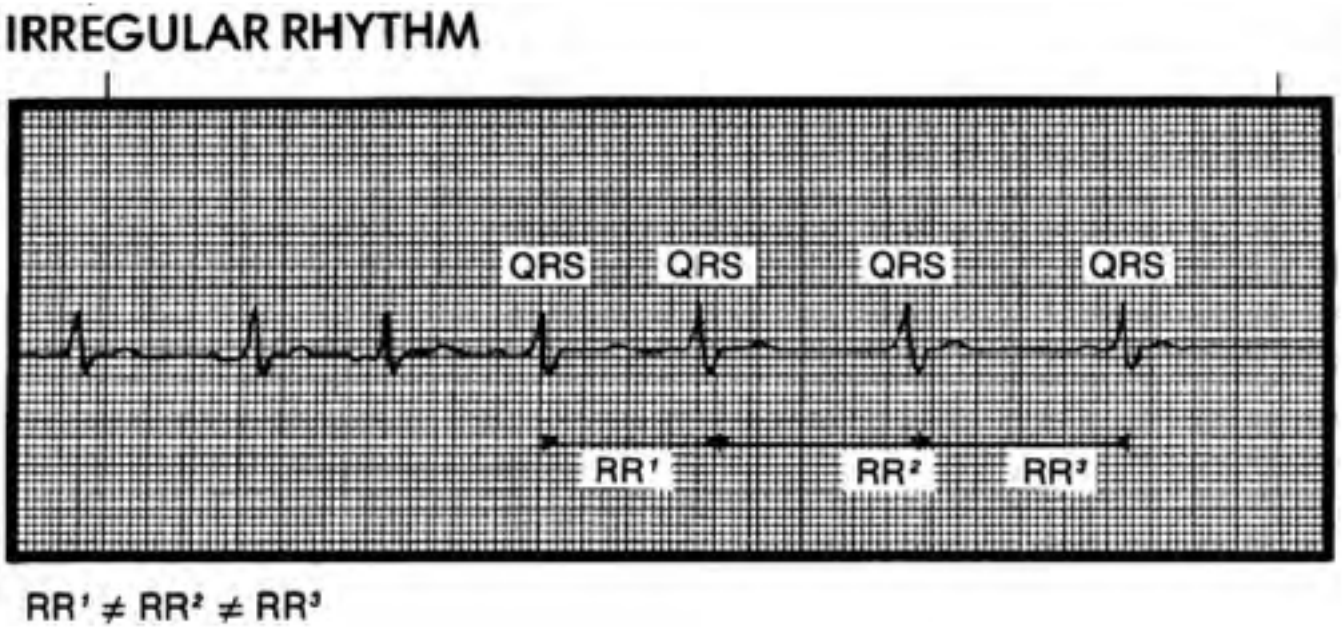
Rule of 300

- Accurate only if rhythm is regular
- Result of Method 2 of R-R Interval Method
- Calculated by dividing 300 by the number of large boxes between consecutive QRS complexes

Step 2: Determine Regularity

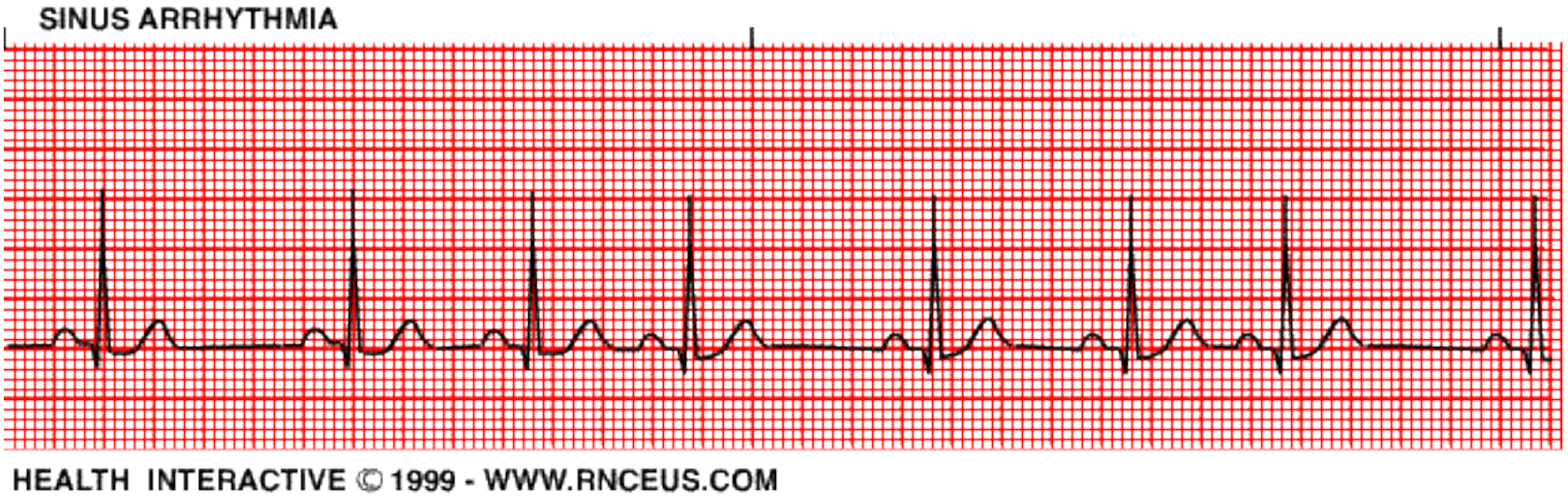
- Determine regularity by:
  - Figuring out the R-R intervals using one of the following methods:
    - Estimating the R-R intervals
    - Measuring R-R intervals using ECG calipers
    - Counting small squares between R waves
  - Comparing the R-R intervals to each other
- Regular rhythm = shortest and longest R-R intervals vary by < 0.08 second

Irregular Rhythms



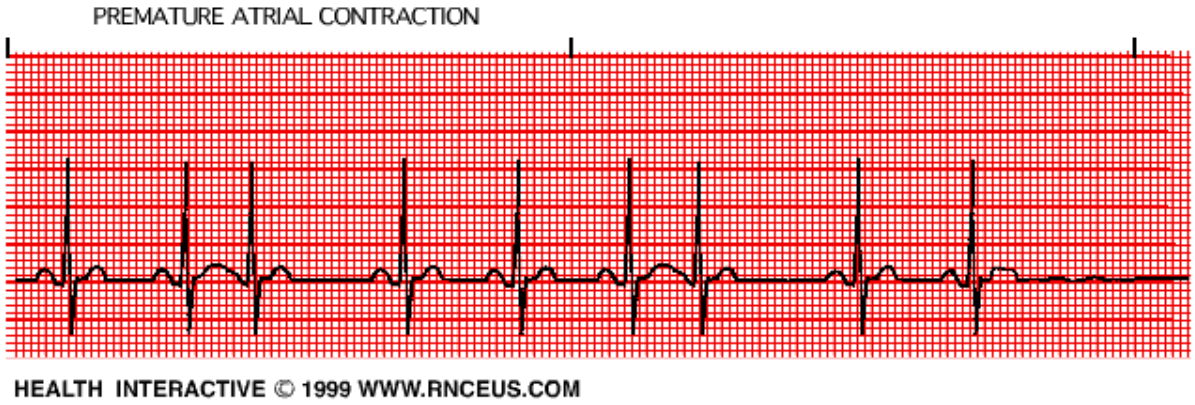
Irregular Rhythms

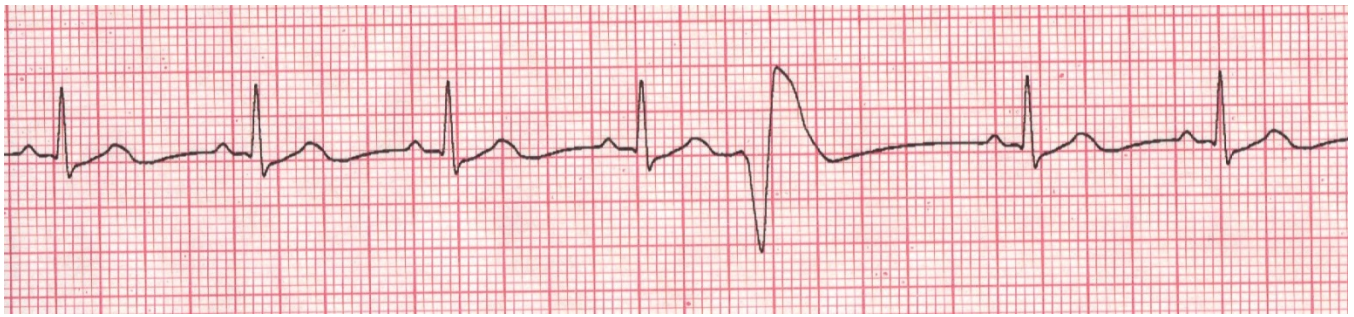
- Irregular rhythm = shortest and longest R-R intervals vary by > 0.08 second
  - Slightly irregular = Amount of R-R interval variation is rarely more than 0.08 second
    - Occurs in Sinus Arrhythmia



Irregular Rhythms

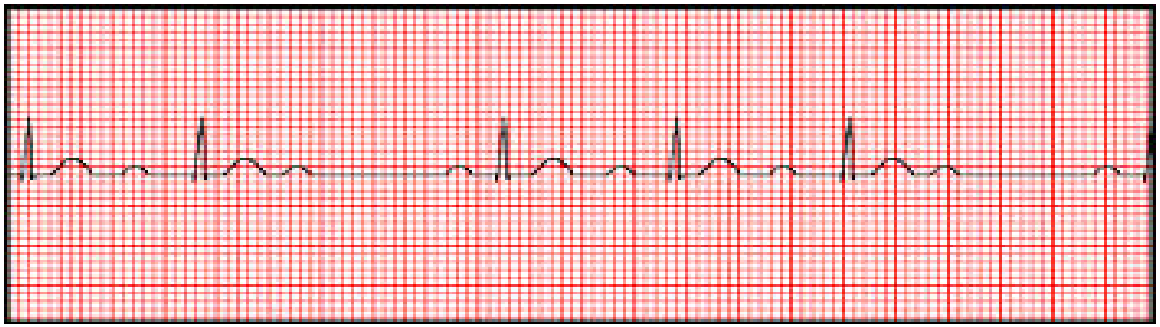
- Occasionally irregular = Occurs when premature complexes occur in otherwise regular rhythm
  - Occurs with PACs, PVCs

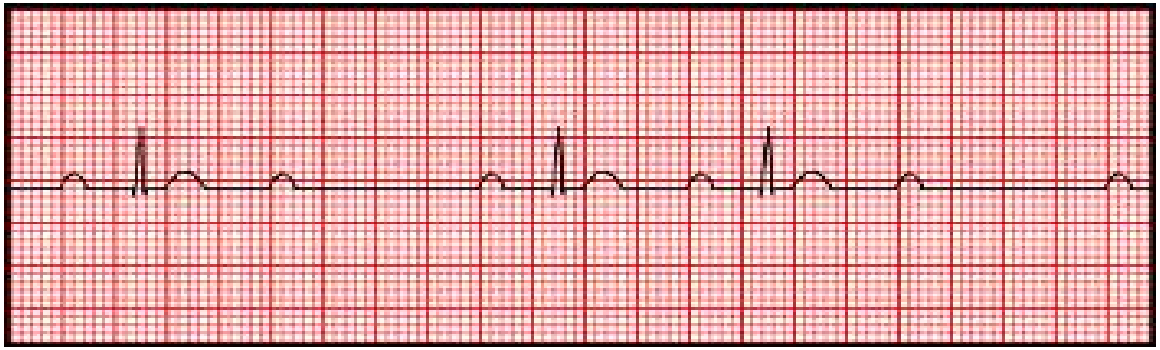




Irregular Rhythms

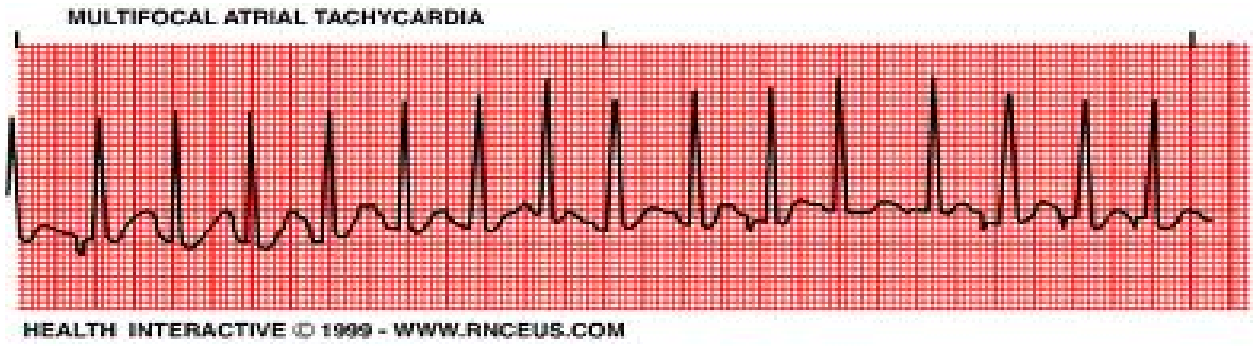
- Regularly irregular = Pattern seen between the measured R-R intervals
  - Occurs with Second Degree AV Block Type I, Second Degree AV Block Type II, Atrial Flutter

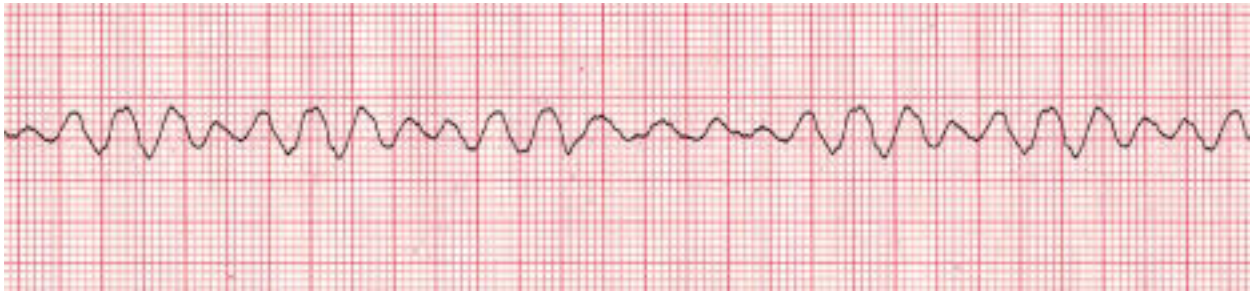




Irregular Rhythms

- Irregularly irregular = No fixed pattern or ratio of R-R intervals
  - Occurs with Atrial Fibrillation, Multifocal Atrial Tachycardia, Ventricular Fibrillation





Step 3: Identify and Analyze the P, F, or f Waves

- Identify the P, F, or f waves
- Determine atrial rate
- Compare and associate atrial rate with ventricular rate
- If P waves absent, determine if atrial flutter (F) or fibrillation (f) waves are present
  - Flutter waves are usually between 240-350/min
    - Rhythm is typically regular
    - QRS occurs regularly after every other or every fourth F wave
  - Atrial fibrillation waves = irregularly shaped, chaotic waves
    - Fine fibrillation waves = < 1 mm high
    - Coarse fibrillation waves = > 1 mm high
    - Rate = 350-600/min

Atrial Flutter Waves

Atrial Fibrillation Waves

Step 4: Determine PR Interval and Atrioventricular Conduction Ratio

- Determine PR interval by measuring distance between onset of P wave and onset of first wave of QRS
- Compare PR intervals to determine if all PR intervals are equal in duration
- Determine if all P waves are followed by QRS
- Determine AV conduction ratio by noting number of P (or F) waves followed by QRS in a given set of P (or F) waves
- Normal PR interval = 0.12-0.20 second
- PR interval is shorter when HR is fast

Irregular PR Interval

- Abnormal PR interval = < 0.12 second or > 0.20 second
  - < 0.12 second
    - Impulse originated in lower part of atria or in AV junction –OR—
    - Impulse progressed from atria to ventricles through abnormal accessory conduction pathway
  - > 0.20 second
    - Delay in conduction of impulse through AV node, bundle of His, or rarely the bundle branches
    - Seen with First Degree AV Block
- If no QRS after P wave, PR interval is absent
  - Indicates blockage of conduction of impulse through AV node, bundle of His, or bundle branches into ventricles

AV Conduction Ratios

- If all P waves followed by QRS, ratio = 1:1
- If every 2 P waves is followed by QRS, ratio = 2:1
- If for every 3 P waves, 2 are followed by QRS, ratio = 3:2

Step 5: Identify and Analyze QRS

- Identify QRS
- Note duration of QRS
  - Normal = 0.12 second or less
  - Long = > 0.12 second
- Note shape of QRS
- Compare QRS to determine if all QRS are equal in duration and shape or if one or more of QRS differ from others
- Determine if there is a P wave associated with QRS

Abnormal QRS

- Impulse progresses through ventricles abnormally
- Types of dysrhythmias with abnormal QRS:
  - Ventricular dysrhythmias
  - Supraventricular dysrhythmias
  - Bundle branch block
  - Intraventricular conduction defect
  - Aberrant ventricular conduction
  - Ventricular preexcitation
- How to tell if abnormal complex is ventricular or supraventricular in origin: Presence of P waves
  - P wave indicates supraventricular origin
  - No P wave = ventricular origin

Step 6: Determine Site of Origin of Dysrhythmia

- Determine site of origin by analyzing P waves, QRS, and their association to each other

- Goal = Determining source of electrical discharge that generated the rhythm

Steps 7and 8

- Step 7: Identify the dysrhythmia
  - Each dysrhythmia has a unique feature of combination of features

- Step 8: Evaluate the significance of the dysrhythmia
  - Rhythm interpretation concentrates on electrical activity in heart
  - Clinical significance is result of mechanical pumping of heart
  - Some dysrhythmias diminish heart's ability to contract efficiently
  - Some dysrhythmias provide significant warning signs that heart is suffering ischemia, ill effects of medications, or electrolyte imbalance

Reference

- Wesley, K. (2011). *Huszar's Basic Dysrhythmias and Acute Coronary Syndromes: Interpretation and Management, 4th Edition*. St. Louis: Elsevier.