

Quick EKG Interpretation

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Pediatric Cardiology

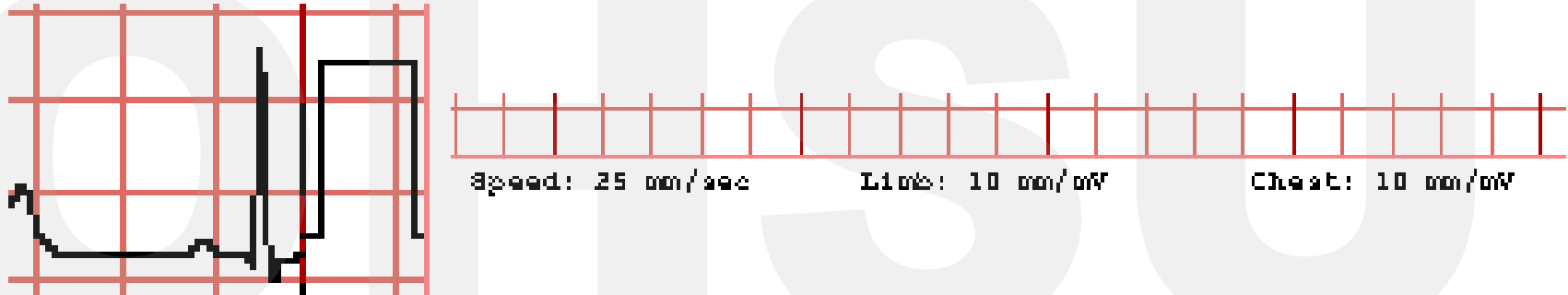
Objectives

- Identify common rhythm abnormalities on EKG
- Be able to recognize atrial and ventricular hypertrophy pattern
- Be able to calculate an accurate QTc
- Understand that EKG's are generally screening tests
 - Result is highly dependent on lead position
- Understand the limitations of the computer interpretation
 - Especially with QTc and ventricular hypertrophy

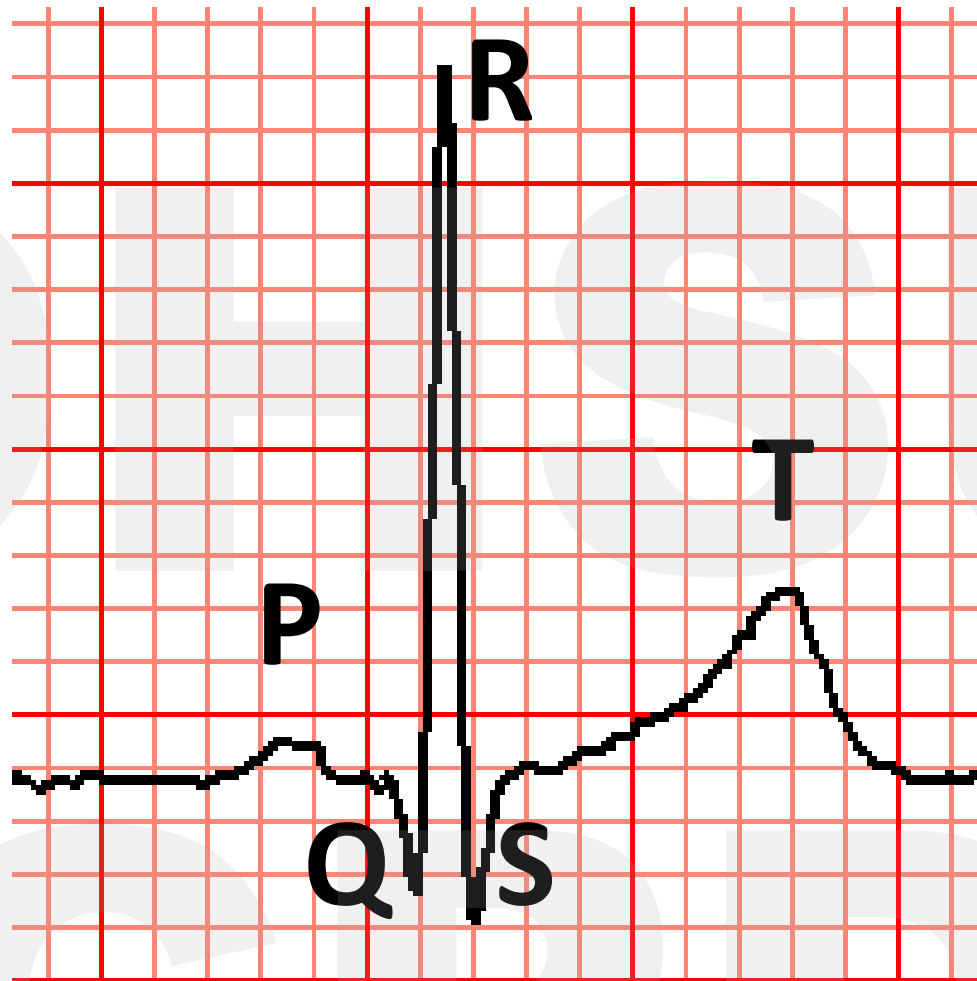
Top Outpatient Concerns on EKGs

- Ventricular hypertrophy and atrial enlargement
- Borderline or prolonged QTc
- Non-sinus rhythms and AV block
- Premature ventricular or atrial contractions
- rSR' in V1
- Q-waves
- ST segment elevation
- T-wave changes

Beginning on the Same Page



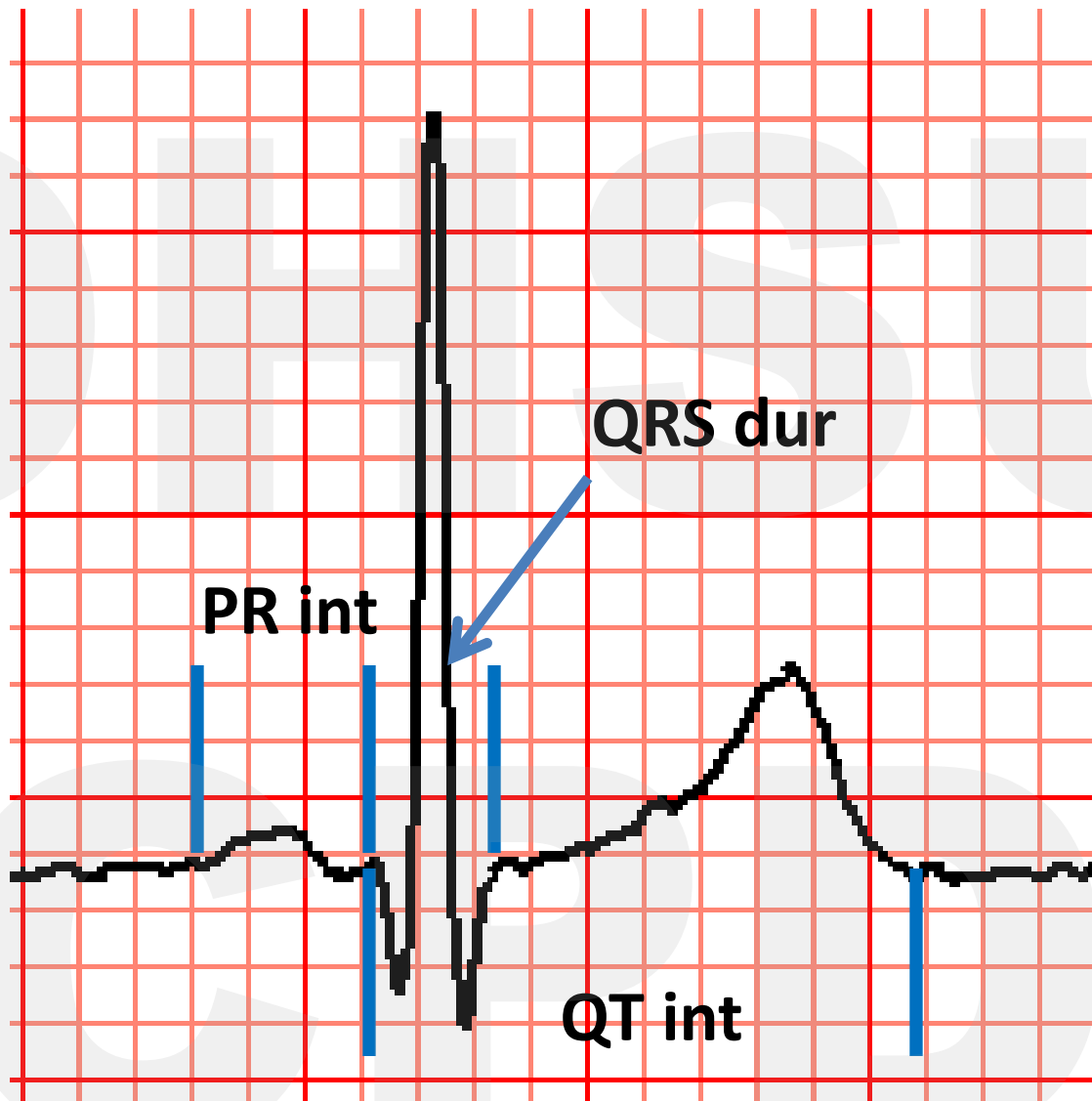
- Paper speed
 - Standard is 25mm/sec
 - Each small box is 40ms, each large box is 200ms
- Voltage standard
 - Standard is 10mm/mV
 - Each small box is 0.1mV, each large box is 0.5mV



R' is the second positive deflection

S' is the second negative deflection after the R wave

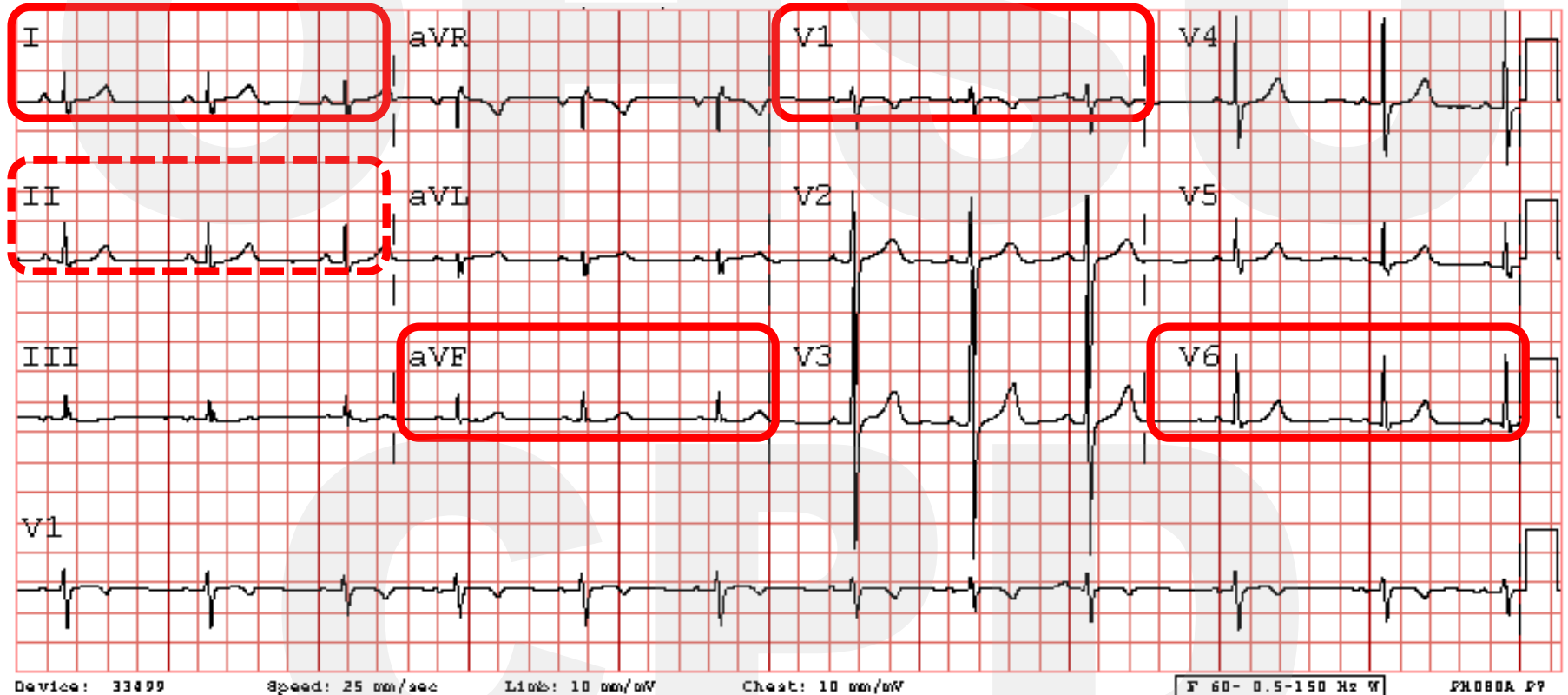
U wave is small positive deflection after the T wave



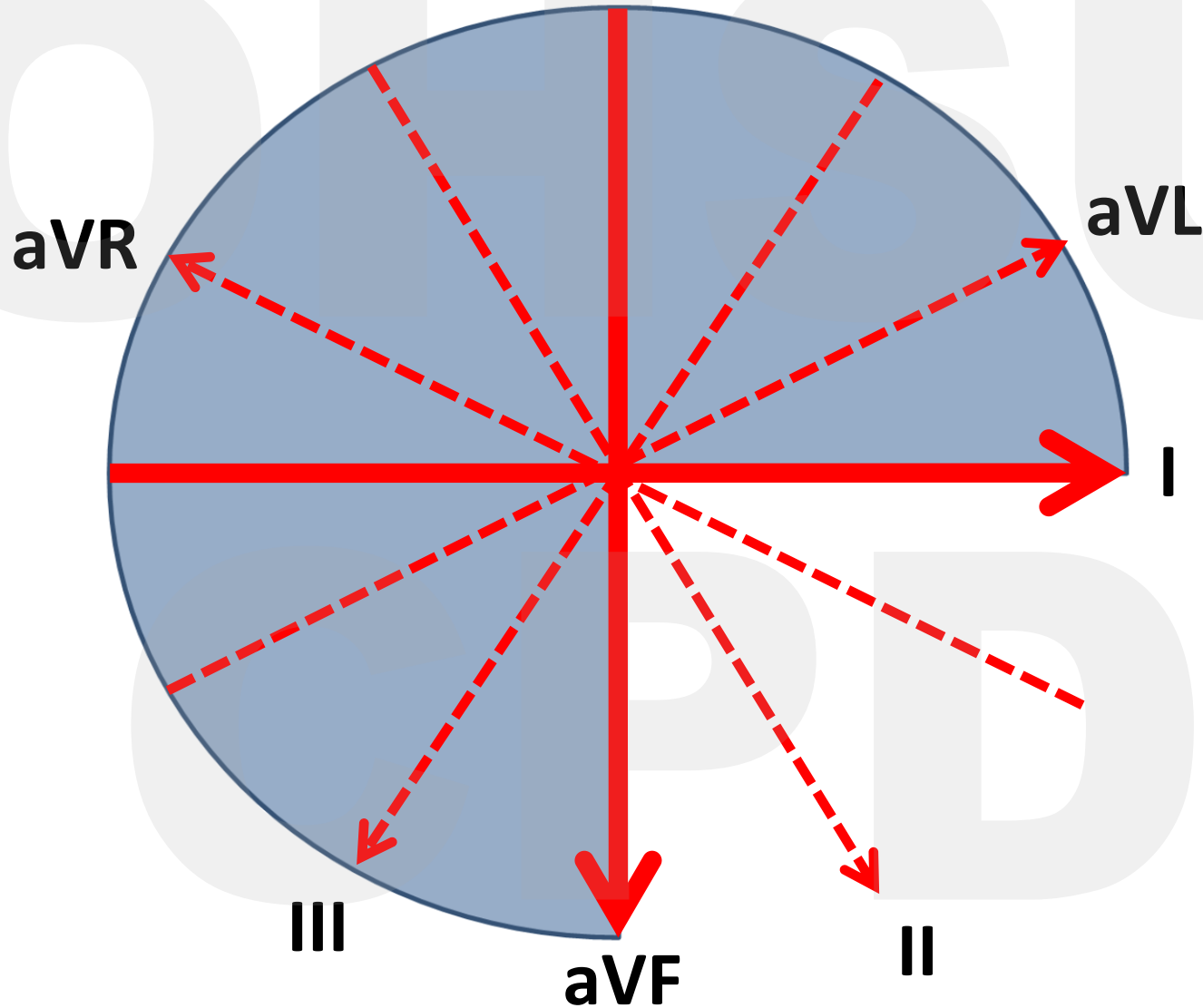
Starting the Interpretation

- Rate (computer rarely gets this wrong)
 - 300-150-100-75-60-50 rule
 - $1500/\#$ of small boxes between QRS complexes
- Sinus Rhythm
 - Only one P wave before every QRS
 - QRS after every P wave
 - P wave $0-90^\circ$ (upright in I and aVF)
- Axis (computer does pretty well)
 - QRS, roughly $0-110^\circ$ (upright in I and aVF)

Where to Look



Axis Determination



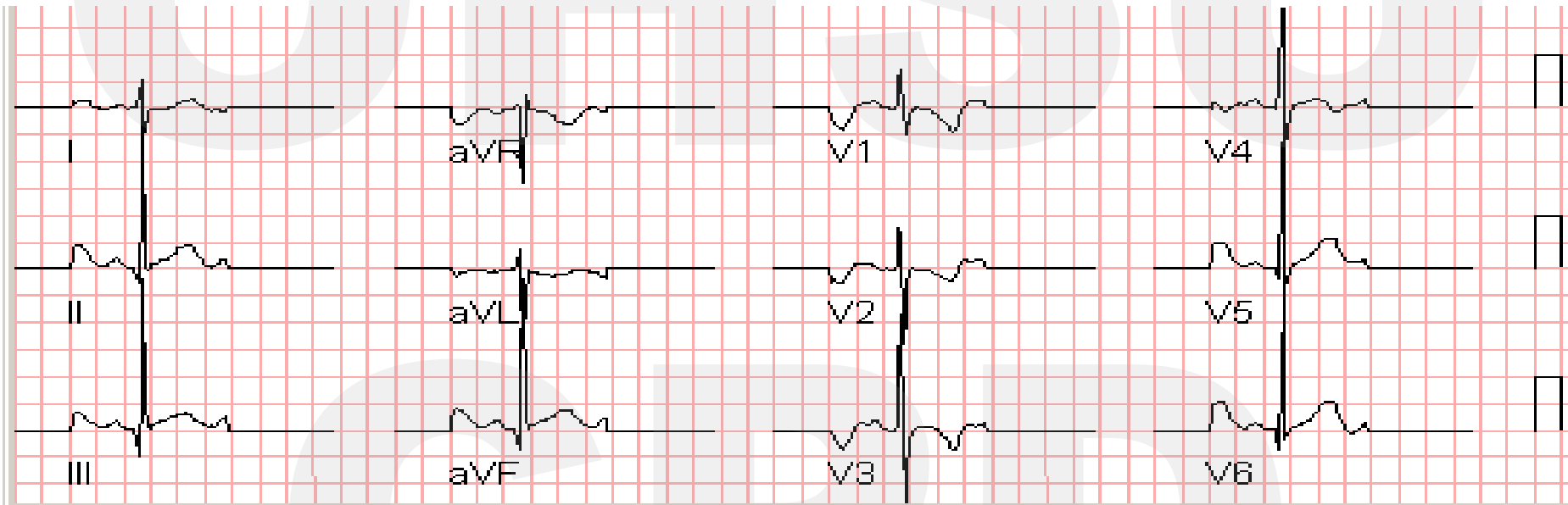
Ventricular Hypertrophy (W/ normal QRS duration)

- 20/20 -25/5 estimation
 - Very useful “on-the-fly”
- V1 20/20
 - R greater than 2.0mV (20 boxes) high think RVH
 - S greater than 2.0mV (20 boxes) deep think LVH
- V6 25/5
 - R greater than 2.5mV (25 boxes) high think LVH
 - S greater than 0.5mV (5 boxes) deep think RVH

Left Ventricular Hypertrophy

- Increased QRS voltages in left-sided leads
 - With normal QRS duration
- V1 S wave deeper than 98% for age
- V6 R wave taller than 98% for age
- Supplemental criteria
 - Left axis deviation for age
 - V6 Q wave >5mm deep (volume overload pattern)
 - Inverted T waves in V6 (LV strain pattern)

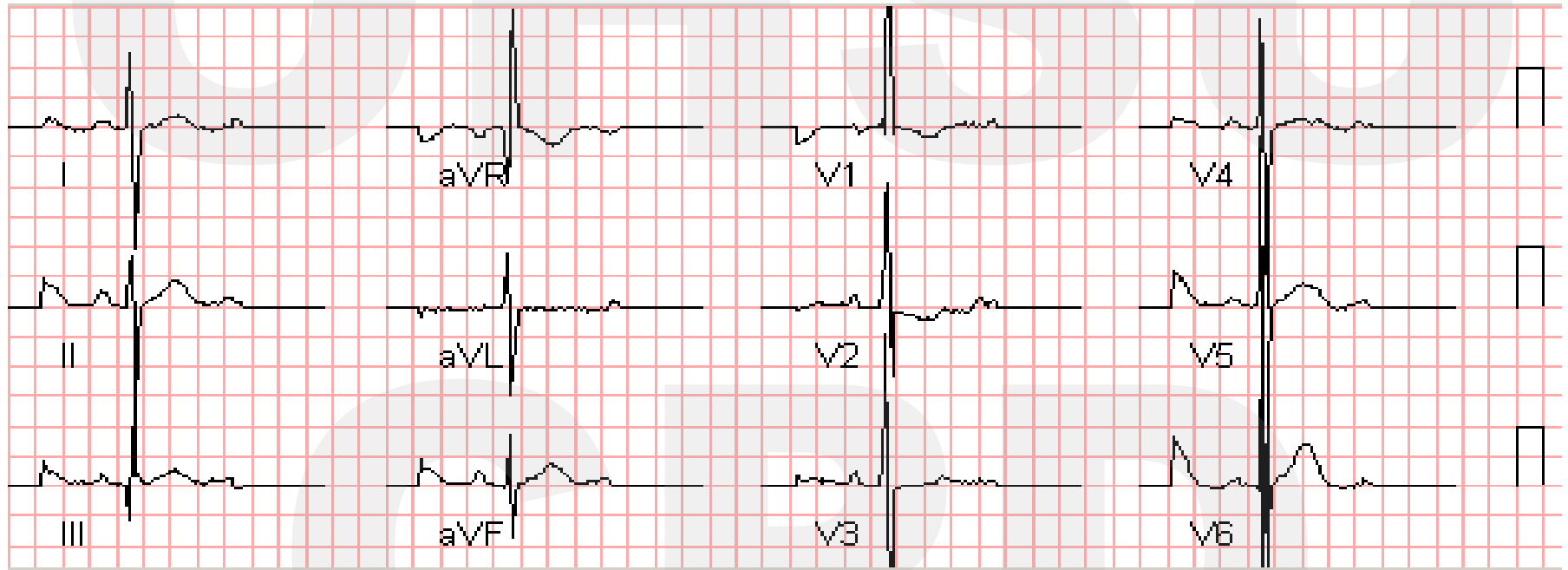
LVH by Voltage Criteria in V6



Right Ventricular Hypertrophy

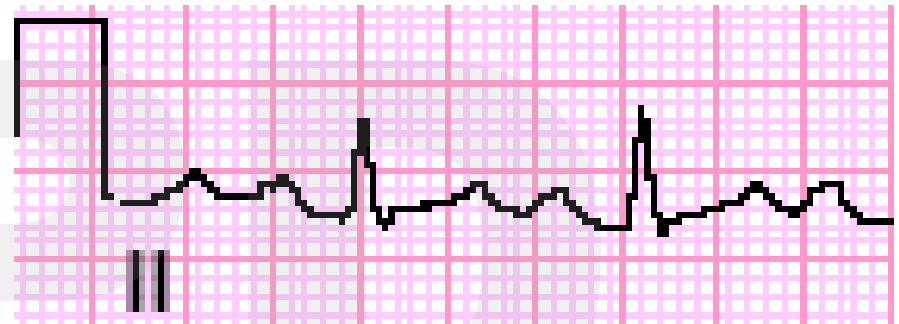
- Increased anterior/right-sided QRS voltages
 - With normal QRS duration
- V1 R wave taller than 98% for age
- V6 S wave deeper than 98% for age
- Upright T wave in V1 for pts 3days-6years old
- Supplemental criteria
 - Right axis deviation for age
 - V1 qR pattern

RVH by Voltage Criteria in V1 (possible biventricular hypertrophy)



Atrial enlargement

- Right atrial enlargement
 - Tall P wave
 - $\geq 0.3\text{mV}$ (3 boxes) any lead
- Left atrial enlargement
 - Broad P wave
 - $\geq 100\text{ms}$ (2 ½ boxes)
 - $\geq 80\text{ms}$ (2 boxes) in infant



QTc Measurement

- Bazett's formula
 - $QTc = QT \text{ in sec} / \sqrt{\text{preceding RR interval in sec}}$
 - Up to 0.49sec may be normal in the first 6 months
 - Up to 0.46sec can be normal
 - Should not exceed 0.44sec w/ symptoms or FamHx
 - Longest QTc follows the shortest RR interval
- The computer tends to OVERESTIMATE
- DON'T include the U wave

Non-sinus Rhythms

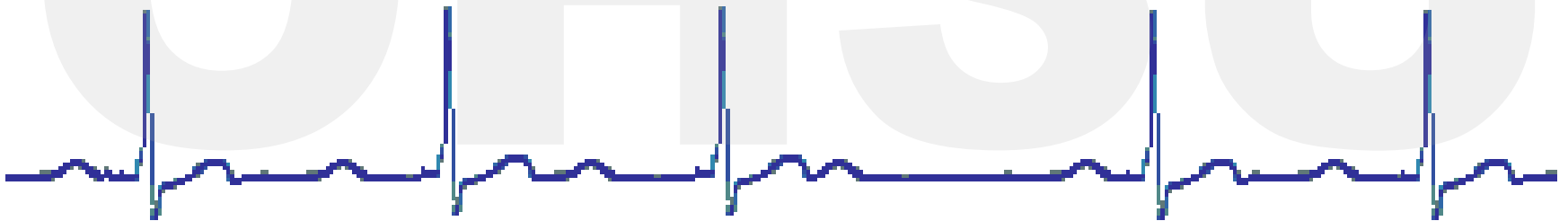
- Sinus arrhythmia
 - Rate increase with inspiration, decrease with expiration
 - Pronounced during teenage years
 - Benign rhythm
- Low atrial and wandering atrial rhythms
 - Unusual or changing P wave morphology or axis
 - Benign rhythm
- Accelerated junctional rhythm
 - Absence of P wave or retrograde P wave
 - Generally benign as long as the ventricular rate is normal

AV Conduction Abnormalities

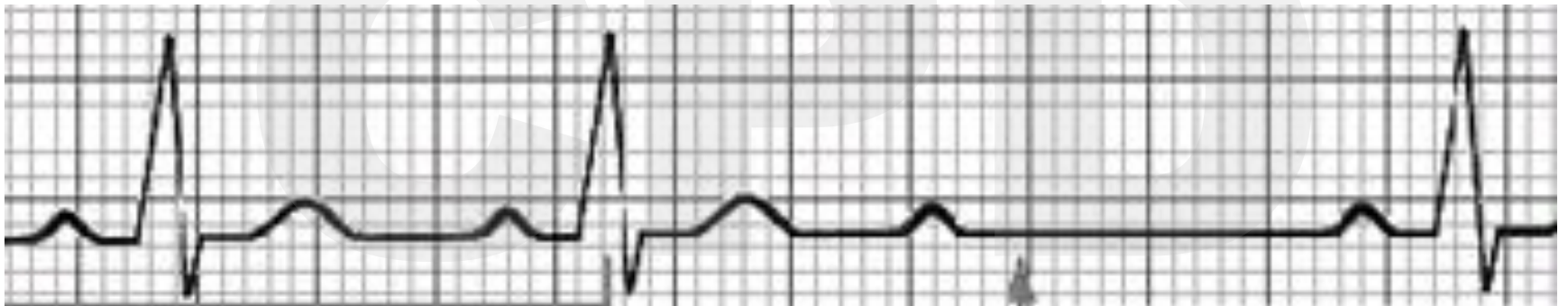
- 1st degree block
 - Prolonged PR interval for age w/ 1:1 AV conduction
 - No treatment needed
- 2nd degree block
 - Mobitz I (Wenckebach) gradual prolonging of PR interval, then a failure to conduct across the AV node
 - Mobitz II no prolongation of PR interval before failure of AV conduction
- 3rd degree block (complete heart block)
 - No AV conduction present
 - Atria rate is faster than the ventricular rate
- AV dissociation (atria and ventricles beat independently)
 - Slowed sinus rate with increased junctional or ventricular rate
 - Complete heart block with escape rhythm

Second Degree AV Block

Mobitz I : Wenckebach



Mobitz II



Third Degree Block

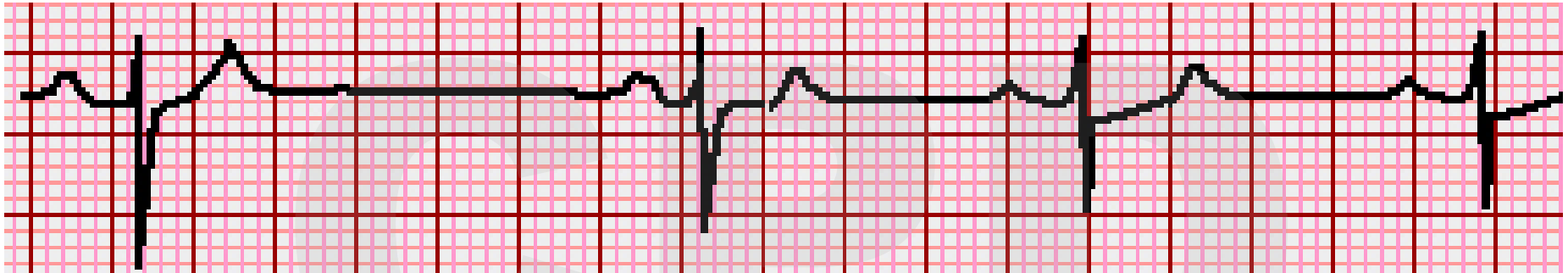


- This is bad

Premature Atrial Contractions



Blocked PAC



2010UpToDate

- Common in newborns and healthy children
- Do not require treatment

Premature Ventricular Contractions



- Occasional uniform PVC's are benign
 - Should become less frequent or disappear with exercise
- When to worry...
 - Known underlying heart disease
 - Are associated with symptoms or a family history of sudden death
 - Become more frequent with activity
 - Are not uniform in appearance (multiform)
 - If there are couplets or runs

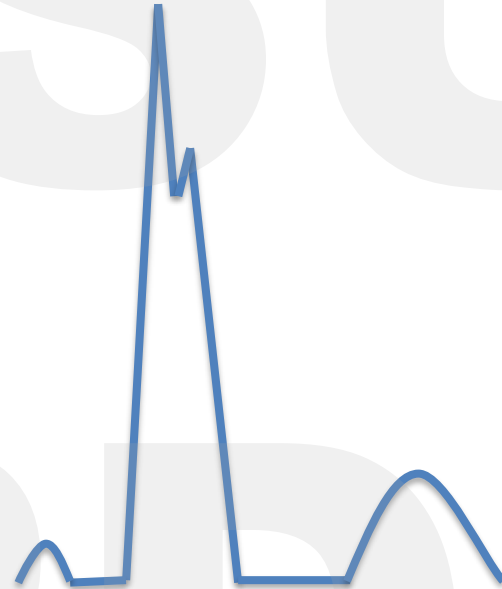
rsR' in V1

- Normal in children when...
 - QRS duration is normal
 - Neither R wave meets criteria for hypertrophy



Crochetage Sign

- Notching near the R wave apex in II, III, aVF
- Often seen in patients with atrial septal defects
 - PPV of up to 77%
 - Specificity 91%, better if the pattern is in all 3 leads
- Improves if the ASD is closed.



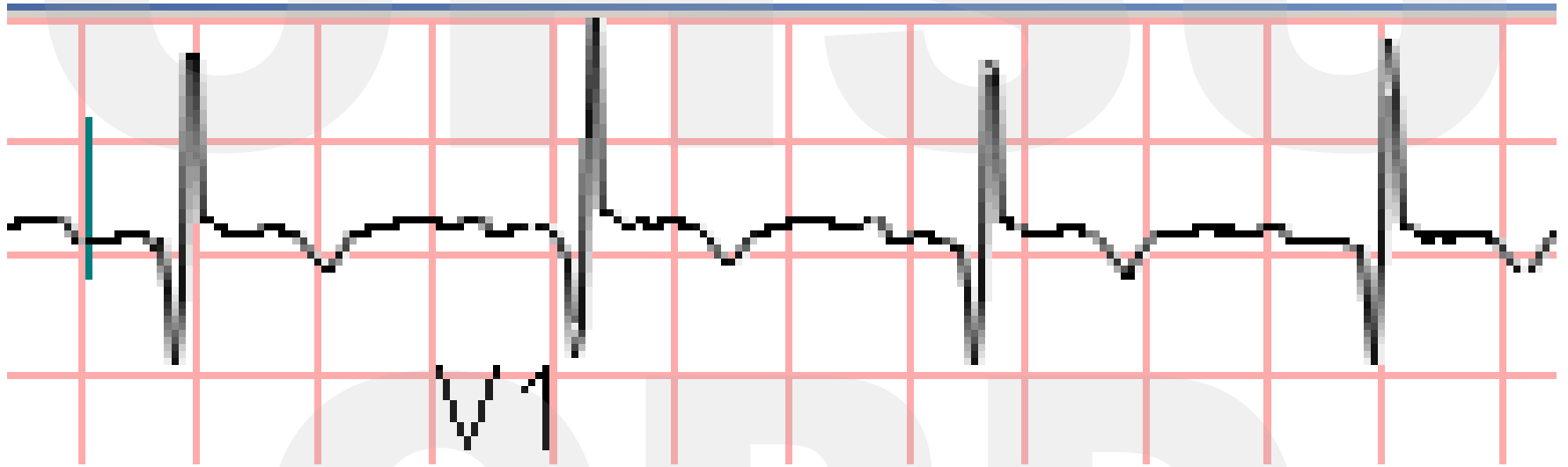
Q Waves

- Normal in leads I, II, III, aVF, V5, V6
 - Should be less than 0.5mV (5 boxes) deep
 - Should be less than 30-40msec (1 box) in duration
- Q wave abnormalities
 - Presence in V1
 - Absence in V6
 - $>0.5\text{mV}$ deep ($>0.8\text{mV}$ in III) or wide ($>40\text{msec}$)

Abnormal Q waves



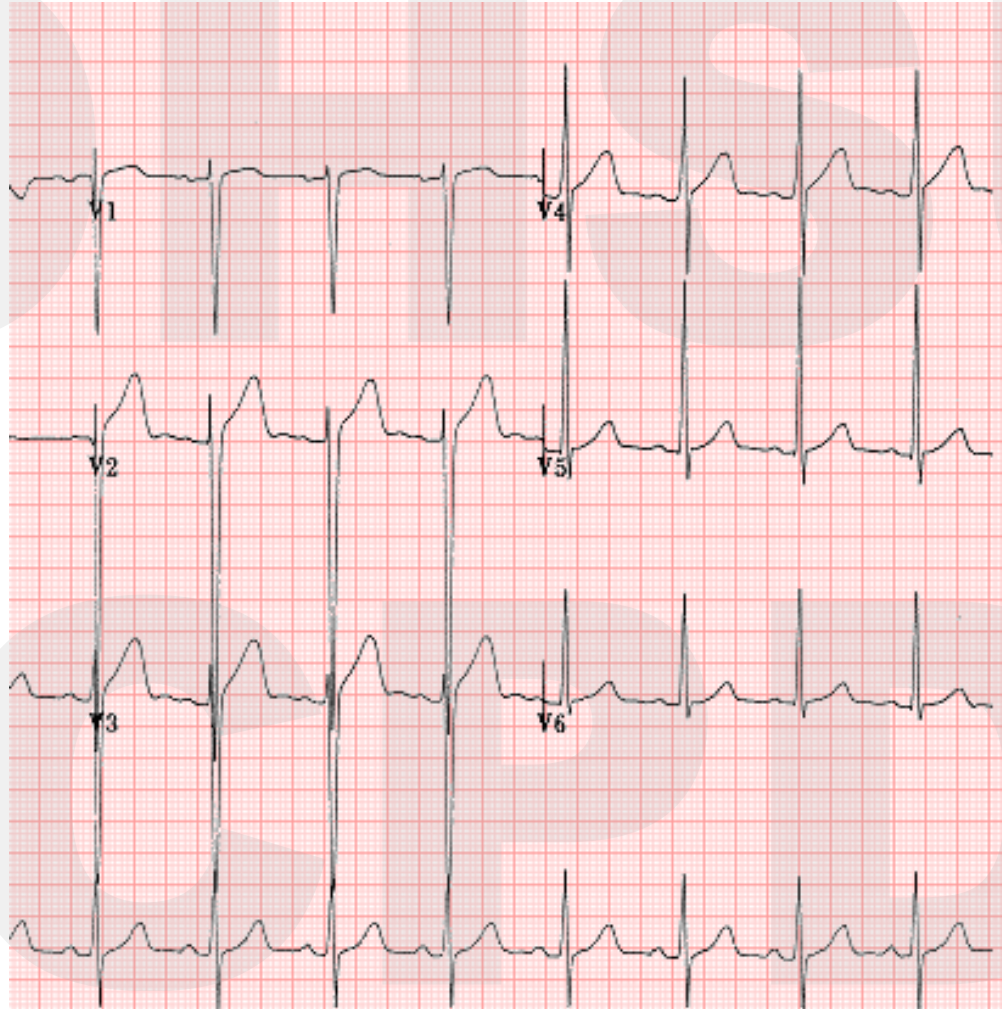
Abnormal Q waves



ST Segments

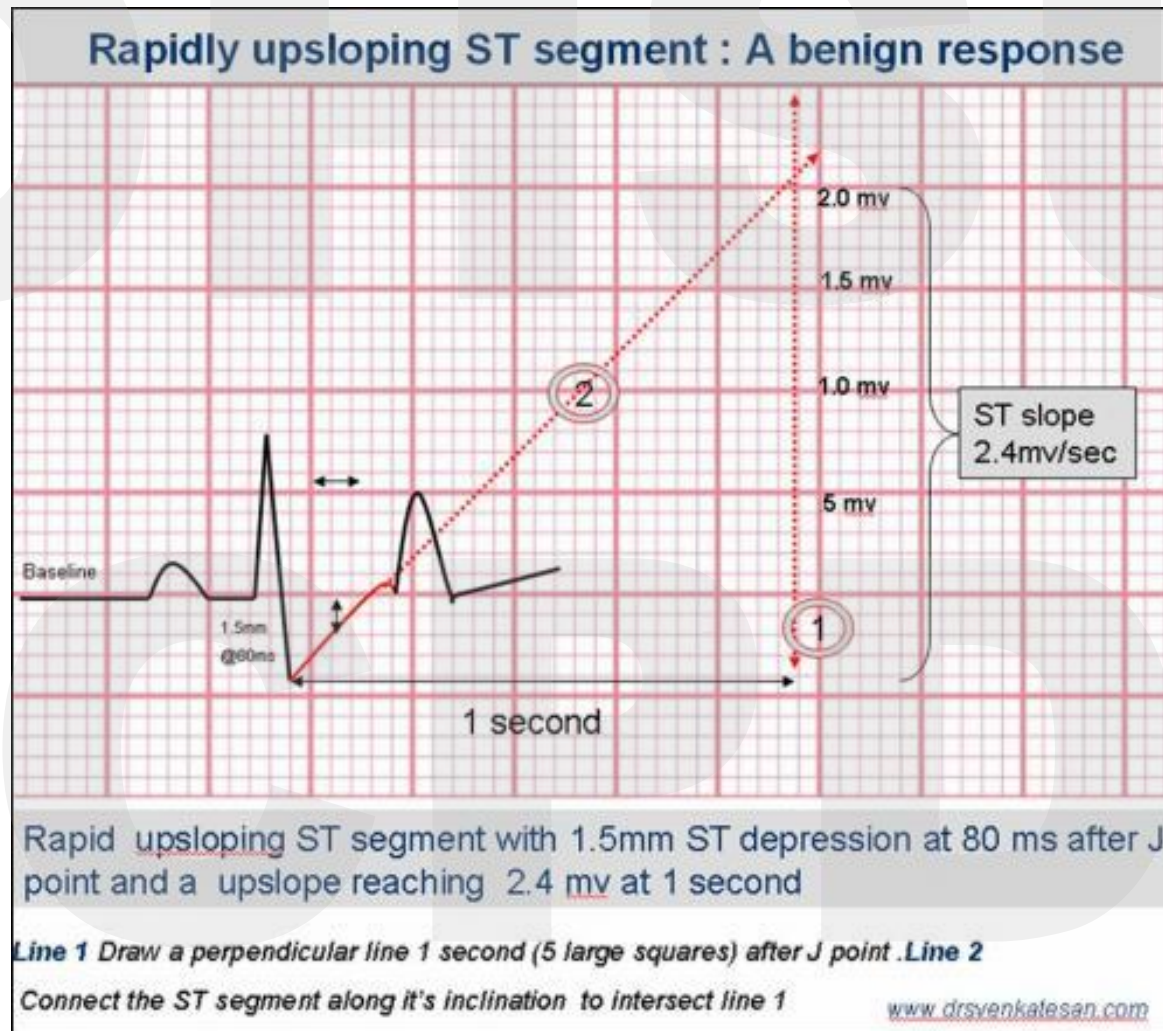
- Normal elevation or depression
 - Limb leads up to 0.1mV (1 box)
 - Precordial leads up to 0.2 mV (2 boxes)
- Early repolarization
- J point depression
- Causes of abnormal ST segments
 - Myocardial infarction, pericarditis, myocarditis, K abnormalities, digitalis effect, intracranial abnormality, LVH/RVH with strain

Early Repolarization

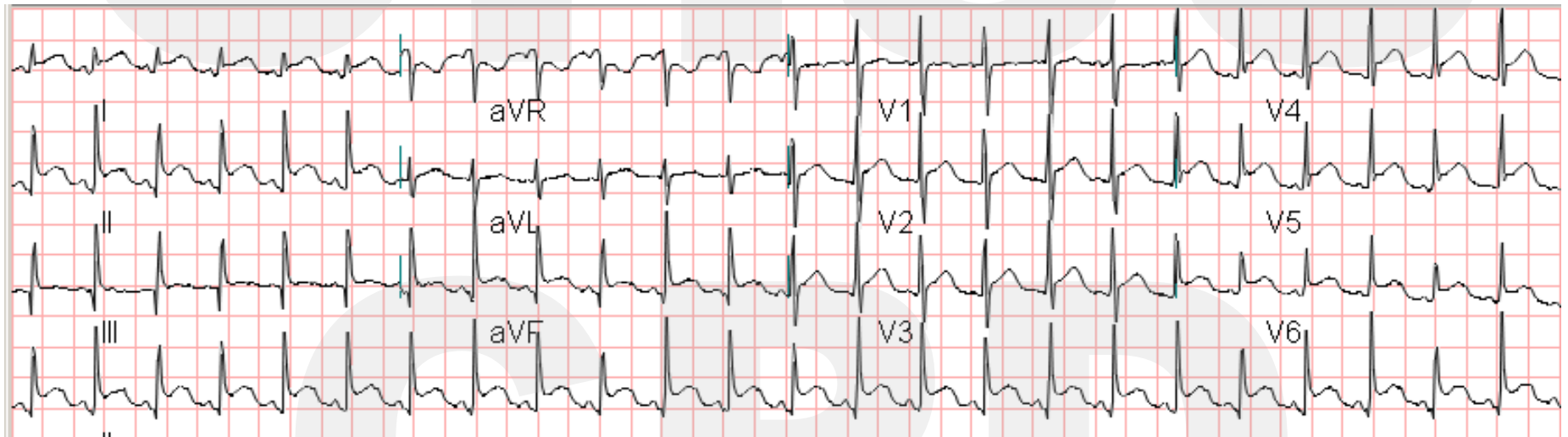


www.health.gov.mt/.../issue/issue1/ipc00103.htm

J point depression



Diffuse ST elevation



Myocardial Infarction Pattern

- Anterior
 - V1, V2, V3
- Lateral
 - I, aVL, V5, V6
- Inferior
 - II, III, aVF
- Posterior (most difficult)
 - V1-V3 tall wide R wave, tall wide T waves

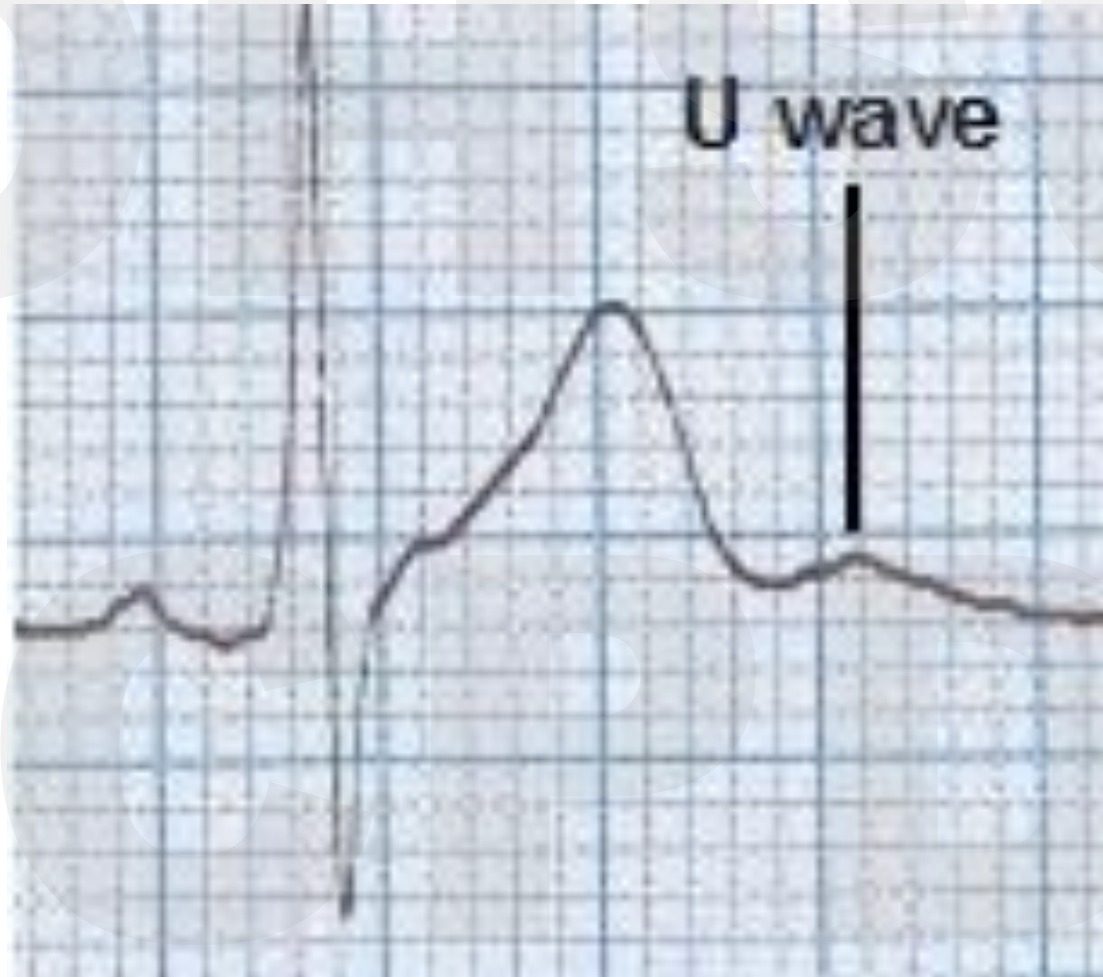
ST elevation MI



T-wave Abnormalities

- T wave axis should be $\sim 0-90^\circ$
 - Abnormal axis may be hypertrophy with strain
- Flattened or small T waves
 - Resolving pericarditis, digoxin, myocarditis
- Peaked T waves
 - Associated with hyperkalemia
- U waves
 - Associated with hypokalemia
- Miscellaneous problems
 - Premature ventricular beats, bundle branch block

U Wave



Long QT: QT = 600 ms; with sinus bradycardia

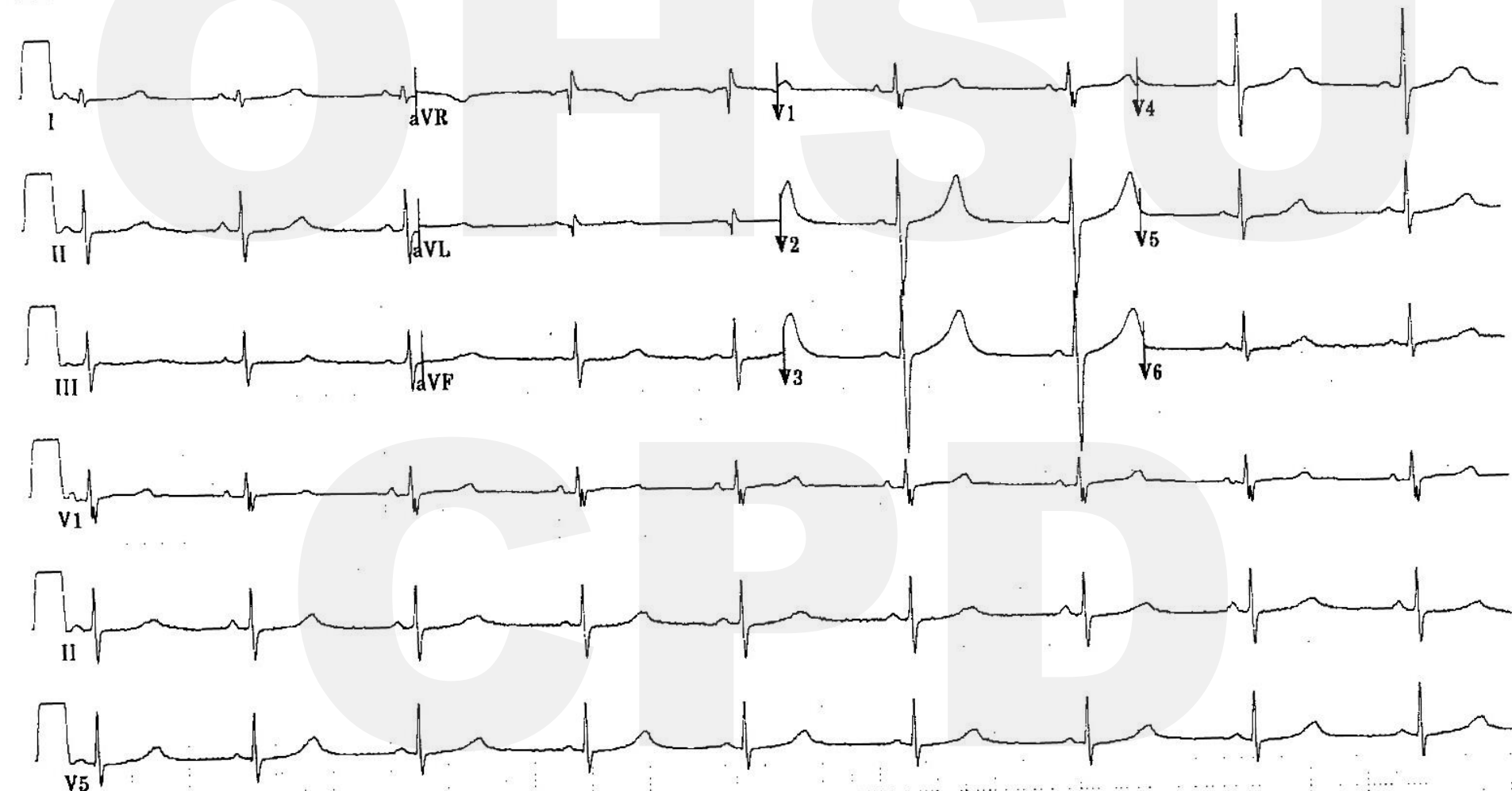
Test ind:

Referred by: BALAJI, S

Unconfirmed

ALT. DATA:

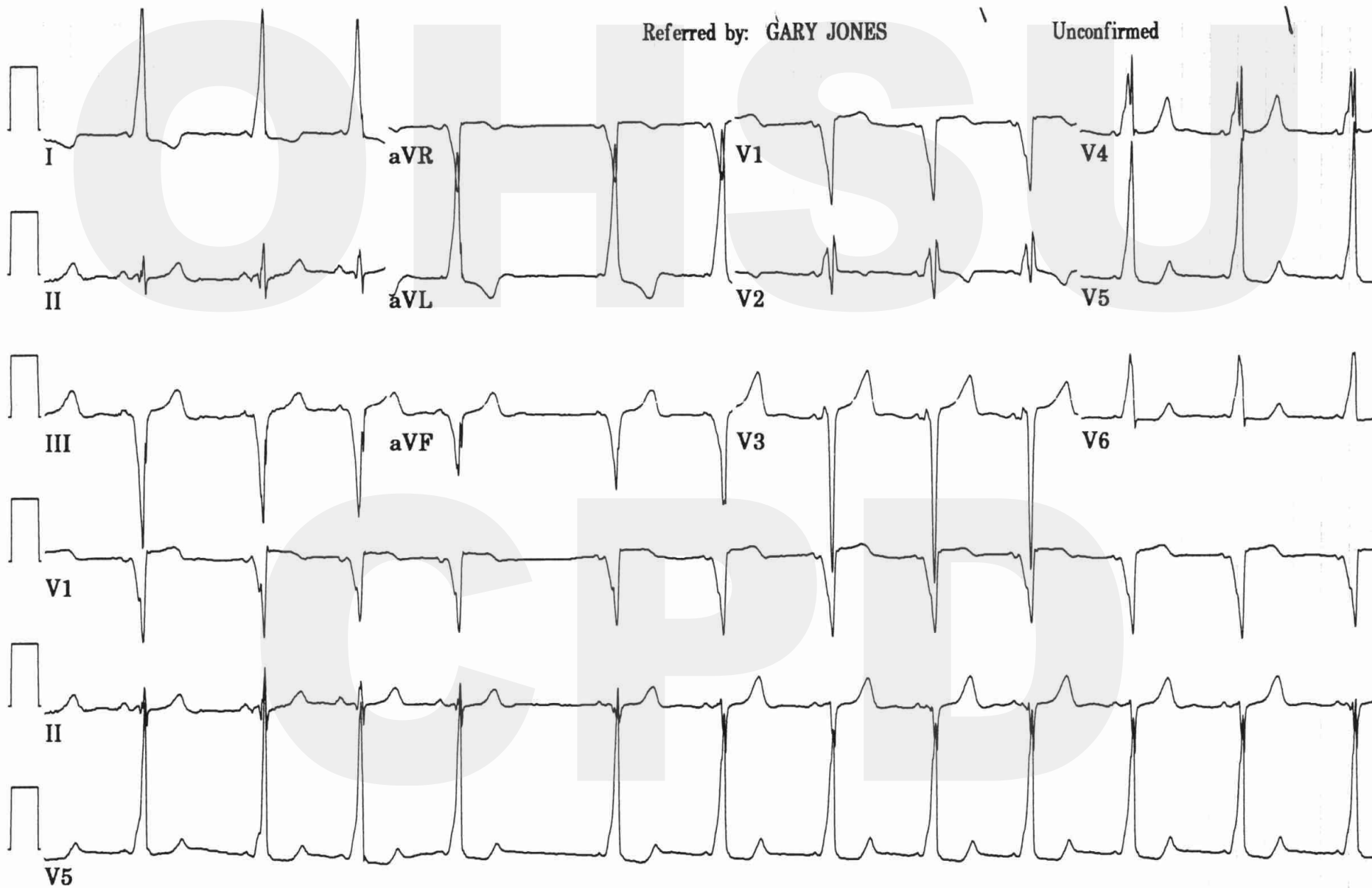
POSITION:



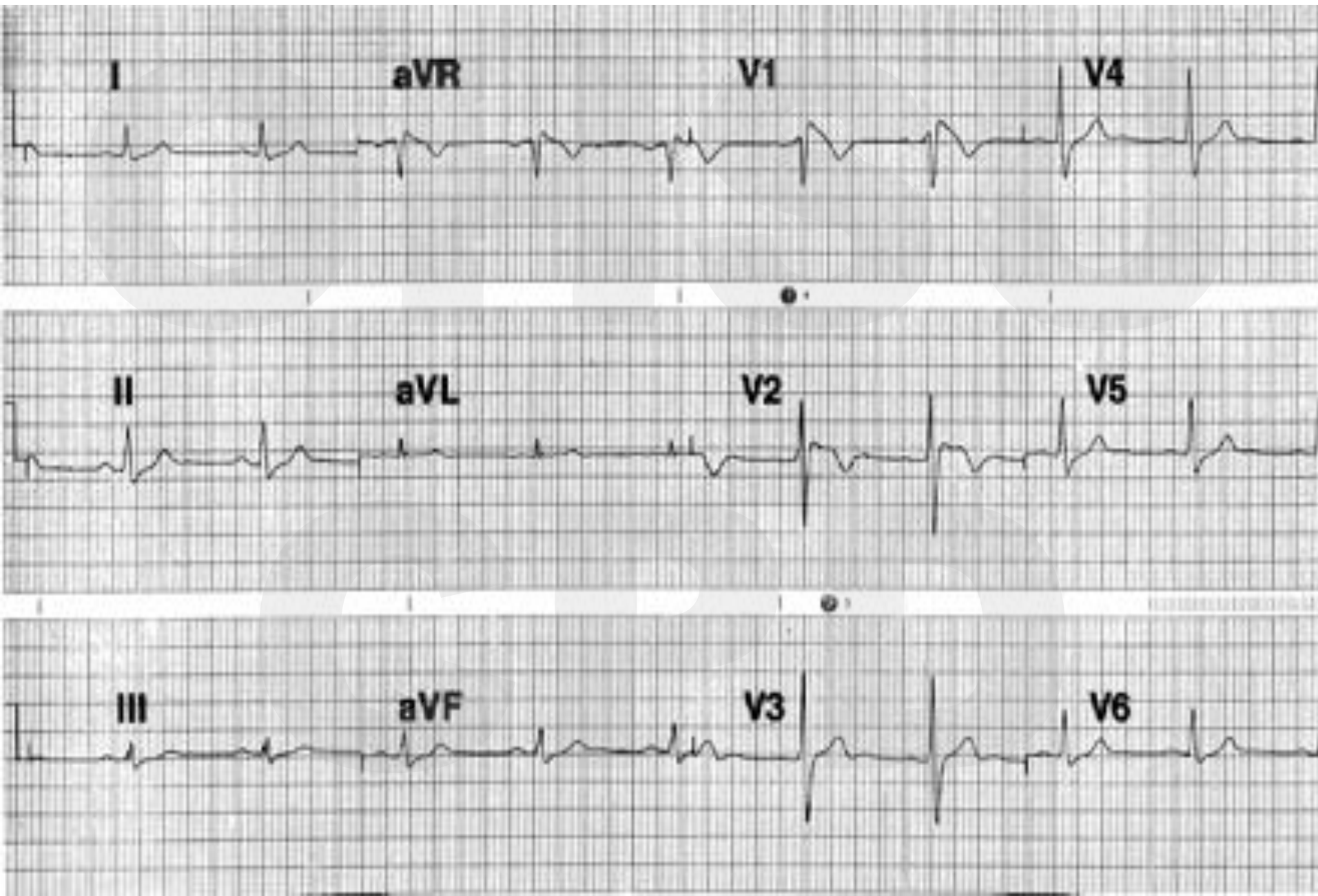
WPW

Referred by: GARY JONES

Unconfirmed



Brugada ECG



Routine Screening EKGs

AAP News Choosing Wisely

Nov 2020

- Do not routinely order a screening ECG as part of a sports preparticipation examination in asymptomatic, otherwise healthy patients with no personal or family history of cardiac disease.
- Do not order a screening ECG prior to initiation of ADHD therapy in asymptomatic, otherwise healthy pediatric patients with no personal or family history of cardiac disease.

Following Covid-19 Infection

- AAP 9/9/2022 (check for more up to date guidelines)
 - Mild, asymptomatic, no EKG needed
 - Mild, symptomatic, EKG
 - Moderate, asymptomatic, EKG
 - Moderate, symptomatic, EKG and cardiology referral
 - Severe and MIS-C, refer to cardiology

A Gentle Reminder

- EKG's are typically screening tests
 - Result is highly dependent on lead position
- Be wary of the computer interpretation
 - Especially with QTc and ventricular hypertrophy
- EKGs are generally read in 24-48hrs
 - Sent electronically to our offices at OHSU
 - Faxed EKG's are difficult to interpret
- For urgent EKG's please page prior to faxing
 - OHSU paging operator 503-494-9000
- Please double check the Holter/Event Monitor orders



SAVE THE DATE: **February 8, 2025**

Pediatric Cardiology for Primary Care Providers

Topics will include:

- Murmurs
- Chest Pain & Myocarditis
- Syncope (including POTS and long Covid)
- Preventive Cardiology
- Case-based "Pick my brain" opportunities

**CME
opportunity**

CME Credit and breakfast will be provided. Registration will open soon.
Contact Hannah Holiman holiman@ohsu.edu for more information