



The ECG In Poisoning

Craig Smollin MD

Professor of Clinical Emergency Medicine, UCSF

Medical Director, California Poison Control System- SF Division

What is the Utility of the ECG in Poisoning?

- Cardiotoxicity is a leading causes of death among poisoned patients.
- Poisoning is leading cause of cardiac arrest in patients < 40 years old.
- ECG can provide key information to guide management.

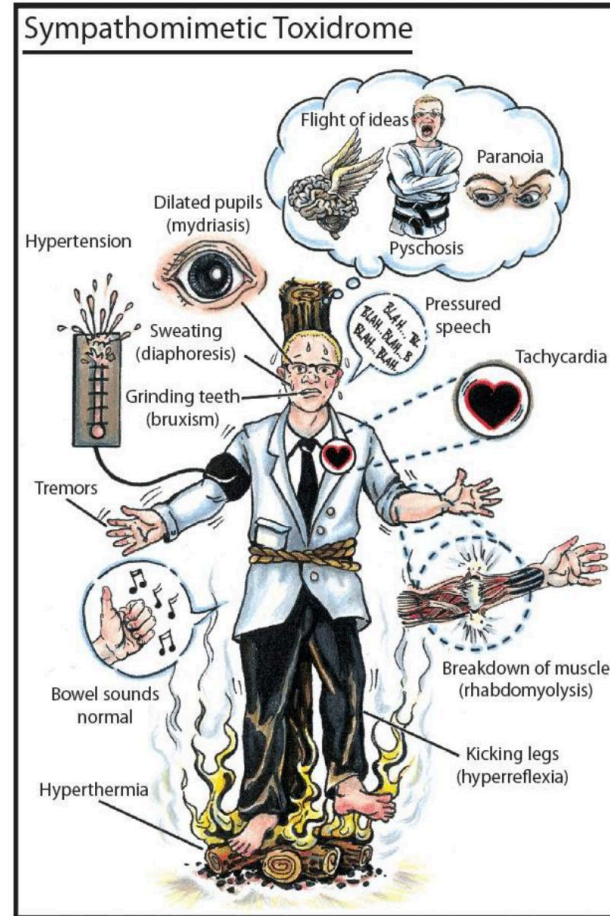
Take a Thorough Medication History



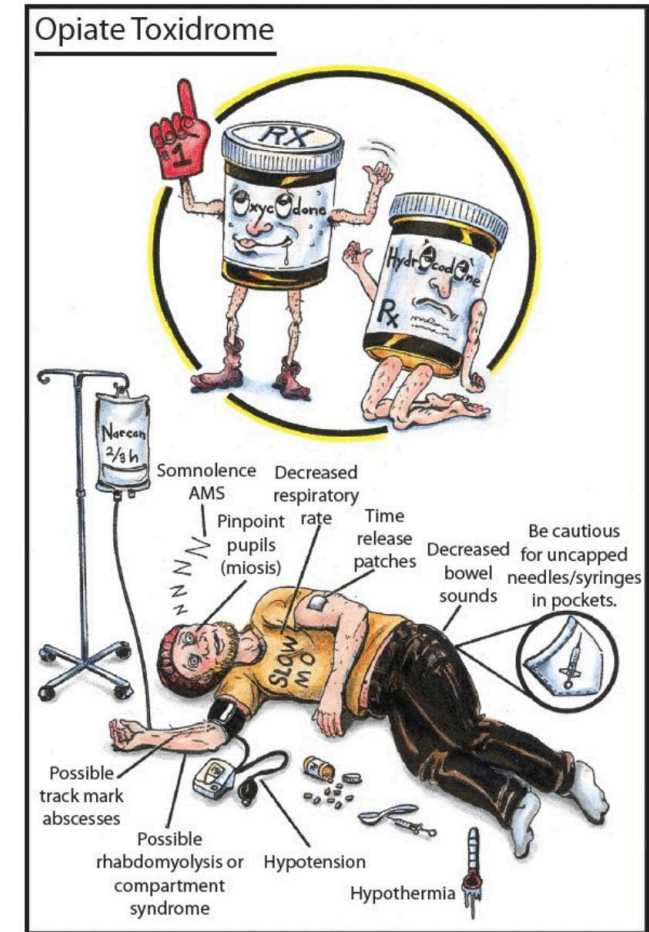
Is There a Toxidrome?



Anticholinergic



Sympathomimetic



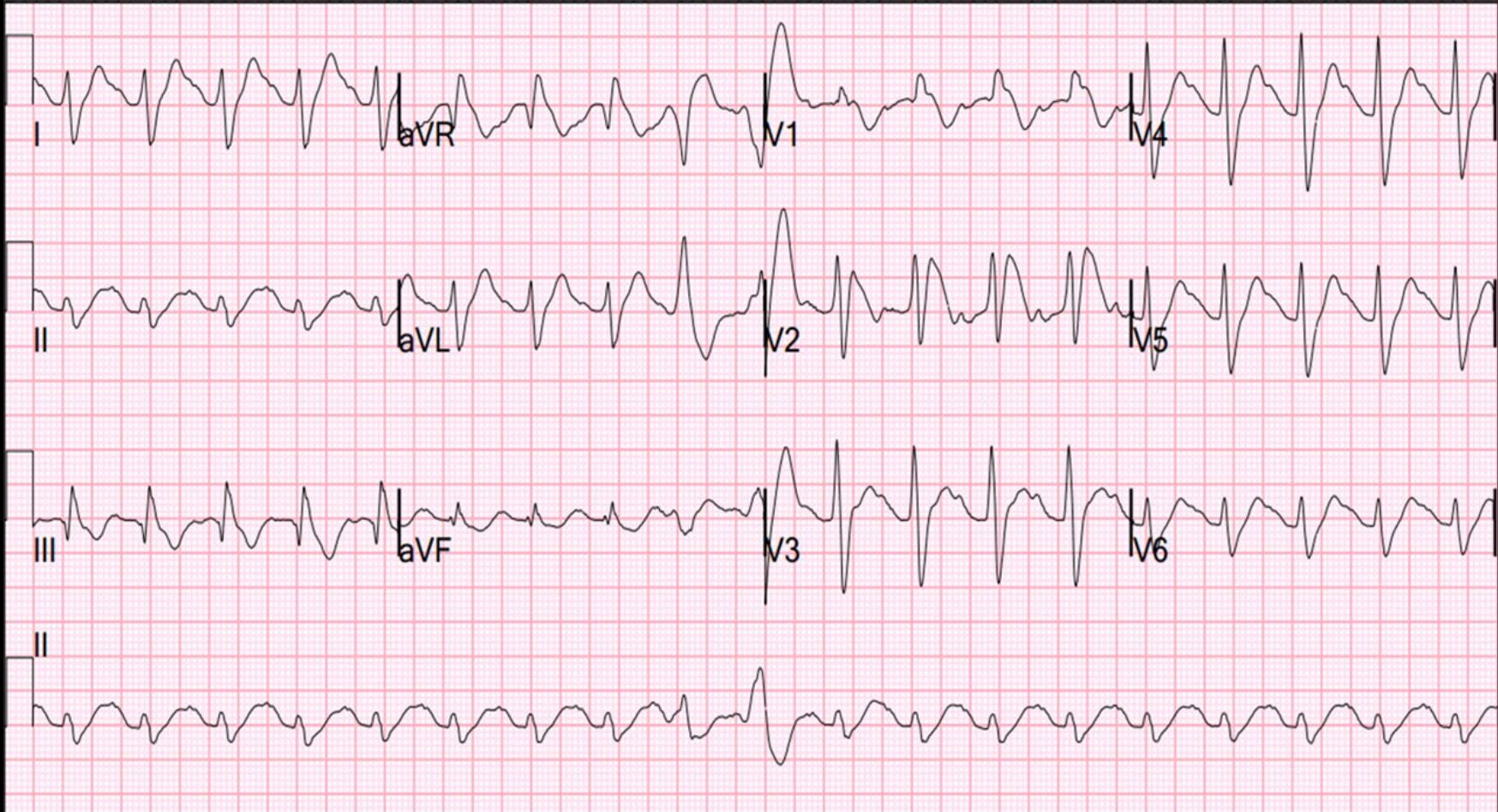
Opiate

What other medical problems does the patient have?

- Prior myocardial infarction or ischemic heart disease.
- Pulmonary hypertension.
- Family history of sudden cardiac death.
- History of prior abnormal ecg (RBBB, LBBB etc.)

Does the ECG Fit the Clinical Picture?





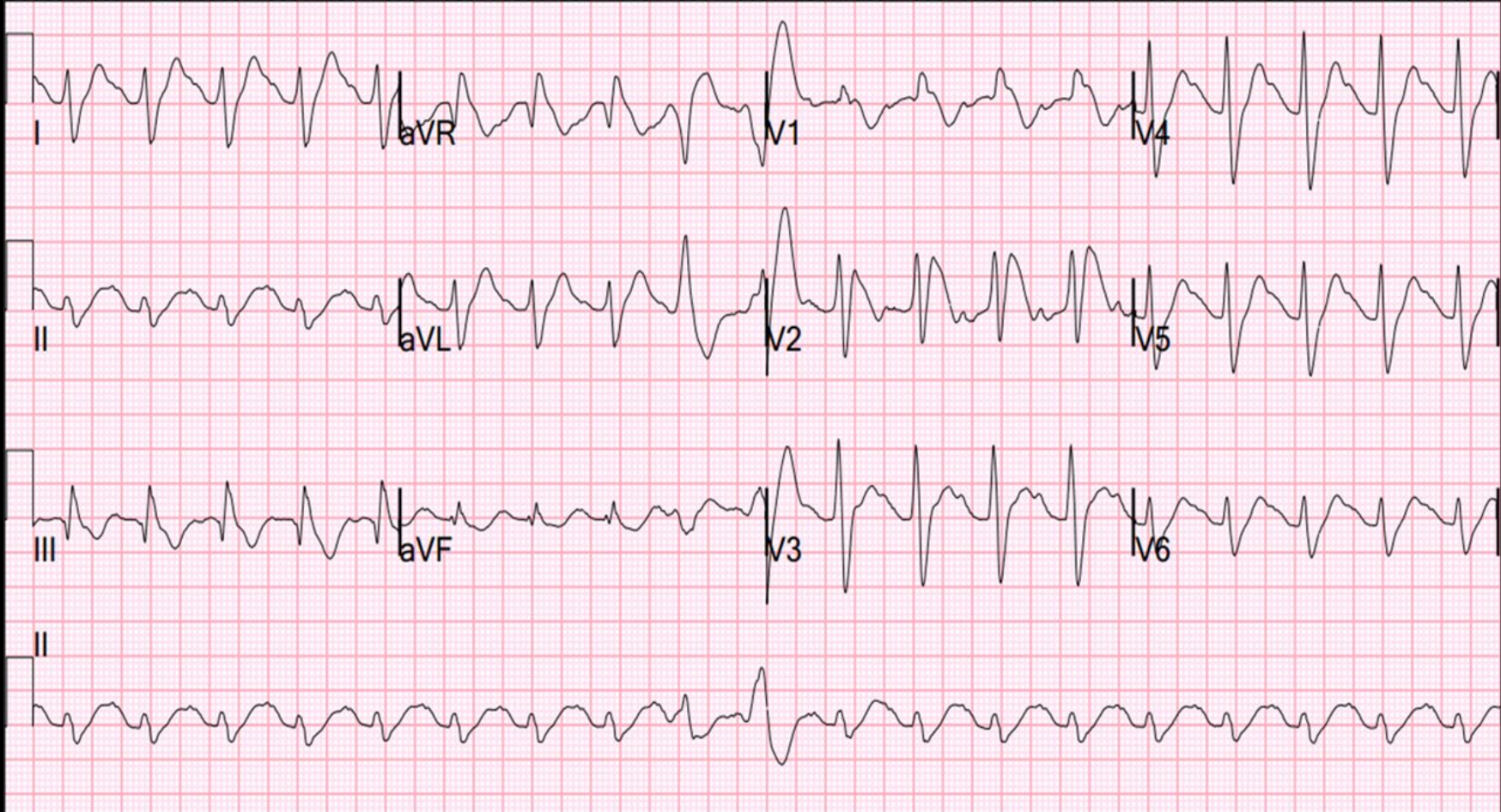
Case #1

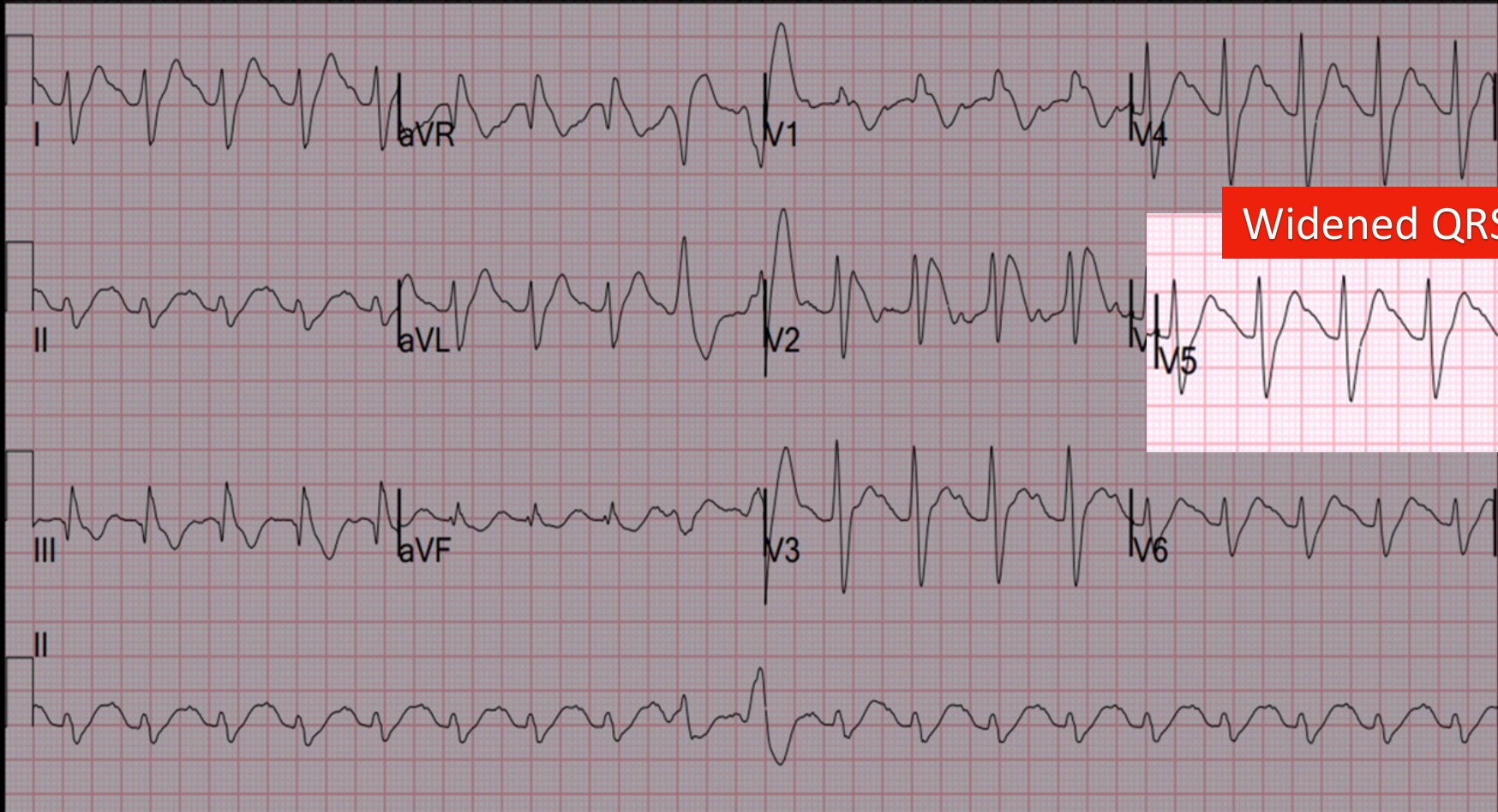
- 43-year-old presents after intentional ingestion of a bottle of her antidepressant medication.
- Vital signs significant for HR 130
- Exam
 - Drowsy with slurred speech
 - Dilated pupils
 - Urinary retention.

Case #1

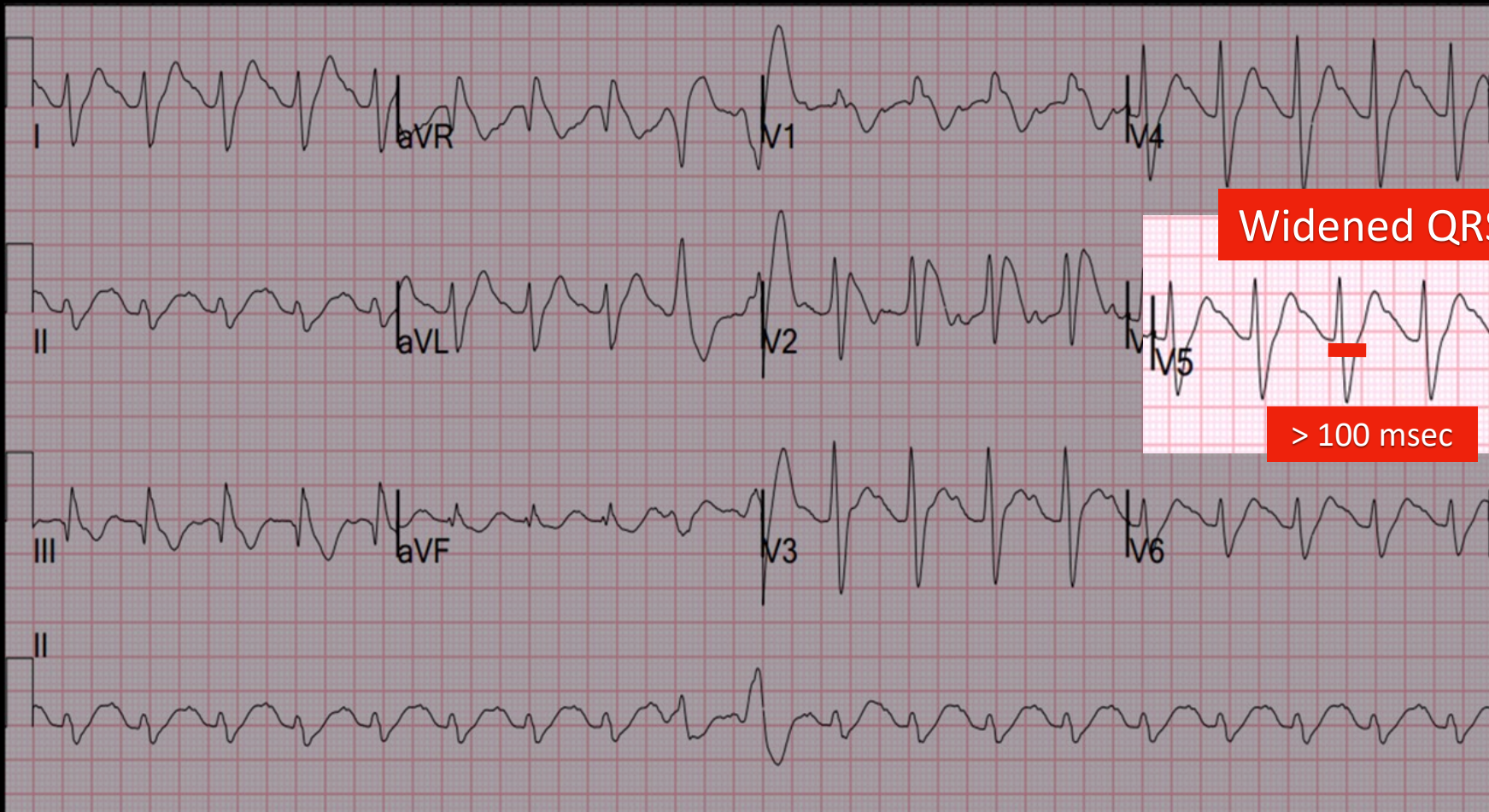
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**Signs and symptoms of
anticholinergic toxidrome**

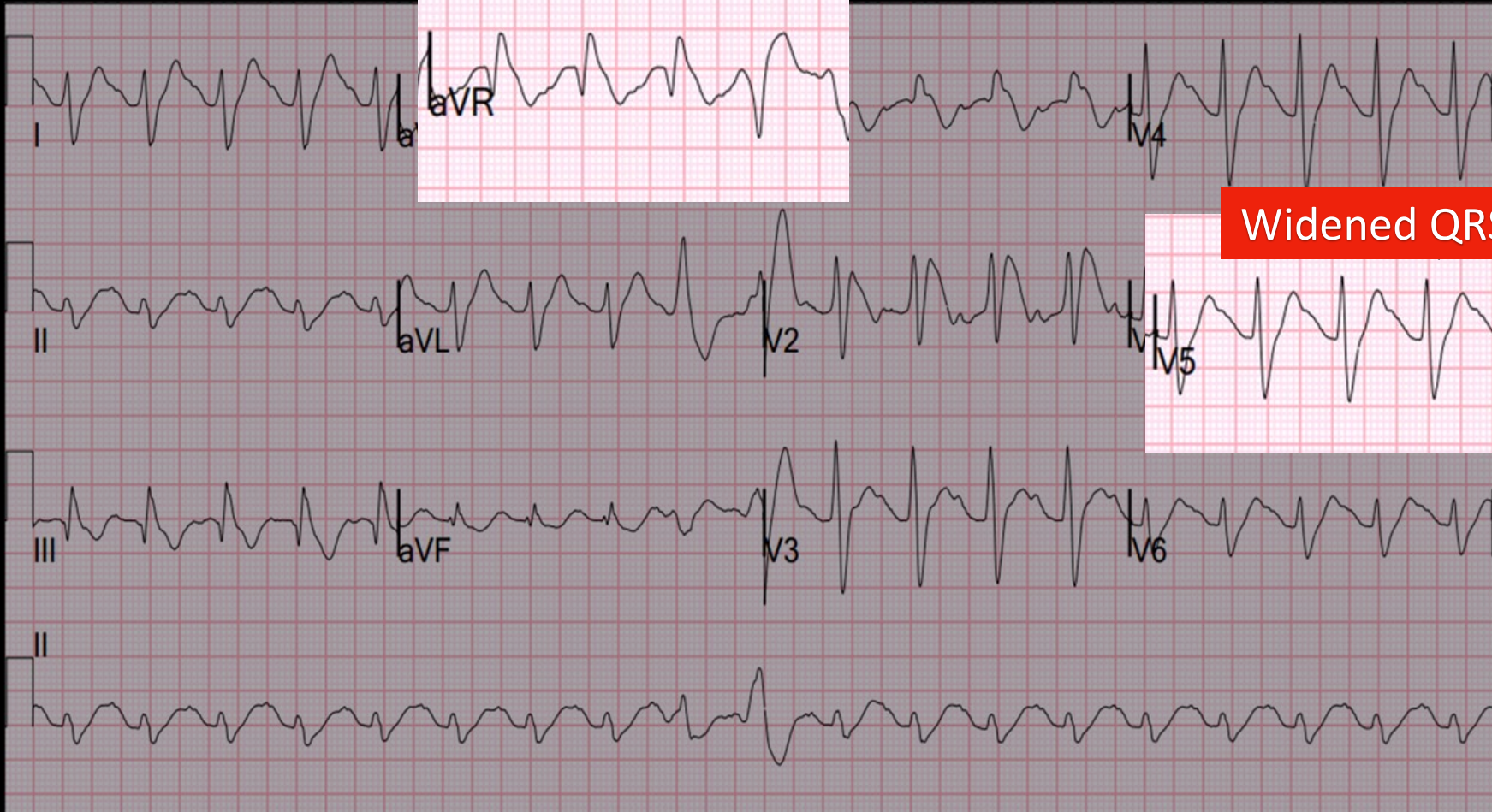




Widened QRS

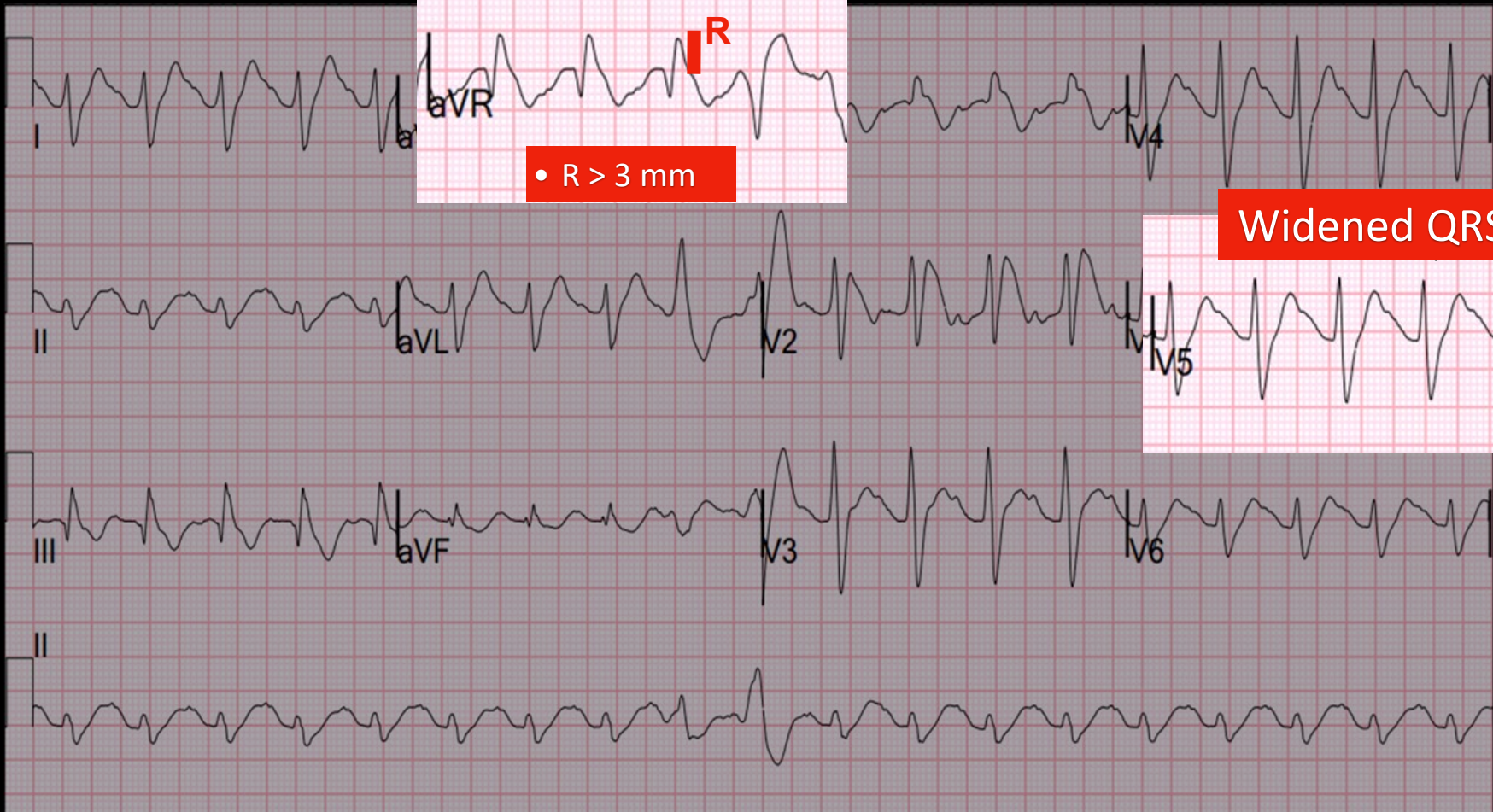


R wave in aVR



Widened QRS

R wave in aVR



• R > 3 mm

Widened QRS

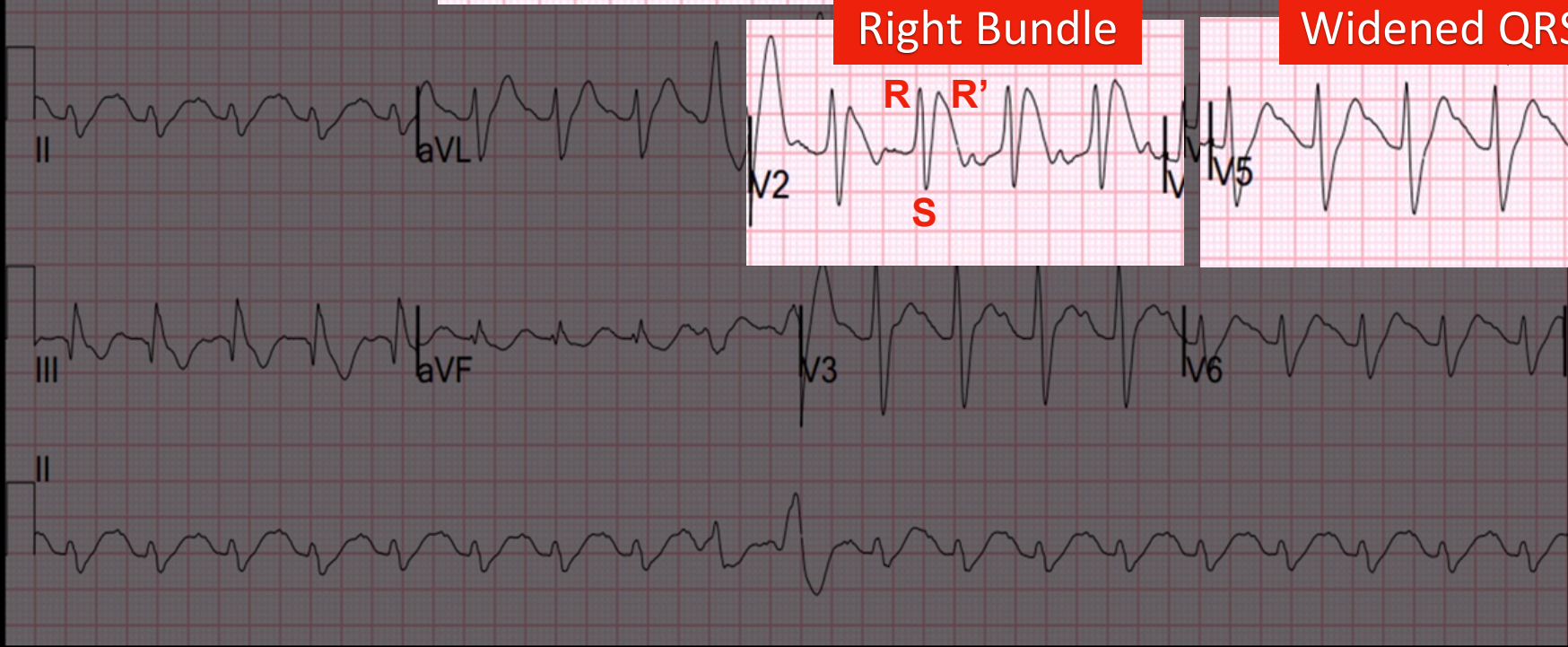
R wave in aVR



Right Bundle



Widened QRS



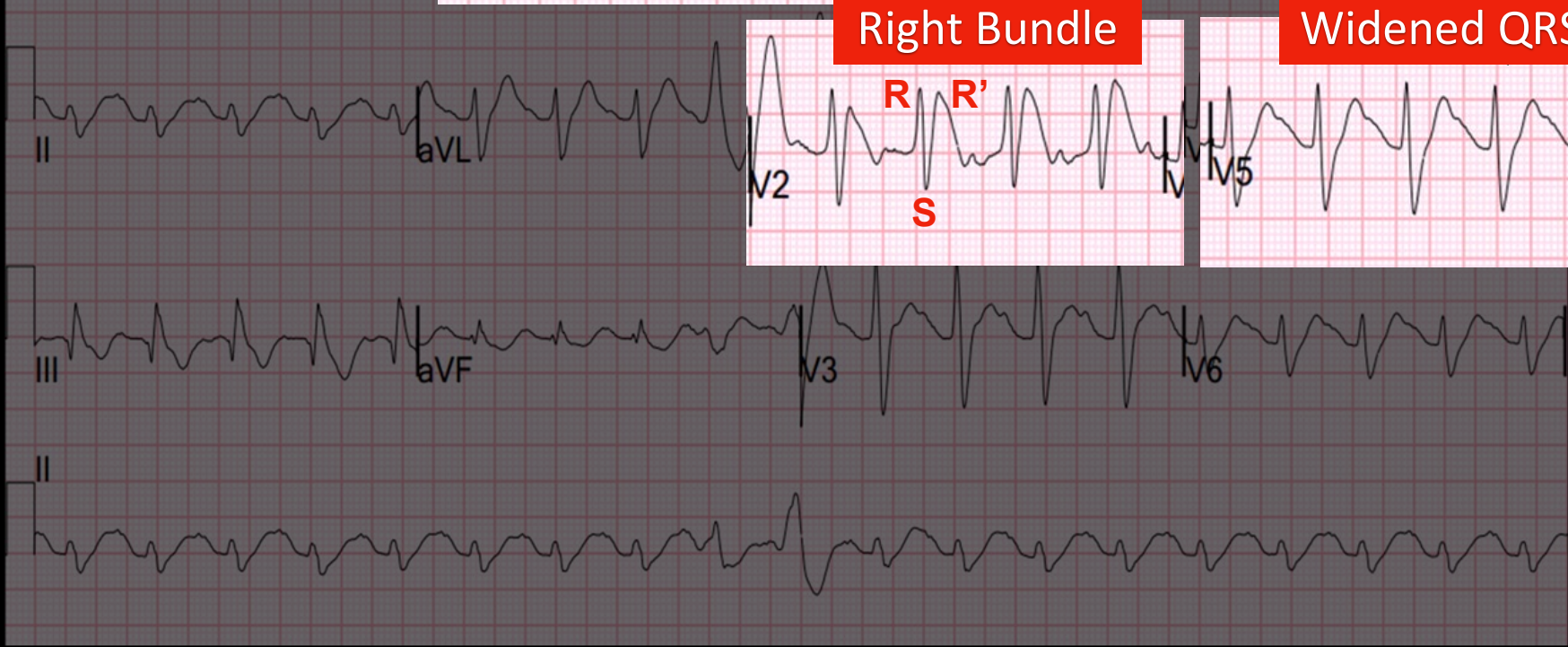
R wave in aVR

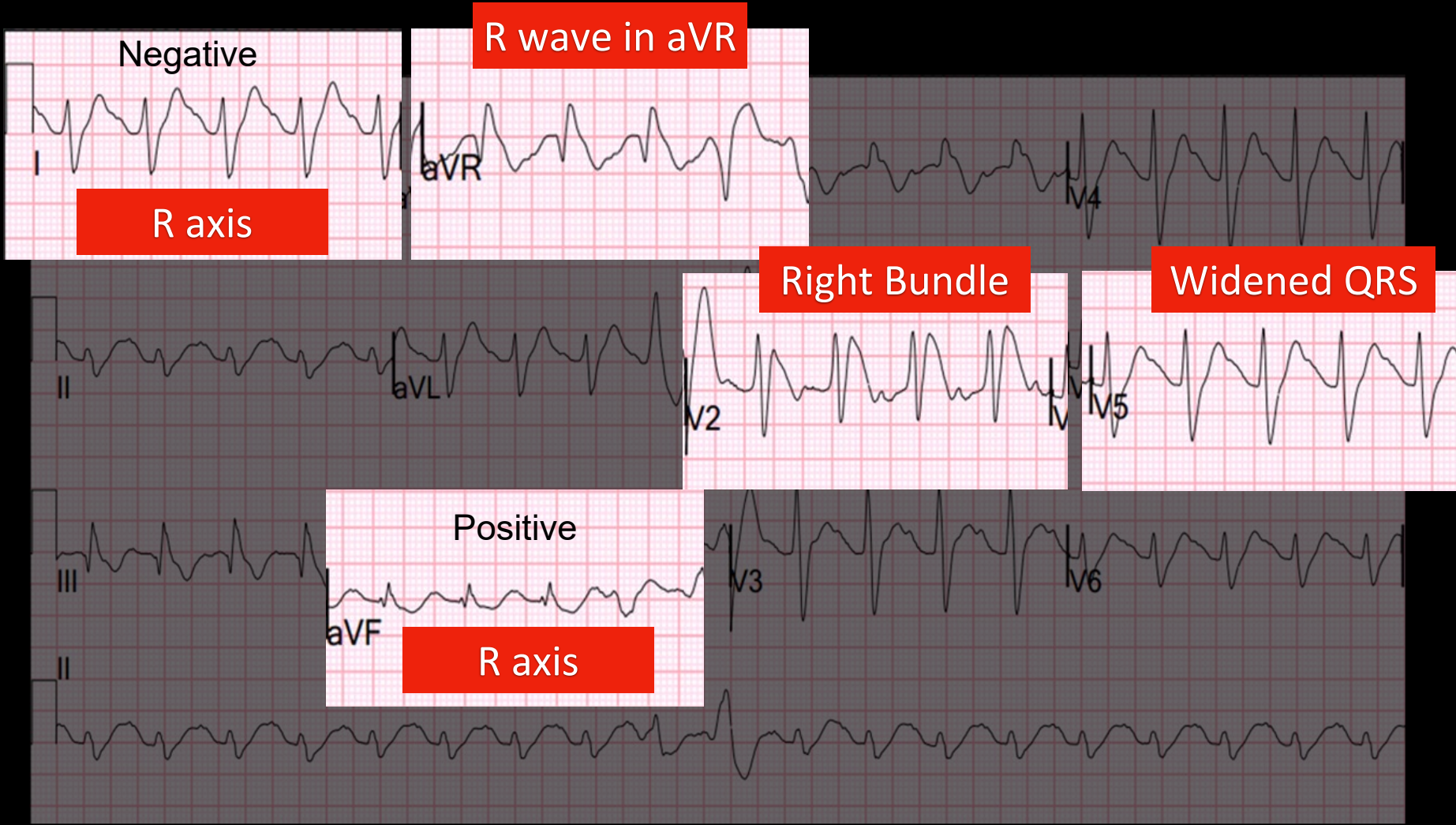


Right Bundle



Widened QRS





Case #1

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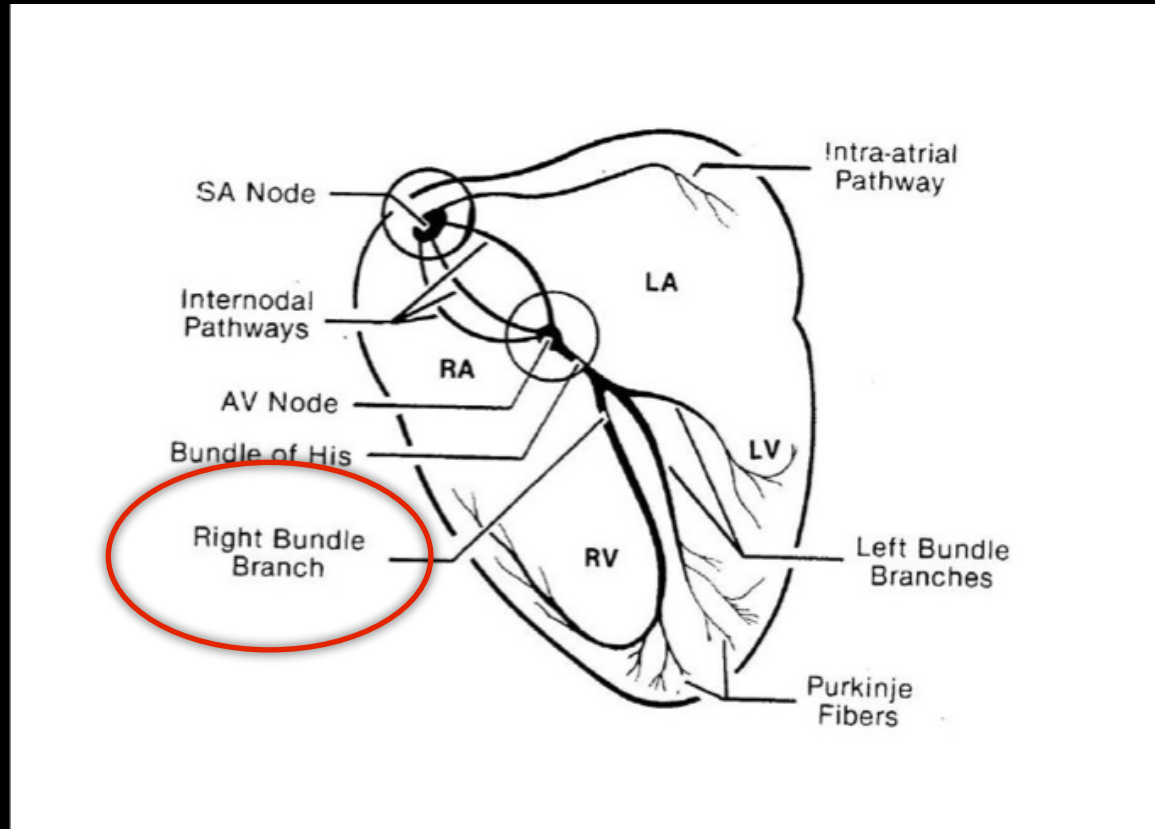
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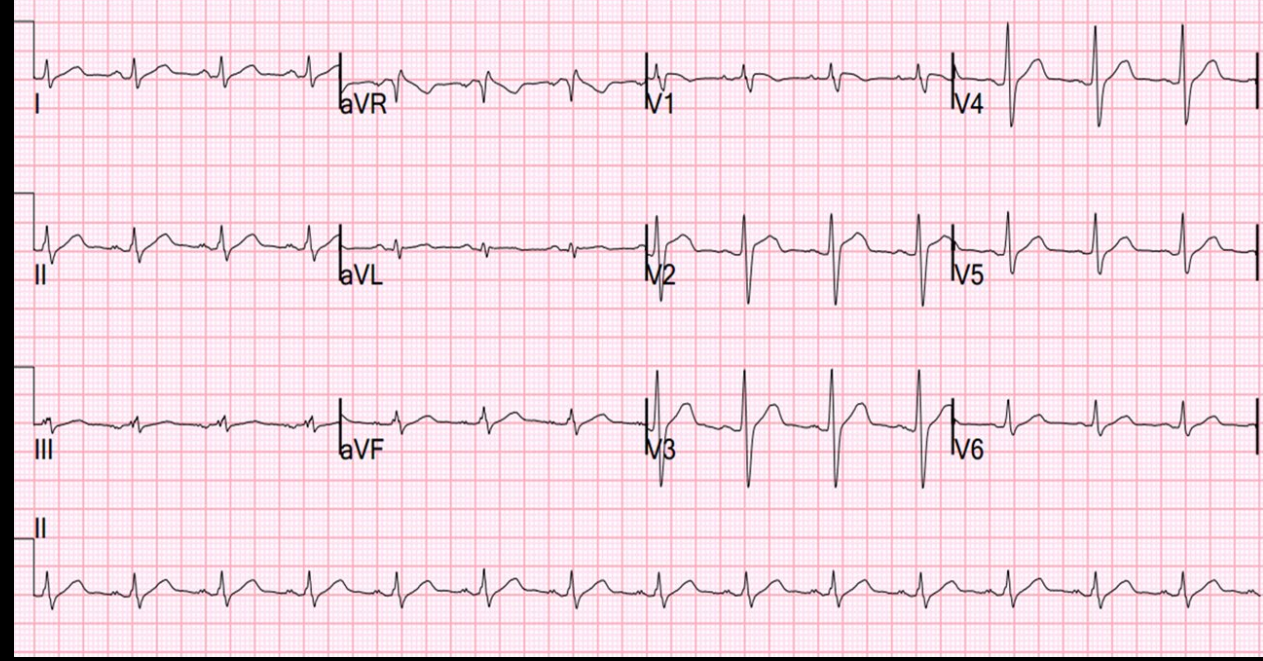
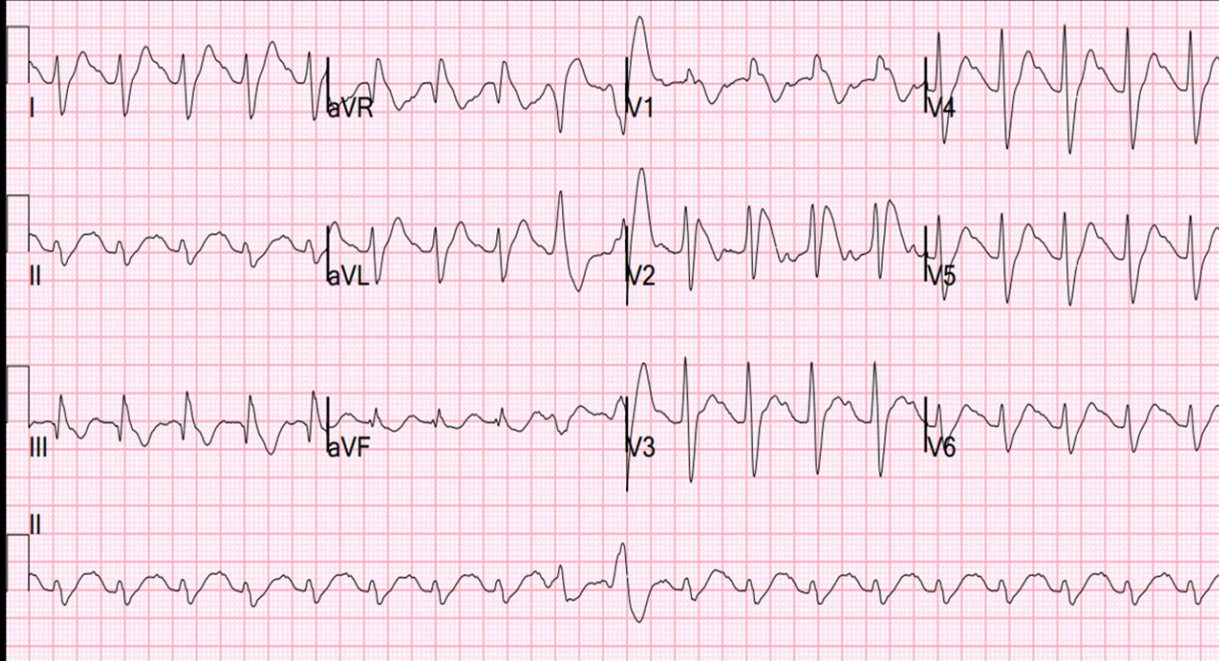
Signs and symptoms of anticholinergic toxidrome

Cardiotoxicity and ECG findings associated with sodium channel blockers

Na⁺ Channel Blocker Toxicity



After Bicarbonate Administration



Case #2

- 18-year-old male with agitation and diaphoresis after cocaine use.
- Vital Signs: BP 160/70, P 127, RR 20, O2 Sat 100%
- Exam:
 - Mydriasis
 - Diaphoresis
 - Paranoia



25mm/s 10.0mm/mV 100Hz
Marquette Medical Systems, Inc.

R axis

R wave in aVR



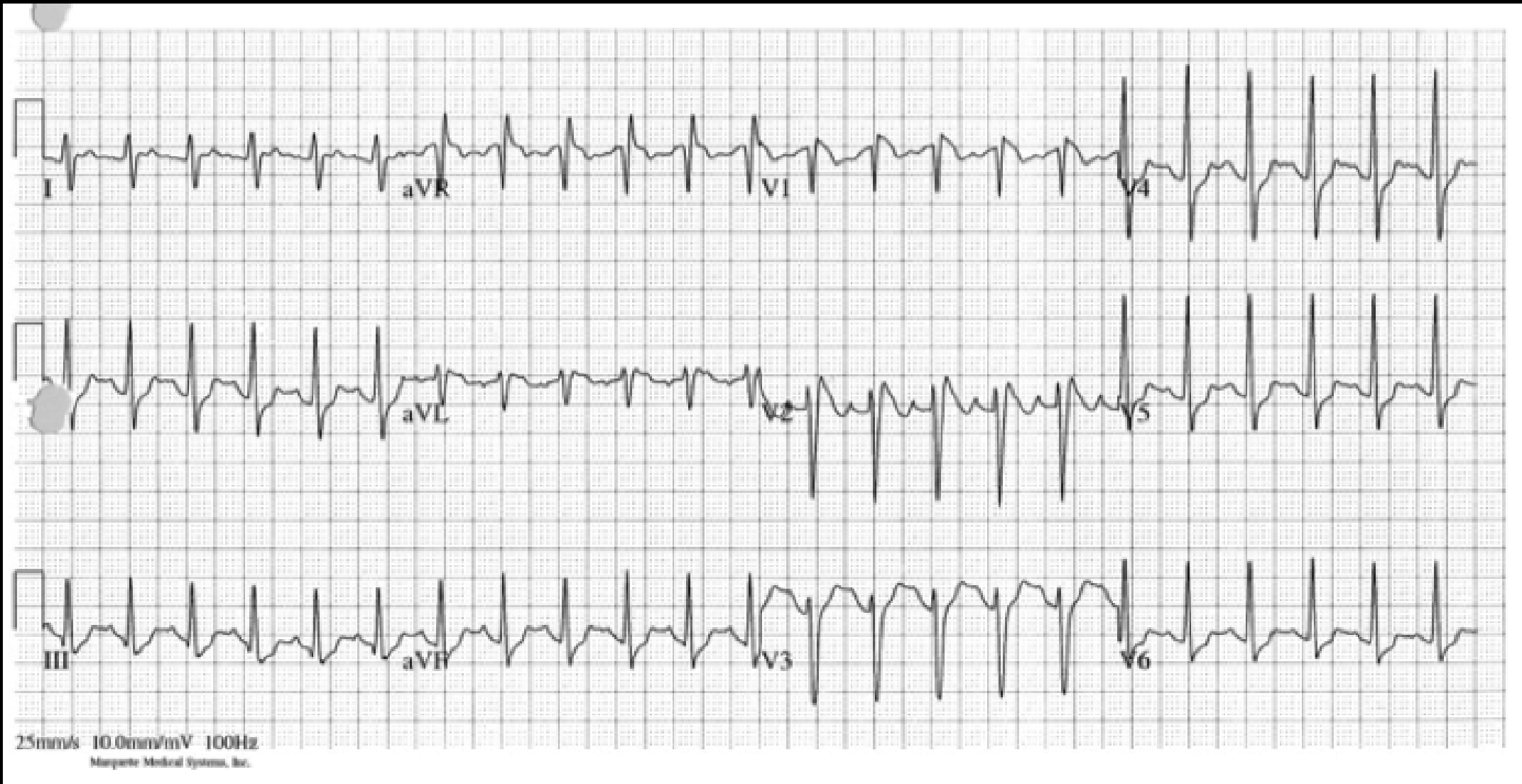
Right Bundle



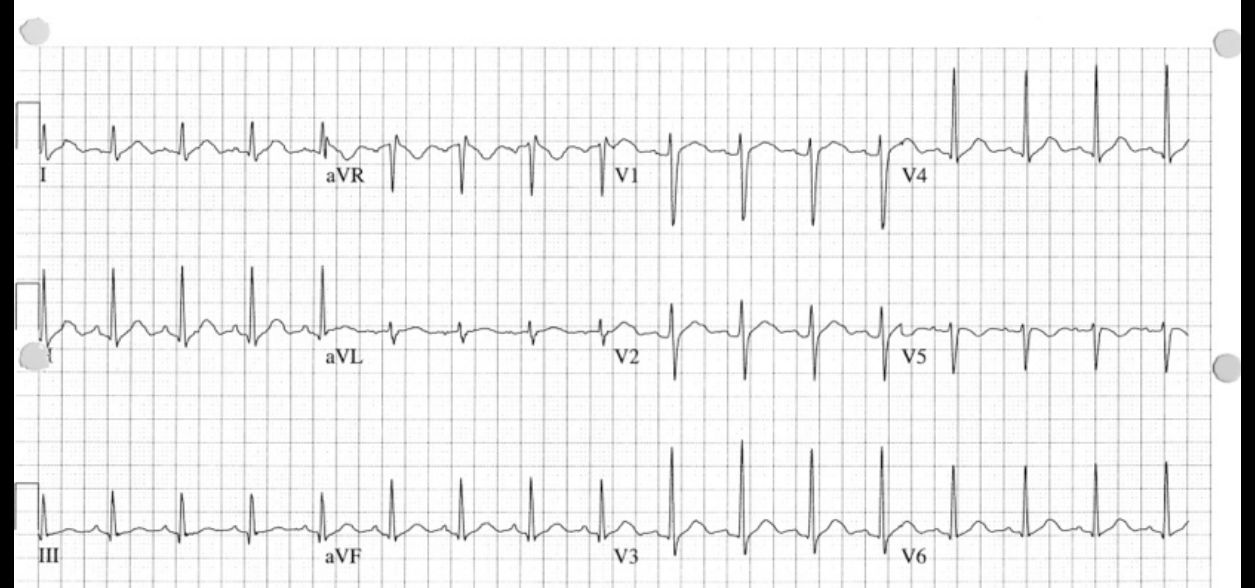
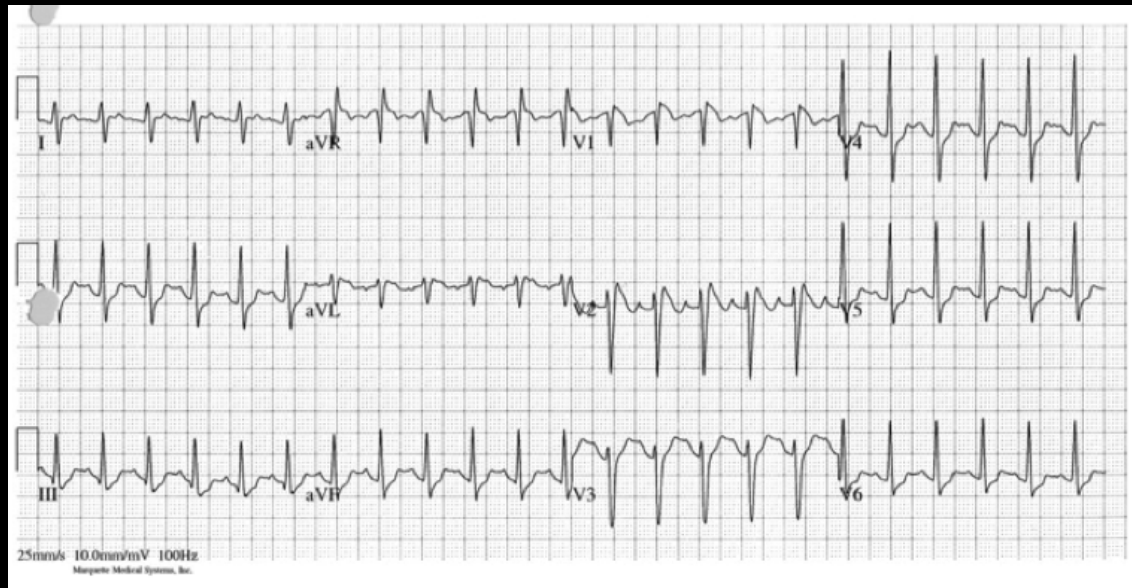
R axis



Brugada Pattern in Cocaine Intoxication



Brugada Pattern in Cocaine Intoxication



Commonly used drugs with Na channel blockade

Anticonvulsants

Carbamazepine

Antidysrhythmics

Class IA and IC

Class II (propranolol)

Class IV (diltiazem)

Antihistamines

Diphenhydramine

Antimalarial drugs

Chloroquine

Hydroxychloroquine

Quinine

Antipsychotics

Phenothiazines

Drugs of abuse

Cocaine

Opioids

Propoxyphene

Other antidepressants

Bupropion

Mirtazapine

Venlafaxine

Tricyclic Antidepressants

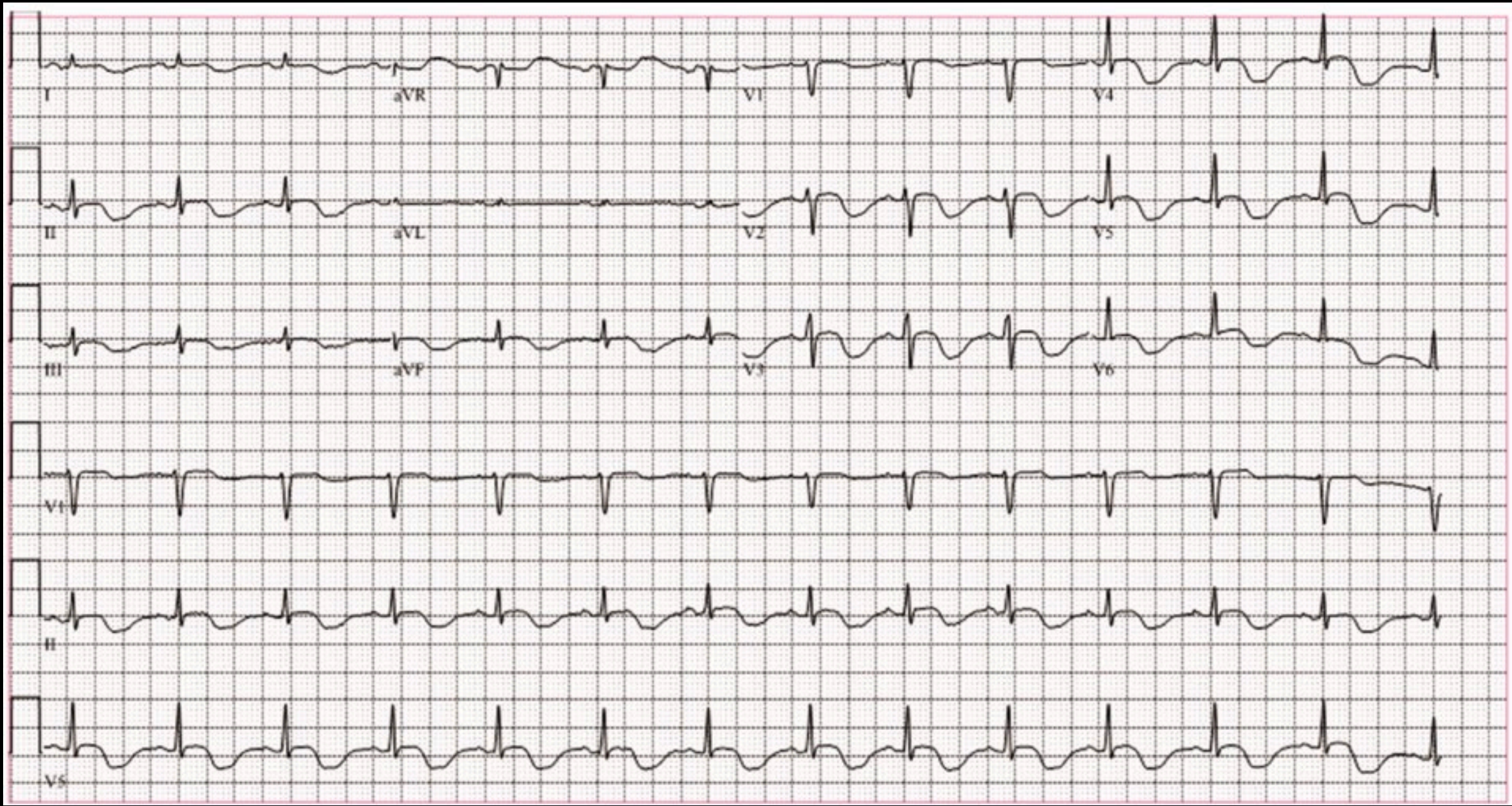
Amitriptyline

Desipramine

Doxepin

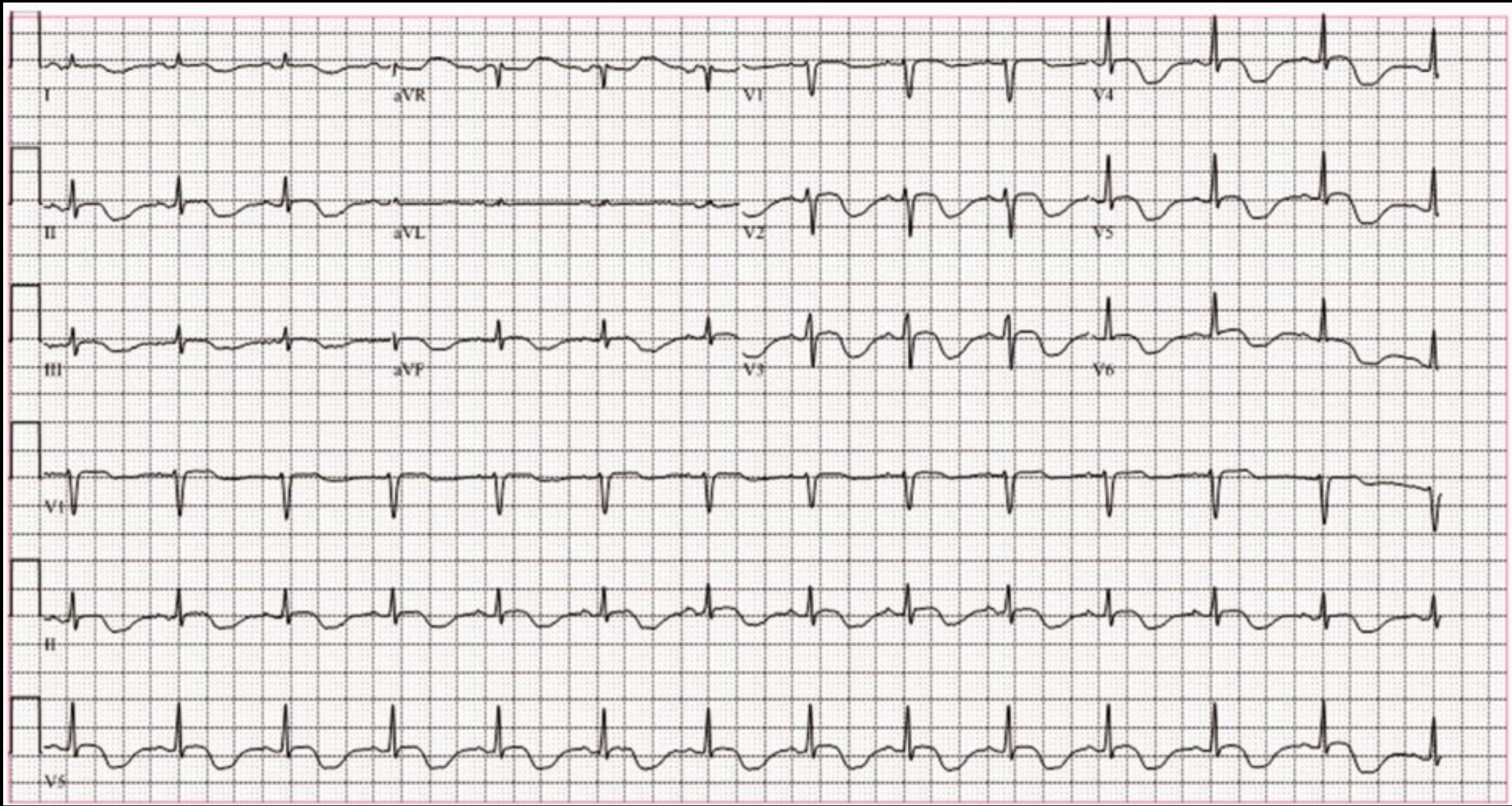
Imipramine

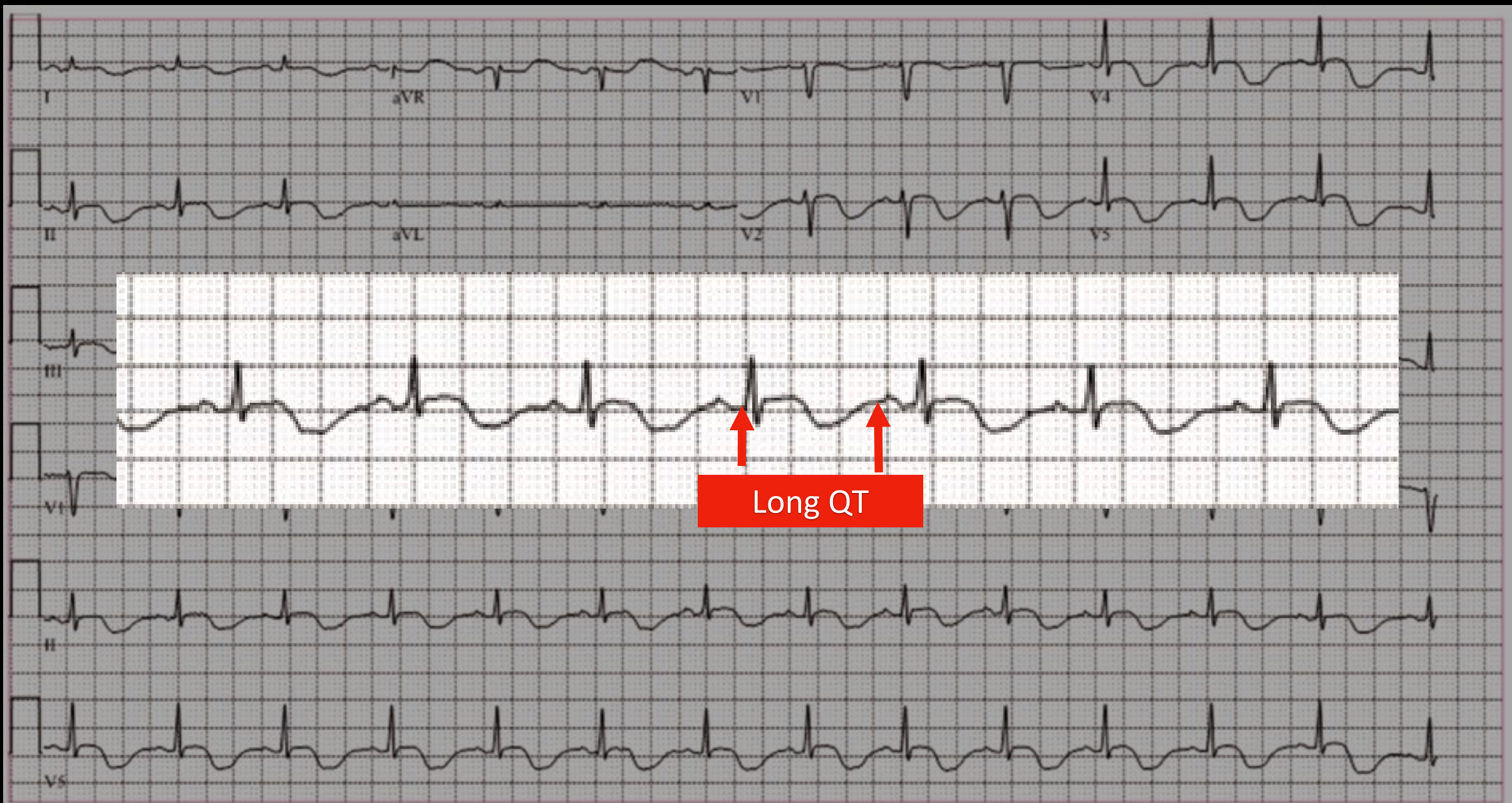
Nortryptiline



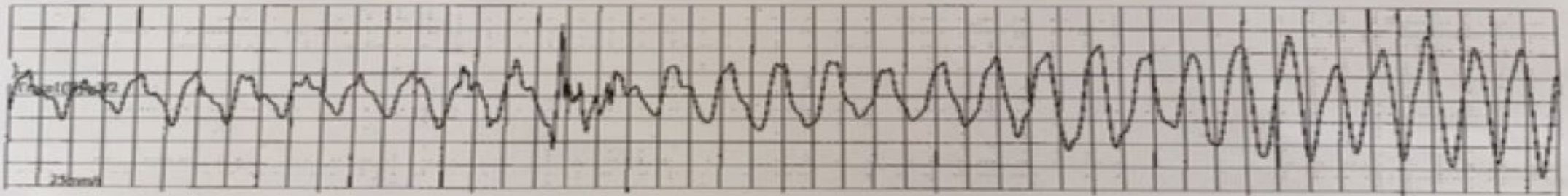
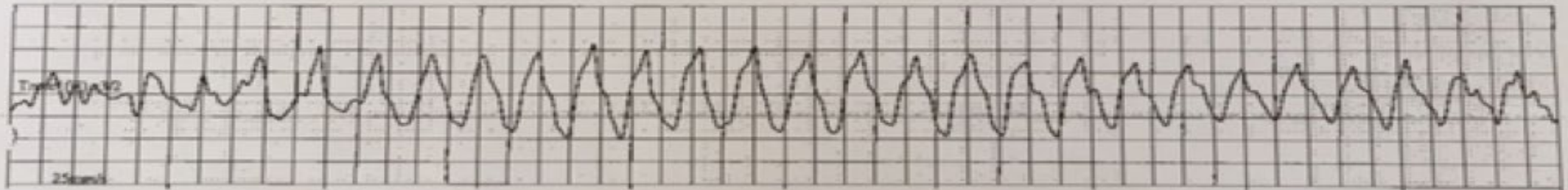
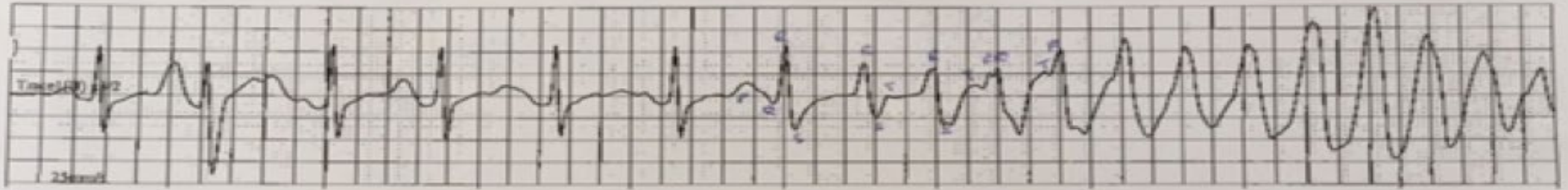
Case #3

- 21-year-old man with two episodes of syncope.
- History of opiate use disorder.
- Initially found altered and unresponsive.
- Mental status improved after naloxone.





Torsades de Pointe



Case #3

- 21-year-old man with two episodes of syncope.
- History of opiate use disorder.
- Initially found altered and unresponsive.
- Mental status improved after naloxone.

Additional history: Patient takes 50-100 tabs of loperamide (2 mg) daily.

Loperamide Cardiotoxicity

- Easily accessible medication
- Peripheral mu-opioid receptor agonist
- Blocks inward rectifying potassium channel resulting in QTc prolongation.
- Also with Na channel blocking properties.



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FDA Drug Safety Communication: FDA warns about serious heart problems with high doses of the antidiarrheal medicine loperamide (Imodium), including from abuse and misuse

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The FDA has issued new information about this safety issue, see the **FDA Drug Safety Communication** issued on [1-30-2018](#)



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FDA Drug Safety Communication: FDA limits packaging for anti-diarrhea medicine Loperamide (Imodium) to encourage safe use

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This is an update to the [FDA Drug Safety Communication: FDA warns about serious heart problems with high doses of the antidiarrheal medicine loperamide \(Imodium\), including from abuse and misuse](#) issued on June 7, 2016

Selected drugs that prolong the QTc

Antidysrhythmics

Quinidine

Amiodarone

Sotalol

Procainamide

Antihistamines

Astemizole

Antibiotics

Macrolides

Fluoroquinolones

Antipsychotics

Phenothiazines

Antipsychotics

Chlorpromazine

Haloperidol

Quetiapine

Droperidol

GI motility agents

Cisapride

Doperidone

Opioids

Methadone

Loperomide

Treatment of Drug Induced TdP

- Correct electrolytes (Ca, Mg, K)
- Remove offending agent
- Increase heart rate (chemical vs pacing)



Case #4

- 64-year-old female with 2 days of weakness, nausea, and vomiting.
- Vital signs: P 40, BP 85/50, RR 20, O2 Sat 95%, Afebrile
- Exam significant for slow irregular rhythm

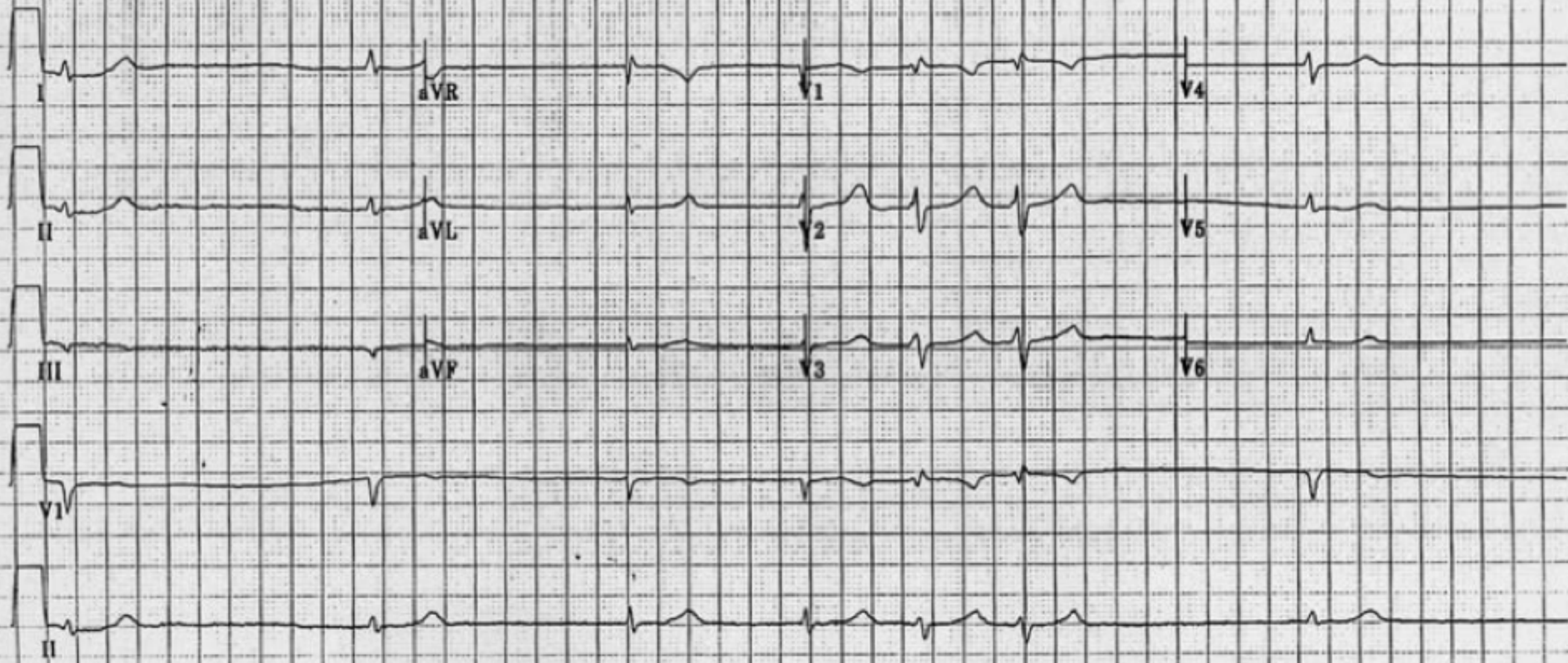
Case #4

- 64 year-old female with 2 days of weakness, nausea, and vomiting.
- Vital signs: P 40, BP 85/50, RR 20, O2 Sat 95%, Afebrile
- Exam significant for slow irregular rhythm

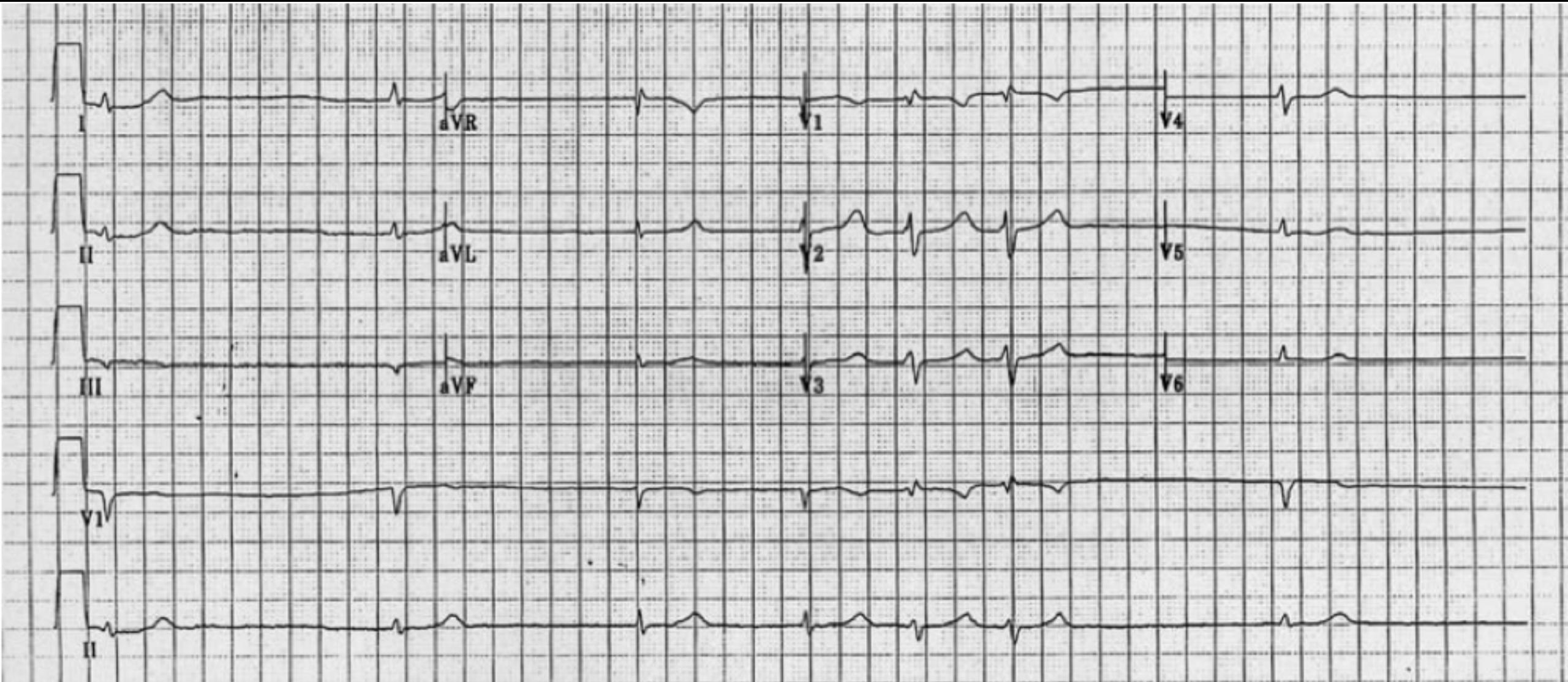
Hypotension and bradycardia!

Toxicology ddx of Hypotension and Bradycardia

Drug	Unique Features
Calcium channel blockers	Hyperglycemia
Beta blockers	Hypoglycemia
Digoxin	Hyperkalemia
Clonidine	Pinpoint pupils, Altered mental status
Organophosphates	“Sludge”
Sedative hypnotics	Pinpoint pupils (opiates), Somnolent



Slow Atrial Fibrillation



Case #4 - continued

- 64 year-old female with present with 2 days of weakness, nausea and vomiting.
- Vital signs: P 40, BP 85, RR 20, O2 Sat 95%, Afebrile
- Exam significant for slow irregular rhythm
- **Labs concerning for: K 6.5, Creatinine 3.3, Digoxin level 4.6 ng/mL**

Cardiac Glycoside Manifestations

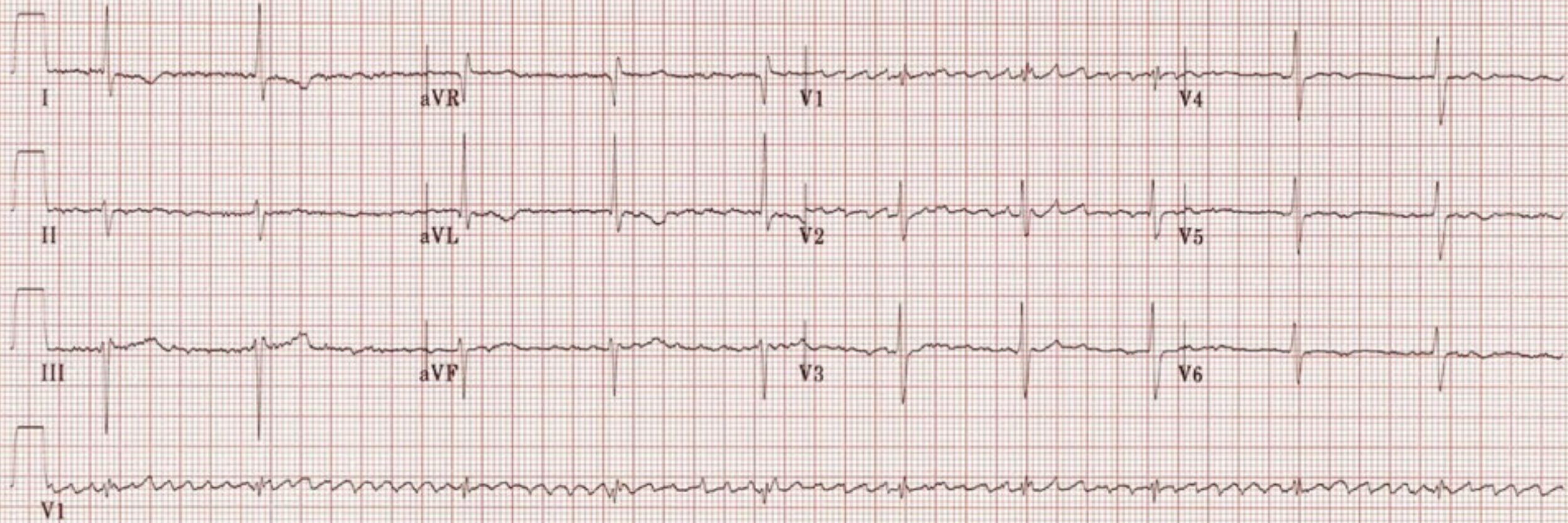
- Cell membrane depolarization – atrial and ventricular irritability
- Increased vagal tone – slowed conduction through the AV node
- Increased intracellular calcium – Increased contractility

Can see almost any arrhythmia except rapidly conducting supraventricular tachycardia.

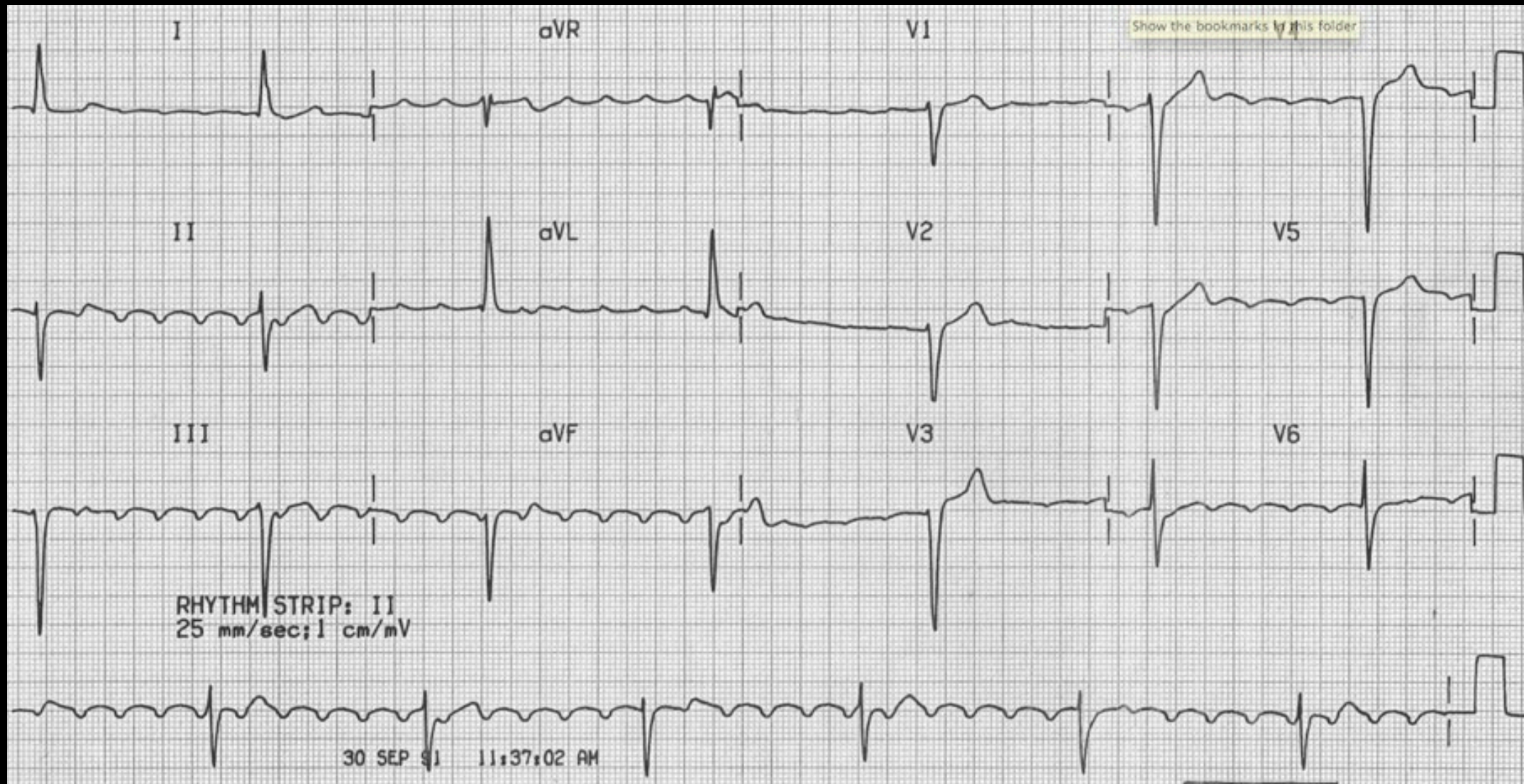
Rhythms Associated with Digoxin Toxicity

Premature ventricular contractions (PVCs)
1st degree heart block
2nd degree heart block
3rd degree heart block
Sinus bradycardia
Sinus tachycardia
SA block or arrest
Atrial fibrillation with slow ventricular response
Atrial tachycardia
Atrial tachycardia with block
Junctional escape rhythm
Atrial ventricular dissociation
Ventricular bigeminy
Ventricular trigeminy
Ventricular tachycardia
Torsades de Pointes
Ventricular fibrillation

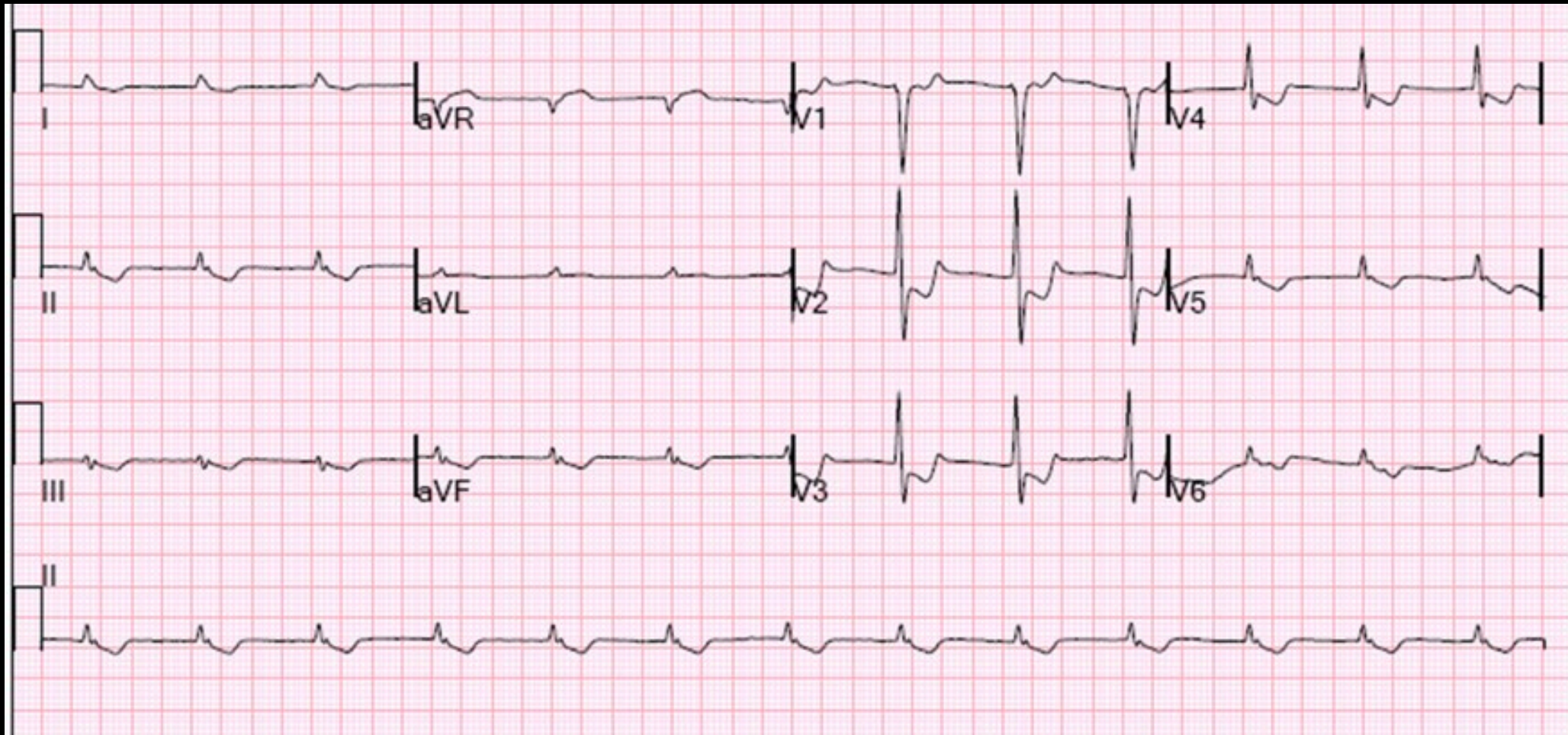
Atrial Flutter with Block



Atrial Flutter with Block

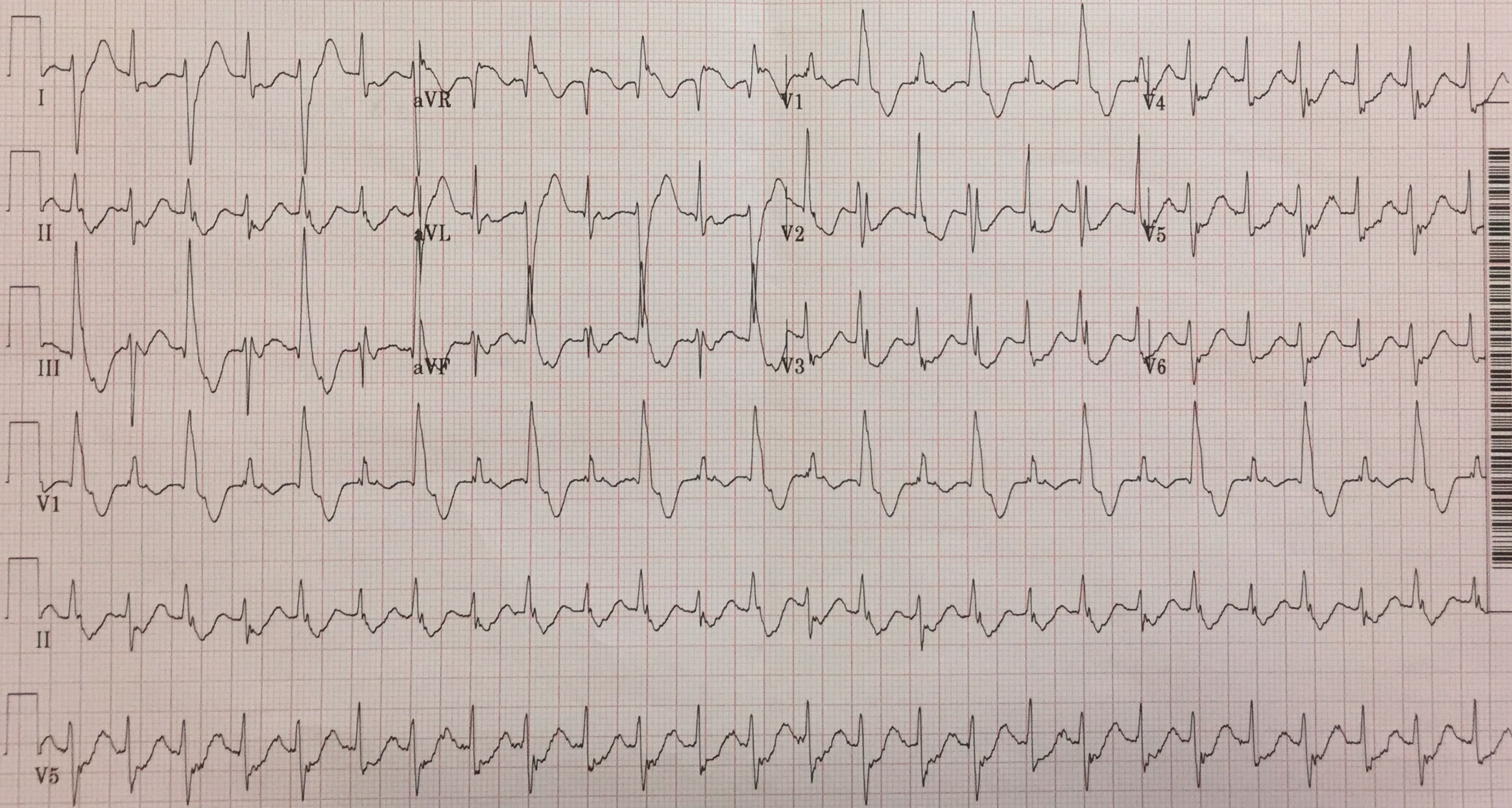


Accelerated Junctional Rhythm



Case #5 - Bonus

- A 56-year-old female presents with dizziness, palpitations and difficult breathing, one hour after drinking an herbal tea.

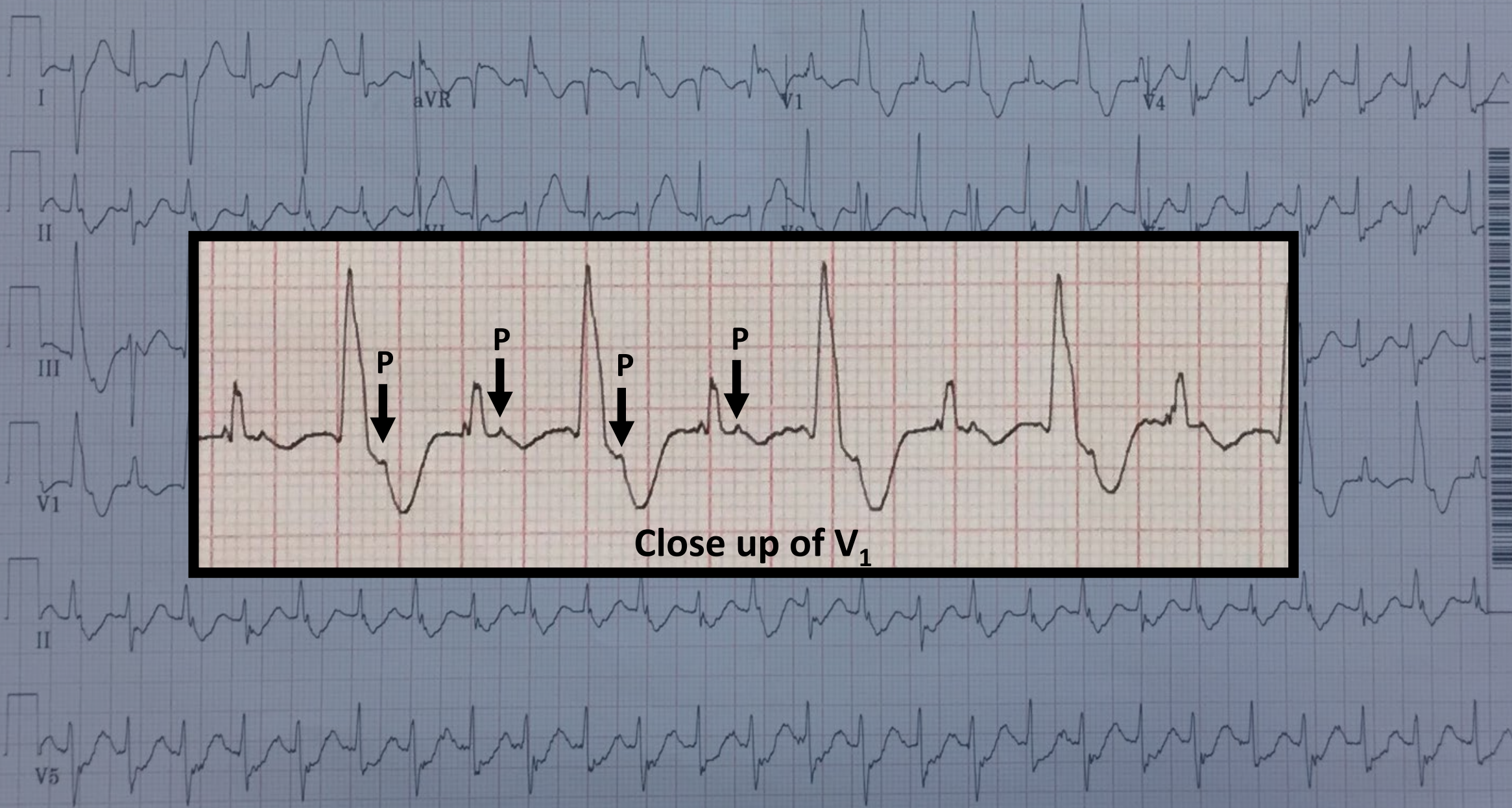


150 Hz 25.0 mm/s 10.0 mm/mV

4 by 2.5s + 3 rhythm lds

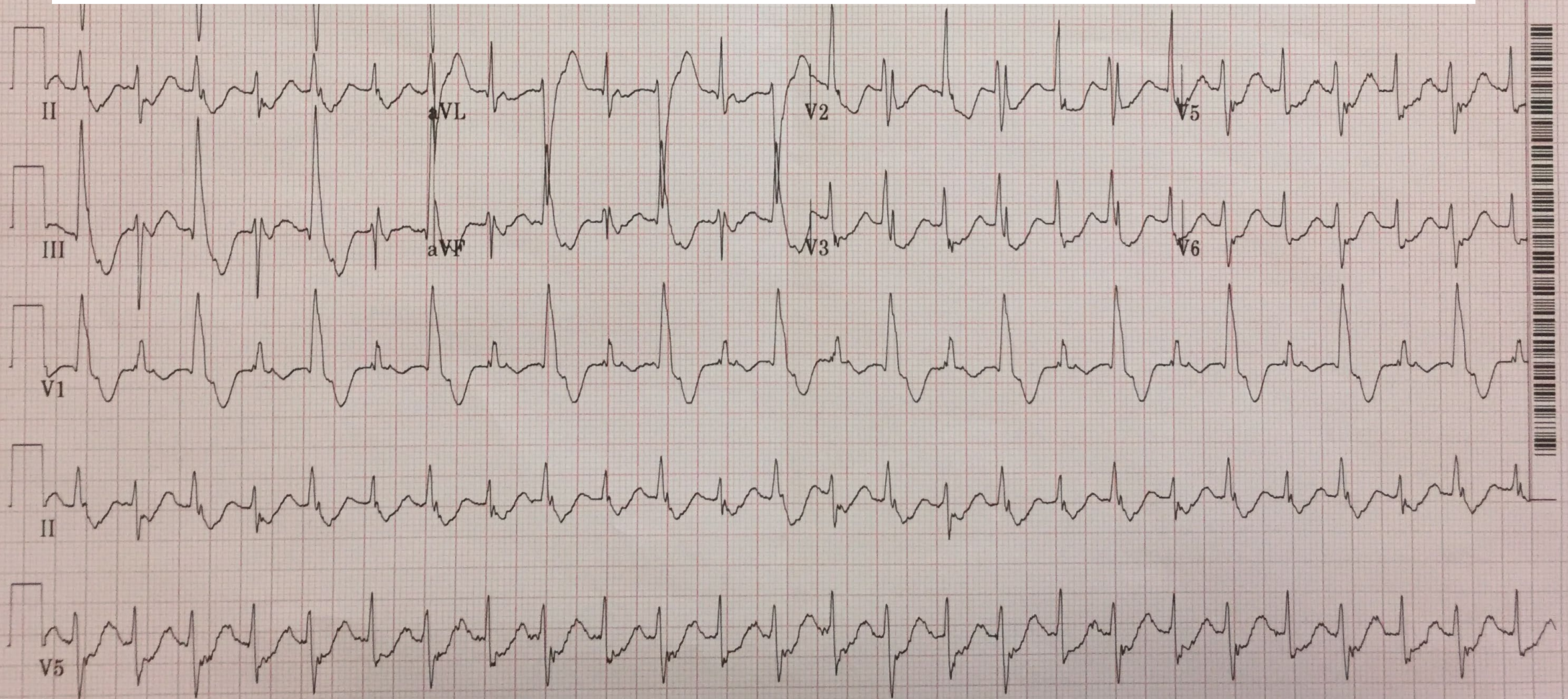
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Close up of V₁

Bidirectional Ventricular Tachycardia



150 Hz

25.0 mm/s

10.0 mm/mV

4 by 2.5s + 3 rhythm lds

MAC55 010A

12SL™ v241 F

Aconite

- Used in traditional Chinese medicine.
- Voltage sensitive sodium channel opener.
 - Increased intracellular sodium and calcium
- Similar to cardiac glycoside but without hyperkalemia.



Further investigation



Edwin M Lee
Mayor

San Francisco Department of Public Health

Barbara A Garcia, MPA
Director of Health

Tomás J. Aragón, MD, DrPH
Health Officer

Communicable Disease Control & Prevention

sfdph.org/cdcp

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HEALTH ALERT

MARCH 13, 2017

TWO CASES OF ACCIDENTAL ACONITE POISONING FROM MEDICINAL HERBS PURCHASED IN SAN FRANCISCO CHINATOWN SHOP

Situation: Two cases of accidental aconite poisoning associated with drinking tea brewed from medicinal herbs have occurred in San Francisco since February 2017. Both were previously healthy individuals who presented to the E.D. with severe, refractory ventricular arrhythmias after purchasing tea from the same herbalist shop (Sun Wing Wo Trading, 1105 Grant Avenue, SF). Blood and/or urine samples and leftover tea were positive for aconite in both cases. SFDPH has removed suspect tea components from the shop and is investigating further.

Background: Aconite is present in *Aconitum* plants, commonly called monkshood, helmet flower, devil's helmet, wolfsbane, "chuanwu," "caowu," or "fuzi" and is used in Asian herbal medicine to treat pain, fever, cough, asthma, and other conditions. It is given as a tincture, paste, or herbal tea. However the plant's leaves, flowers, stems, and roots are highly toxic and serve medicinal purposes only after undergoing a detoxification process. Poisoning occurs with inadequate processing or consuming large quantities. Symptoms begin within minutes to a few hours after ingestion, including severe cardiovascular manifestations.

Media Coverage

Woman Dies After Drinking Deadly Chinatown Tea

March 20, 2017 1:07 PM

Filed Under: Chinatown, Herbal Tea, San Francisco

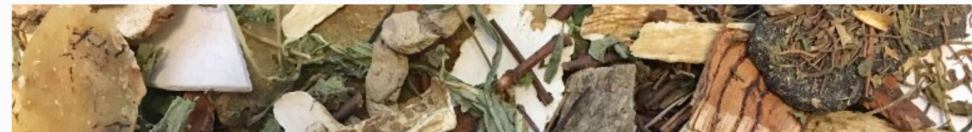


Tea containing Aconite, a plant-based lethal poison. (SFPD Photo)

Woman dies after drinking poisonous herbal tea

By Johanzynn Gatewood

Updated 5:12 PM ET, Tue March 21, 2017



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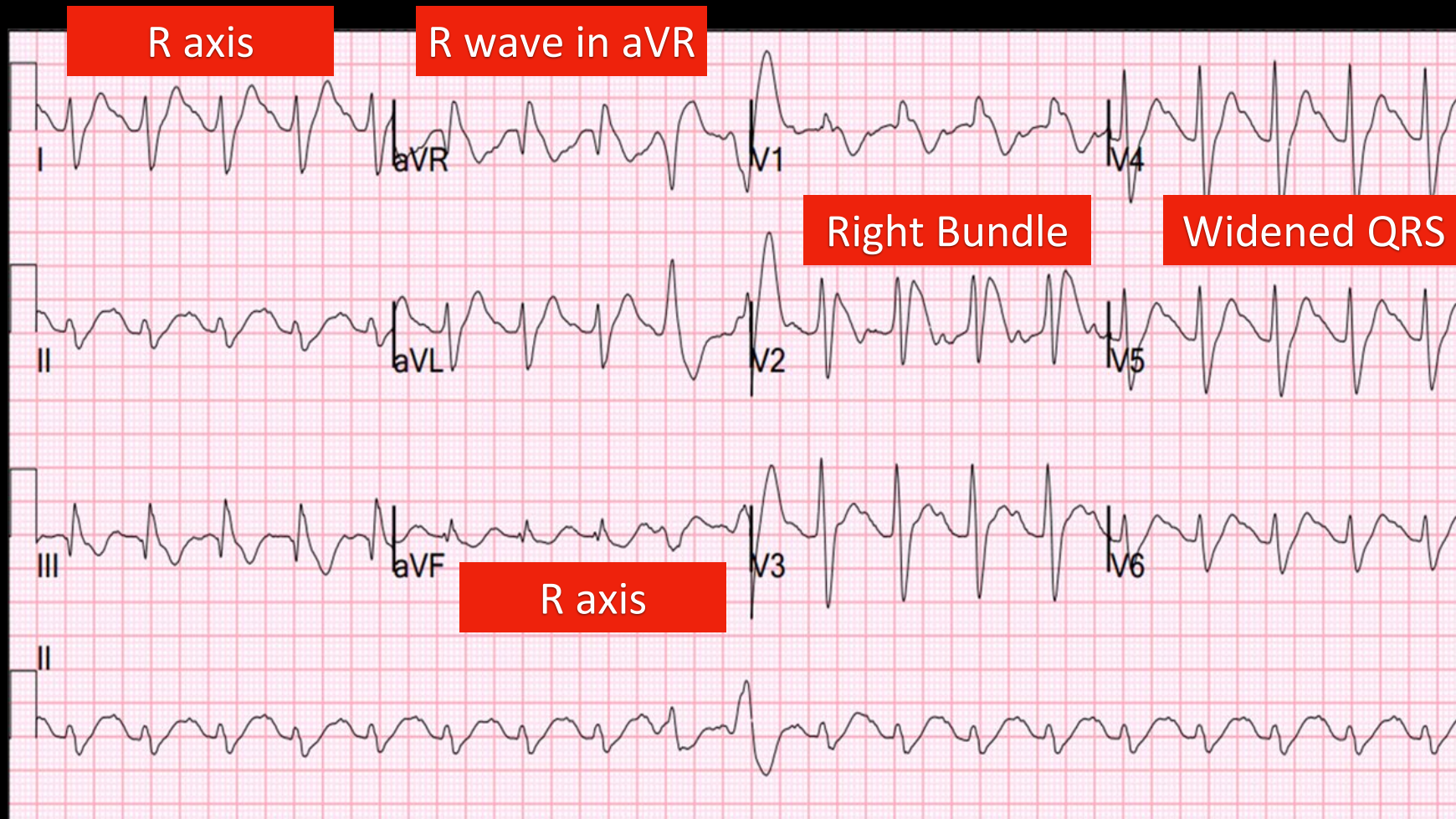
Family of Woman Who Died After Drinking Herbal Tea From SF Chinatown Store Files Lawsuit

The tea leaves bought at Sun Wing Wo Trading Company, at 1105 Grant Avenue, contained the plant-based toxin Aconite

Key Points

- Sodium channel blockade leads to characteristic changes on ECG.
- Loperamide in high doses can cause QTc prolongation and Torsades.
- Digoxin can cause almost any type of arrhythmia except rapidly conducting SVT.
- Aconite is a rare poison found in traditional Chinese herbs that can cause bidirectional ventricular tachycardia.

Na⁺ Channel Blocker Toxicity



The predictive value of “R wave” in TCA toxicity

Table 3.

Value of ECG parameters in predicting seizures and arrhythmias.

ECG Parameters	PPV	NPV
R_{aVR} 3 mm or more	43% (13 of 30)	94% (45 of 48)
R/S_{aVR} .7 or more	46% (12 of 26)	92% (48 of 52)
QRS interval 100 msec or more	35% (14 of 40)	92% (36 of 39)

From Leibelt et. al. ECG Lead aVR Versus QRS Interval in Predicting Seizures and Arrhythmias in Acute Tricyclic Antidepressant Toxicity, *Annals of Emergency Medicine* Aug '95

Questions?

MASTERS OF POISON...

CALIFORNIA'S POISON HOTLINE, RUN BY UCSF, HELPS 700 PEOPLE A DAY ANSWER ONE URGENT QUESTION: IS IT HARMFUL?

ILLUSTRATIONS BY CAT SIMS

