Syncope:
Evaluation of the Weak and Dizzy

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Disclosures

- Medtronic, Inc. (Clinical Events Committee, consultant)
- Biosense-Webster, Boston Scientific, Medtronic, St. Jude
  (UF EP Fellowship Support)

Syncope Is Nothing New

William Shakespeare (~1564-1616)

Works in Which a Character Faints from Strong Emotion

Table 2 Works in which a character faints from strong emotion

Play or poem and reference*	Character fainting	Emotion and its cause
Two Gentleman of Verona 5.4.84	Julia	Grief at lover's betrayal
2 Henry VI 3.2.32	King Henry	Grief at uncle's murder
3 Henry VI 1.3.9	Rutland (child)	Fear of being murdered
3 Henry VI 5.5.43	Queen Margaret	Grief at son's stabbing
Venus and Adonis, line 645	Venus†	Fear of Adonis' being gored
2 Henry IV 4.3.111	King Henry	Joy at defeat of rebels
Romeo and Juliet 3.2.56	Nurse†	Horror at Tybalt's bloody corpse
Much Ado About Nothing 4.1.107	Hero	Shock at father's threatening to stab her
Julius Caesar 1.2.245	Julius Caesar†‡	Excitement at offer of crown
As You Like It 4.3.155	Rosalind	Horror at seeing Orlando's blood
Othello 4.1.41	Othello§	Horror at Desdemona's "infidelity"
King Lear 4.6.41	Gloucester	Belief that he had fallen off a cliff
King Lear 5.3.217	Kent†	Grief at Lear's madness
Antony and Cleopatra 4.16.70	Cleopatra	Grief at Antony's "suicide"
Pericles 22.34	Thaisa	Joy at reunion with husband
The Winter's Tale 3.2.144	Hermione	Grief at son's death
The Winter's Tale 5.2.80	Onlookers†	Grief at Hermione's death
Cymbeline 4.2.334	Imogen	Horror at finding headless corpse wearing husband's clothes

*Plays are listed in order of composition. References (act, scene, line) are to the Norton Shakespeare.[6]
†Faint off stage.
‡Probably grand mal epilepsy; described as foaming at mouth, "falling sickness."
§Possibly grand mal epilepsy; called such by Iago; also occurred the day before.

Heaton KW. BMJ 2006; 333:1335

Syncope and Current Events

Etiologies of true syncope include:

1. Seizures
2. Trip and Falls
3. Vasovagal faints
4. Intoxications
5. Psychogenic

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2. Trip and Falls
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European Heart Journal (2009) **30**, 2631–2671
doi:10.1093/eurheartj/ehp298

ESC GUIDELINES

Guidelines for the diagnosis and management of syncope (version 2009)

The Task Force for the Diagnosis and Management of Syncope of the European Society of Cardiology (ESC)

Developed in collaboration with, European Heart Rhythm Association (EHRA)[1], Heart Failure Association (HFA)[2], and Heart Rhythm Society (HRS)[3]

Endorsed by the following societies, European Society of Emergency Medicine (EuSEM)[4], European Federation of Internal Medicine (EFIM)[5], European Union Geriatric Medicine Society (EUGMS)[6], American Geriatrics Society (AGS), European Neurological Society (ENS)[7], European Federation of Autonomic Societies (EFAS)[8], American Autonomic Society (AAS)[9]

2015 Heart Rhythm Society Expert Consensus Statement on the Diagnosis and Treatment of Postural Tachycardia Syndrome, Inappropriate Sinus Tachycardia, and Vasovagal Syncope

Robert S. Sheldon, MD, PhD, FRCPC, FHRS (Chair),[1] Blair P. Grubb II, MD, FACC (Chair),[2] Brian Olshansky, MD, FHRS, FACC, FAHA, CCDS,[††3] Win-Kuang Shen, MD, FHRS, FAHA, FACC,[4] Hugh Calkins, MD, FHRS, CCDS,[5] Michele Brignole, MD, FESC,[*6] Satish R. Raj, MD, MSCI, FRCPC, FHRS,[7] Andrew D. Krahn, MD, FRCPC, FHRS,[8] Carlos A. Morillo, MD, FRCPC, FHRS,[9] Julian M. Stewart, MD, PhD,[10] Richard Sutton, DSc, FHRS,[11] Paola Sandroni, MD, PhD,[**12] Karen J. Friday, MD, FHRS,[§13] Denise Tessariol Hachul, MD, PhD,[†14] Mitchell I. Cohen, MD, FHRS,[15] Dennis H. Lau, MBBS, PhD, FHRS,[‡16] Kenneth A. Mayuga, MD, FACC, FACP,[17] Jeffrey P. Moak, MD,[§§18] Roopinder K. Sandhu, MD, FRCPC, FHRS,[19] Khalil Kanjwal, MD, FACC[20]

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Definition of Syncope

- Transient loss of consciousness, associated with an inability to maintain postural tone, rapid and spontaneous recovery, and the absence of clinical features specific for another form of transient loss of consciousness such as epileptic seizure

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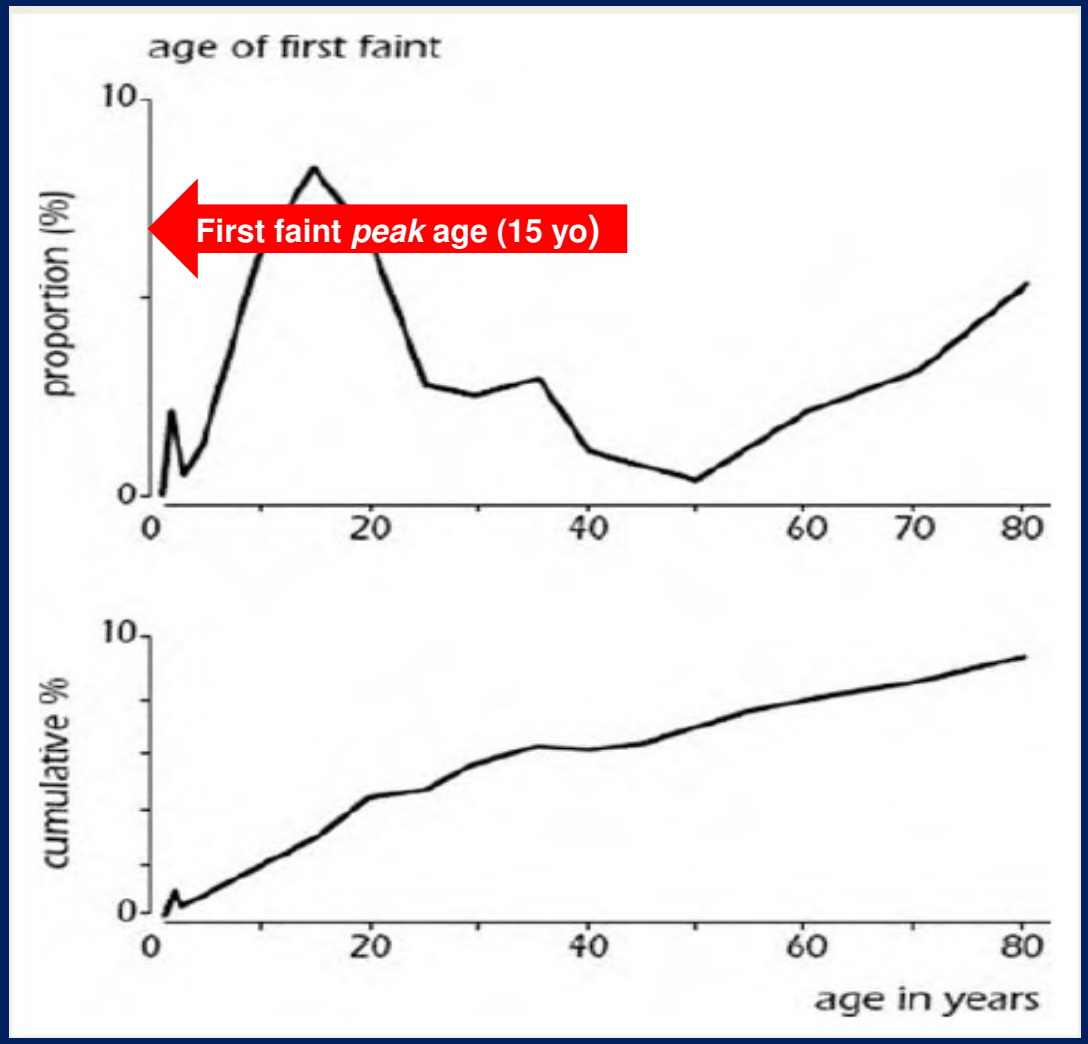
Epidemiology of Syncope



a.) First episode typically occurs between ages 10 to 30
b.) Cumulative incidence Increase with age

European Heart Journal (2009) 30. 2631-2671

Causes of loss of consciousness

Neurally-mediated	Orthostatic hypotension	Cardiac arrhythmia	Structural cardio-pulmonary	Non-syncopal

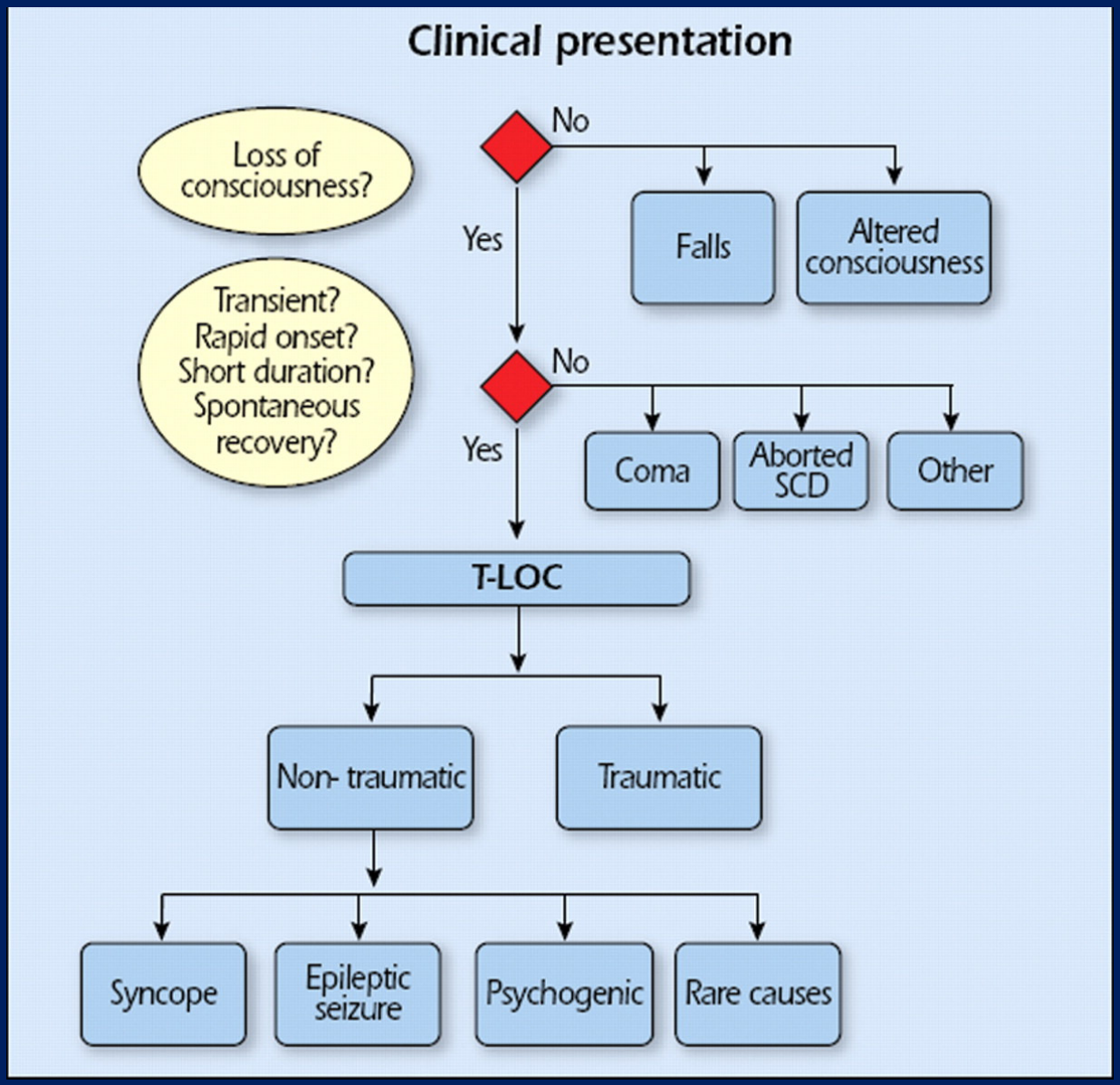
1
• Vasovagal
• Carotid sinus
• Situational
  ▲ Cough
  ▲ Micturition
  ▲ Defaecation
  ▲ Swallow
  ▲ Others
	2
	• Drug induced
	• ANS failure
	  ▲ Primary
	  ▲ Secondary
	• Volume depletion
		3
		• Brady
		  ▲ Sick sinus
		  ▲ AV block
		• Tachy
		  ▲ VT
		  ▲ SVT
		• Inherited
			4
			• AMI
			• Aortic stenosis
			• HOCM
			• Pulmonary hypertension
			• Others
				5
				• Metabolic
				• Epilepsy
				• Intoxications
				• Drop-attacks
				• Psychogenic
				• TIA
				• Falls

66%	10%	11%	5%	6%

Unknown cause = 2%

Brignole, M. Heart 2007;93:130-136

Syncope Evaluation



European Heart Journal (2009) 30. 2631-2671

Syncope patients with the poorest prognosis are those with:

1. Vasovagal syncope
2. Orthostatic syncope
3. Carotid sinus hypersensitivity
4. Cardiac cause of syncope
5. Syncope of undetermined cause

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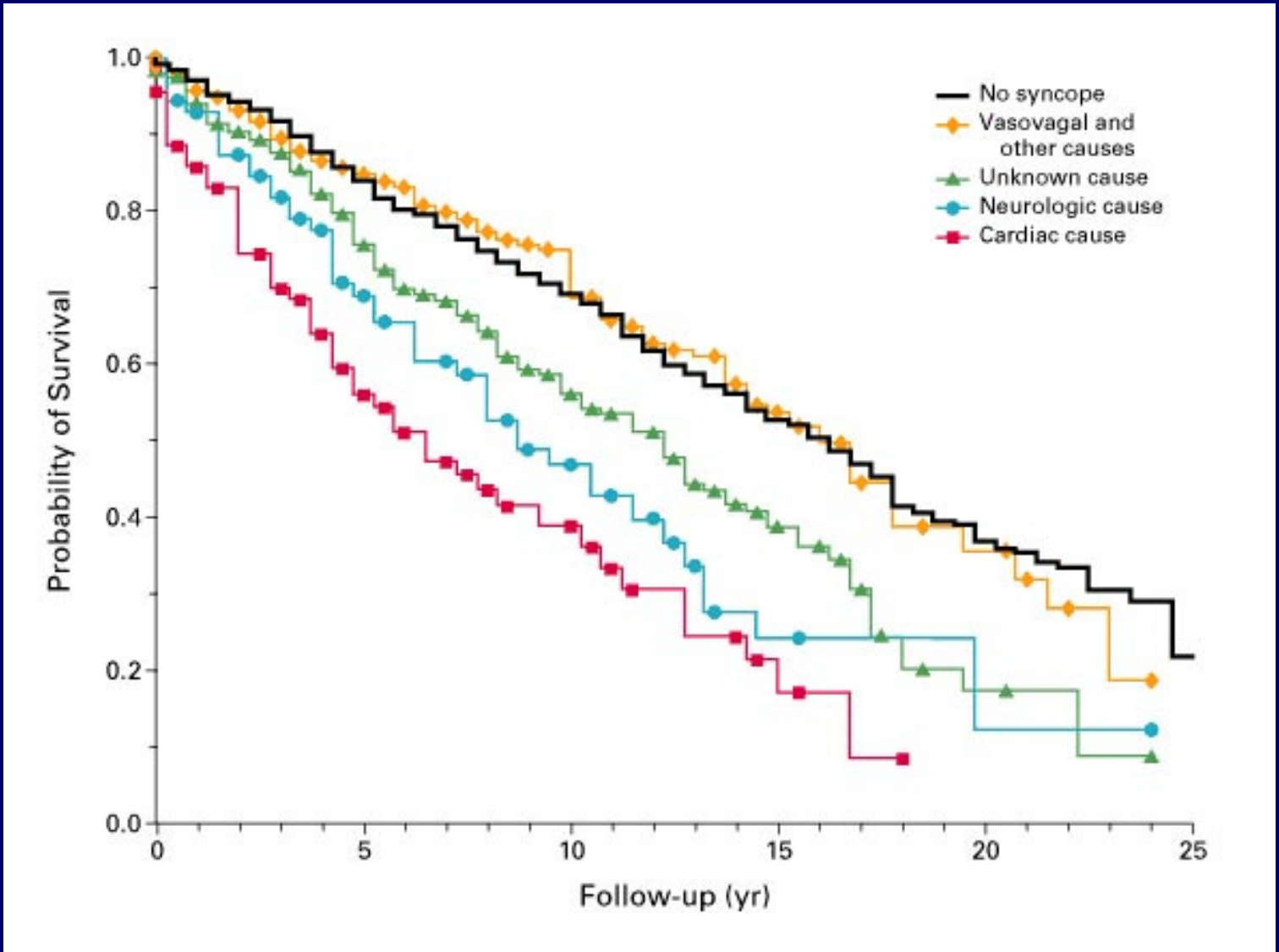
Survival of Patients With Syncope



Soteriades, N Engl J Med 2002;347:878-85

Initial evaluation of syncope should include:

1. Orthostatic blood pressure
2. ECG
3. Tilt table test
4. CT scan of the head
5. 1 and 2 only
6. All of the above

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Syncope: Initial Assessment

- History
- Physical examination
  - Orthostatic BP
- ECG

Seizure vs. Syncope

Clinical findings that suggest the diagnosis

	Seizure likely	Syncope likely
Findings during loss of consciousness (as observed by an eyewitness)	• Tonic-clonic movements are usually prolonged and their onset coincides with loss of consciousness • Hemilateral clonic movement • Clear automatisms such as chewing or lip smacking or frothing at the mouth (partial seizure) • Tongue biting • Blue face	• Tonic-clonic movements are always of short duration (<15 s) and they start after the loss of consciousness
Symptoms before the event	• Aura (such as funny smell)	• Nausea, vomiting, abdominal discomfort, feeling of cold, sweating (neurally-mediated)[a] • Lightheadedness, blurring of the vision
Symptoms after the event	• Prolonged confusion • Aching muscles	• Usually short duration • Nausea, vomiting, pallor (neurally-mediated)

Brignole et al, ECS Task Force on Syncope. European Heart Journal 2004;25:2054

Clinical Features Suggestive of Specific Causes of Loss of Consciousness

- *Neurally mediated syncope*
  - Absence of cardiac disease
  - Long history of syncope
  - After sudden unexpected unpleasant sight, sound, smell or pain
  - Prolonged standing or crowded, hot places
  - Nausea, vomiting associated with syncope
  - During a meal or in the absorptive state after a meal
  - With head rotation, pressure on carotid sinus (as in tumors, shaving, tight collars)
  - After exertion

Brignole et al, ESC Task Force on Syncope. European Heart Journal 2004;25:2054

Clinical Features Suggestive of Specific Causes of Loss of Consciousness

- *Syncope due to orthostatic hypotension*
  - After standing up
  - Temporal relationship with start of medication leading to hypotension or changes of dosage
  - Prolonged standing especially in crowded, hot places
  - Presence of autonomic neuropathy or Parkinsonism
  - After exertion

Brignole et al, ESC Task Force on Syncope. European Heart Journal 2004;25:2054

Clinical Features Suggestive of Specific Causes of Loss of Consciousness

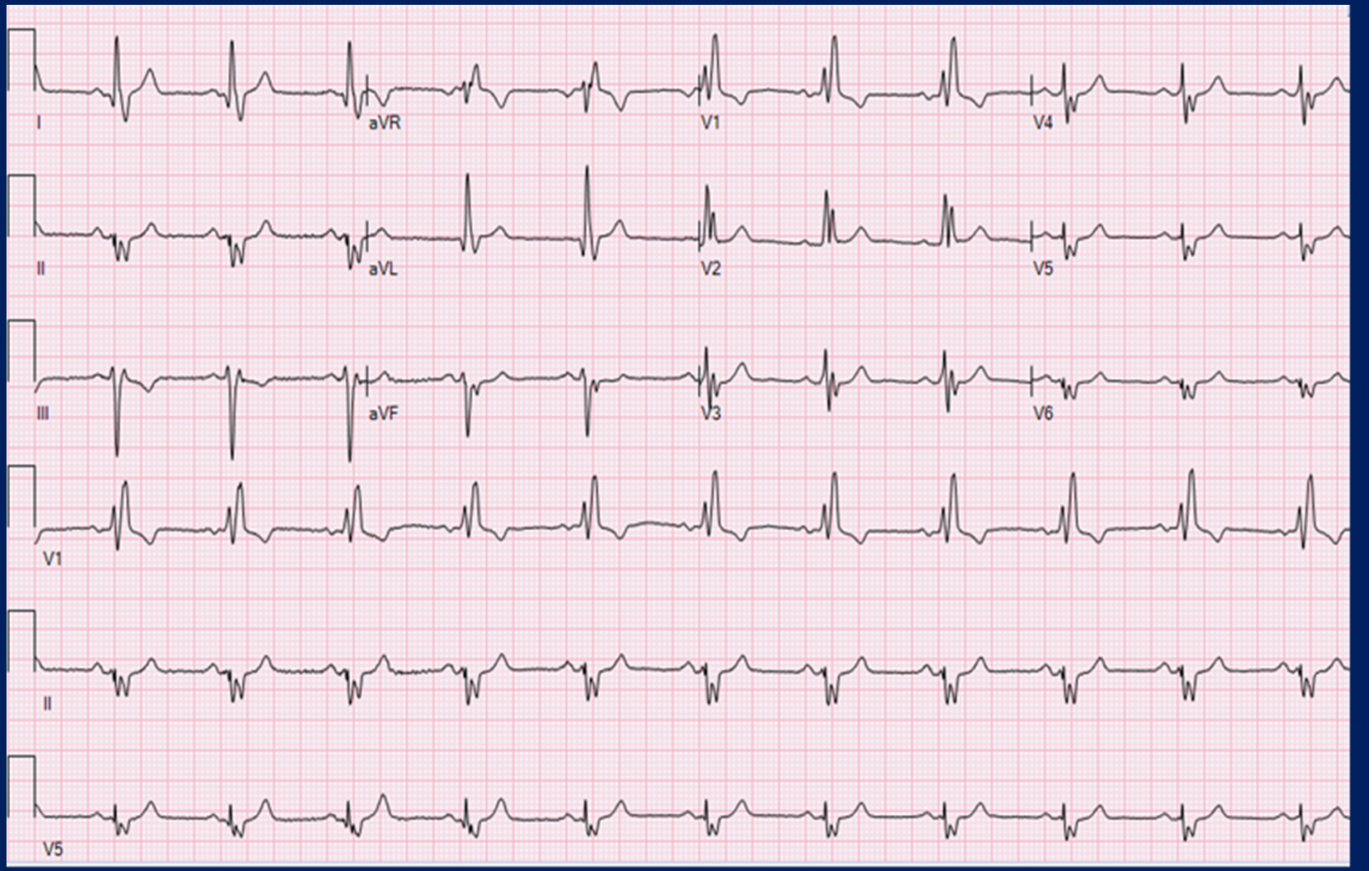
- *Cardiac syncope*
  - Presence of definite structural heart disease
  - During exertion, or supine
  - Preceded by palpitation
  - Family history of sudden death
- *Cerebrovascular syncope*
  - With arm exercise
  - Differences in blood pressure or pulse in the two arms

Brignole et al, ESC Task Force on Syncope. European Heart Journal 2004;25:2054

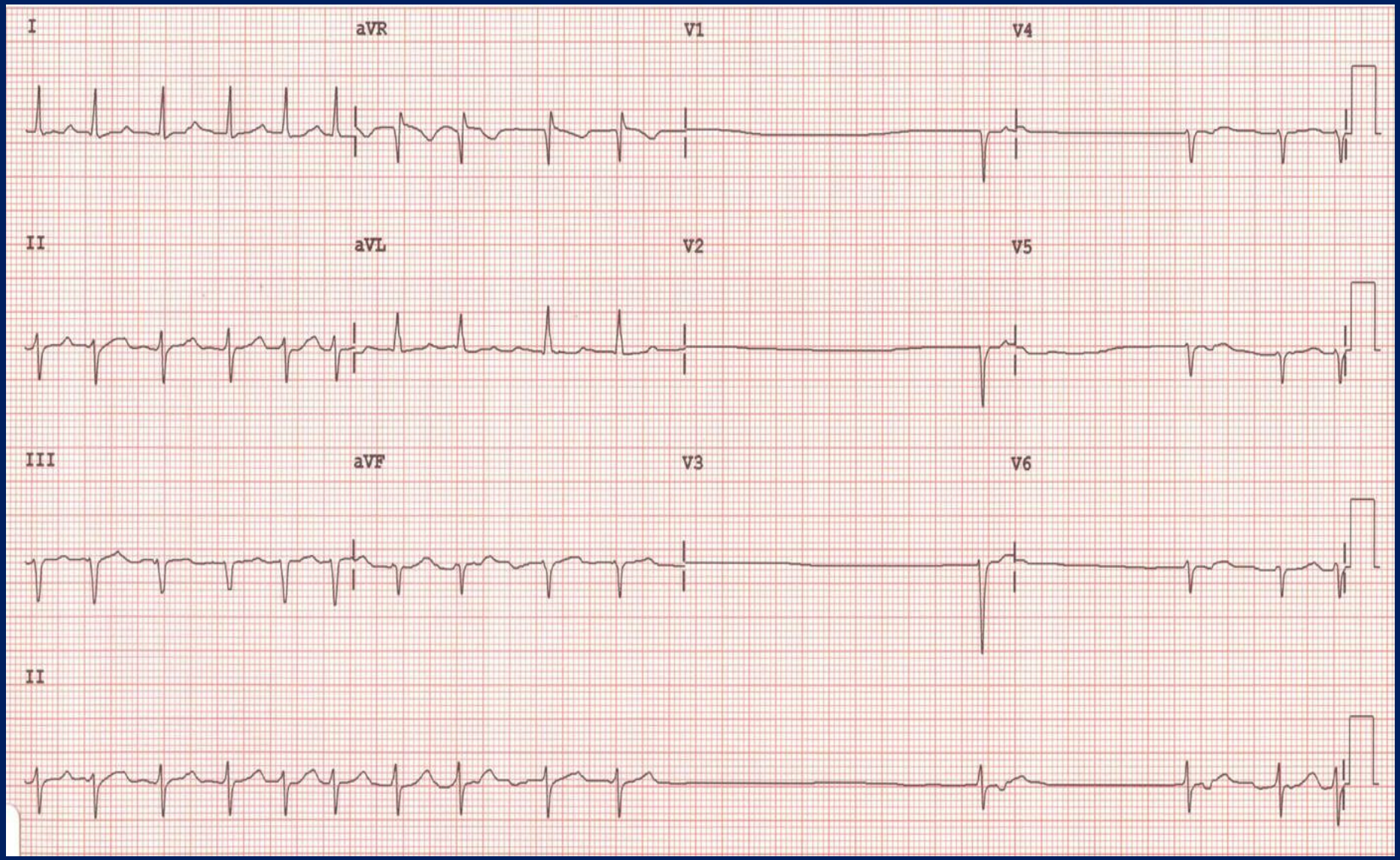
ECG Abnormalities Suggesting Arrhythmic Syncope

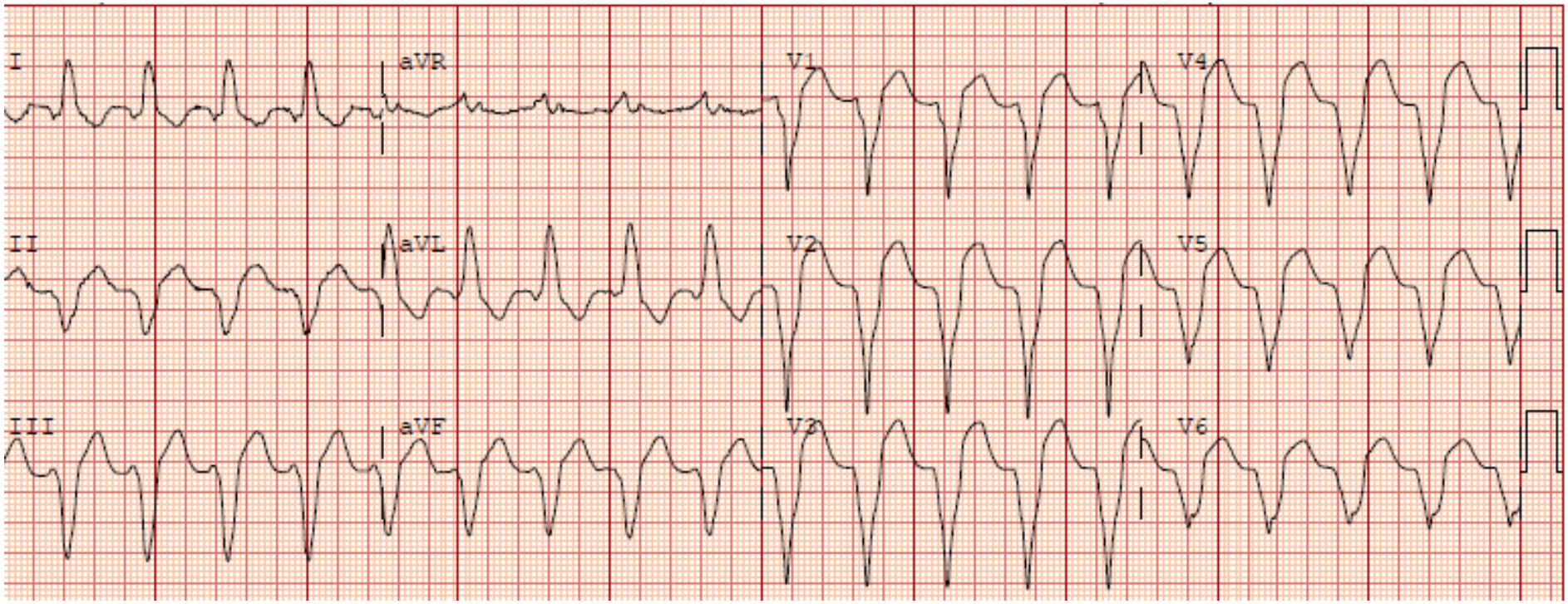
- Bifascicular block or IVCD ≥ 0.12 s
- Second degree AV block
- Asymptomatic sinus bradycardia < 50 bpm, sinoatrial block or sinus pause ≥ 3 s in the absence of negatively chronotropic meds
- Preexcited QRS complexes
- Prolonged QT interval
- Changes in right precordial leads suggestive of Brugada syndrome or ARVD
- Q waves suggesting myocardial infarction

Bifasicular Block



Tachy/Brady

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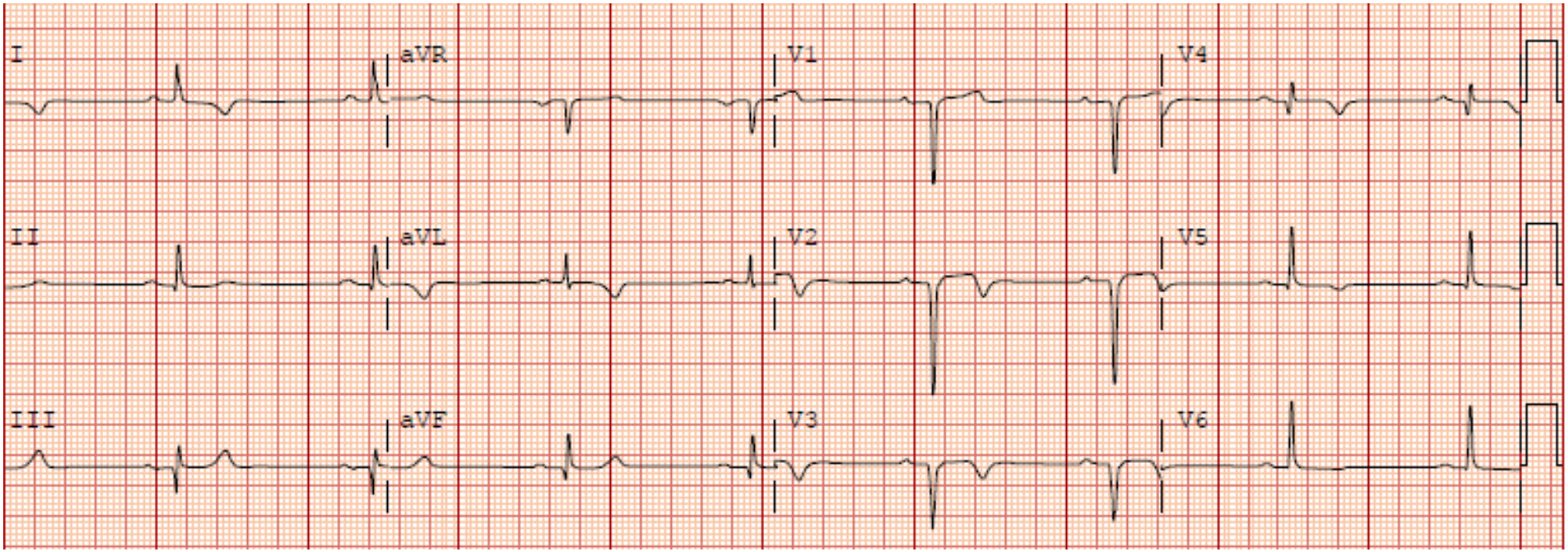
V2
V5
III
aVF
V3
V6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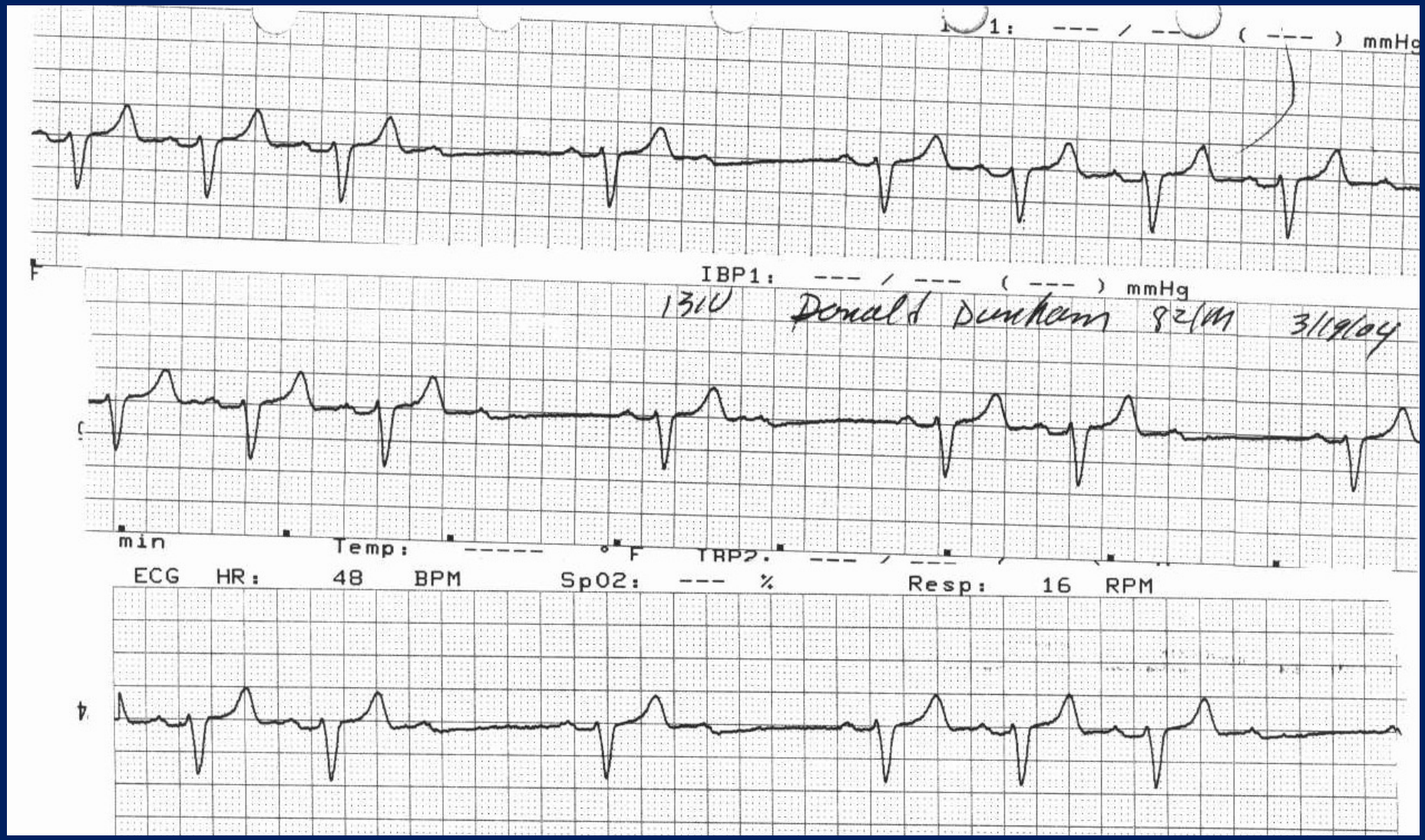
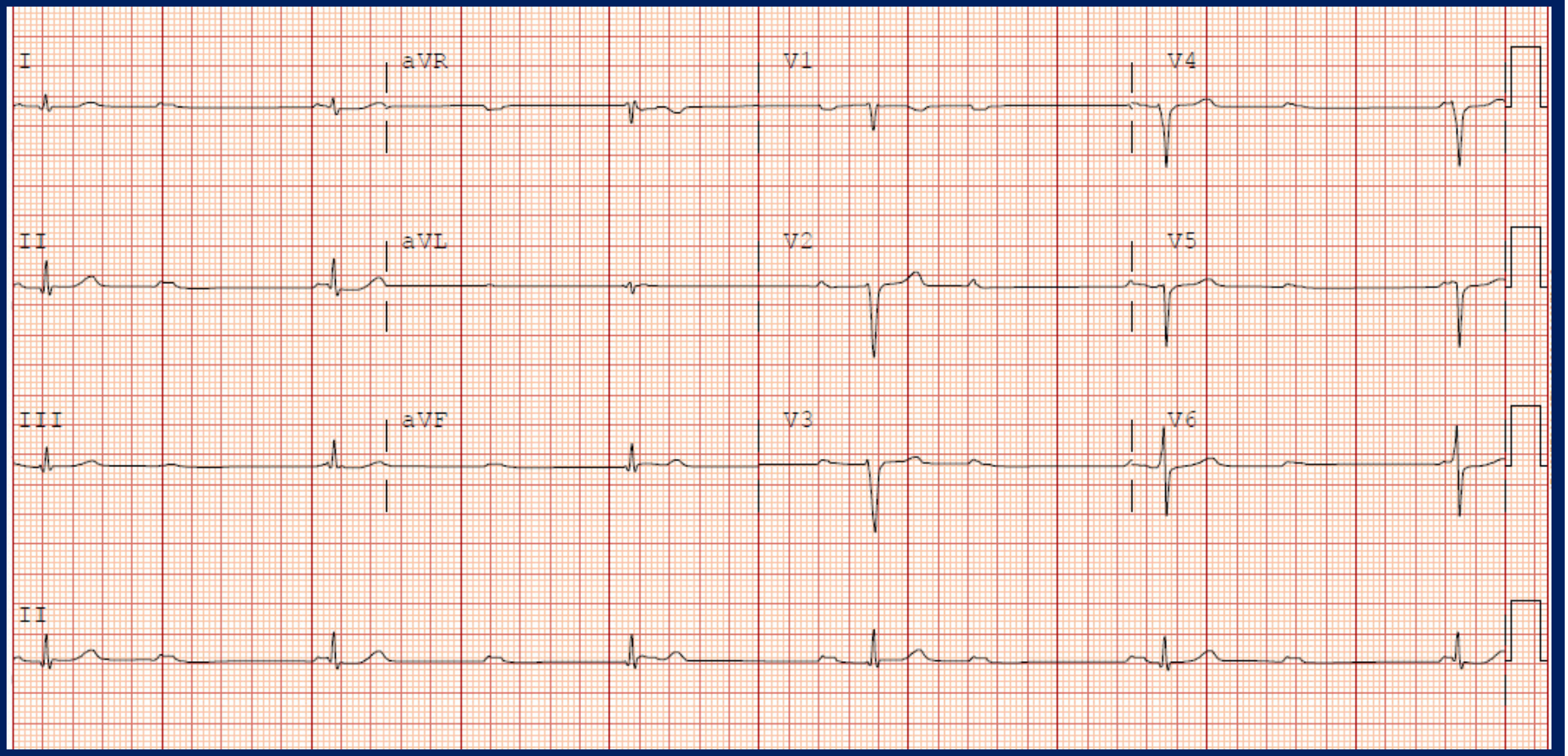
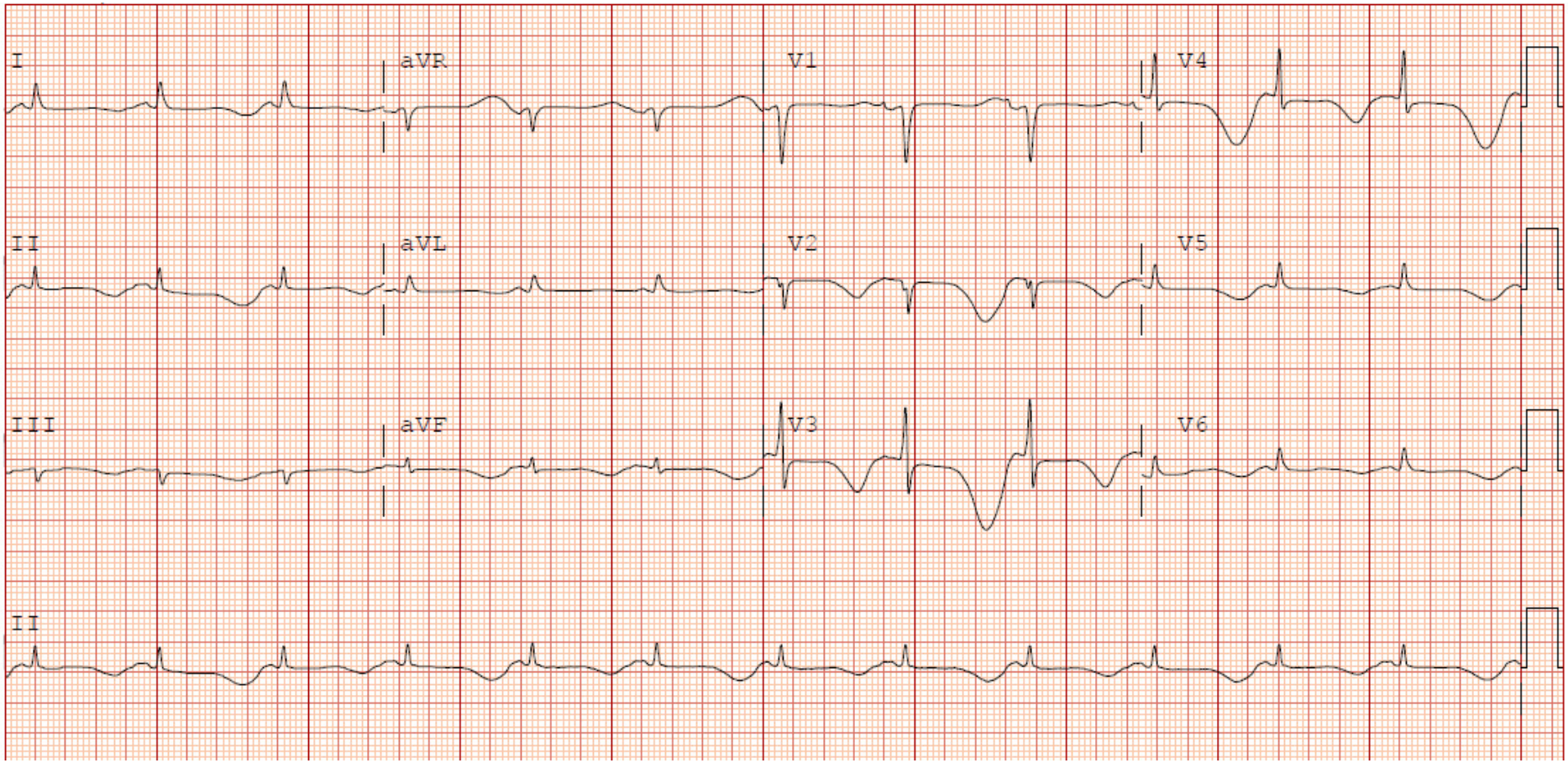
V6

Type II AV Block



High-Grade AV Block

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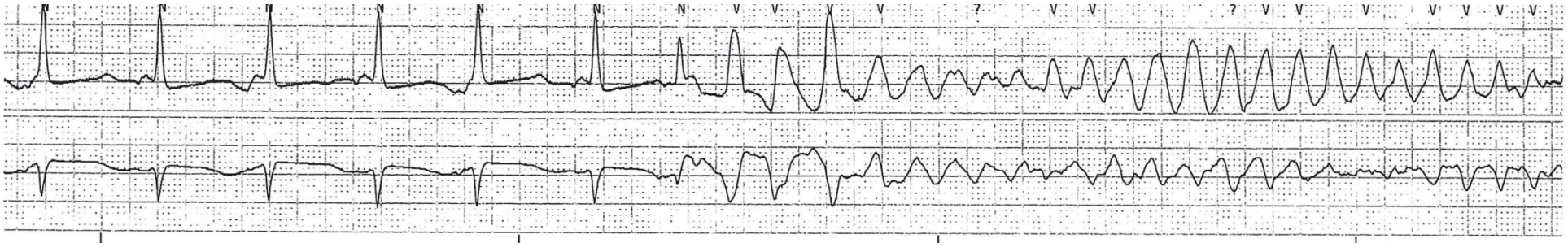
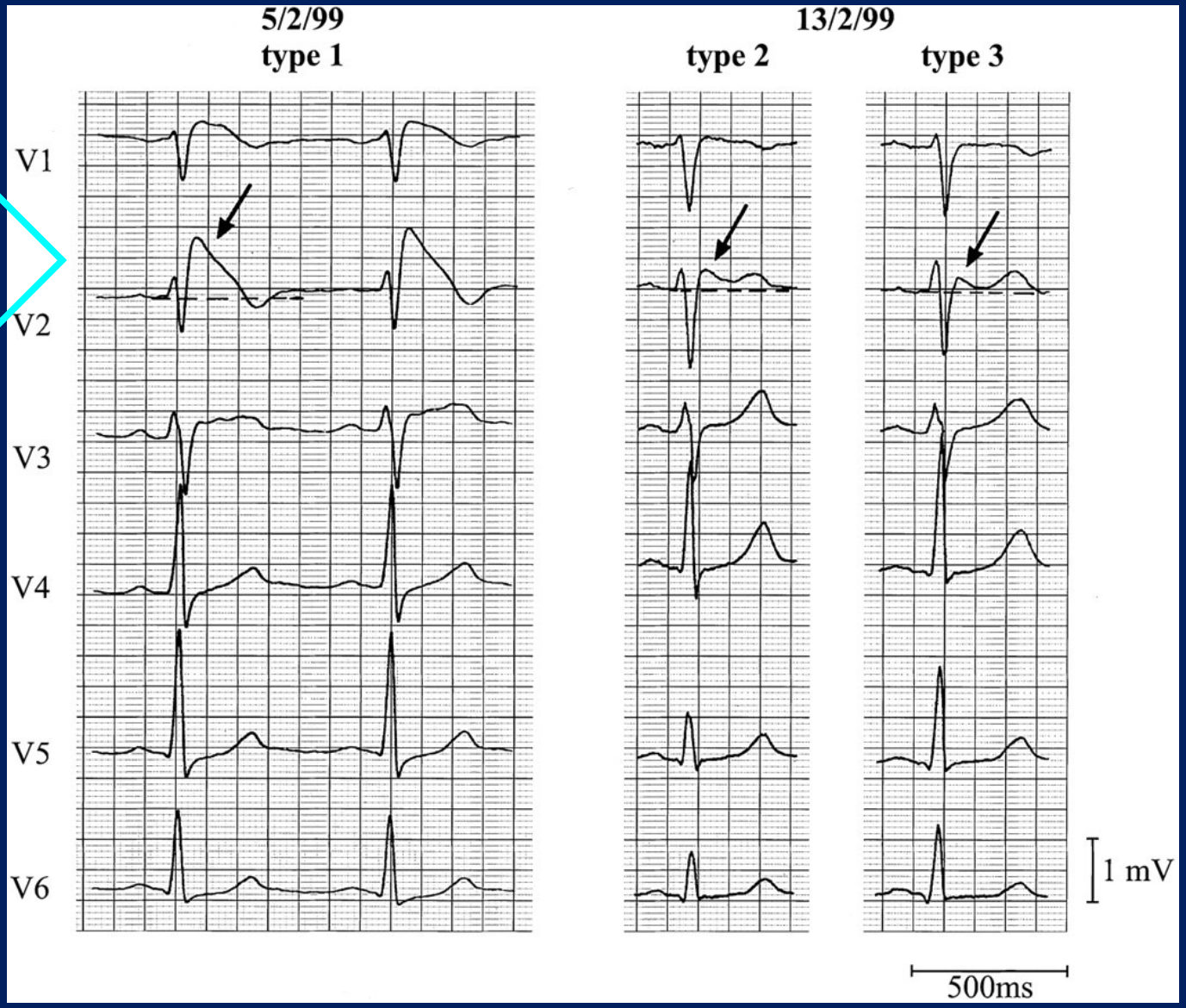


Brugada Pattern

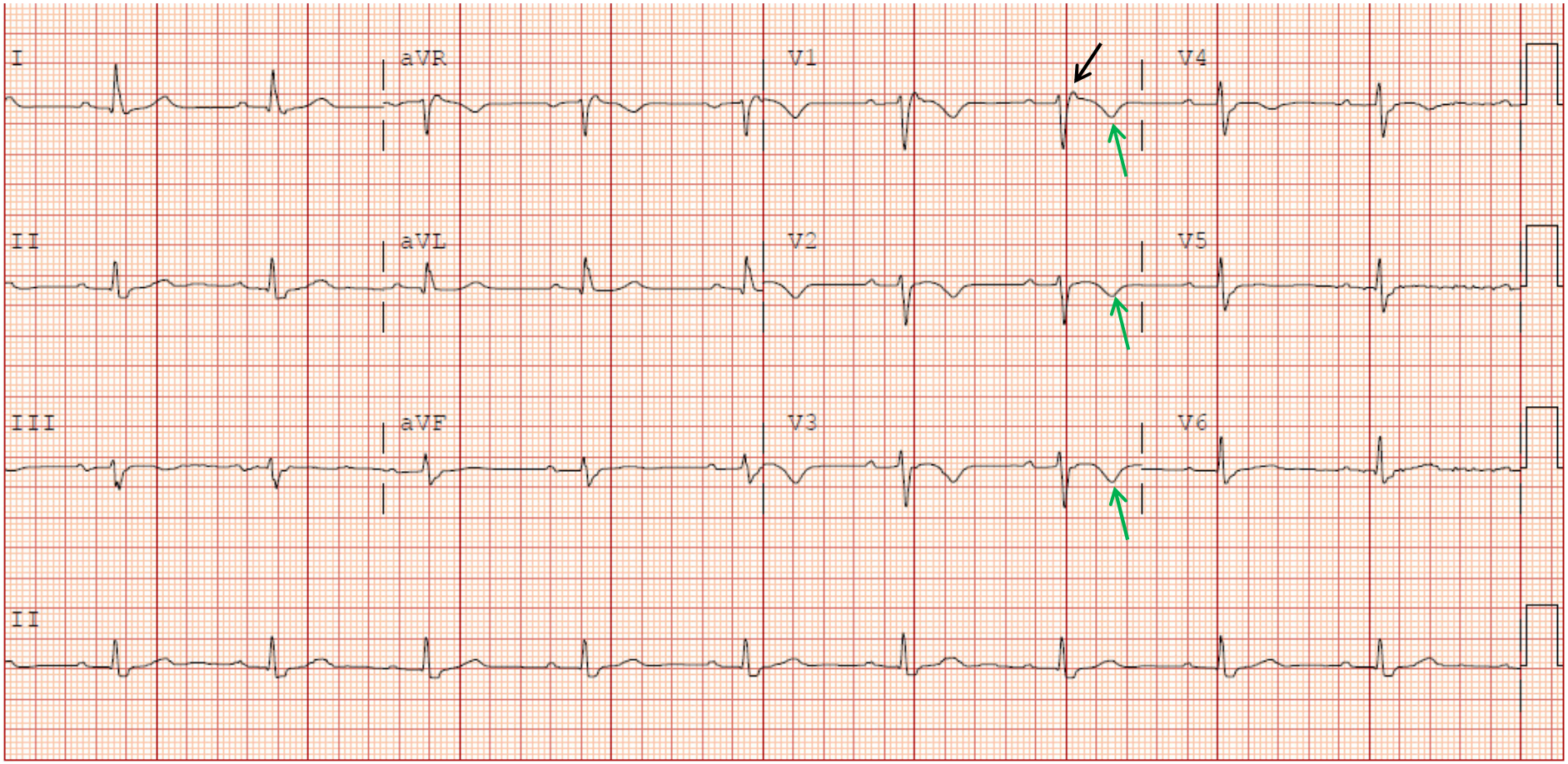


Coved ST Elevation

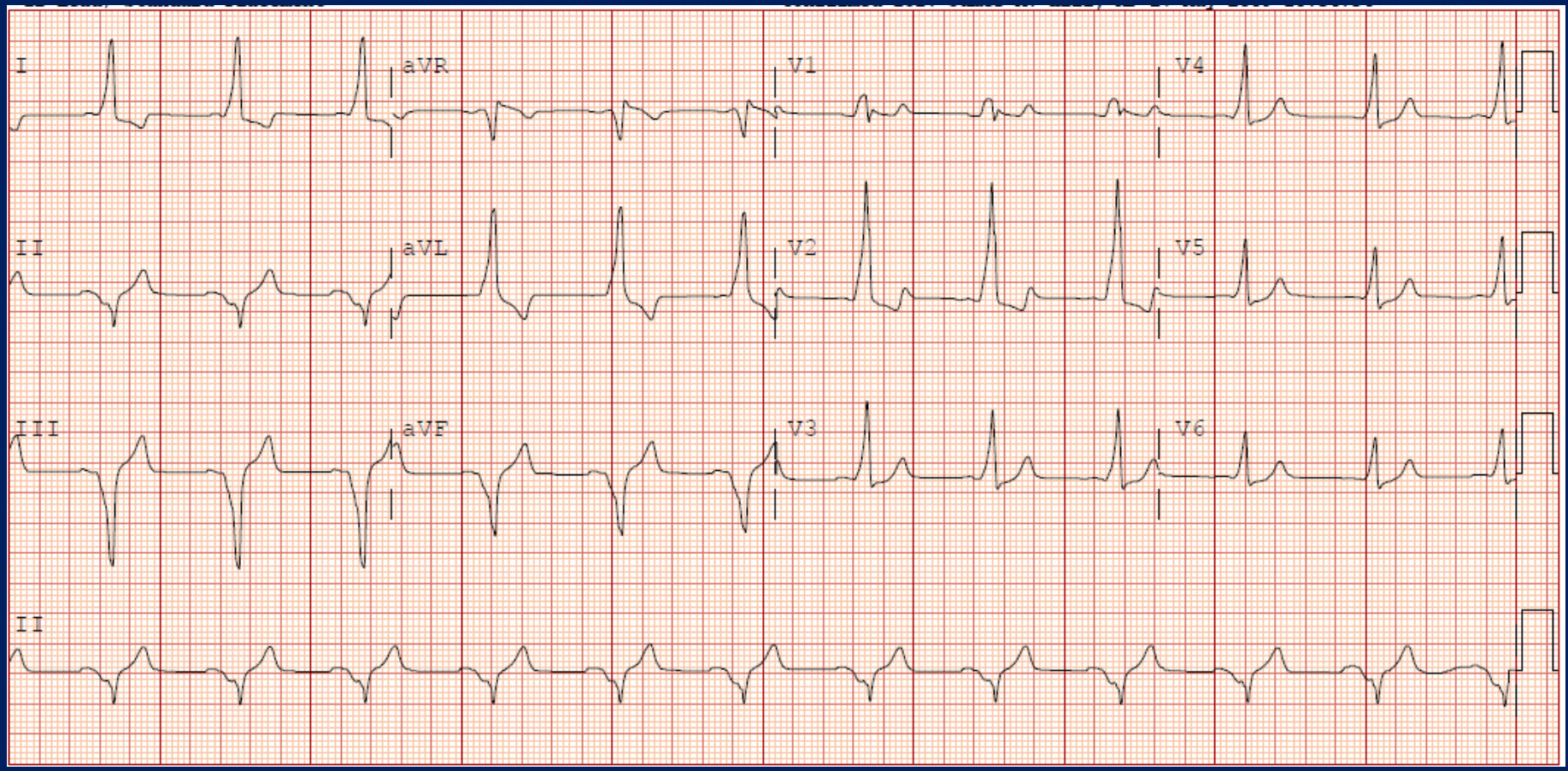
Wilde et al. Circulation. 2002;106:2514-2519

Arrhythmogenic Right Ventricular Dysplasia

54 y.o. male with palpitations and syncope; family history of sudden death



Preexcited EKG (WPW syndrome)



Unexplained Syncope

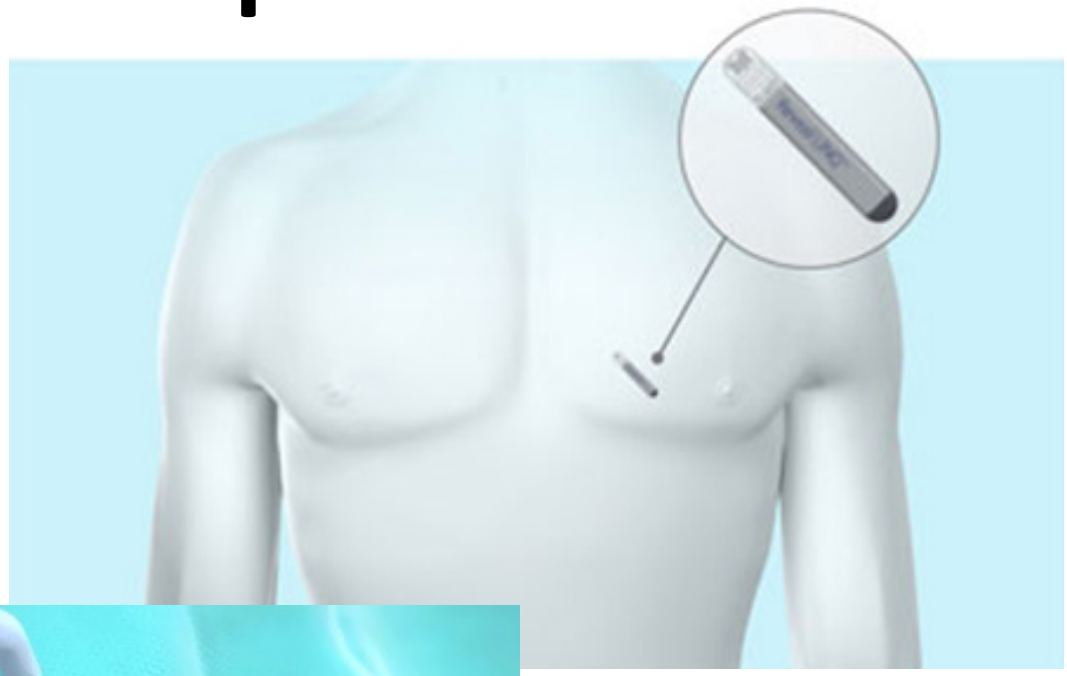
Patients with Structural Heart Disease or ECG Abnormalities

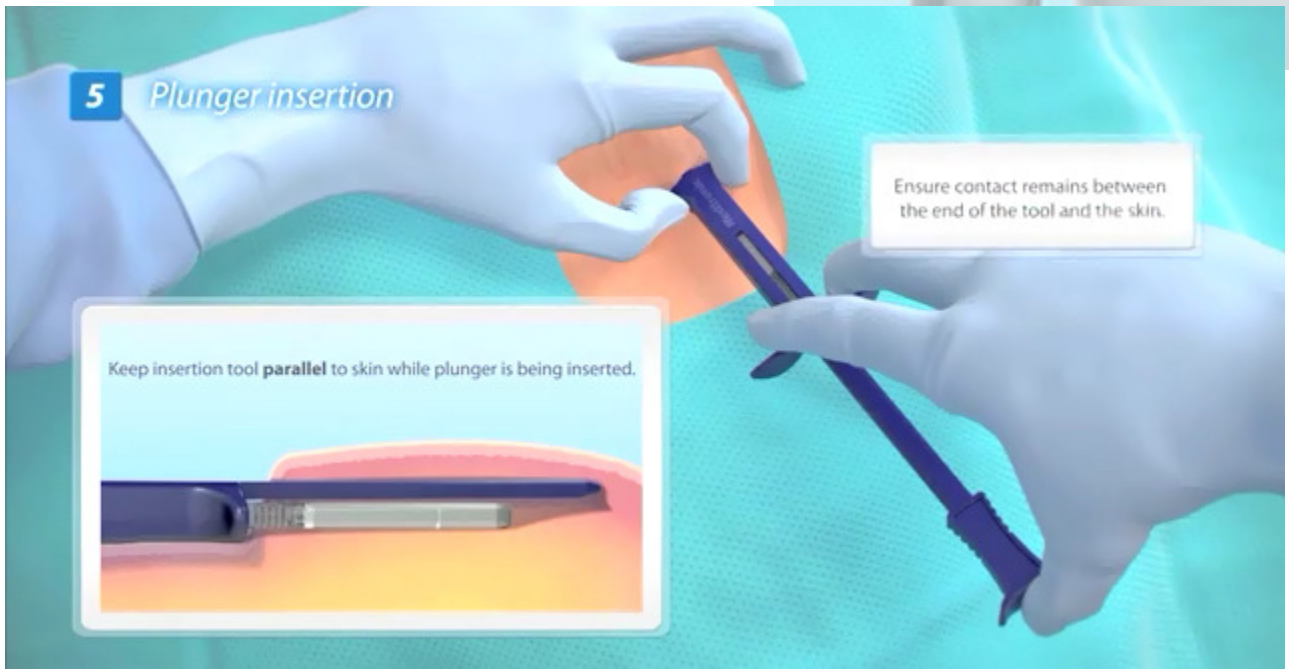
- Chief concern is arrhythmias
- Consider echocardiography, stress testing and/or 24 hr. ECG monitoring
- Electrophysiology study
- If EP study negative but symptoms suggest arrhythmia,
  - Continuous-loop event monitoring
  - Tilt table test

Evaluation of Syncope due to Cardiac Arrhythmias

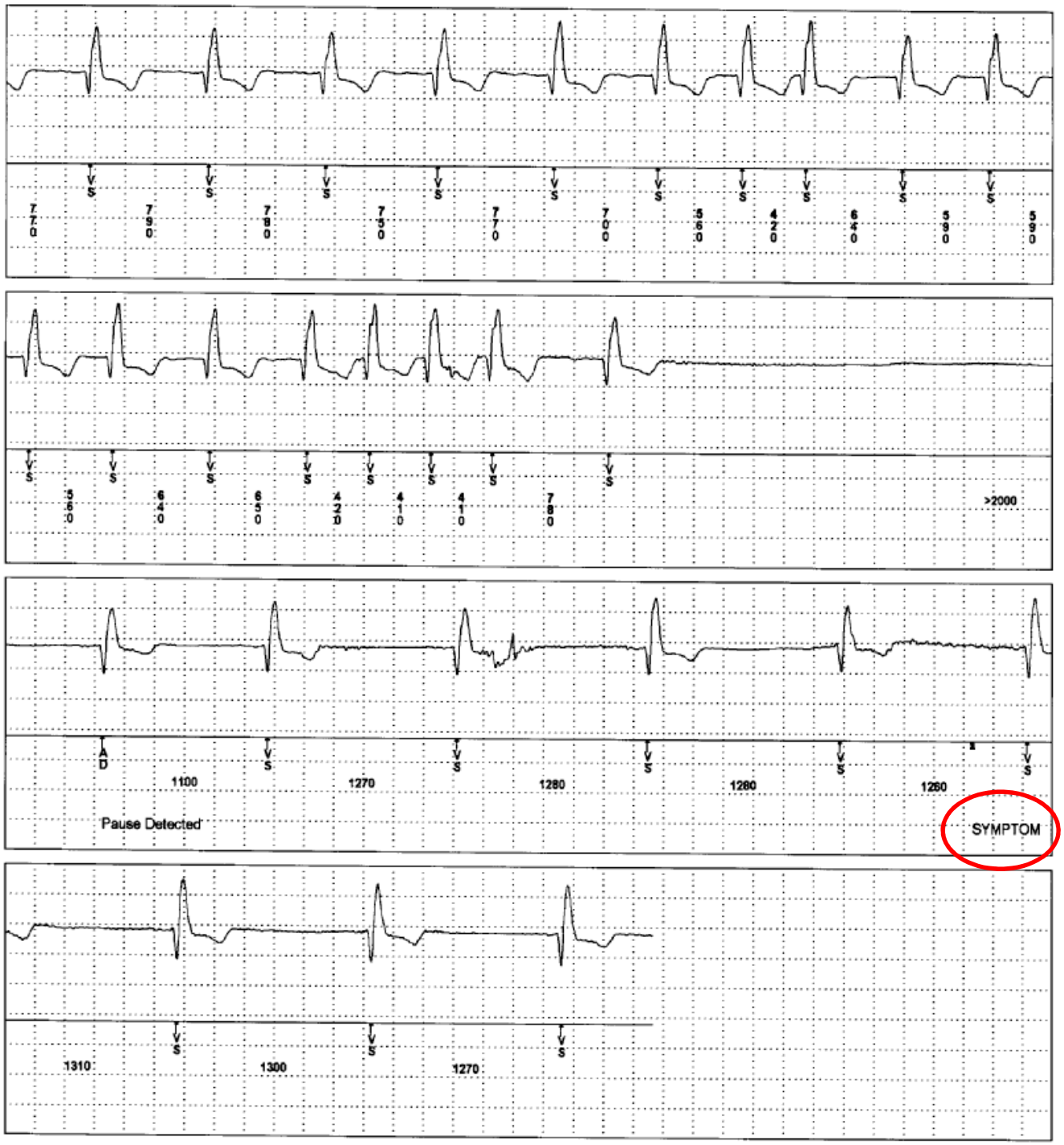
- ECG recording during event (Holter, event recorder, implantable loop recorder)
  - Most definitive diagnosis
  - Risk of death/injury with recurrent event
  - Usefulness depends on event frequency
- Provocative tests: tilt table, electrophysiology study
  - False negatives and false positives

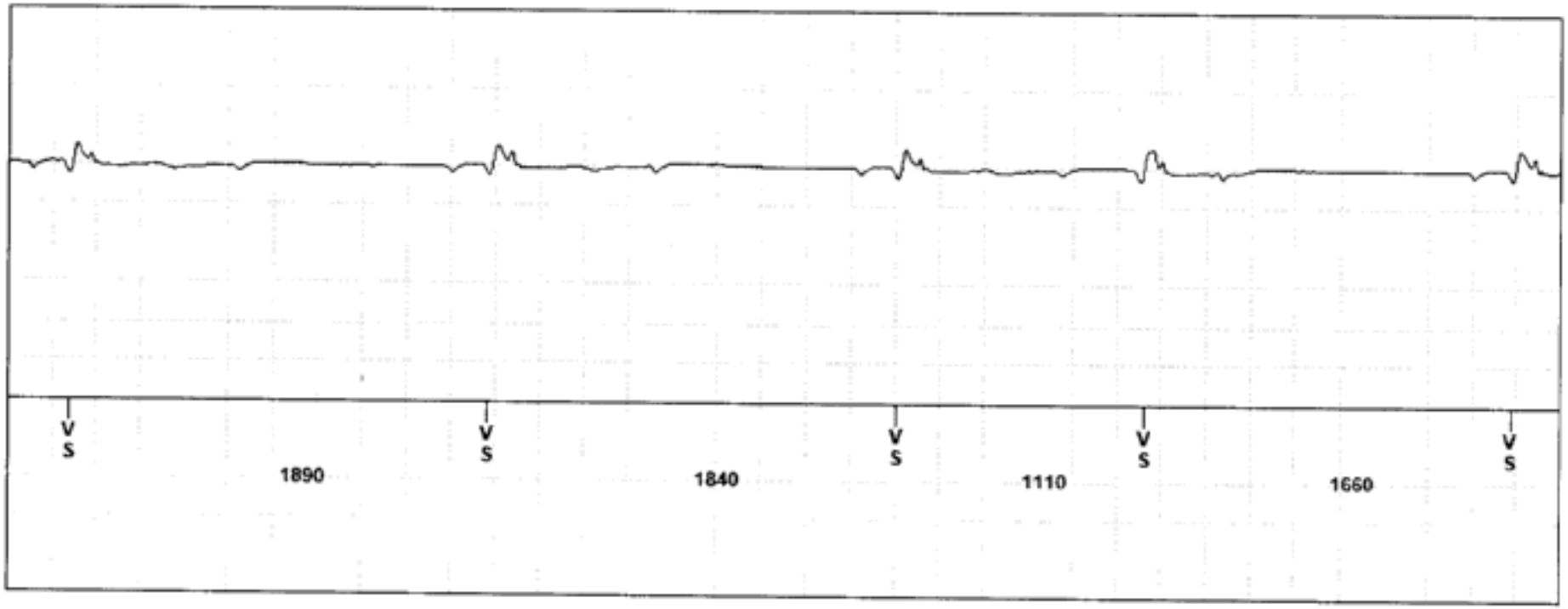
Implantable Loop Recorder



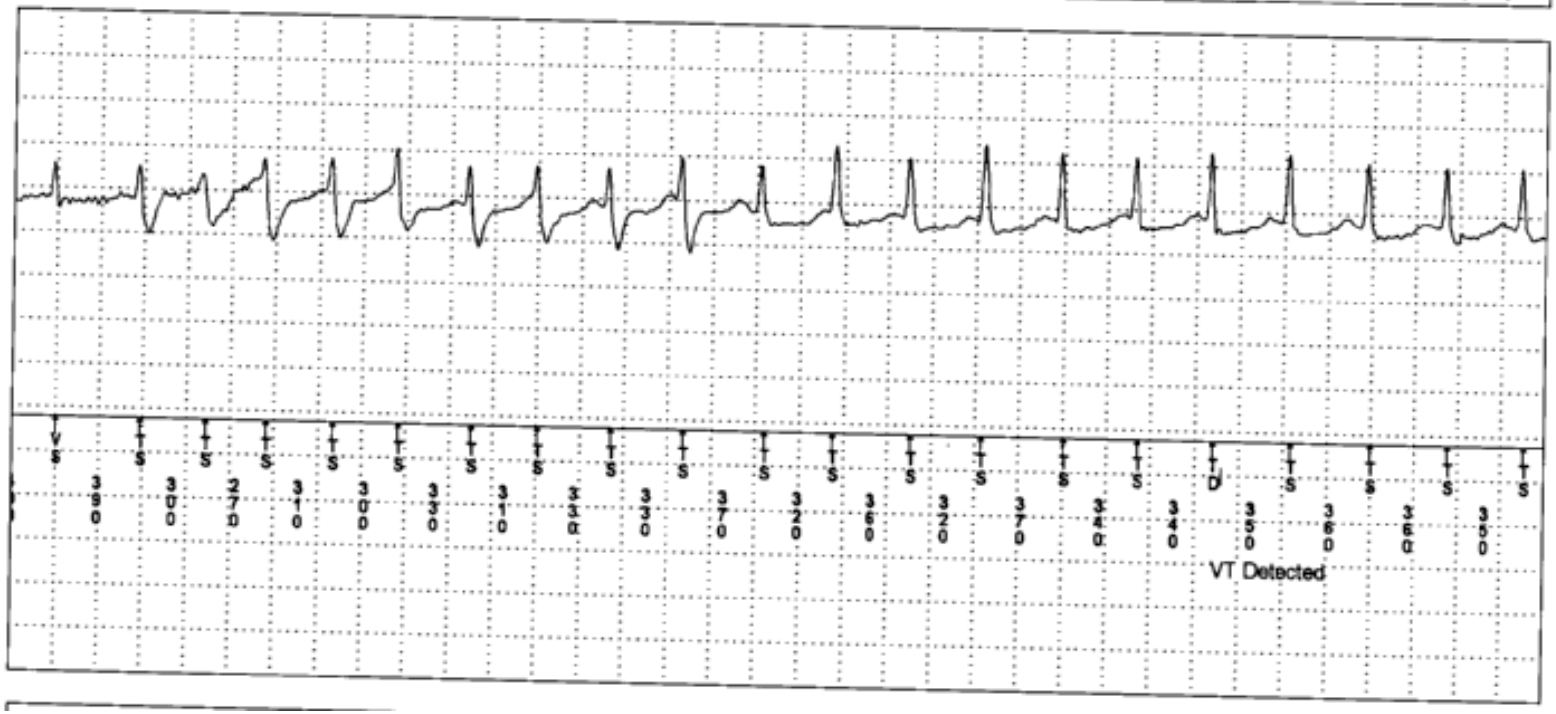


Courtesy Medtronic


VS 770 VS 790 VS 780 VS 750 VS 770 VS 700 VS 560 VS 420 VS 640 VS 590 VS 590
VS 560 VS 640 VS 650 VS 420 VS 410 VS 410 VS 780 VS >2000
AD 1100 VS 1270 VS 1280 VS 1280 VS 1260 VS
Pause Detected
SYMPTOM
1310 VS 1300 VS 1270 VS


V
S
1890
V
S
1840
V
S
1110
V
S
1660
V
S

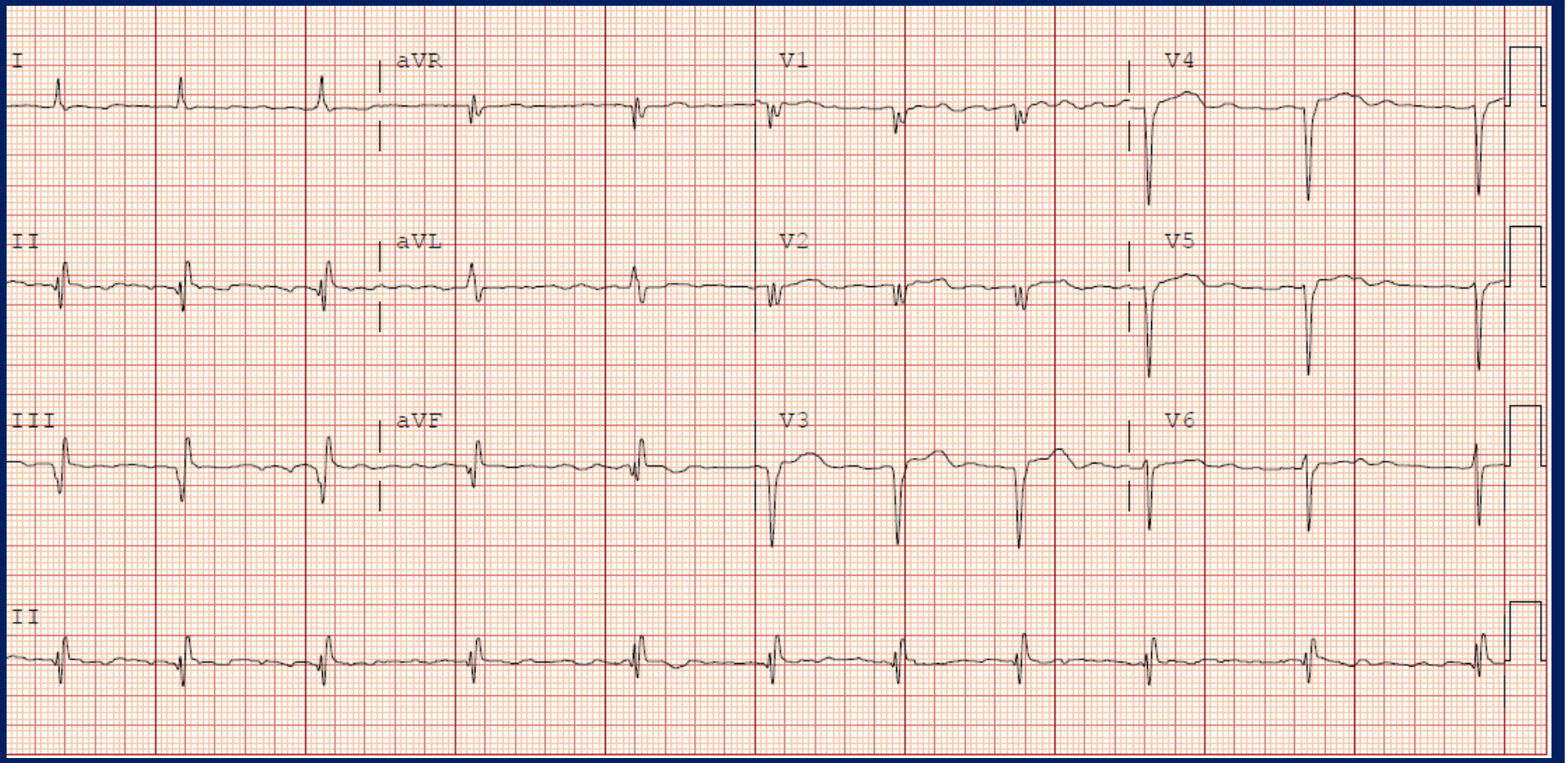

ECG Filter On
ECG Reveal
(0.1 mV)
Markers
Interval (ms)


VT Detected

Usefulness of EP Studies in the Evaluation of Syncope

- Sinus nodal function
  - Sinus node recovery time
  - Sino-atrial conduction time
- AV conduction abnormalities
  - AH and HV interval
  - AV block
  - Dual AV nodal pathways
  - Accessory pathways
- Induction of tachycardia
  - Supraventricular
  - Ventricular

68 y.o. male with syncope in the woods while hunting;
woke up bruised but continued hunting.
History of CABG, EF 45%



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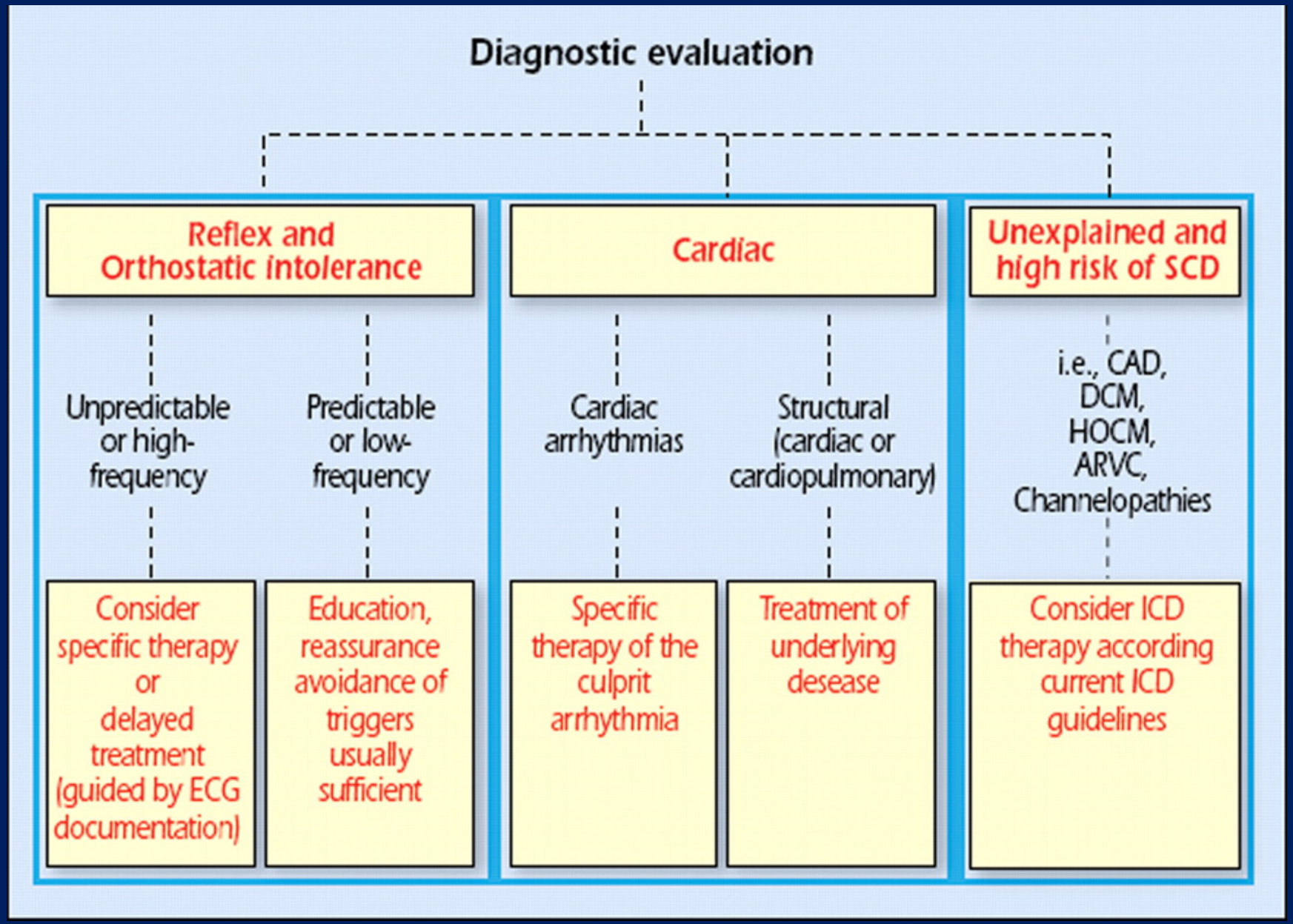
Induction of Sustained Monomorphic VT

Neurologic Testing

- EEG provides diagnostic information in <2% of patients
  - Almost all have symptoms or history suggestive of a convulsive disorder
- CT scan provides diagnostic information in 4% of patients
  - Almost all have focal neurologic findings or history consistent with a seizure
- No studies demonstrating usefulness of transcranial or carotid Doppler
  - TIAs involving carotid or vertebrobasilar arteries rarely result in syncope

EEG Makes the Diagnosis of Arrhythmic Syncope

Treatment of Syncope



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Which one is not like the other?

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Definition of Vasovagal Syncope

- Syncopal syndrome that usually
  - Occurs with upright posture held for more than 30 seconds or with exposure to emotional stress, pain, or medical settings
  - Features diaphoresis, warmth, nausea, and pallor
  - Is associate with hypotension and relative bradycardia, when known
  - Is followed by fatigue

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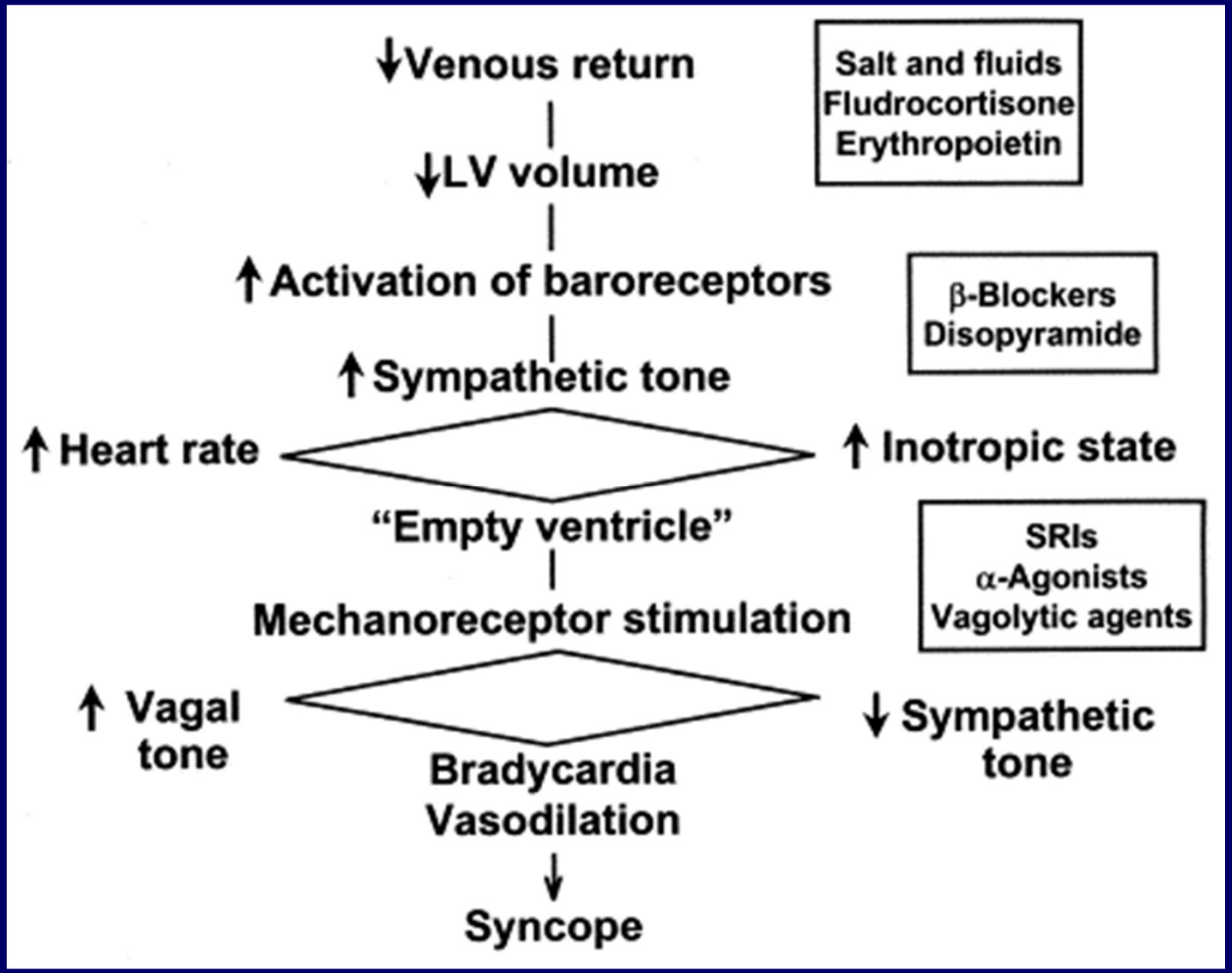
Neurally Mediated Syncope

- Exaggeration of normal physiology
- Results from autonomic nervous system reflexes (sympathetic and parasympathetic)
- Cardioinhibitory and vasodepressor responses

Pathophysiology of Vasovagal Syncope



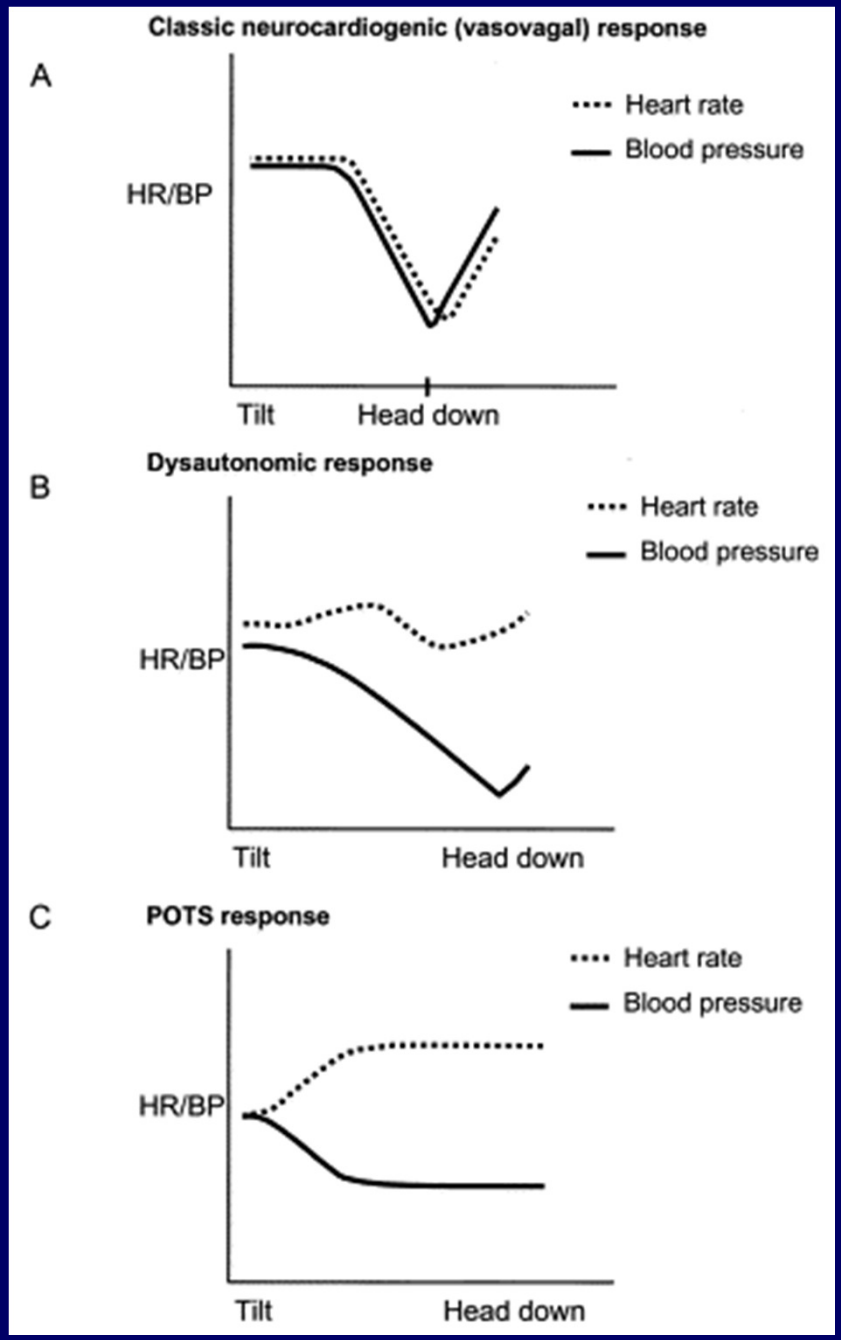
Calkins, Am J Cardiol 1999;84 (21 Oct)

Fear Syncope

Deglutition (Swallow) Syncope

Micturation Syncope?

Micturation vs. Defecation Syncope?



Grubb, Am J Cardiol 1999;84 (21 Oct)

Tilt Testing for Neurally Mediated Syncope

Limitations:

- False negatives and false positives (Bayes theorem applies)
- Reproducibility
- No “gold standard”
- Tilt protocols not standardized

Tilt table tests should be performed in which syncope patients?

- All patients with syncope
- Patients with a classic story for vasovagal syncope
- Syncope patients with documented structural heart disease
- Patients with suspected vasovagal syncope without a confident diagnosis after initial assessment
- The predictive value of tilt table testing is so poor that it is of no use in syncope patients

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Investigation of Vasovagal Syncope

Recommendations—Investigation of Vasovagal Syncope

	Class	Level
Tilt-table testing can be useful for assessing patients with suspected vasovagal syncope who lack a confident diagnosis after the initial assessment.	IIa	B-NR
Tilt-table testing is a reasonable option for differentiating between convulsive syncope and epilepsy, for establishing a diagnosis of pseudosyncope, and for testing patients with suspected vasovagal syncope but without clear diagnostic features.	IIa	B-NR
Implantable loop recorders (ILRs) can be useful for assessing older patients with recurrent and troublesome syncope who lack a clear diagnosis and are at low risk of a fatal outcome.	IIa	B-R
Tilt testing is not recommended for predicting the response to specific medical treatments for vasovagal syncope.	III	B-R

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Treatment of Vasovagal Syncope

Recommendations—Lifestyle and Medical Treatment for Vasovagal Syncope

	Class	Level
Education, reassurance, and promoting salt and fluid intake are indicated for patients with vasovagal syncope, unless contraindicated.	I	E
Reducing or withdrawing medications that can cause hypotension can be beneficial for patients with vasovagal syncope.	IIa	E
Physical counterpressure maneuvers can be useful for patients with vasovagal syncope who have a sufficiently long prodromal period.	IIa	B-R
The use of fludrocortisone seems reasonable for patients with frequent vasovagal syncope who lack contraindications for its use.	IIb	E
Beta-blockers may be considered for patients older than 40 years with frequent vasovagal syncope.	IIb	B-R
The use of midodrine seems reasonable for patients with frequent vasovagal syncope and no hypertension or urinary retention.	IIb	B-R

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Physical Counter Pressure Maneuvers

Can, Benditt. In Yan, Kowey (Eds), Management of Cardiac Arrhythmias

Vasovagal Syncope

Treatment Strategy

- For patients with only occasional syncope:
  - Reassure
  - Stress fluid and salt intake
  - Teach counterpressure maneuvers
  - Do not treat patients who have not fainted in the past year
- For patients with recurrent episodes:
  - Begin conservatively as above
  - Reduce or withdraw drugs that might cause hypotension
  - Consider fludrocortisone, midodrine, or beta blockers (if older than age 40) prior to pacing, recognizing that there is no high-level evidence for their use

Reasons to Try to Avoid Permanent Pacemakers in Neurally Mediated Syncope

- Vasodilation is a central feature in most patients
- Recurrent episodes are often clustered and subsequently disappear
- Many patients are young and otherwise healthy

Vasovagal Syncope

Pacemaker Treatment

- Pacing should only be considered in highly selected patients:
  - Older than 40 years
  - Frequent recurrences associated with repeated injury, limited prodromes and documented asystole
- Establishing a relationship between symptoms and severe bradycardia is essential before considering permanent pacing
  - Prolonged ECG monitoring, usually by an ILR, is usually necessary

Treatment of Vasovagal Syncope
Pacing

Recommendations—Pacemakers for Syncope

	Class	Level
Dual-chamber pacing can be effective for patients 40 years of age or older with recurrent and unpredictable syncope who have a documented pause ≥3 seconds during clinical syncope or an asymptomatic pause ≥6 seconds.	IIa	B-R
Tilt-table testing may be considered to identify patients with a hypotensive response who would be less likely to respond to permanent cardiac pacing.	IIb	B-NR

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Diagnosis and Treatment of Syncope
Conclusions

- The initial evaluation for syncope consists of history and physical examination, including orthostatic blood pressure and ECG
- The initial evaluation may lead to
  - Certain diagnosis
  - Suspected diagnosis that needs to be confirmed by appropriate diagnostic tests
  - No diagnosis

Brignole, M. Heart 2007;93:130-136

Diagnosis and Treatment of Syncope
Conclusions

- The strategy of evaluation varies according to:
  - The severity and frequency of the episodes
  - The presence or absence of heart disease
- In general, the absence of heart disease excludes a cardiac cause of syncope
  - Conversely, the presence of heart disease has relatively low specificity, as about half of patients with heart disease have a non-cardiac cause of syncope

Brignole, M. Heart 2007;93:130-136

Diagnosis and Treatment of Syncope
Conclusions

- The strategy of evaluation varies according to:
  - The severity and frequency of the episodes
  - The presence or absence of heart disease
- Determining the mechanism of syncope is a prerequisite for:
  - Advising patients with regard to prognosis
  - Developing an effective mechanism-specific treatment

Brignole, M. Heart 2007;93:130-136

Diagnosis and Treatment of Syncope
Conclusions

- Determining the mechanism of syncope is a prerequisite for:
  - Advising patients with regard to prognosis
  - Developing an effective mechanism-specific treatment
- Most patients with syncope require only reassurance and education regarding the nature of the disease and the avoidance of triggering events

Brignole, M. Heart 2007;93:130-136

Diagnosis and Treatment of Syncope
Conclusions

- Most patients with neurocardiogenic syncope require only reassurance and education regarding the nature of the disease and the avoidance of triggering events

Brignole, M. Heart 2007;93:130-136

Thank You!

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