



대한순환기학회

The Korean Society of Circulation

2005

2005년  
순환기 관련학회  
춘계 통합 학술대회

The Korean Society of Circulation

# How to Manage the Patients with PVC's?

Apr. 15 2005

Inter-Burgo Hotel, Daegu



49

가

2005.2.18.

3

가

, FC II-III, Skipped beat

:

가 :



LVEDD :59mm, LVESD 48mm, LVEF 35%,  
Absence of regional wall motion abnormalities

#### Holter Findings

Mean HR 91bpm, min HR 70bpm and max HR 151bpm

PVC 19,021 beats/day

177 couplets

NSVT 3 beats fastest run 152 bpm at 21:50



Modified Bruce protocol, stage 6(10.3 Mets), suggestive +  
PVC at rest, stage 2 and recovery phase

2005.2.23.

SHIN, Y H

ID:15574724

23-MAR-2005 16:31:13

YEUNGNAM UNIV. MEDICAL CENTER

49 yr  
Female Asian  
Room:IMC  
Loc:0

Vent. rate 74 BPM  
PR interval 196 ms  
QRS duration 90 ms  
QT/QTc 364/404 ms  
P-R-T axes 40 47 261

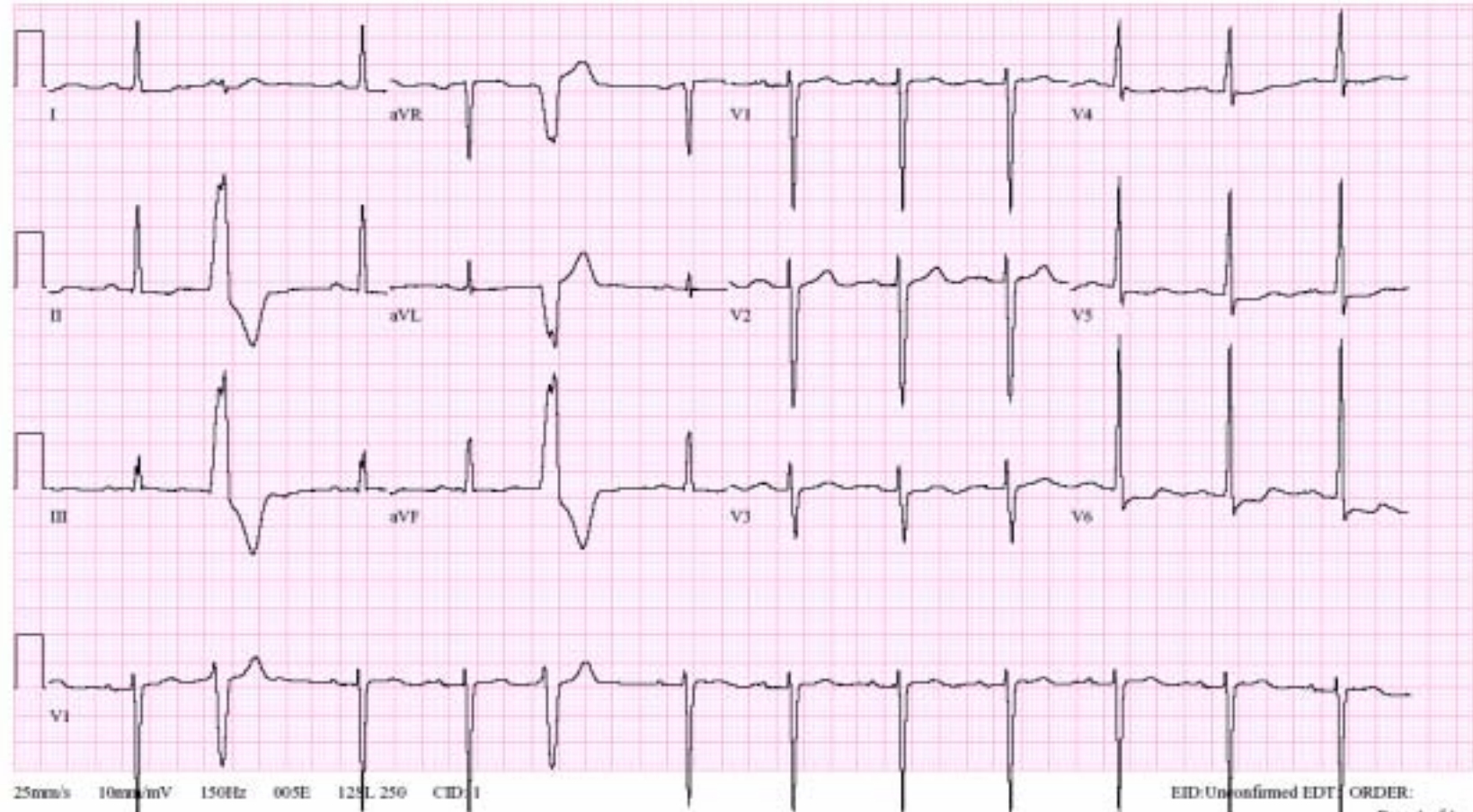
Normal sinus rhythm with occasional Premature ventricular complexes  
Voltage criteria for left ventricular hypertrophy  
ST & T wave abnormality, consider inferolateral ischemia  
Abnormal ECG  
When compared with ECG of 16-MAR-2005 13:58, (unconfirmed)  
Vent. rate has decreased BY 37 BPM  
Nonspecific T wave abnormality has replaced inverted T waves in Anterior leads

Technician: J

Referred by:

Unconfirmed

CONFIRMED: DONG-GU SHIN



EID: Unconfirmed EDT ORDER:

Page 1 of 1



## 12SL REPORT

Yeungnam Univ Hospital

Shin Yeung-hee  
 Patient ID: 15574724  
 2005/03/09  
 11:55:07am

Female, Asian, 150 cm, 50.0 kg  
 49yrs, 6m.

110/70 mmHg

PRETEST  
 SUPINE  
 00:11

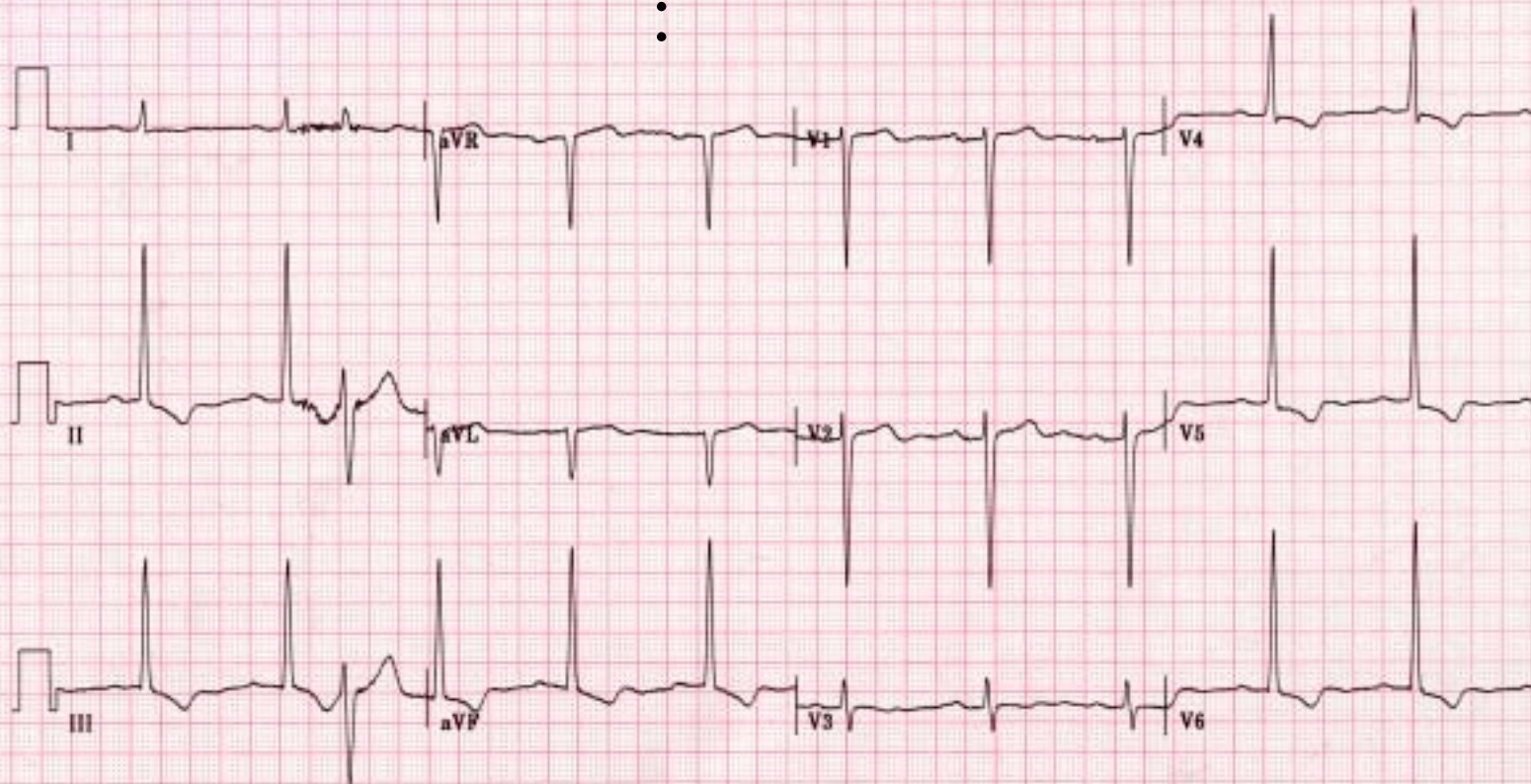
MODBRUCE  
 0.0 km/h  
 0.0 %

Vent. Rate 69 bpm  
 PR interval 206 ms  
 QRS duration 90 ms  
 QT/QTc 394/422 ms  
 P-R-T axes 61/80/268

Normal sinus rhythm with occasional premature ectopic complexes  
 Moderate voltage criteria for LVH, may be normal variant  
 ST & T wave abnormality, consider inferolateral ischemia  
 Abnormal ECG

Technician:

Medication: none





12-LEAD REPORT

Youngnam Univ Hospital

Shin Yeung-hee  
 Patient ID: 15574724  
 2005/03/09  
 12:12:50pm

117 bpm

RECOVERY  
 #1  
 00:50

MODBRUCE  
 0.0 km/h  
 0.0 %

Measured At 60ms Post J (10mm/mV)  
 Auto Points

| Lead | ST(mm) | Lead | ST(mm) |
|------|--------|------|--------|
| I    | 0.00   | V1   | 1.30   |
| II   | -1.30  | V2   | 1.60   |
| III  | -1.35  | V3   | 0.50   |
| aVR  | 0.35   | V4   | -1.00  |
| aVL  | 0.60   | V5   | -1.80  |
| aVF  | -1.30  | V6   | -1.65  |

⋮ (1)





LINKED MEDIANS

Yeungnam Univ Hospital

Shin Yeung-hee  
 Patient ID: 15574724  
 2005/03/09  
 12:17:50pm

87 bpm  
 05:21 110/70 mmHg

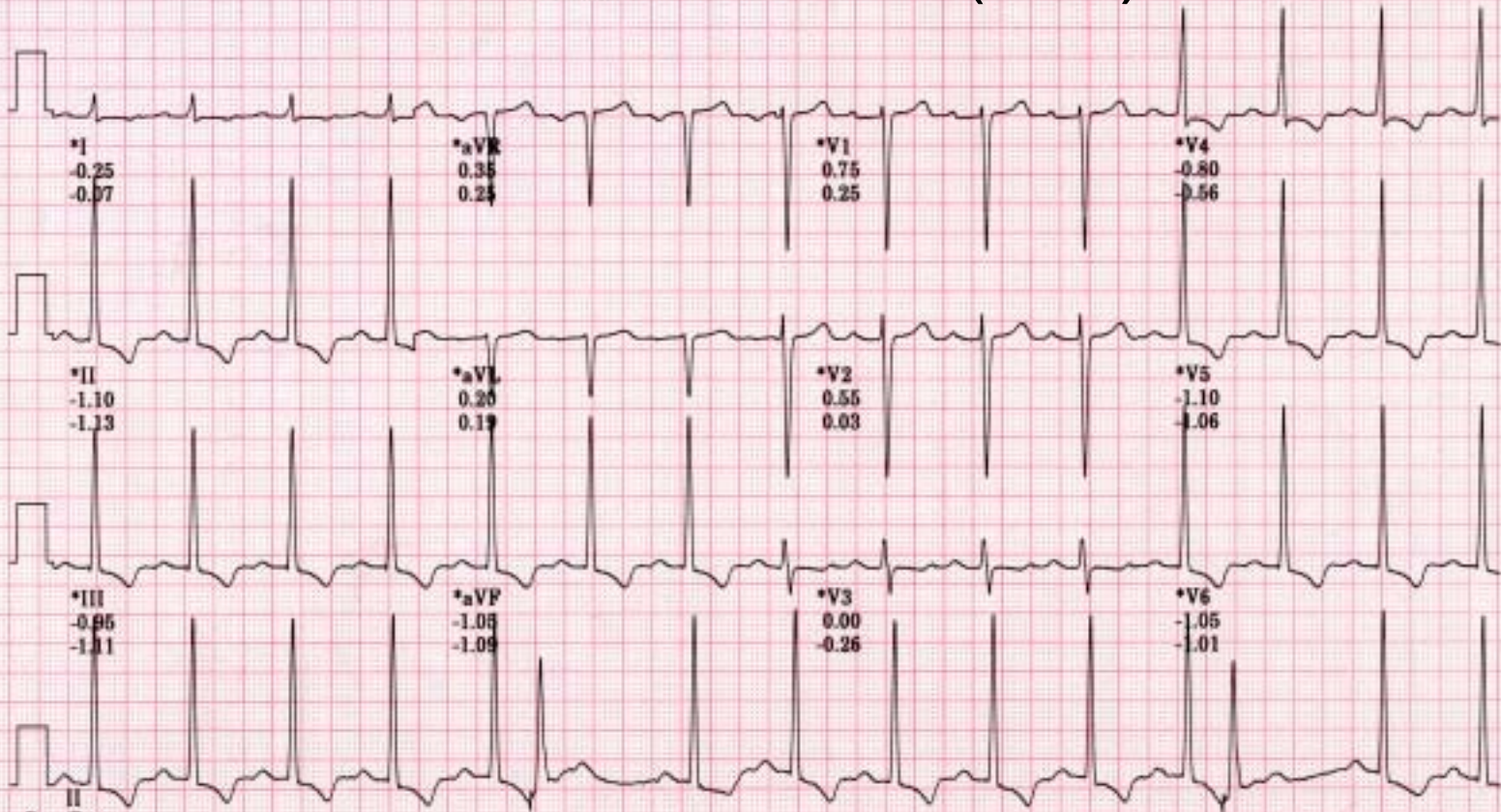
RECOVERY #1  
 05:50

MODBRUCE  
 0.0 km/h  
 0.0 %

Lead  
 ST Level (mm)  
 ST Slope (mV/s)

ST @ 10mm/mV  
 60 ms post J

( 5 )



Raw Data

\*Computer Synthesized Rhythms

## 49

:

:

Sinus and AV node function :

No significant ventricular arrhythmia induced by 3 VEST at RV apex and RVOT  
3 drive cycle lengths

Progress:

2005. 3.14. Discharge with medication

Acertil

Aldactone

Lasix

Aspirin

Cordarone

2005. 3.28. Aborted SCD

**“Declare the past  
Diagnose the present  
Foretell the future “**

**Aphorisms II**

**Hippocrates 460BC to 377BC**



# Background : PVC

- 1922, Gallavardin<sup>1</sup>

- 1969, Rosenbaum<sup>2</sup>

'Rosenbaum ventricular extrasystole'.

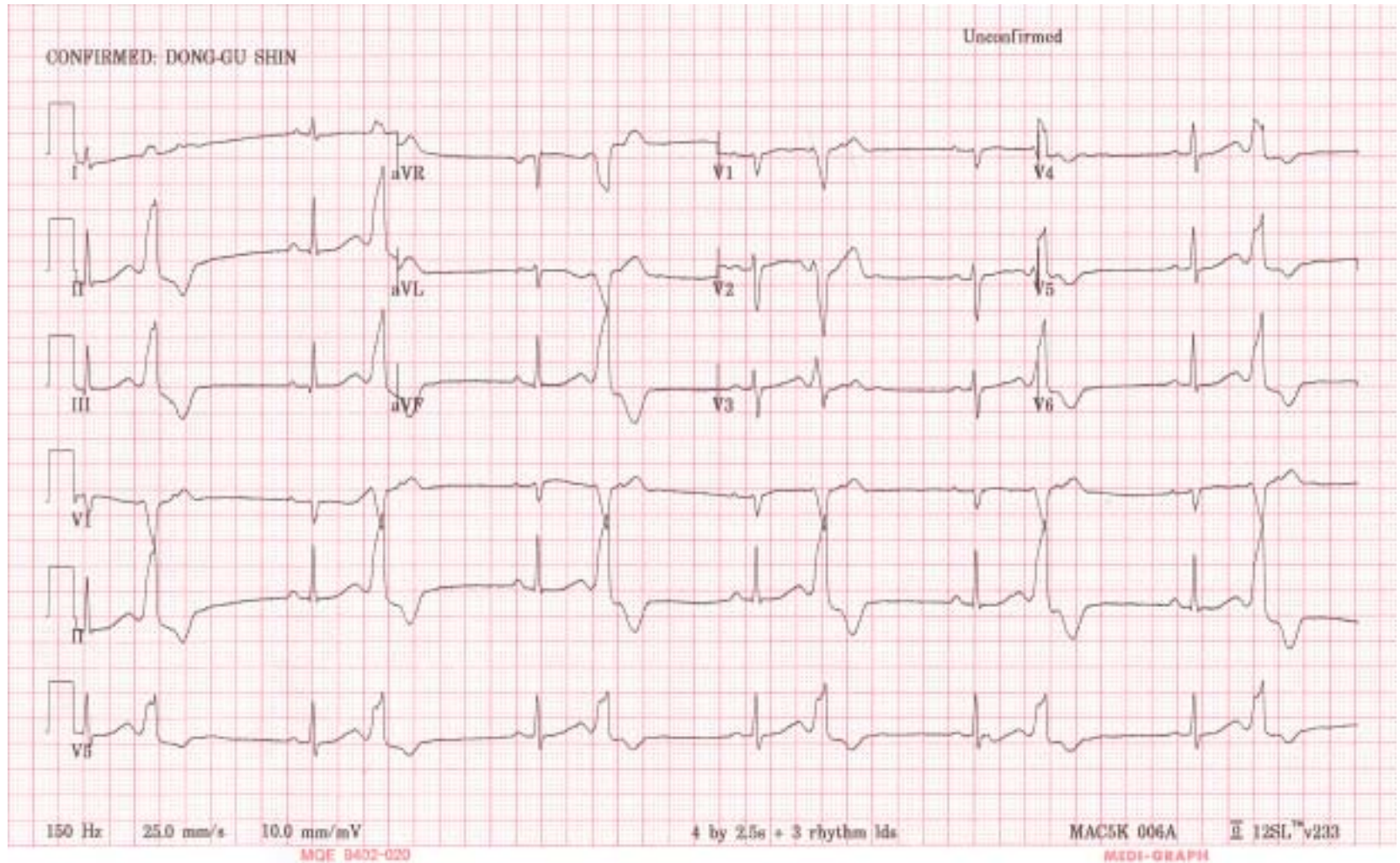
Rosenbaum reviews the classification of ventricular premature beats and adds a benign form that arises from the right ventricle and is not associated with heart disease.

- Ventricular extrasystoles are a common finding in patients with and without heart disease.
- Frequent and repetitive extrasystoles are an independent predictive factor of total mortality and sudden death in the presence of heart disease,
- Very frequent monomorphic ventricular complexes and even bursts of ventricular tachycardia in subjects without evidence of heart disease are generally considered benign in the presence of heart disease, .

1. Gallavardin L. Extrasistolie ventriculaire a` paroxysmes tachycardiques prolonge´s. Arch Mal Coeur 1922;15:298 –306.

2. Rosenbaum MB. Classification of ventricular extrasystoles according to form. J Electrocardiol 1969;2:289 –98.

# Premature Ventricular Contraction(PVC)



# Prognosis of PVC from Right Ventricular Outflow Tract

- 161 pts(12 pts with cardiac diseases)
- Male 62
- $55 \pm 15$  yo
- 50 pts FU for  $28.5 \pm 18.1$  months
- Results
  - NSVT 5(10%, including 1 DCM)
  - Sustained VT 2( 4%, including 1 CAD)
  - Loss of PVC 4( 8%)
  - SCD 1( 2%)
  - Conclusion : In the patients with frequent RVOT VPBs, sustained ventricular tachycardia or sudden death could develop. Therefore, careful observation is required in patients with frequent RVOT VPBs.



# Long-Term Follow-Up of Right Ventricular Monomorphic Extrasystoles

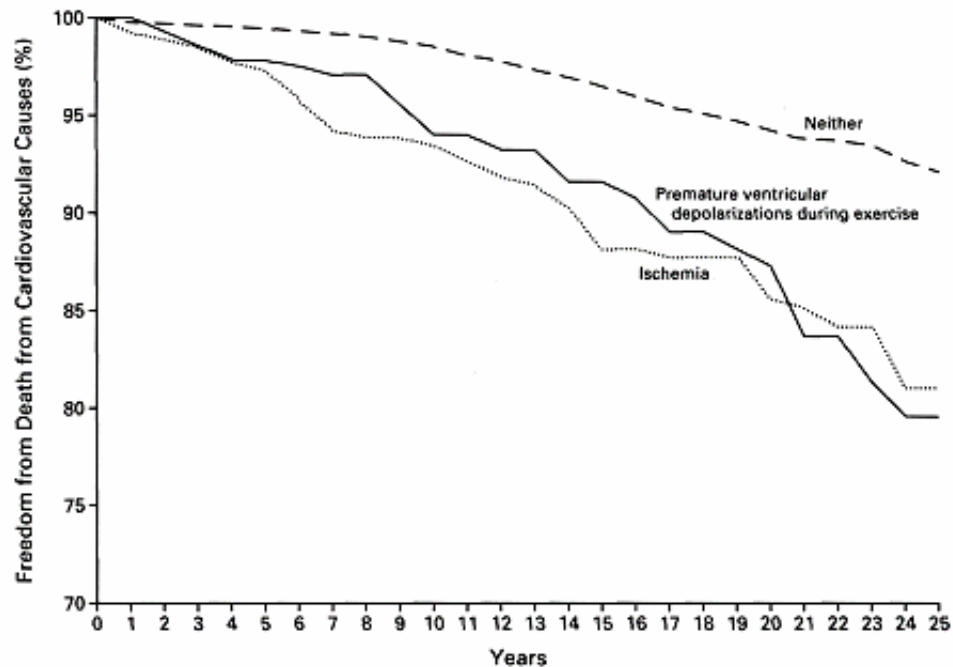
- 61 patients
- $15 \pm 2$  years(12-20 years)
- Clinical examination, ECG, Holter, stress test, SAECG, Echocardiography and cardiac MR (11 patients)
- Results
  - 55 alive, and 6 died(No SCD)
  - 47 patients examined had normal ECG
  - 24 (51%), extrasystoles were no longer present
  - 7 (15%), late potentials were present
  - Right ventricle was normal at echocardiography.
  - In 8 of 11 patients (73%), cardiac MR showed focal fatty replacement and other abnormalities of the right ventricle.

# Cardiac MR imaging findings in patients with RVOT premature contractions

- 19 patients :13 males, mean: 44 years, with frequent (> 100 per hour), monomorphic (LBBB and inferior axis morphology) PVC's
- 10 volunteers : 4 males, mean age 36.7 years, without structural heart disease.
- Cardiac MR findings :Reduced wall thickness, systolic bulging, and decreased systolic thickening  
ED Ø of the RVOT(transverse plane)
- RESULTS:
  - Mean AP Ø : $39.6 \pm 4.6$  mm vs.  $29.9 \pm 4.8$  mm ( $P < 0.01$ )
  - Transverse Ø :  $27.5 \pm 3.8$  mm vs.  $20.5 \pm 2.5$  mm ( $P < 0.01$ )
  - Wall motion and morphological abnormalities: 16/19 (84%)
  - The anterolateral wall in 15/16 cases
  - All normal subjects: normal MR imaging findings ( $P = 0.008$ )

# Long-term Outcome in Asymptomatic Men with Exercise-induced PVC

- 6101 asymptomatic French men (42 to 53 years of age)
- Free of clinically detectable cardiovascular disease
- A standardized graded exercise test between 1967 and 1972.





# Long-term Outcome in Asymptomatic Men with Exercise-induced PVC

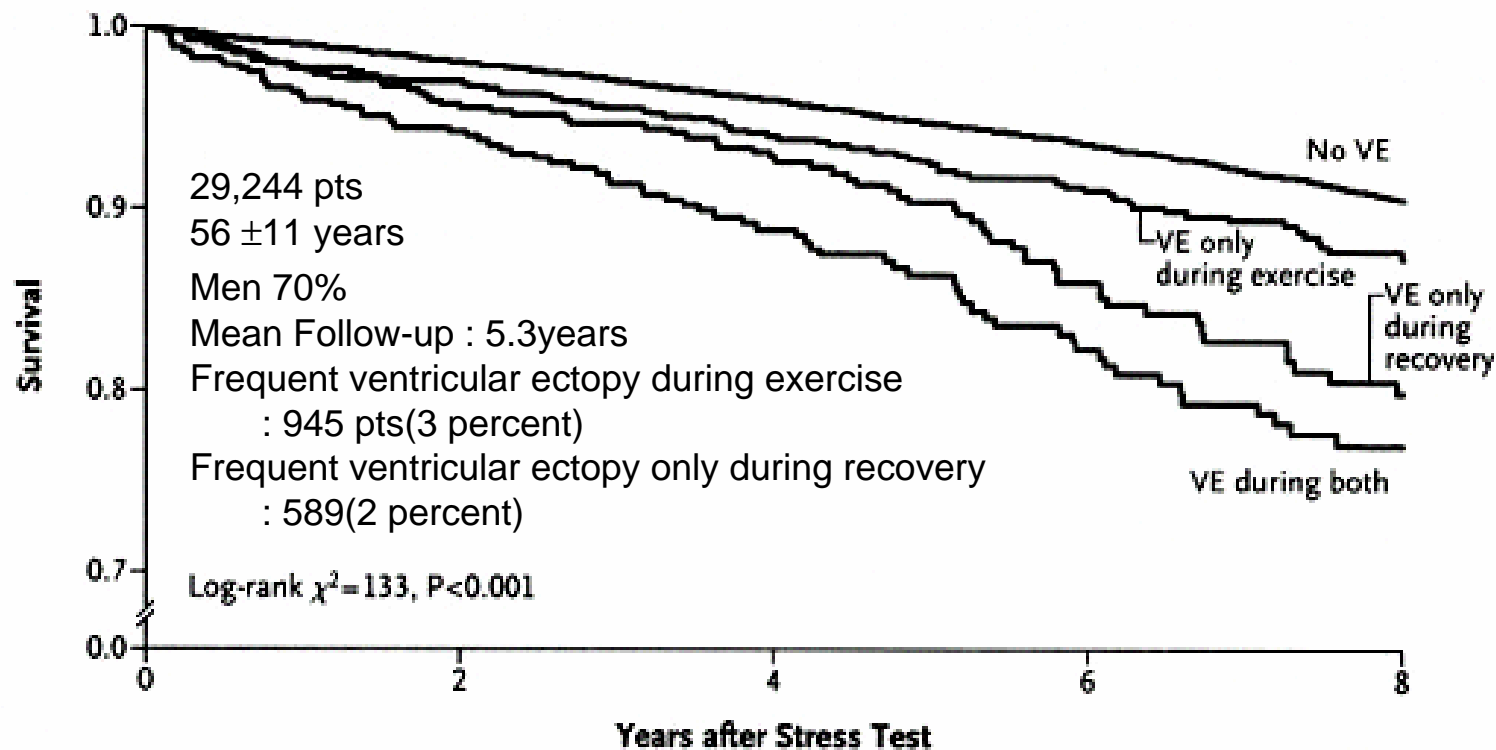
## Death Rates according to the Frequency of PVC

**TABLE 1. DEATH RATES ACCORDING TO THE FREQUENCY OF PREMATURE VENTRICULAR DEPOLARIZATIONS OCCURRING BEFORE, DURING, OR AFTER EXERCISE.\***

| CATEGORY                            | BEFORE EXERCISE |         |        |       | DURING EXERCISE |         |         |        | AFTER EXERCISE |         |         |       |
|-------------------------------------|-----------------|---------|--------|-------|-----------------|---------|---------|--------|----------------|---------|---------|-------|
|                                     | 0               | ≤10%    | >10%   | P     | 0               | ≤10%    | >10%    | P      | 0              | ≤10%    | >10%    | P     |
|                                     | (N=5932)        | (N=121) | (N=48) | VALUE | (N=5443)        | (N=520) | (N=138) | VALUE  | (N=5479)       | (N=448) | (N=174) | VALUE |
|                                     | percent         |         |        |       | percent         |         |         |        | percent        |         |         |       |
| Death from all causes               | 26.8            | 28.1    | 25.0   | 0.91  | 26.3            | 27.9    | 41.3    | <0.001 | 26.5           | 27.7    | 35.0    | 0.05  |
| Death from noncardiovascular causes | 19.7            | 16.5    | 18.8   | 0.67  | 19.5            | 20.6    | 24.6    | 0.28   | 19.4           | 20.6    | 27.0    | 0.04  |
| Death from cardiovascular causes    | 7.1             | 11.6    | 6.2    | 0.16  | 6.8             | 7.3     | 16.7    | <0.001 | 7.1            | 7.1     | 8.0     | 0.89  |
| Fatal myocardial infarction         | 2.4             | 3.3     | 0      | 0.45  | 2.3             | 2.3     | 5.1     | 0.11   | 2.4            | 2.2     | 1.1     | 0.53  |
| Sudden death                        | 1.4             | 2.5     | 0      | 0.43  | 1.3             | 1.7     | 2.9     | 0.25   | 1.4            | 2.0     | 1.7     | 0.49  |
| Other                               | 3.3             | 5.8     | 6.2    | 0.16  | 3.2             | 3.3     | 8.7     | 0.002  | 3.3            | 2.9     | 5.2     | 0.35  |

\*The frequency of premature ventricular depolarizations was defined as the maximal number of premature ventricular depolarizations divided by the total number of ventricular depolarizations recorded on any of the 30-second electrocardiograms. The subjects with more than 10 percent premature ventricular depolarizations include subjects with runs of consecutive premature ventricular depolarizations. P values are by global chi-square test, with 2 df.

# Frequent Ventricular Ectopy after Exercise as a Predictor of Death



## No. at Risk

|                         | 0      | 2      | 4      | 6      | 8      |
|-------------------------|--------|--------|--------|--------|--------|
| No VE                   | 27,219 | 26,295 | 22,900 | 19,576 | 16,708 |
| VE only during exercise | 945    | 900    | 840    | 687    | 598    |
| VE only during recovery | 589    | 564    | 474    | 425    | 331    |
| VE during both          | 491    | 459    | 403    | 329    | 265    |

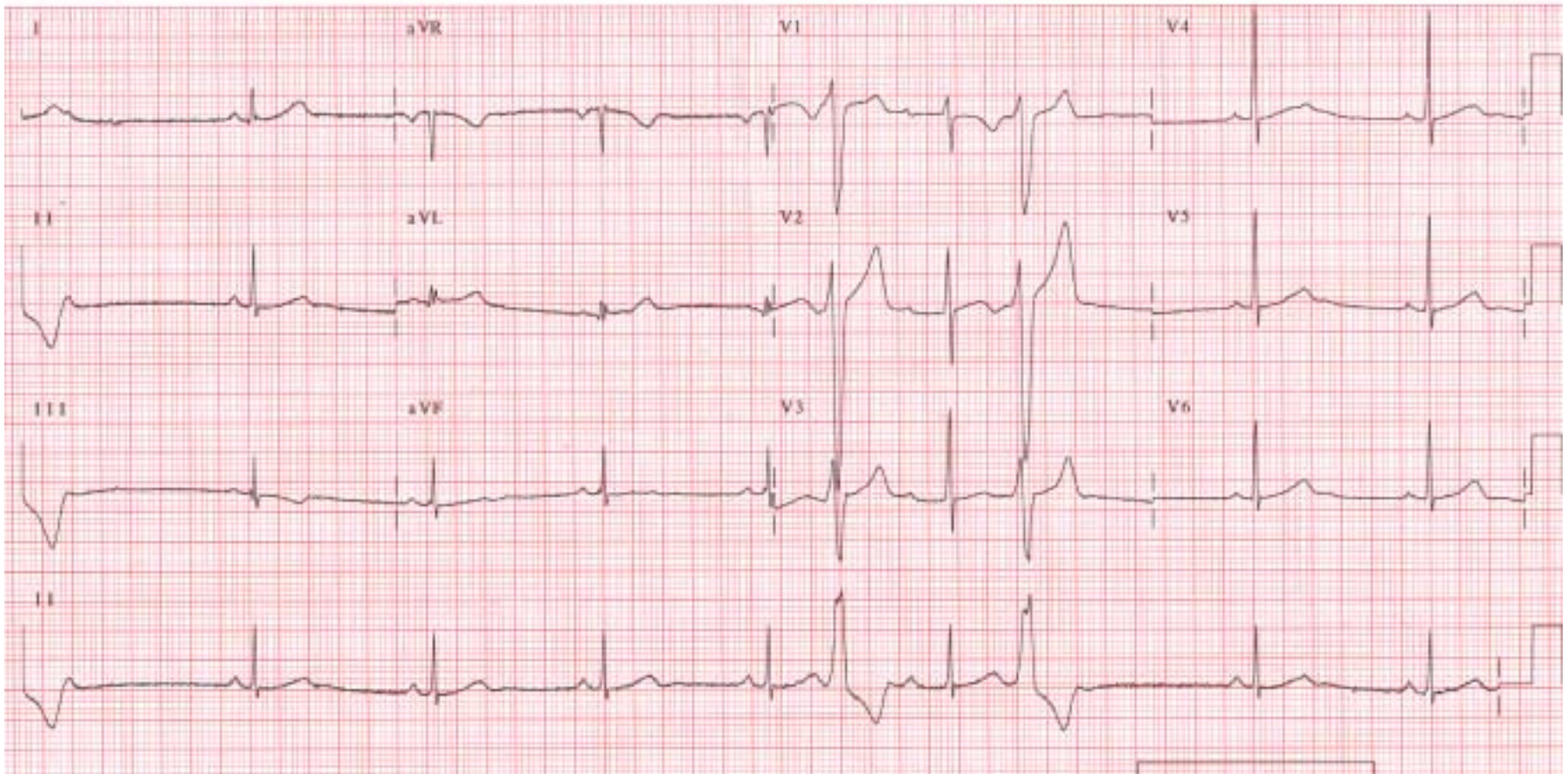
Rate 52 - Sinus rhythm, rate 52  
PR 157 - Multiple premature complexes: ventr. & sventr.  
QRSD 70 - Early transition  
QT 425 - Nonspecific inferior T abnormalities  
QTc 395

--AXIS--

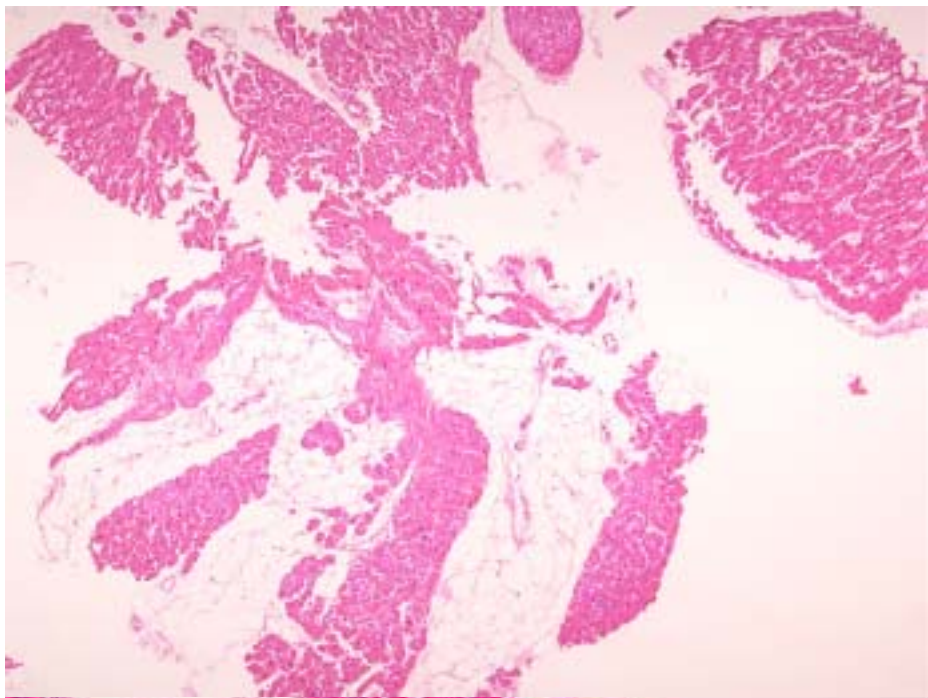
P 45  
QRS 43  
T 7

- ABNORMAL ECG -

Signature

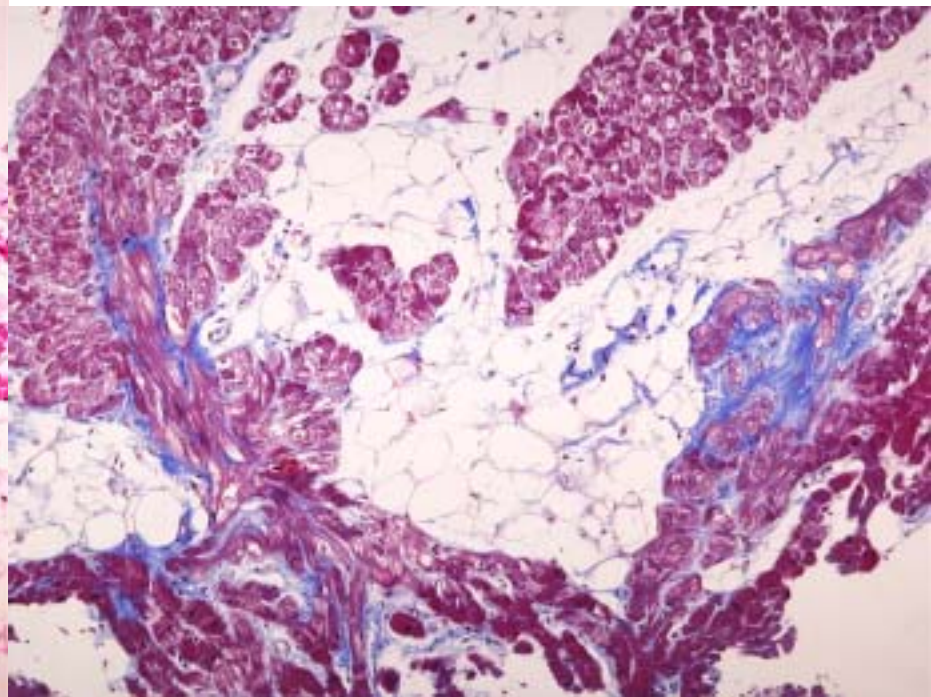
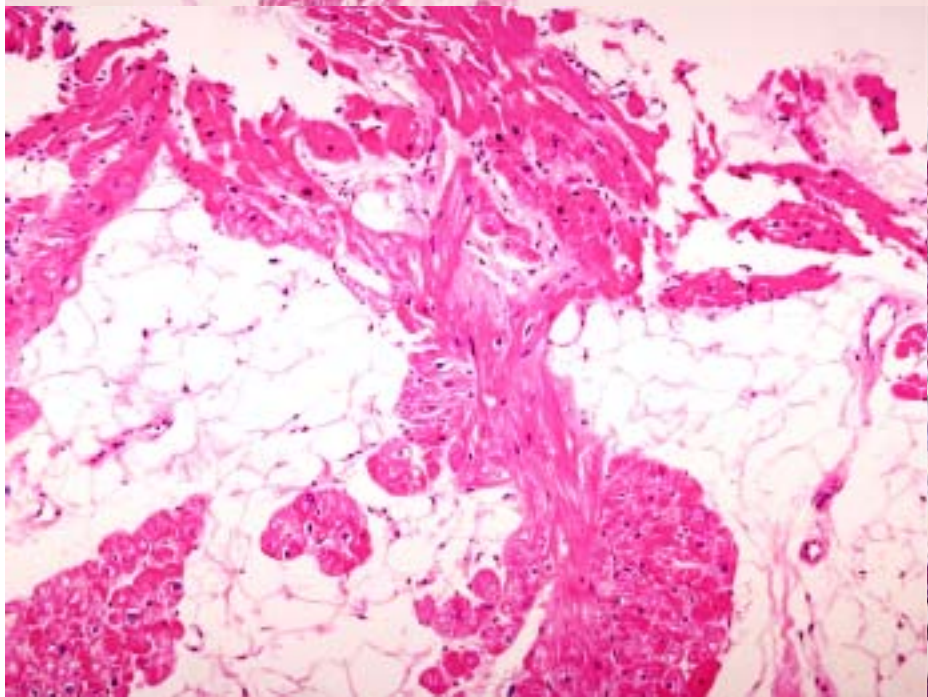




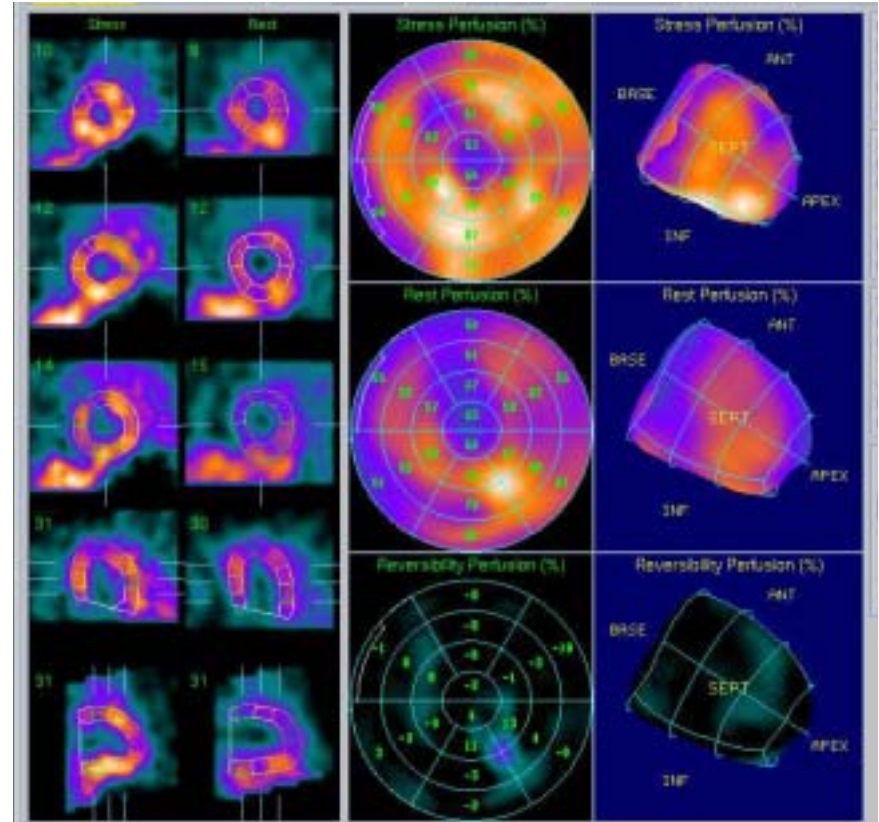
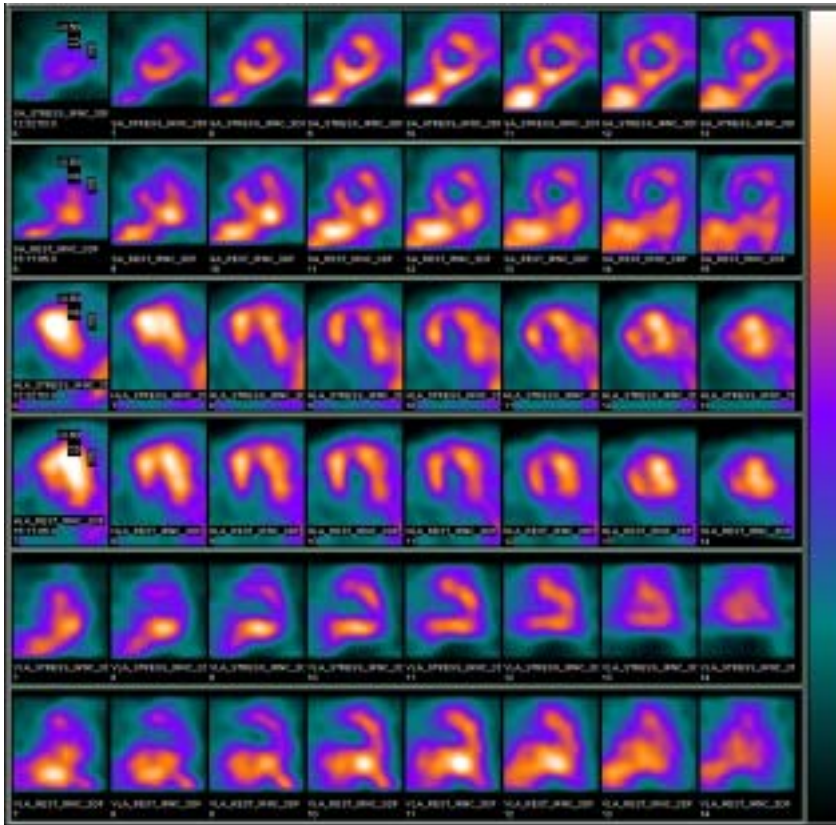


|          |                 |
|----------|-----------------|
| HE × 40  |                 |
| HE × 100 | Trichrome × 100 |

2047425



# $^{123}\text{I}$ MIBG Imaging for Sympathetic Innervation



21148375PVC

42

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- 2 palpitation presyncope
- 7.2km/hr
- 
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- 가
- 

X- routine ECG:

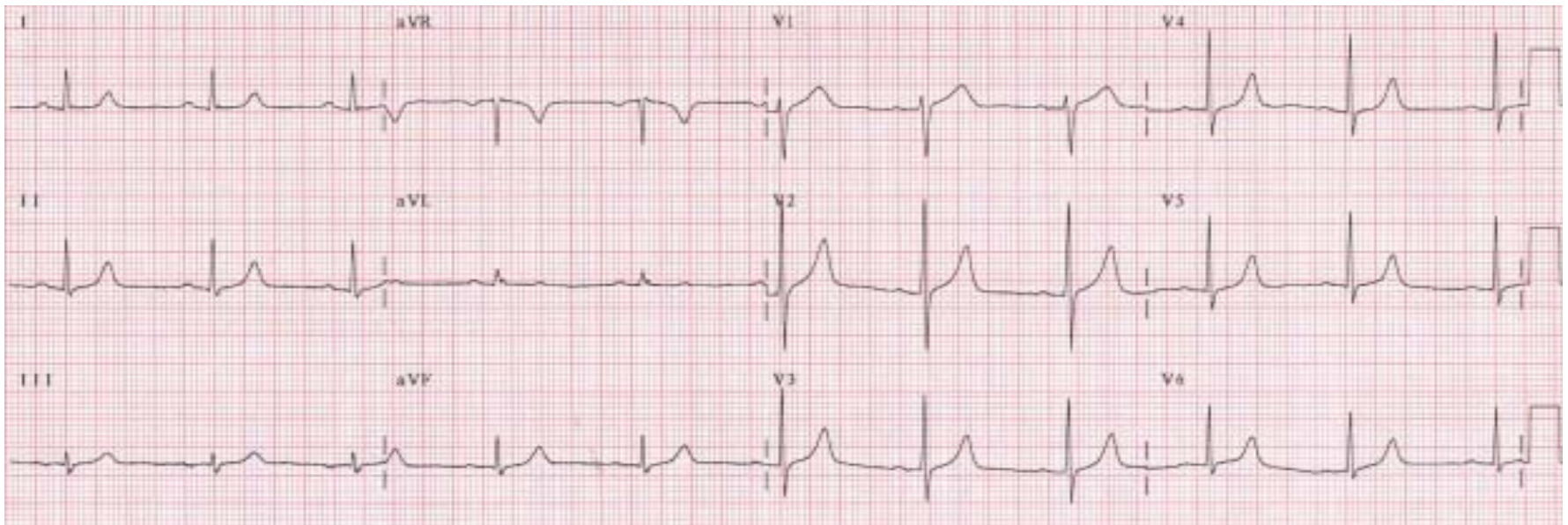
:

:

Holter ECG:



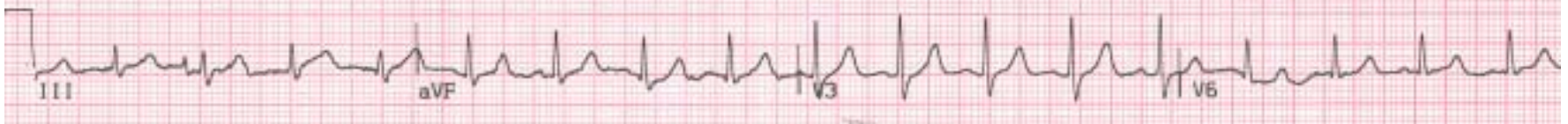
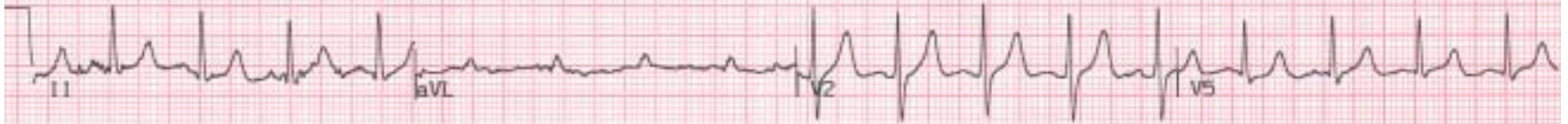
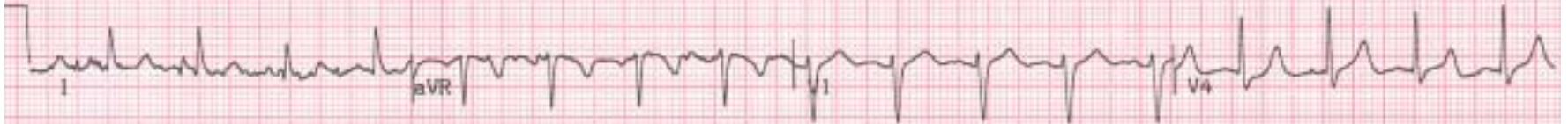
- X - routine ECG:
- :
- :
- Holter ECG:





0:11:55 ID: 2006984 BRUCE Clock 1: 01:02 Measured At: 60ms post J (10mm/mV)  
25mm/s EXERCISE 1 Clock 2: 01:02 Auto Points  
10mm/mV HR: 106bpm Speed: 1.7mph  
20Hz Grade: 10.0%

| Lead | ST(mm) | Lead | ST(mm) |
|------|--------|------|--------|
| I    | 0.0    | V1   | 1.3    |
| II   | 0.2    | V2   | 1.7    |
| III  | 0.4    | V3   | 0.9    |
| aVR  | 0.0    | V4   | 0.6    |
| aVL  | -0.2   | V5   | 0.4    |
| aVF  | 0.3    | V6   | 0.1    |





10:16:25

ID: 2006984

BRUCE

Clock 1: 05:32

Measured At 60ms post J (10mm/mV)

25mm/s

EXERCISE 2

Clock 2: 02:32

Auto Points

10mm/mV

HR: 131bpm

Speed: 2.5mph

Lead ST(mm)

20Hz

BP: 150/90

Grade: 12.0%

Lead ST(mm)

I -0.1 V1 1.8

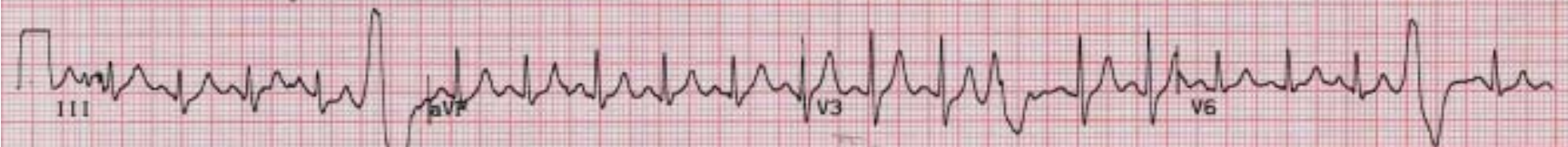
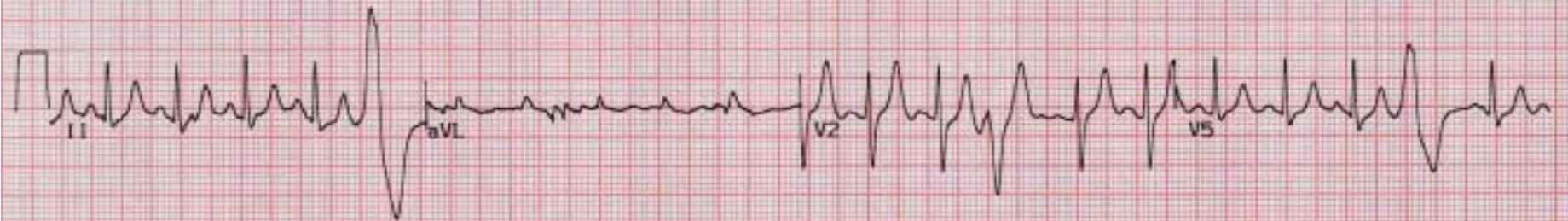
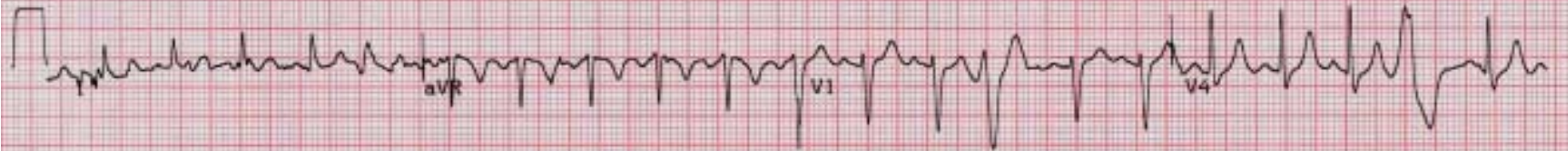
II 0.7 V2 2.9

III 0.9 V3 1.7

aVR -0.1 V4 1.3

aVL -0.5 V5 0.8

aVF 0.8 V6 0.3





10:21:53

ID: 2006984

BRUCE

Clock 1: 11:00

Measured At 60ms post J ( 10mm/nV)

25mm/s

EXERCISE 3

Clock 2: 03:50

Auto Points

10mm/nV

HR: 231bpm

Speed: 3.4mph

Lead ST(mm)

20Hz

Grade: 14.0%

I 0.52 V1 4.52

RELEARN at EXERCISE 10:57

II 3.07 V2 7.67

III 2.87 V3 0.27

aVR -1.87 V4 -9.77

aVL -1.37 V5 -10.87

aVF 2.97 V6 -12.07





Female

Analysis Filter : 40-250Hz  
 Std. QRS Duration (unfiltered) : 98 ms  
 Total QRS Duration (filtered) : 113 ms  
 Duration Of HFLA signals < 40uV : 48 ms  
 RMS Voltage in terminal 40 ms : 13 uV  
 Mean Voltage in terminal 40 ms : 9 uV

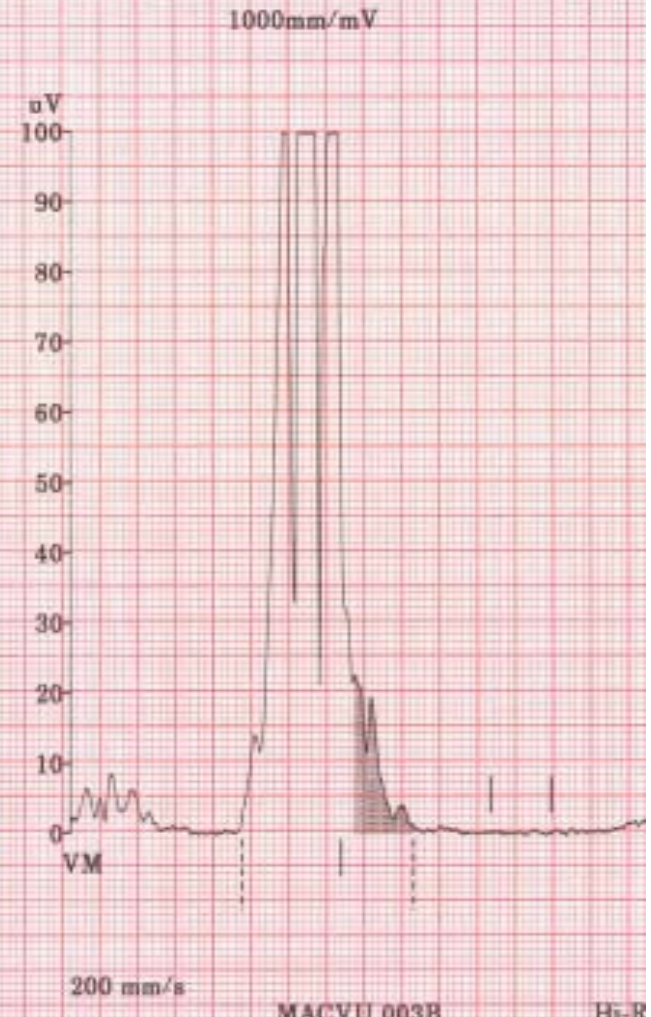
Number Of Beats Averaged: 305  
 Number Of Beats Detected: 455  
 Noise Level (Std. Devn.) : 0.20 uV

**fQRSd  $\geq 114$  ms**  
**LAS40  $\geq 38$  ms**  
**RMS40  $< 20$   $\mu$ V**

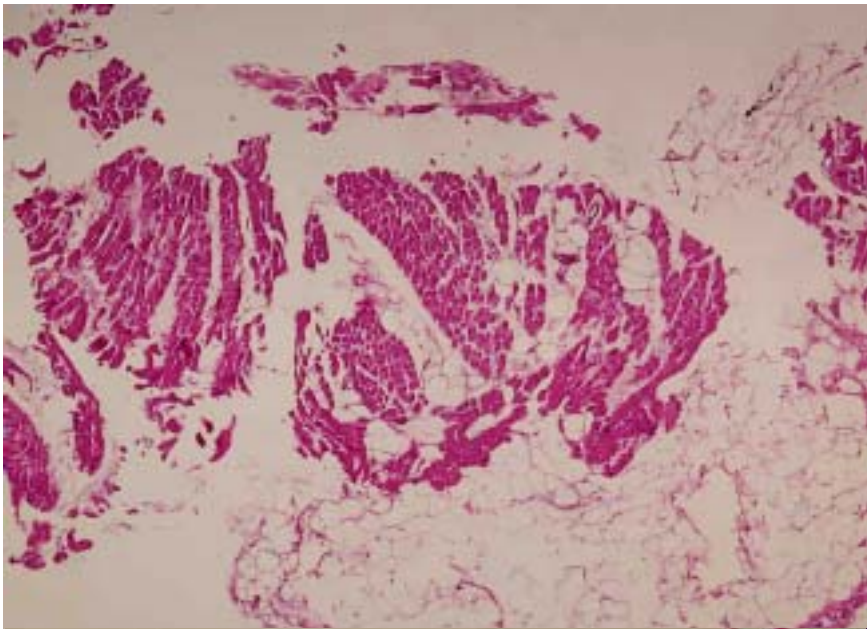
Technician:  
 Test ind:

Referred by:

Unconfirmed





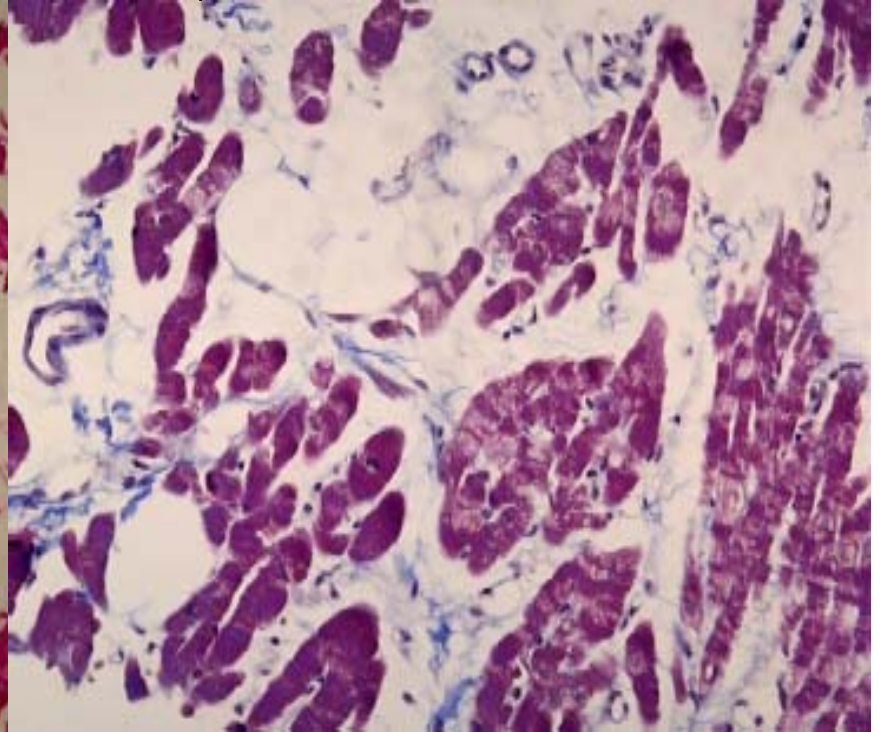
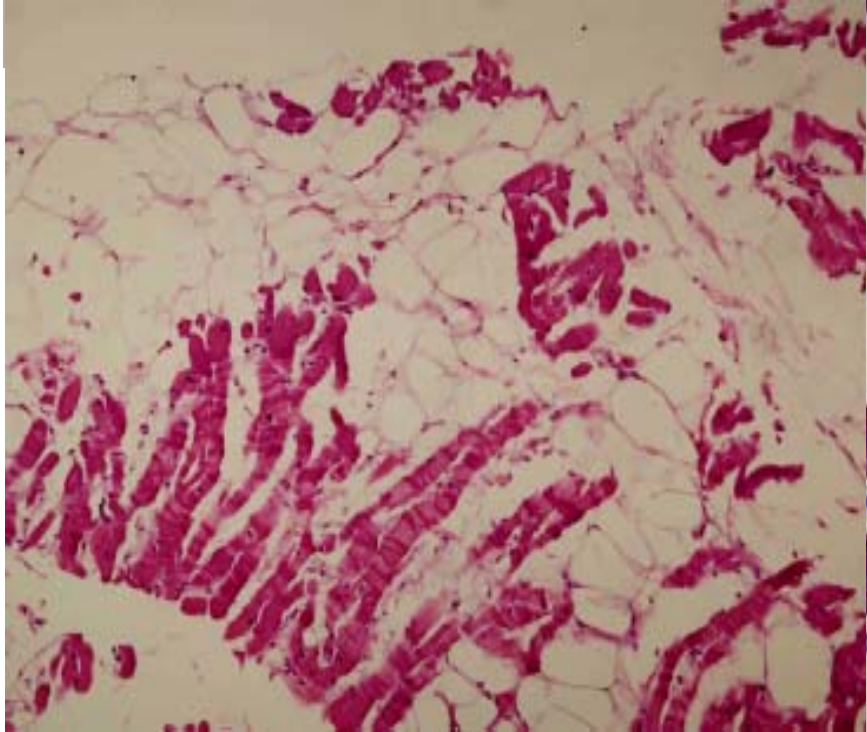


HE × 40

HE × 100

Trichrome ×100

2006984



## 35

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- :
- :
- : slide
- : slide



35 yr  
Male Oriental  
Room:IMC

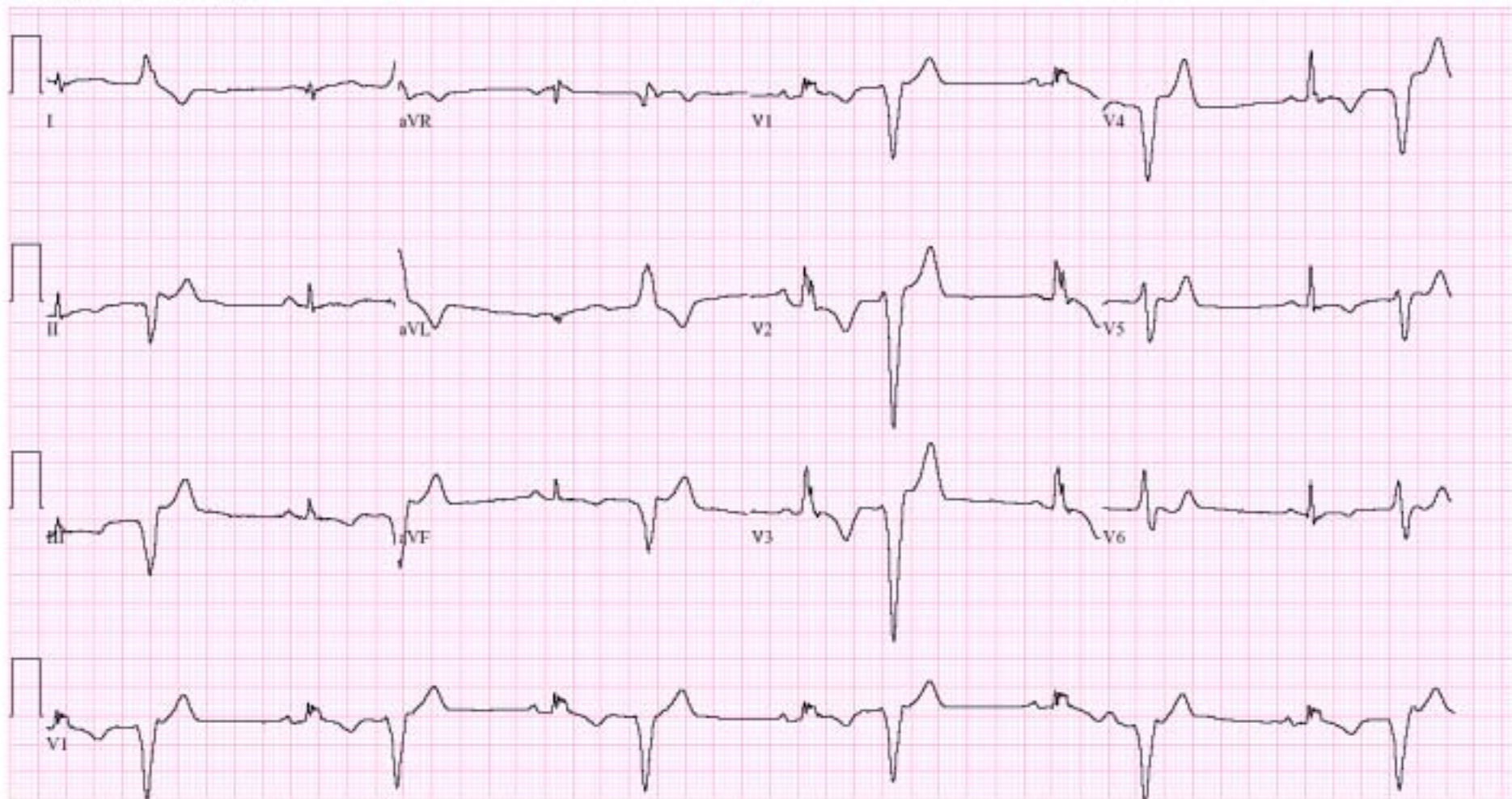
Vent. rate 69 BPM  
PR interval 164 ms  
QRS duration 128 ms  
QT/QTc 456/488 ms  
P-R-T axes 81 94 -20

\*\*\* Age and gender specific ECG analysis \*\*\*  
Marked sinus bradycardia with frequent Premature ventricular complexes in a pattern of bigeminy and Possible  
Premature atrial complexes with Aberrant conduction  
Right bundle branch block  
T wave abnormality, consider inferolateral ischemia  
Abnormal ECG  
No previous ECGs available

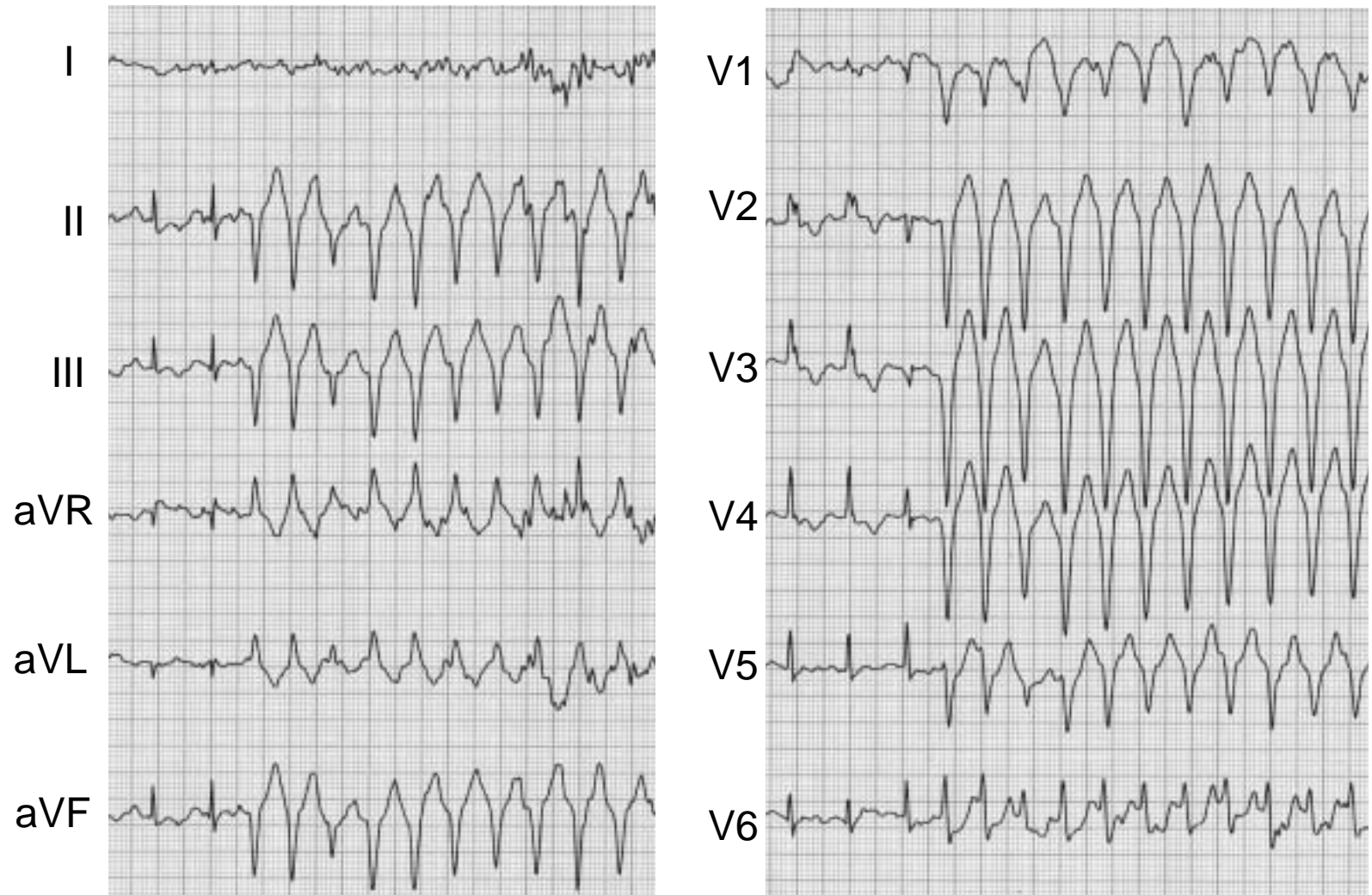
Referred by:

Unconfirmed

CONFIRMED:DONG-GU SHIN



## Modified Bruce protocol, stage 6





# Cause:PVC

## ■ Cardiac

- Myocardial ischemia or infarction
- Myocarditis
- Cardiomyopathy(dilated, hypertrophic)

## ■ Medications

- Digoxin, sympathomimetic, TCA....

## ■ Substance abuse

- Alcohol, tobacco, caffeine, cocaine, amphetamine.....

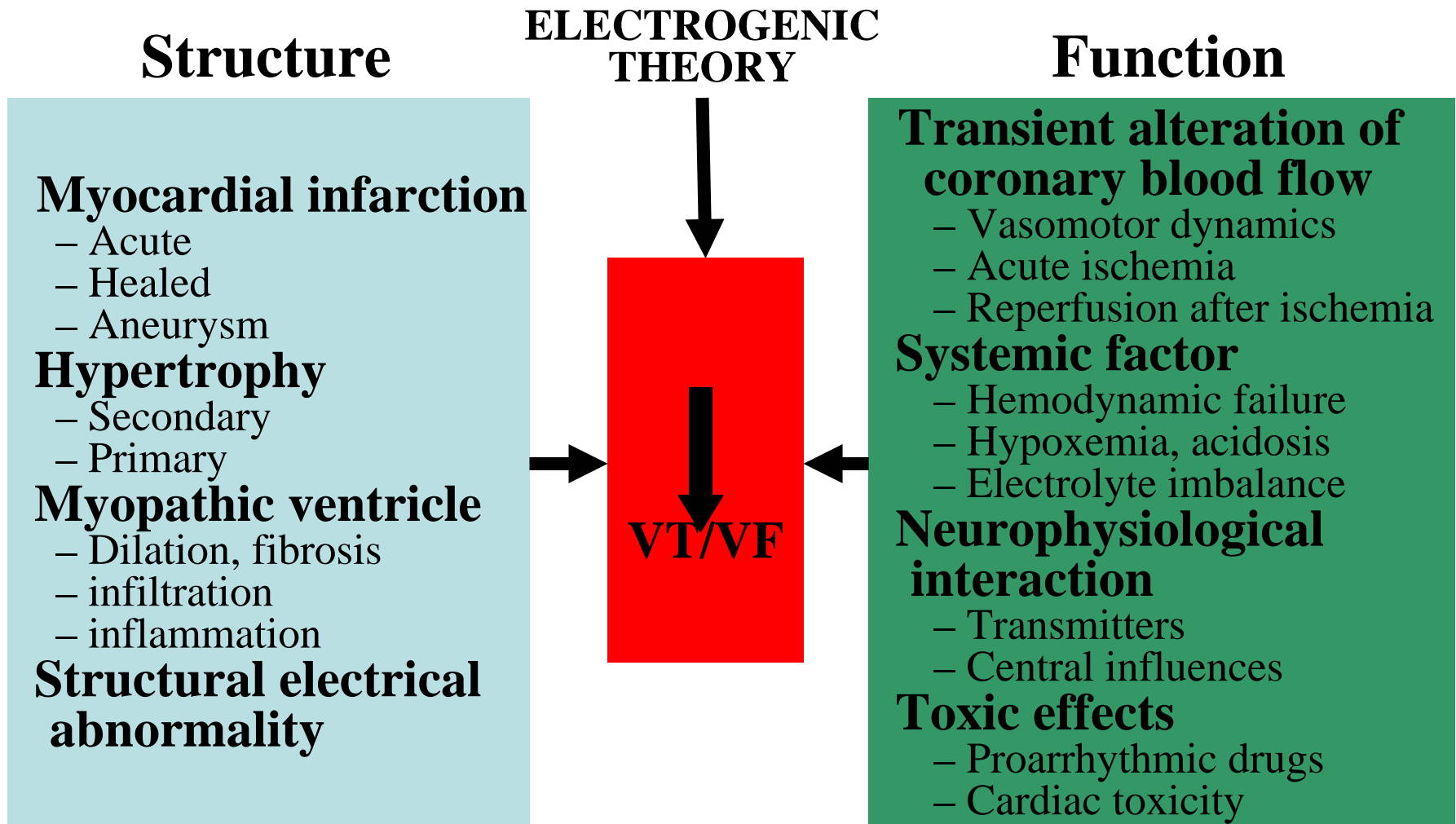
## ■ Electrolyte Imbalance

- Hypokalemia, hypomagnesemia, hypercalcemia

## ■ Others

- Anxiety or stress, fatigue

# Biological model of SCD



# Evaluation

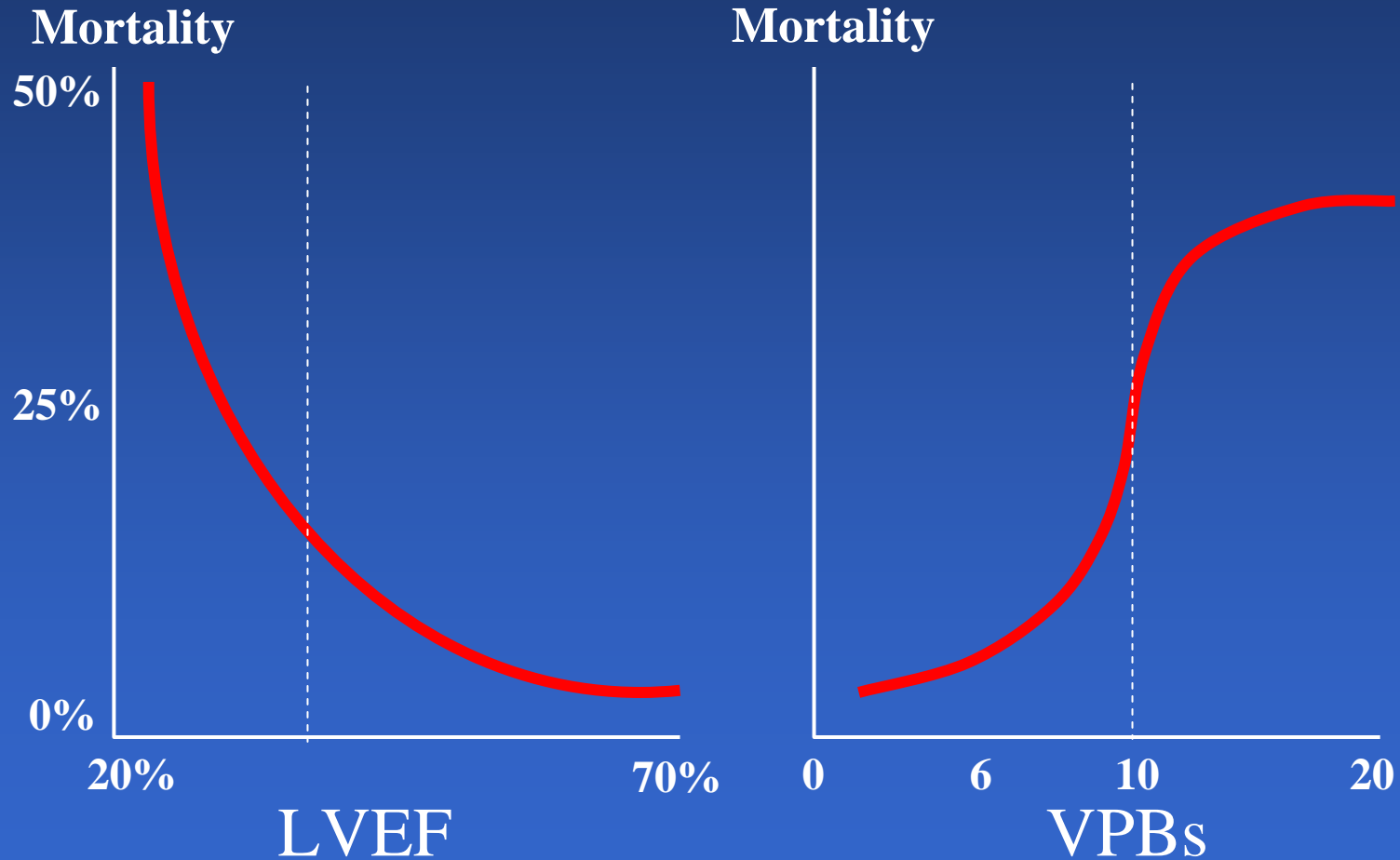
- History and PE
- Blood chemistry
- Chest PA
- EKG
- Signal-averaged ECG
- Holter monitoring
- Exercise Stress Test
- RI scan
- Cardiac electrophysiologic study.....

# Clinical Substrates Associated with SCD

- Coronary artery disease
- Idiopathic cardiomyopathy
- Hypertrophic cardiomyopathy
- Long QT syndrome
- RV dysplasia
- Rarely: WPW syndrome
- .....

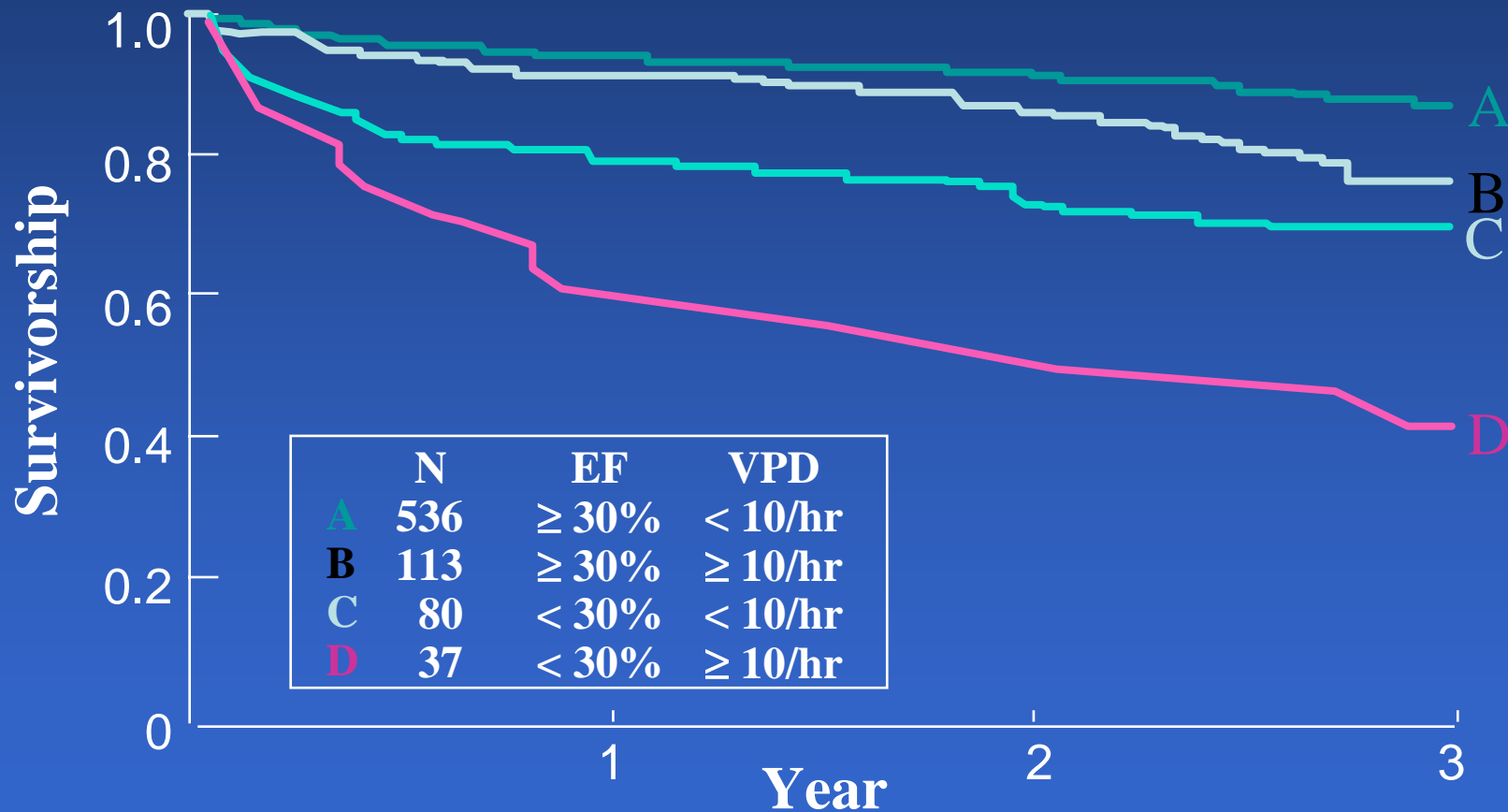


# Conventional Risk Prediction Post AMI

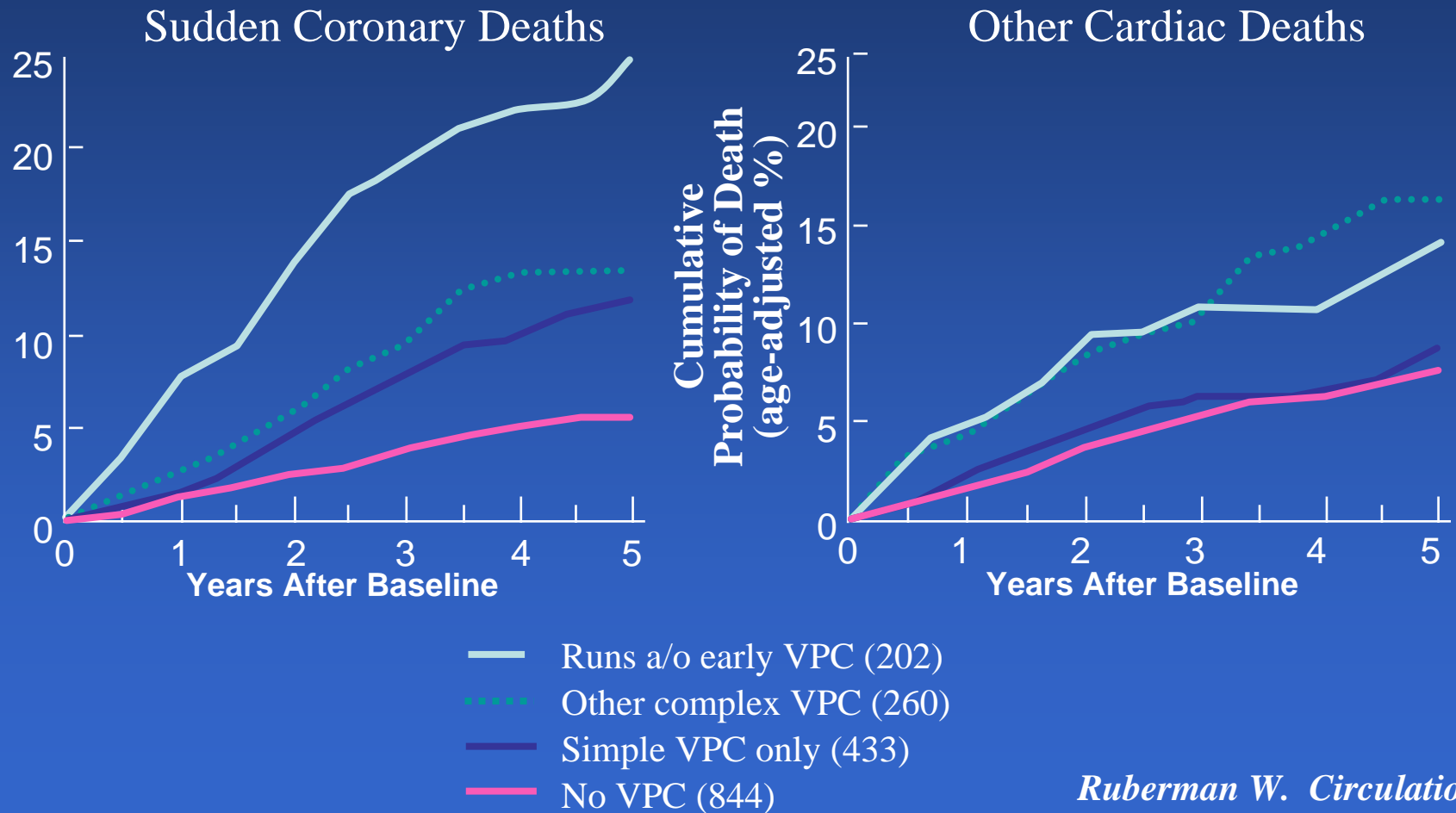


# Survival After Acute MI

Bigger JT. Am J Cardiol. 1986;57:12B



# Risk of SCD in Relation to Complexity of Ventricular Arrhythmia

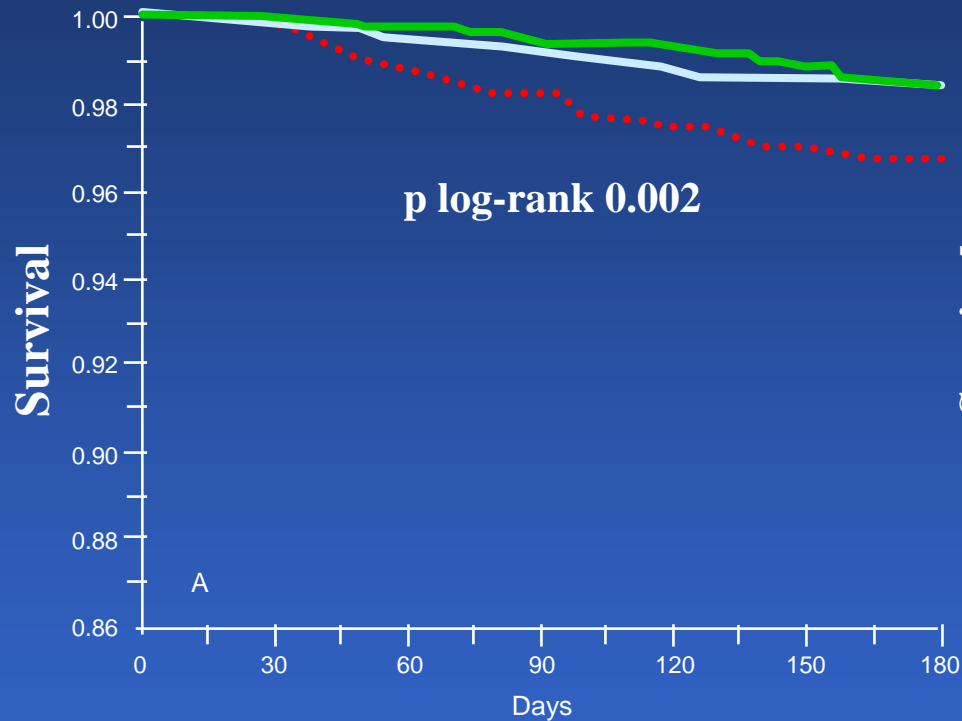


*Ruberman W. Circulation. 1981;64(2):297-305.*

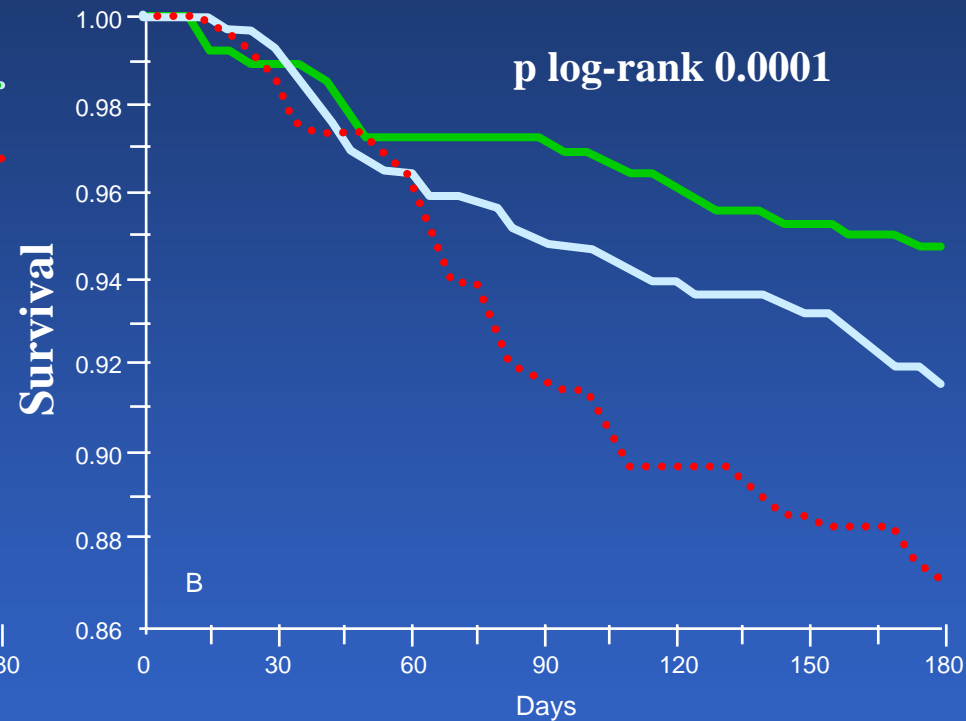


# Risk of SCD :

## Data from GISSI-2 Trial



Patients without  
LV Dysfunction



Patients with  
LV Dysfunction

# Significance of PVC

- Depends on the clinical setting
- Marker of Disease Severity
  - Structural Heart Disease
    - Myocardial infarction
    - Congestive heart failure
    - .....
  - Underlying Cardiac Function

# Management

## Patient with No Cardiac Disease

### Asymptomatic PVC

- No Treatment, regardless of configuration or frequency
- Reassurance

### Symptomatic PVC

- Elimination of causes
- Avoid substance(alcohol, tabocco, caffein...)
- Anxiolytics
- Beta-blocker, calcium channel blocker
- AADs(Class I and III)
- RFCA if highly symptomatic.



# Management

## Patient with organic heart disease

- Depends on the clinical setting
- PVC suppression :efficacy not known(CHF-STAT, GESICA trial)
- Treatment of underlying condition
- Acute situation
  - IV lidocaine, procainamide, propranolol and magnesium
- For long-term treatment
  - AAD I, II including beta-blocker, and III(not Ic)
  - RFCA
  - ICD

# Conclusion

- Management of PVC depends on the clinical setting
- PVC of normal heart , especially from RVOT, is always benign?
- Therefore, meticulous study for the assessment of clinical significance of PVC might be needed.