

A HISTORY OF SUDDEN CARDIAC DEATH

The Role of the Autonomic
Nervous System

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“Why did he die on Tuesday and not on Monday?”

~ *Douglas Zipes*

OBJECTIVES

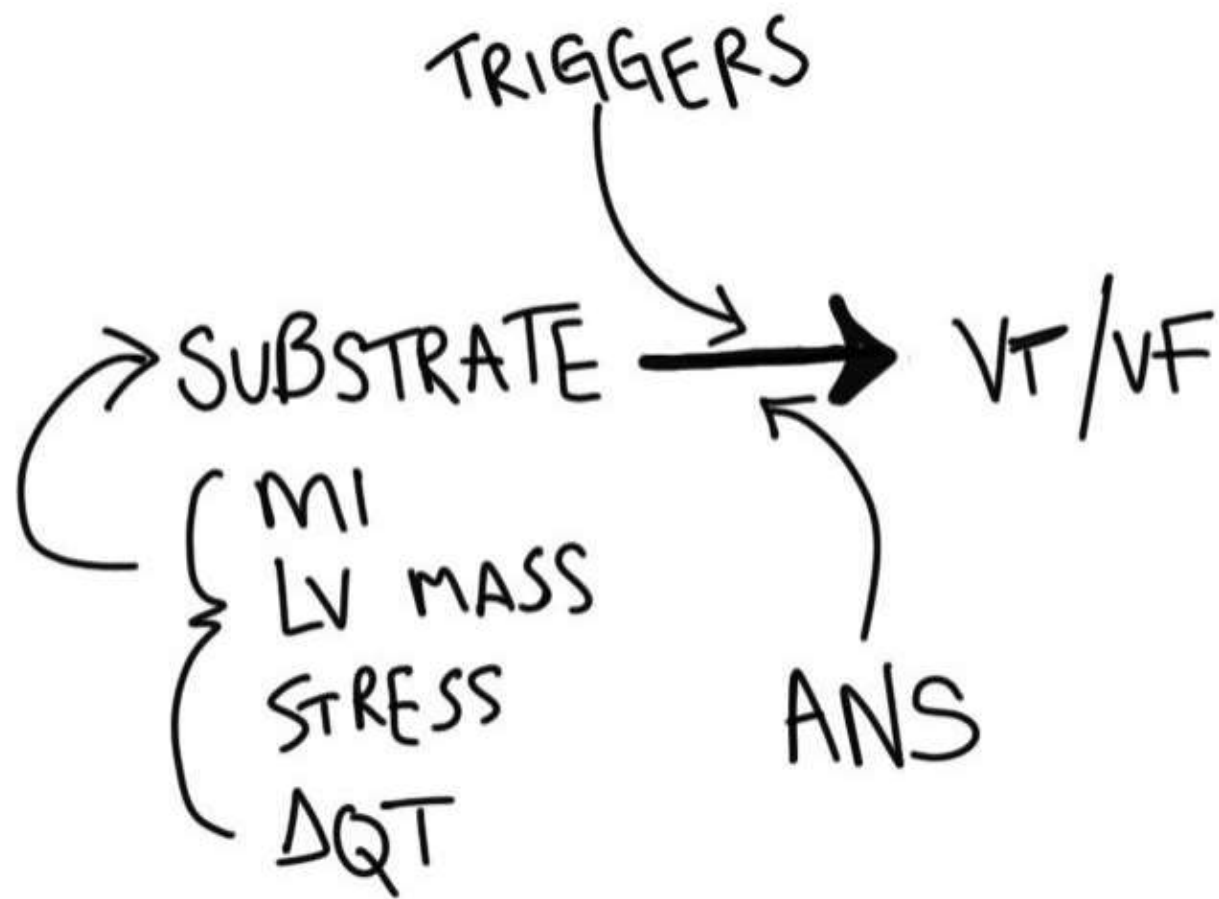
Understand how the ventricular substrate is affected by psychological triggers, which are modulated by the autonomic nervous system, leading to ventricular tachycardia and ventricular fibrillation.

ROAD MAP

- 1.Ventricular substrate
- 2.History
- 3.Story of sudden cardiac death
- 4.Autonomic modulation
- 5.Heart rate variability
- 6.Triggering sudden death
- 7.Autonomic risk

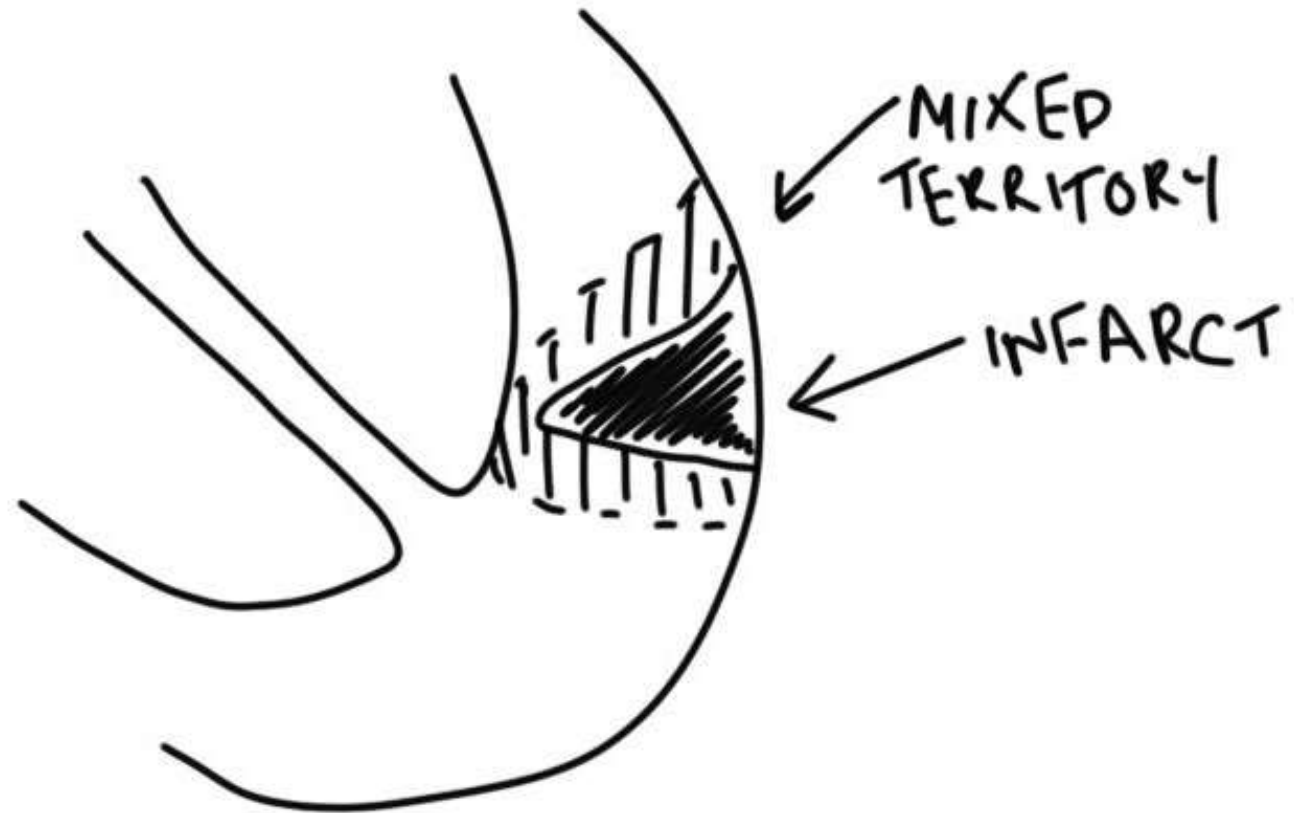
What do we know about sudden death?

- Complications of an MI
- VF arrest is sent to the cath lab
- ICD are placed for low EF

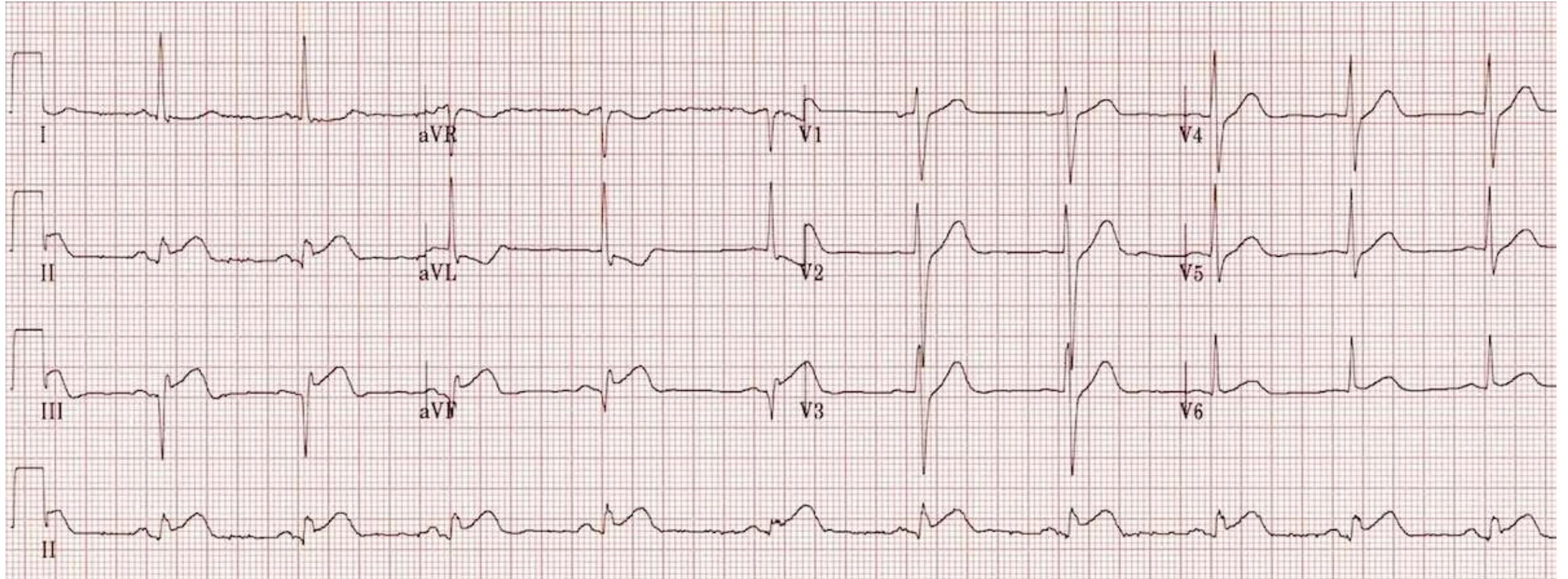


VENTRICULAR SUBSTRATE

Ischemia



Differential innervation



LV size

Table 2. Unadjusted Odds Ratios for Sudden Cardiac Death

| Parameter | OR (95% CI) | P Value |
|---|-------------------|---------|
| Black race | 3.0 (1.6 to 5.7) | <0.01 |
| Moderate or severely dilated LV vs normal | 2.1 (1.3 to 3.4) | <0.01 |
| Severely dilated LV vs moderately or mildly dilated or normal | 4.0 (1.7 to 9.3) | <0.01 |
| LVEF \leq 35% | 2.0 (1.4 to 2.9) | <0.01 |
| LVEF \leq 35% with normal LV size or mild LV dilatation* | 1.5 (1.0 to 2.3) | 0.06 |
| LVEF \leq 35% and either moderate or severe LV dilatation* | 2.6 (1.4 to 4.7) | <0.01 |
| LVEF \leq 35% and severe LV dilatation* | 4.9 (1.9 to 12.7) | <0.01 |

HISTORY

John MacWilliam

VF proposed as cause of SCD in 1889:

- fatal syncope
- delirium cordis
- circus contraction
- intervermiform movement

The first defibrillation

Claude Beck performed the first *successful* human defibrillation in **1947**

Precordial thump

1194

THE NEW ENGLAND JOURNAL OF MEDICINE

Nov. 26, 1970

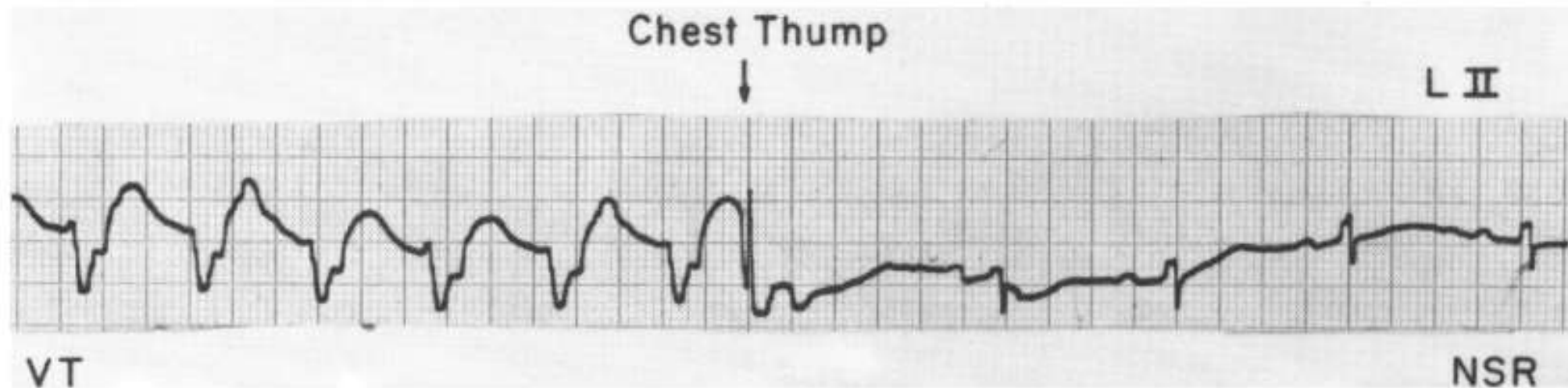


Figure 3. VT Terminated with a Single Sharp Blow Delivered to Lower Sternum in Case 1.

Precipitating death

- Threat, grief, arousal, personal danger, reunion precede sudden death... 8 cases, 1971
- Anxiety/anger precipitated SCD in depressed factory workers... 26 cases, 1972
- Increased life stress precedes SCD by several months... 226 cases, 1973

STORY OF SUDDEN DEATH

Advent of the CCU

Dr. Bernard Lown was an advocate:

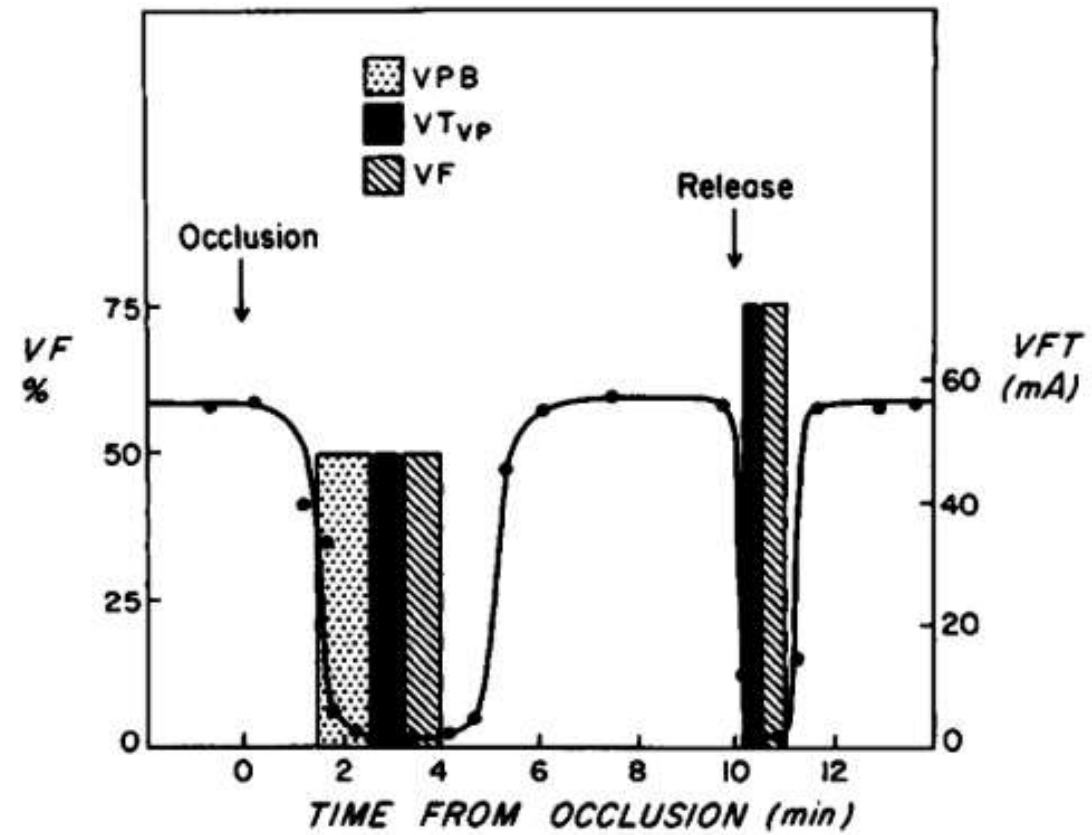
- restful rooms
- cardiac monitoring and nurses
- arrhythmia management (chemical and electrical)

Mortality prior >30%, and after <20%

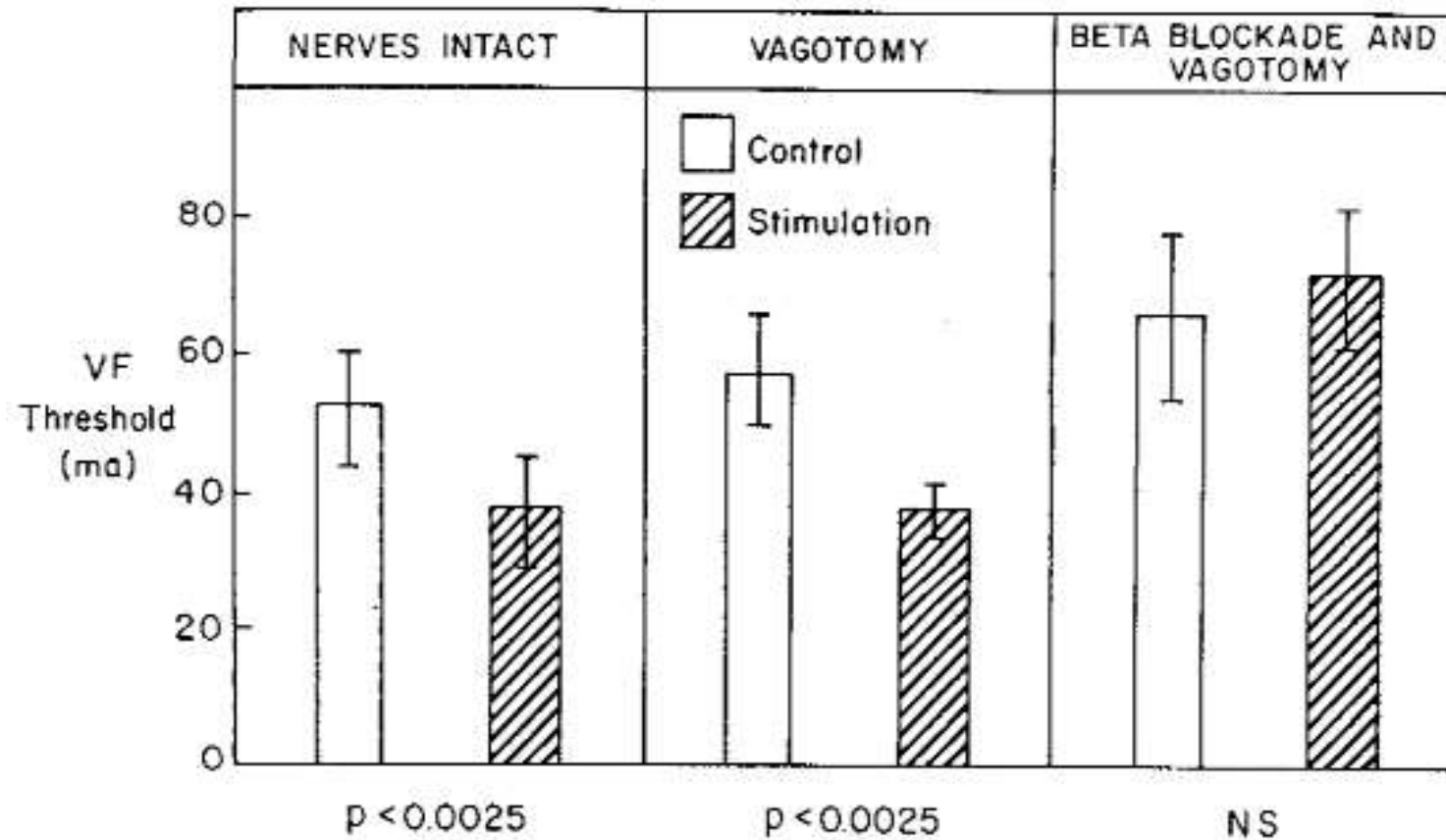
Ideas behind sudden death

1. Mechanism of SCD is VF
2. Electrical instability precedes catastrophe
3. Ventricular beats predispose the vulnerable heart to VT/VF
4. Transient nervous risk factors induce electrical instability

VF threshold

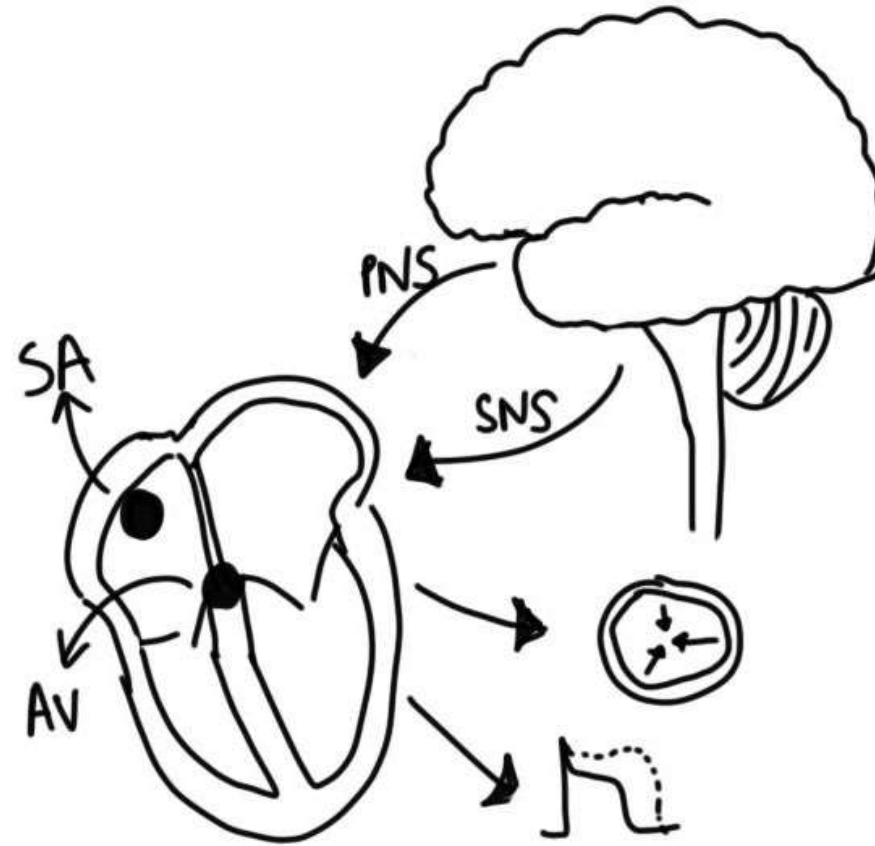


Changing VFT by hypothalamic stimulation

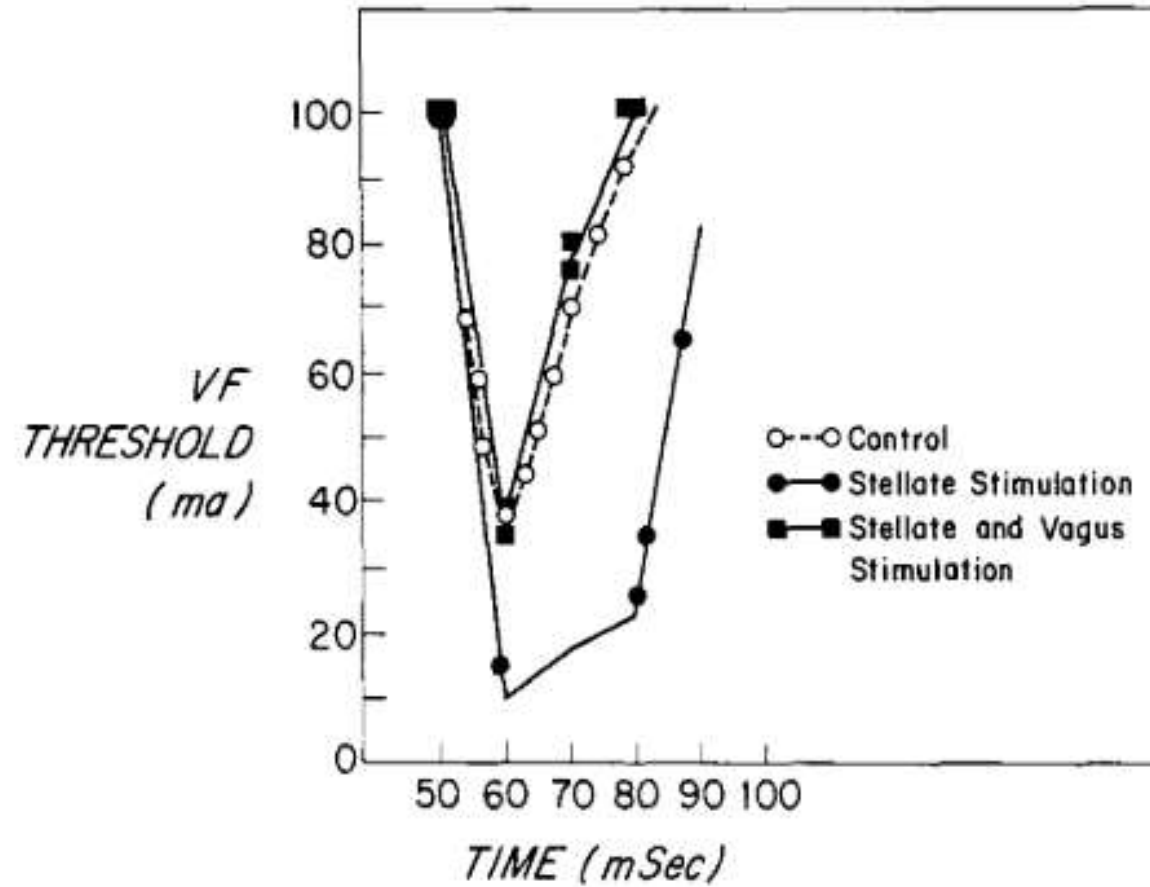


AUTONOMIC MODULATION

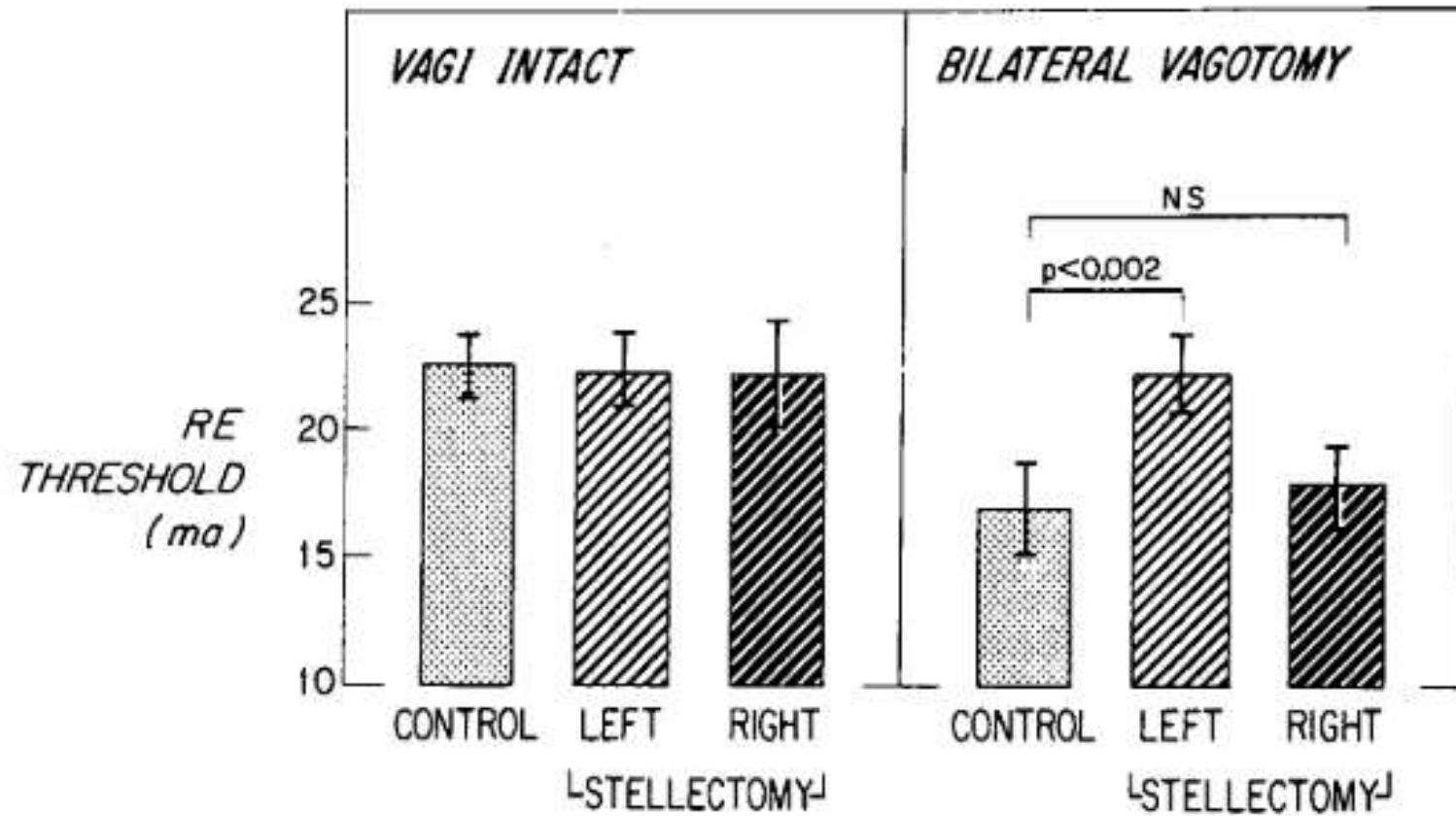
Neurocardiac axis



Stellate and vagal stimulation on VFT



Stellectomy and vagotomy on VFT



HEART RATE VARIABILITY

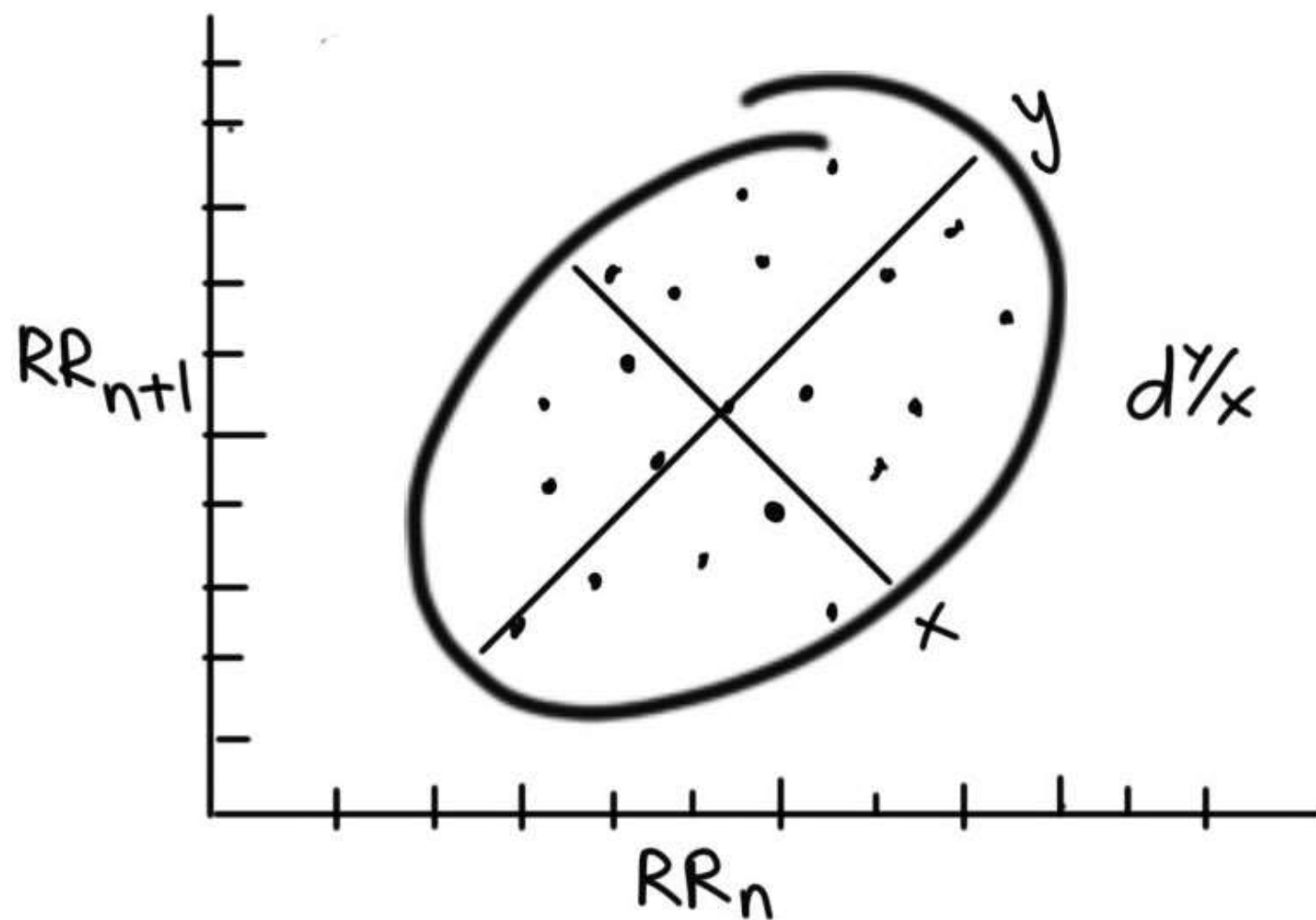
What is HRV?

The variability in between each beat:

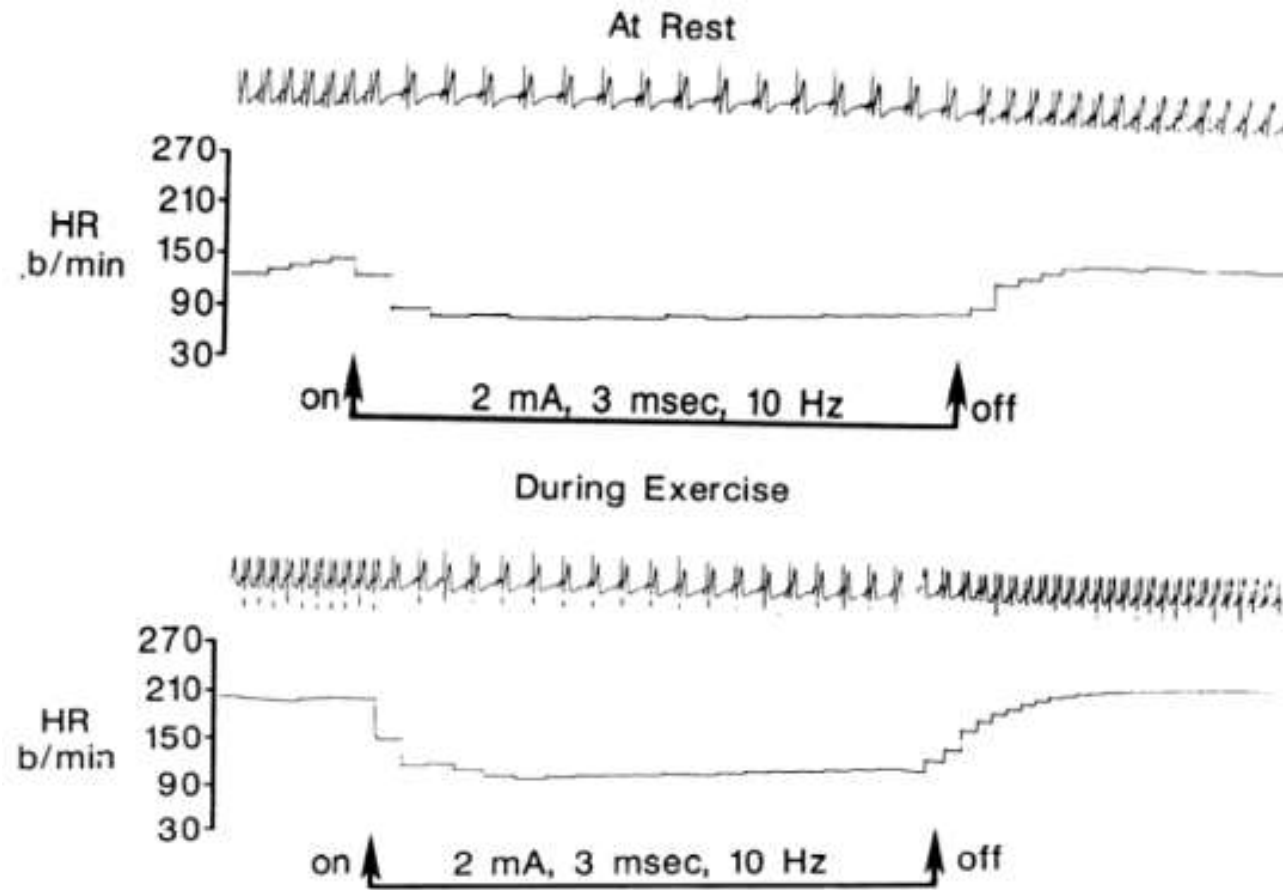
- Geometric domain
- Non-linear domain
- Frequency domain

The final integration of sympathovagal balance on the SA node.

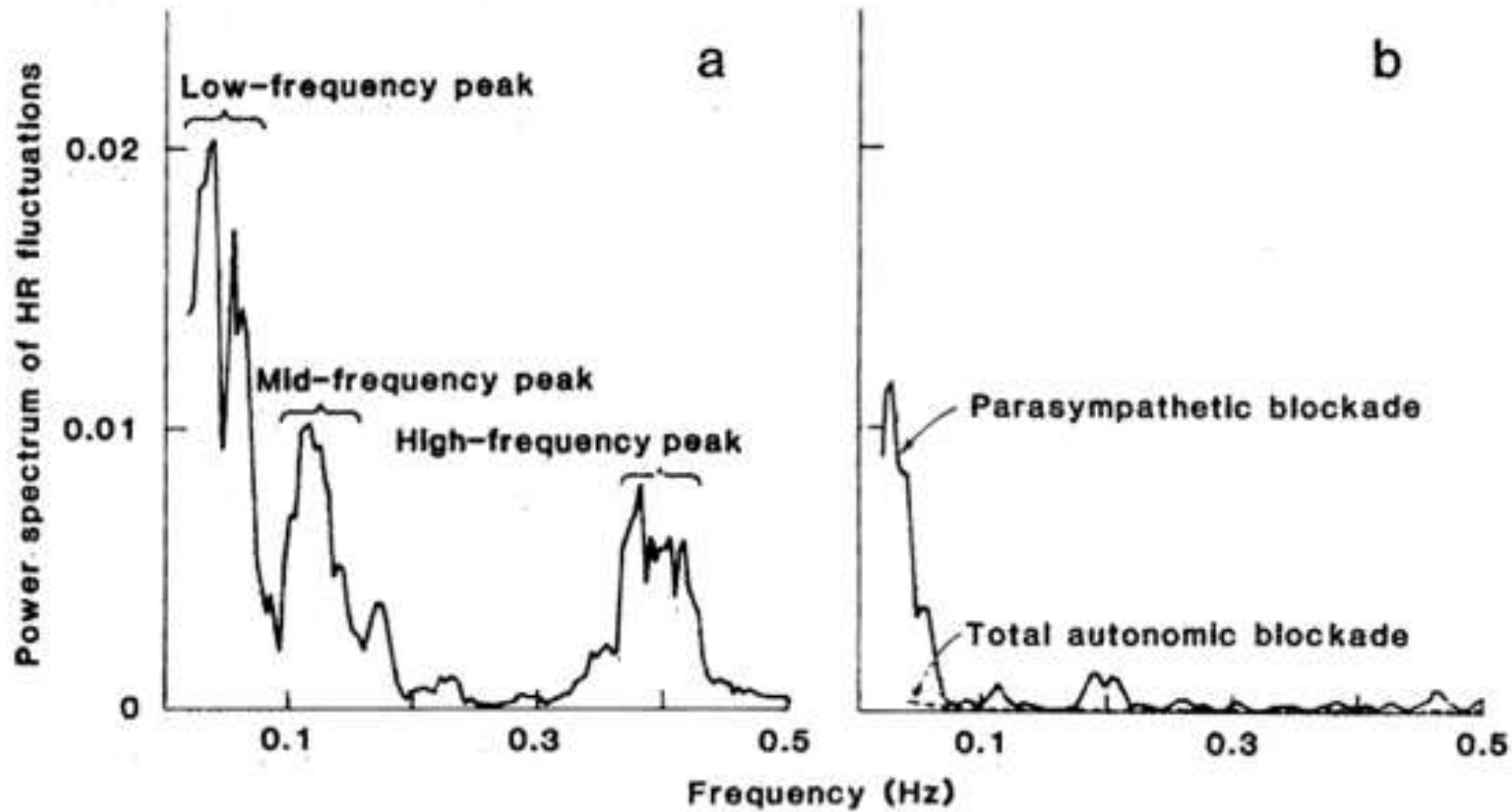
Poincaré plot



Accentuated antagonism

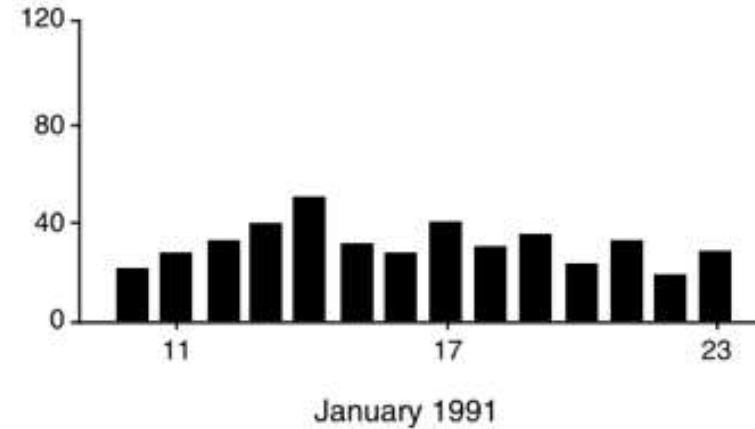
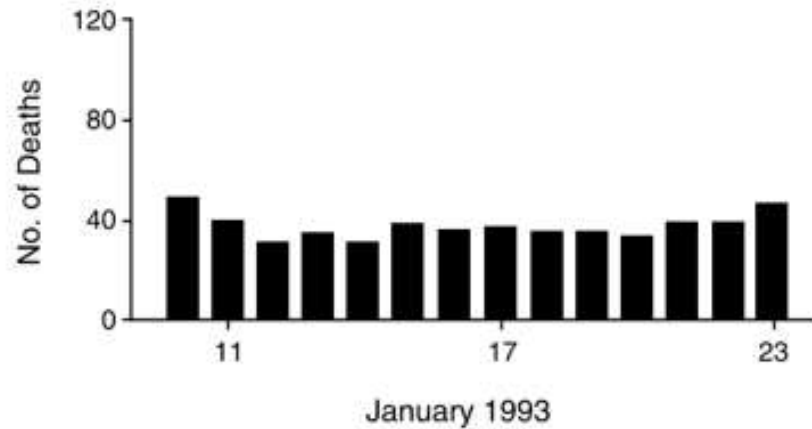
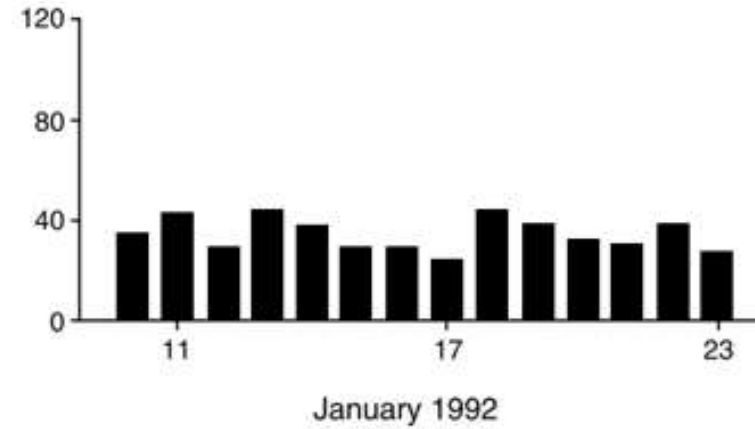
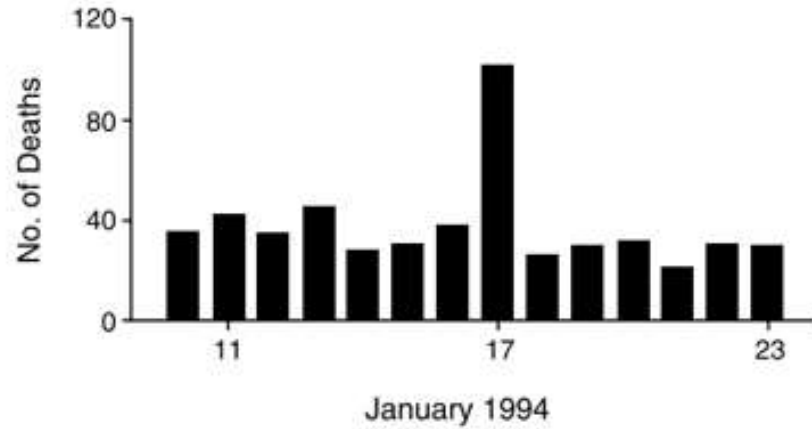


Power spectral analysis

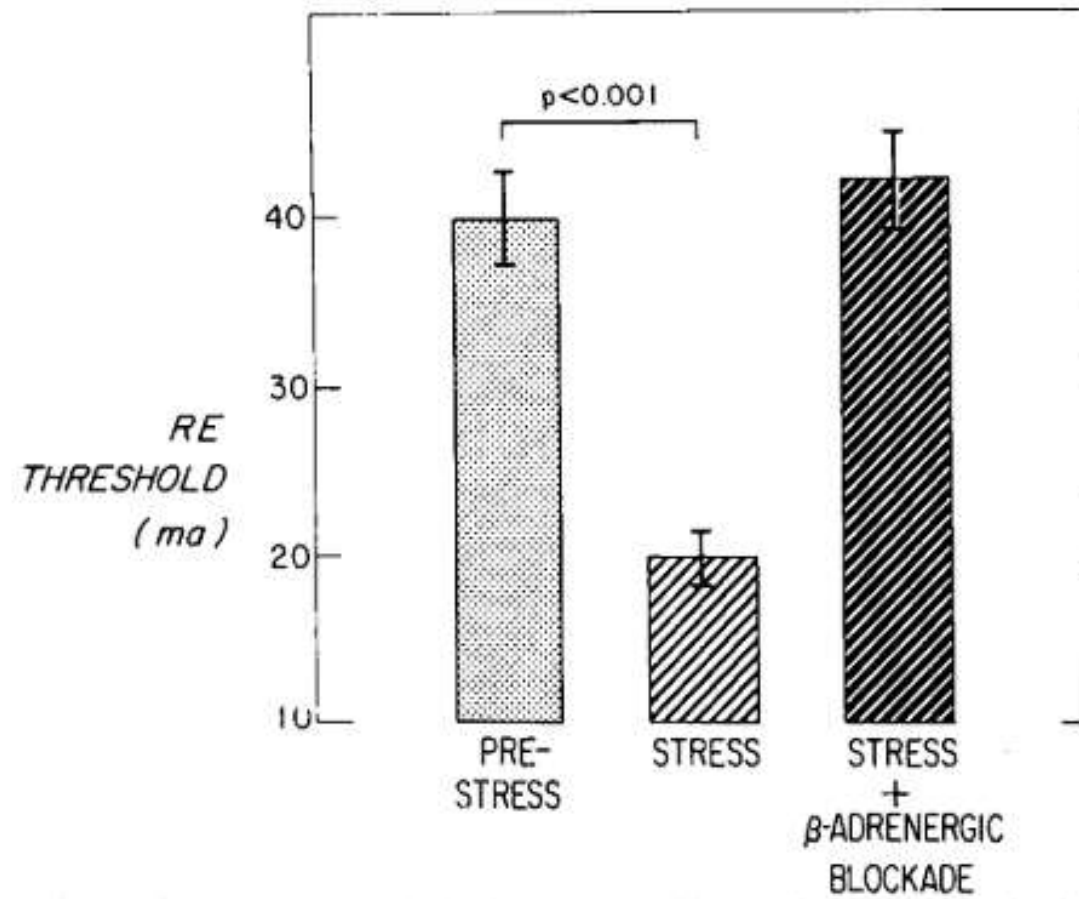


TRIGGERING SUDDEN DEATH

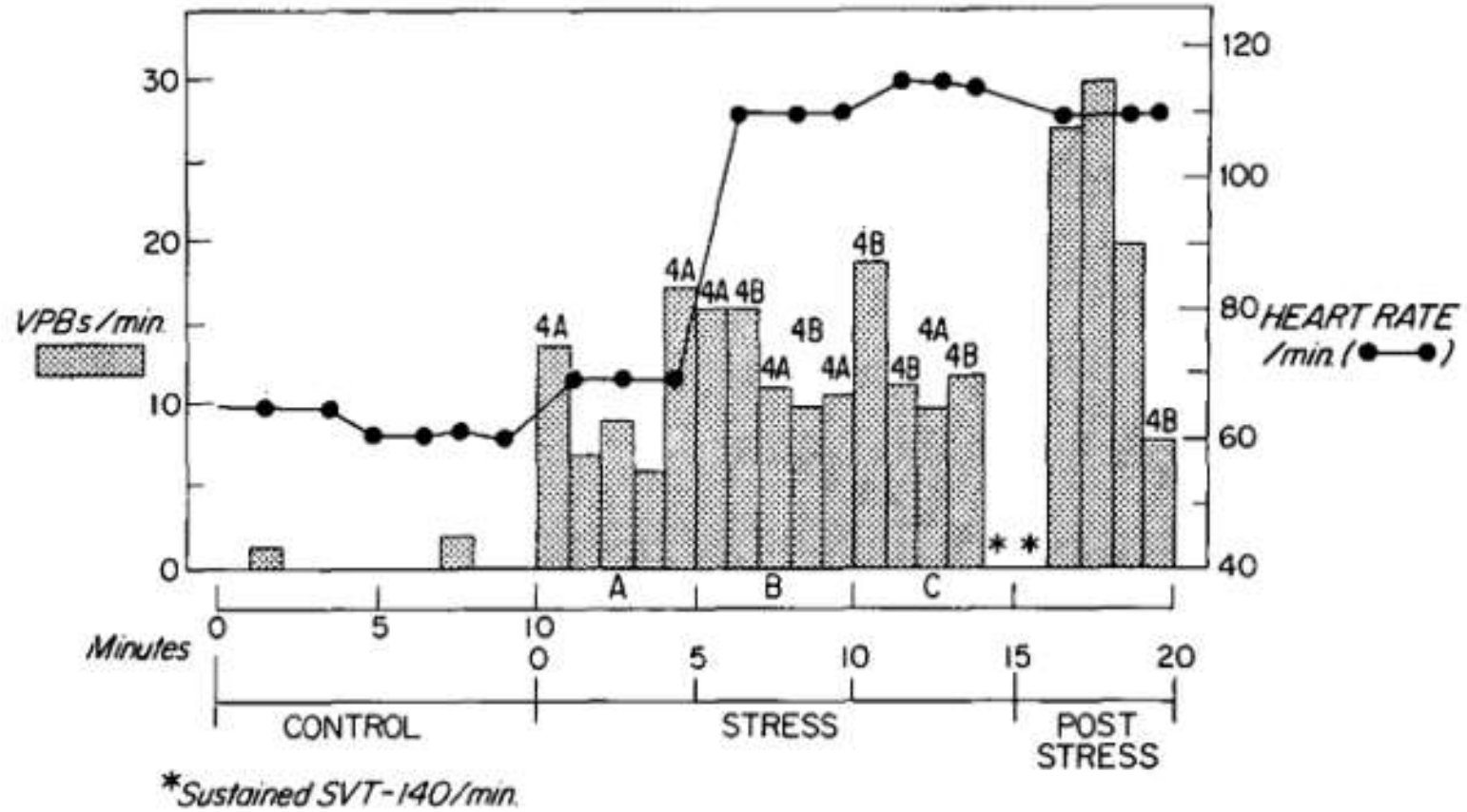
Northridge earthquake



VF threshold

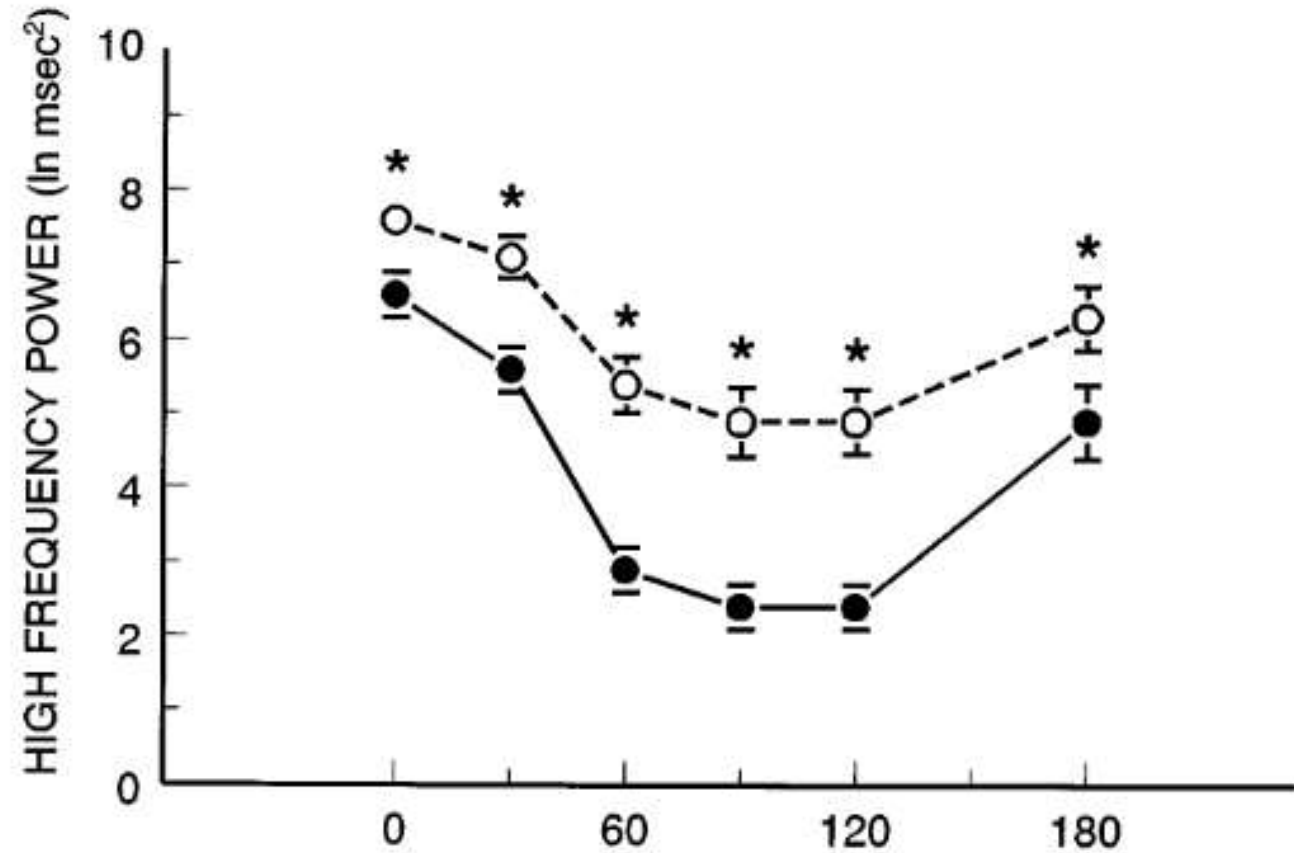


Frequency of PVCs

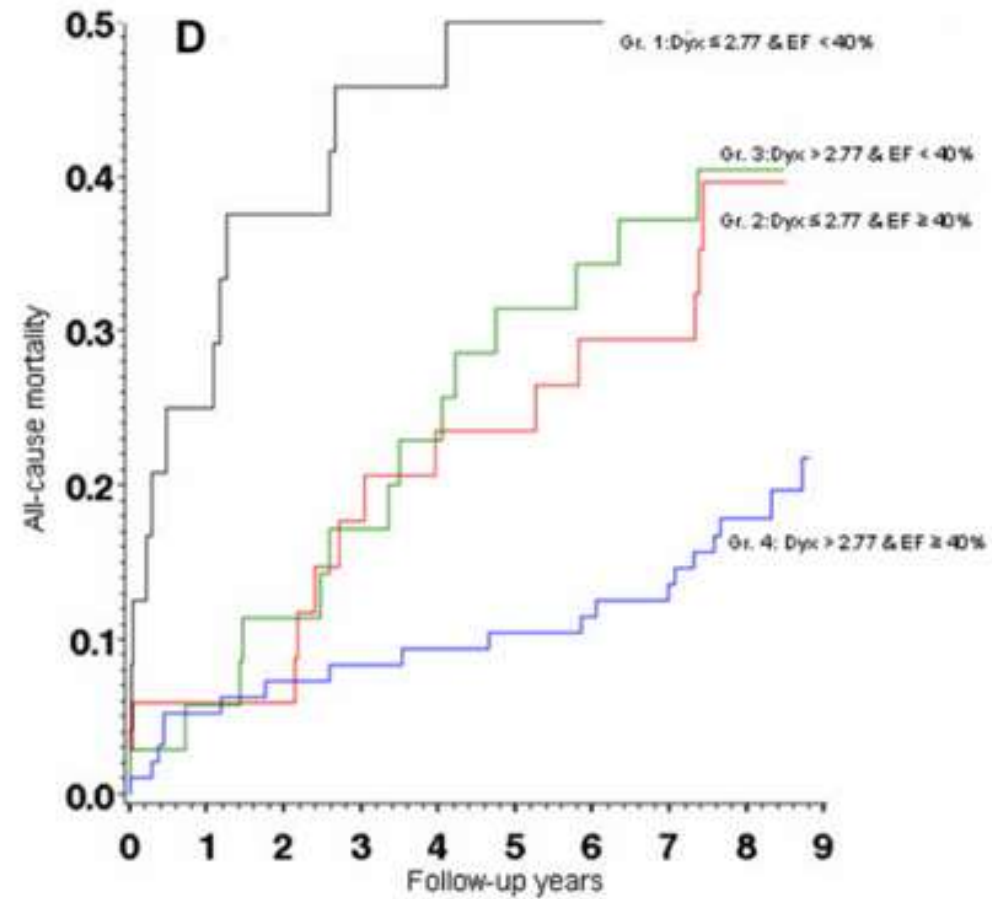


AUTONOMIC RISK

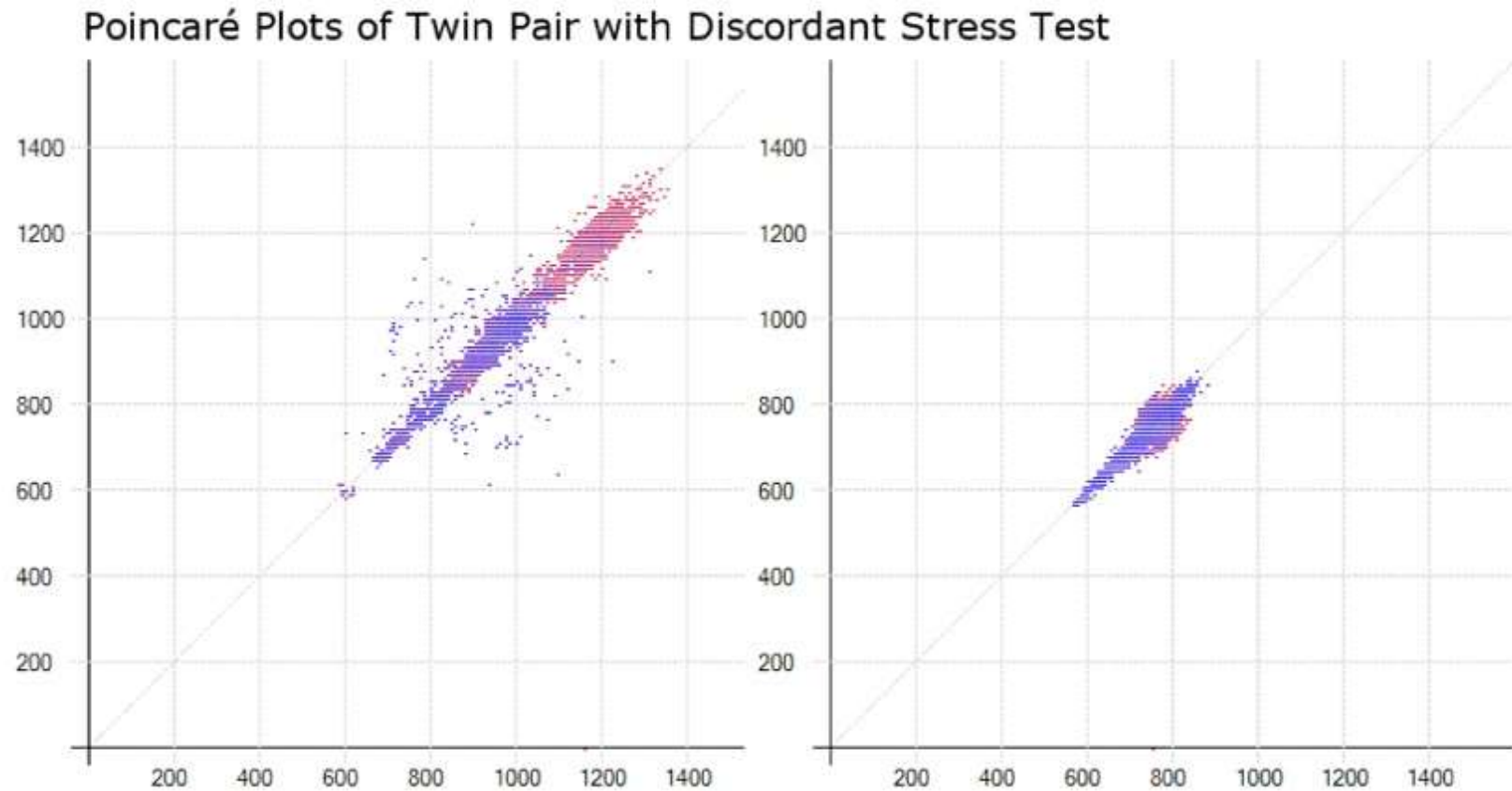
Canine model of VF susceptibility



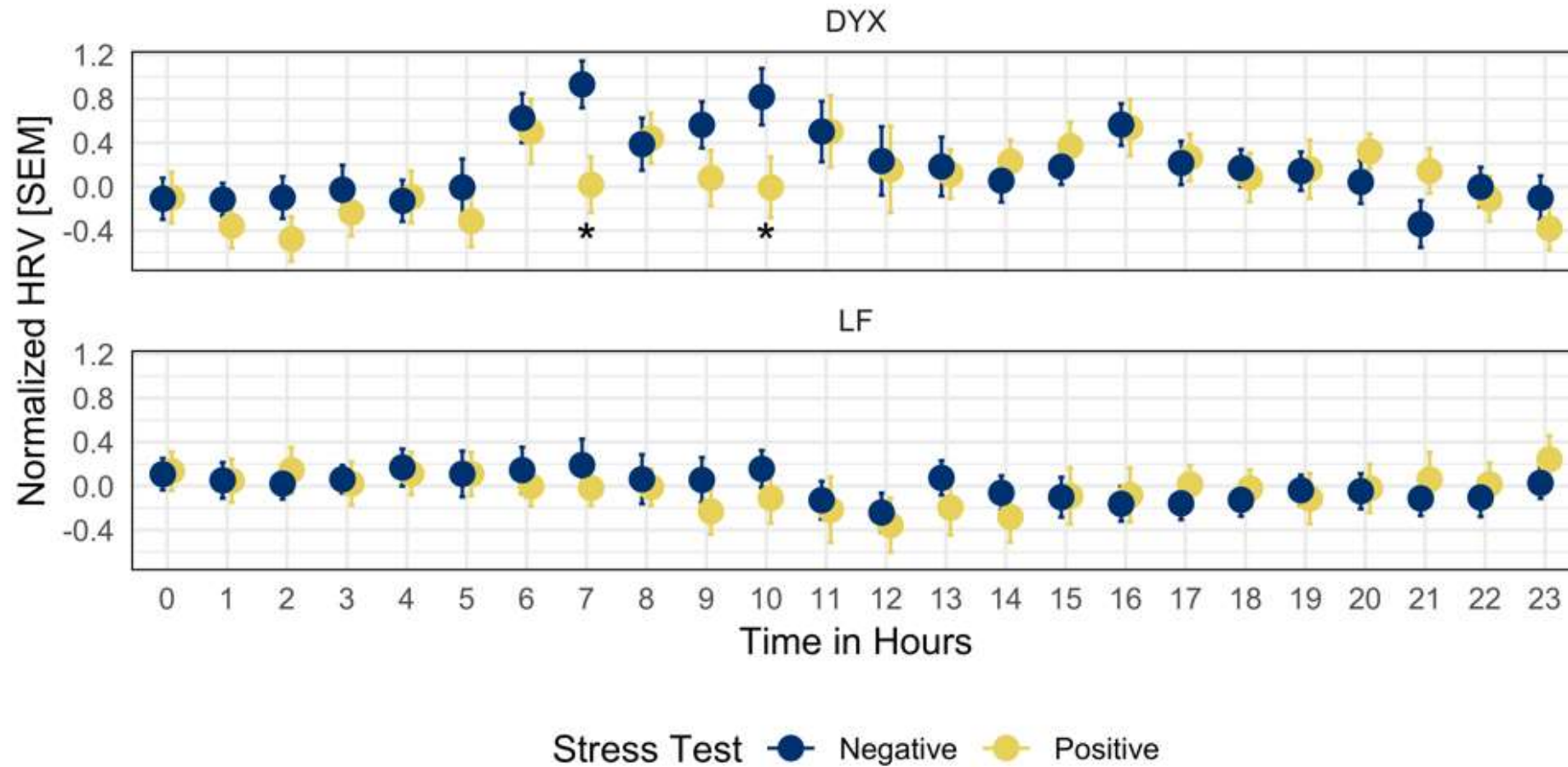
Dyx and mortality



Poincaré and ischemia



Circadian decreases in HRV





THANK YOU

