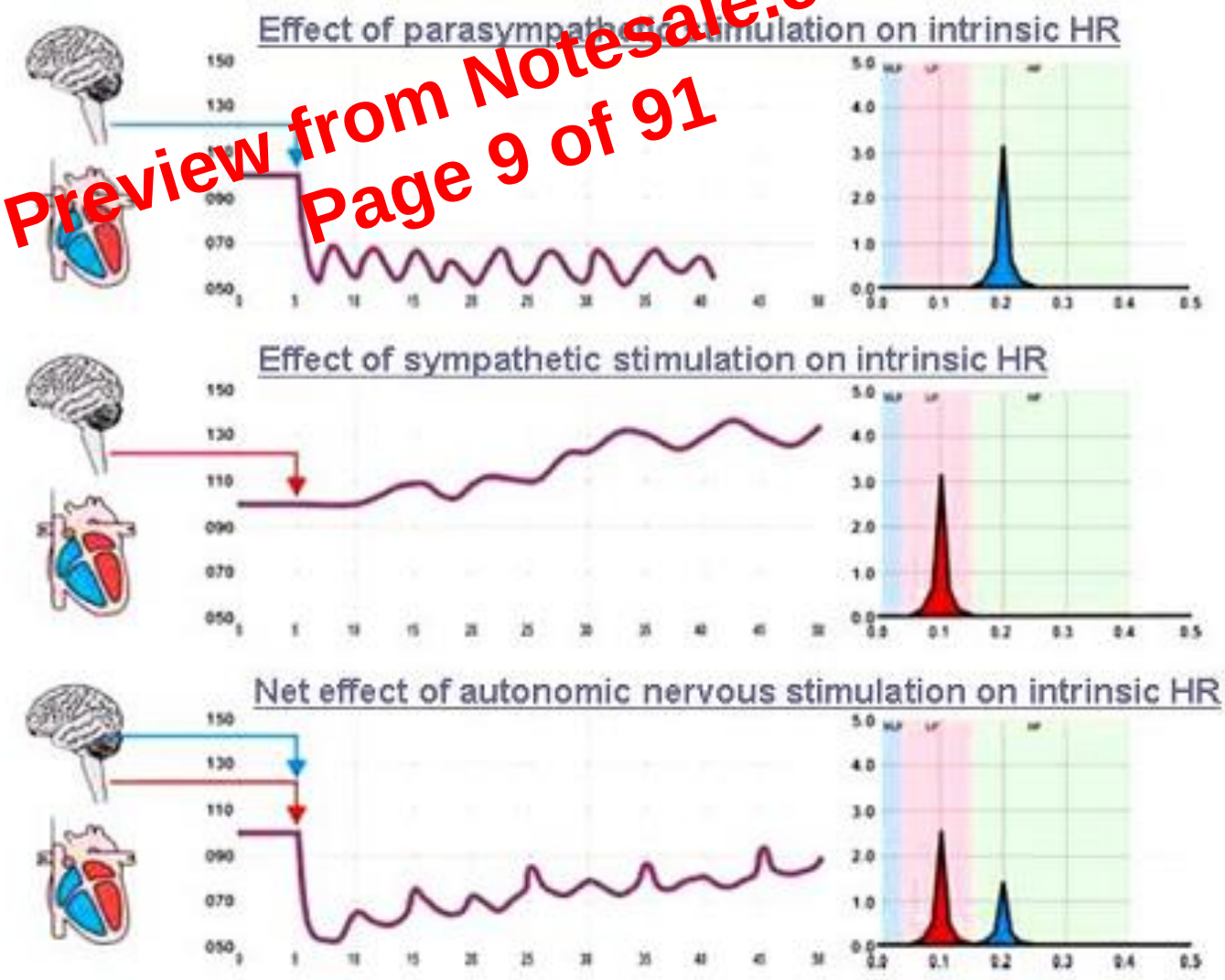
Effect of ANS on intrinsic HR



About The Task Force

- The task force was established by the Board of the European Society of Cardiology and co-sponsored by the North American Society of Pacing and Electrophysiology.
- The specific goals:

  1. To standardize nomenclature and develop definitions of terms
  2. To define physiological and pathophysiological correlates
  3. To describe currently appropriate clinical applications
  4. To identify areas for future research

- The standards of measurement, physiological interpretation, and clinical use was the major goal of the task force.

Stress And Autonomic Nervous System

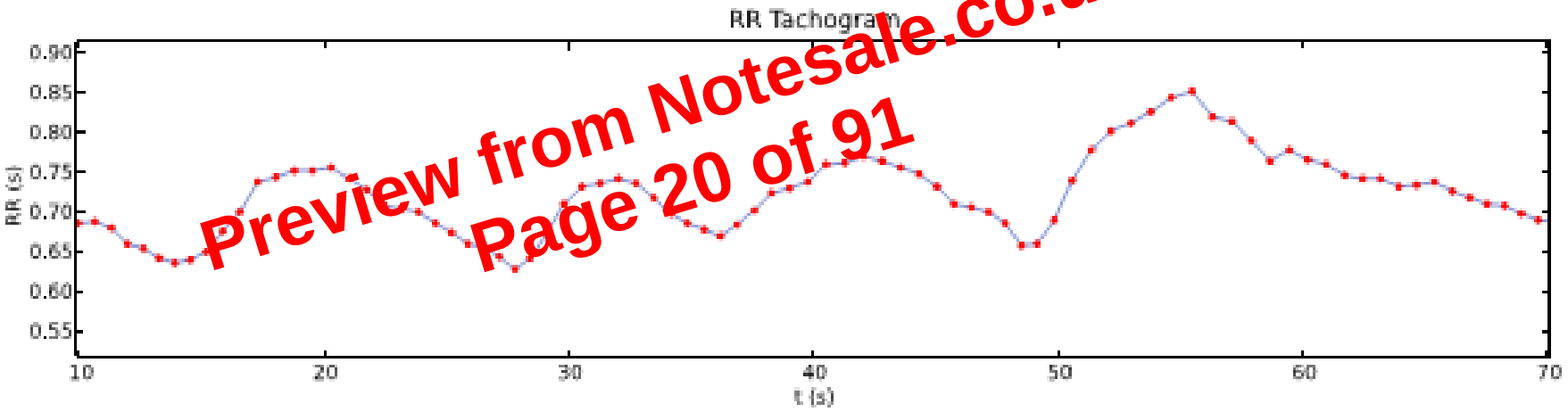
- Allostasis which means "maintaining stability, or homeostasis, through change."
- The body actively copes with a challenge by expending energy and attempting to put things right.
  - Most of the time it succeeds but the real problems arise when….

    (1) The systems involved in allostasis don't shut off when not needed or don't become active when they are needed.

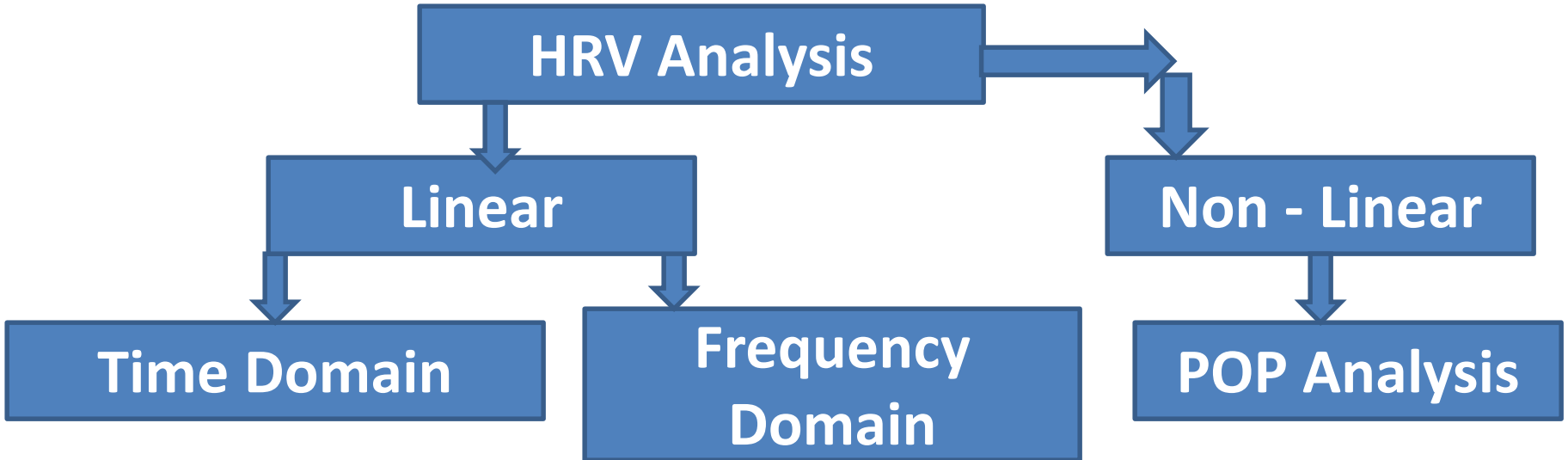
    (2) The balance between SNS and PNS can be disturbed and either SNS or PNS can predominate over the other leading to stress related health problems.

    (3) The body doesn't return to a state of rest after an emergency state

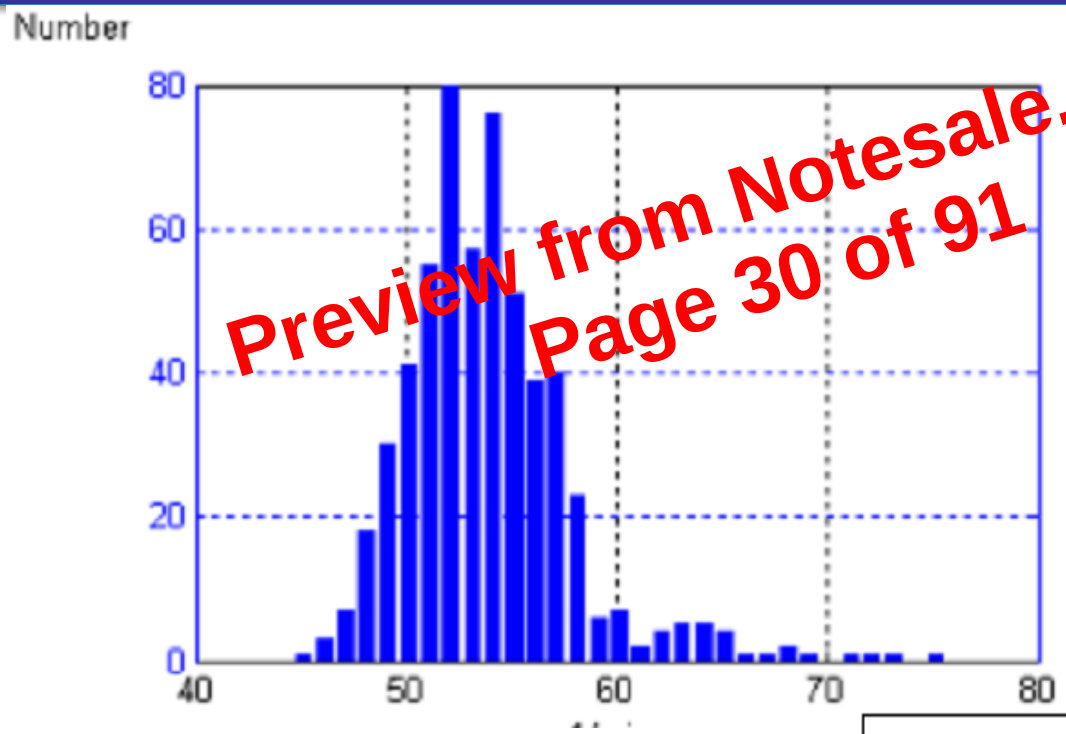
METHODOLOGY AND TERMINOLOGY OF HRV ANALYSIS



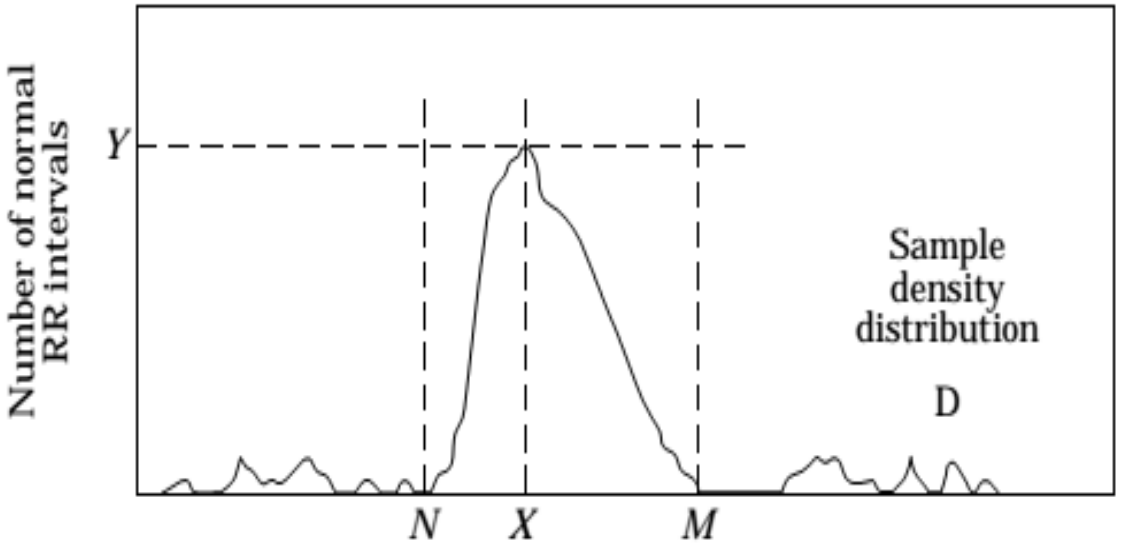
- All the standard methods normally used in HRV analysis are derived from the RR tachogram



Geometrical methods



Histogram of RR Intervals

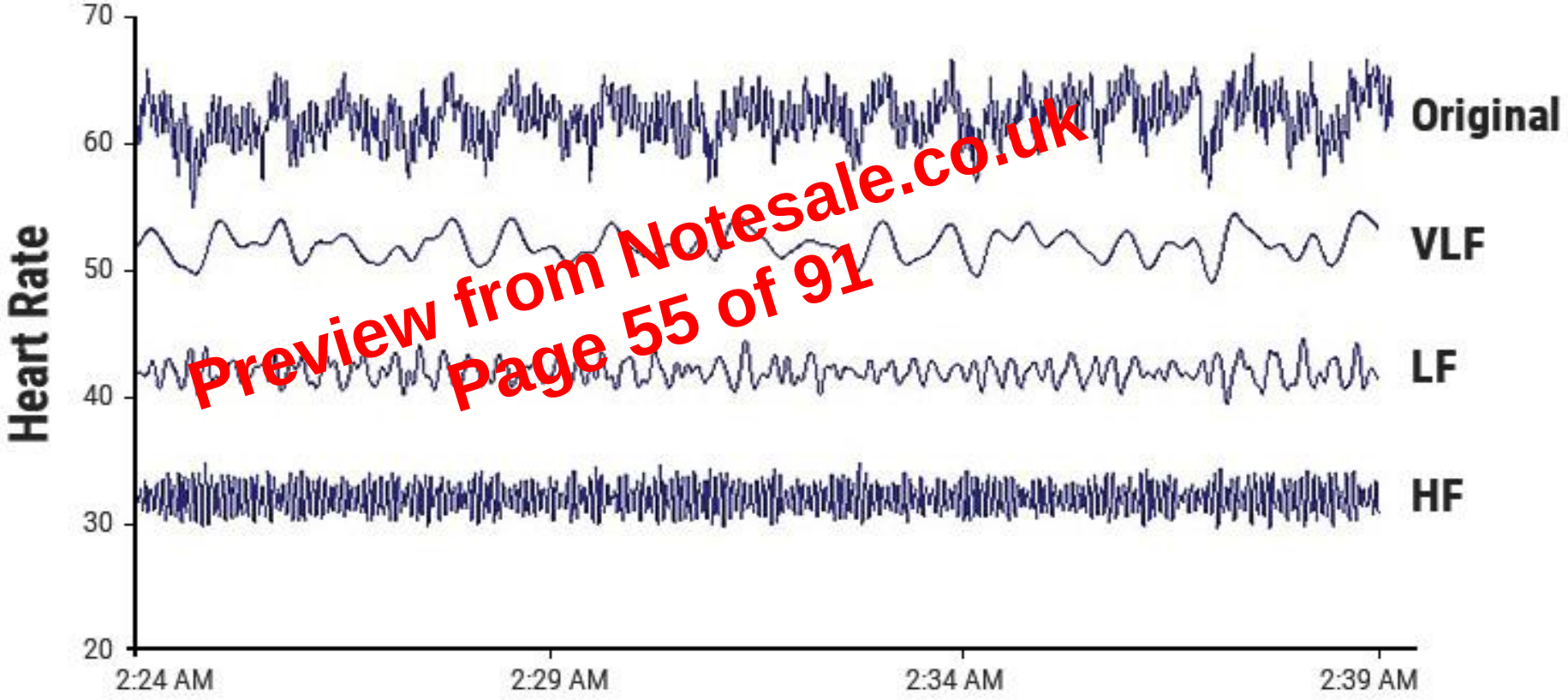


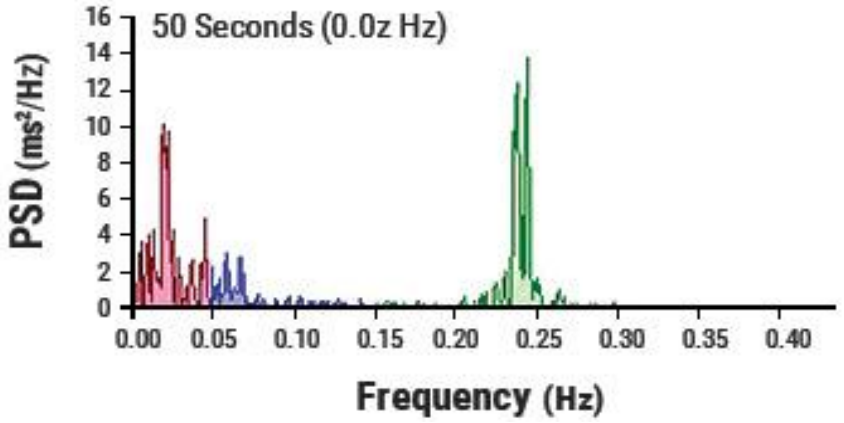
Geometrical methods

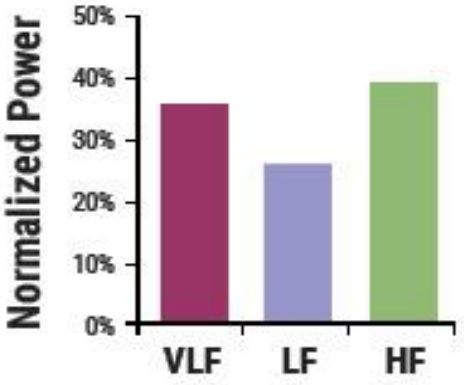
- HRV triangular index - Total number of all NN intervals divided by the height of the histogram of all NN intervals
  - *HRV index* = (total number of all NN intervals)*/Y*
  - (*Y* = *D*(*X*)).
- TINN - Triangular interpolation of NN interval
  - Baseline width of the minimum square difference triangular interpolation of the highest peak of the histogram of all NN intervals
  - *T INN = M − N*

Frequency Domain Methods

- Frequency domain method of analysis is one of the key factors of HRV analysis
- Various spectral methods for the analysis of the tachogram have been applied since the late 1960s.
- The most common power spectral estimation technique used in HRV analysis is the Power Spectral Density (PSD) analysis.
- PSD estimation provides the basic information of how the power of the signal (i.e., its variance) distributes as a function of frequency.
- This technique separates the heart rate spectrum into various components and quantifies sympathetic and vagal influences on the heart.





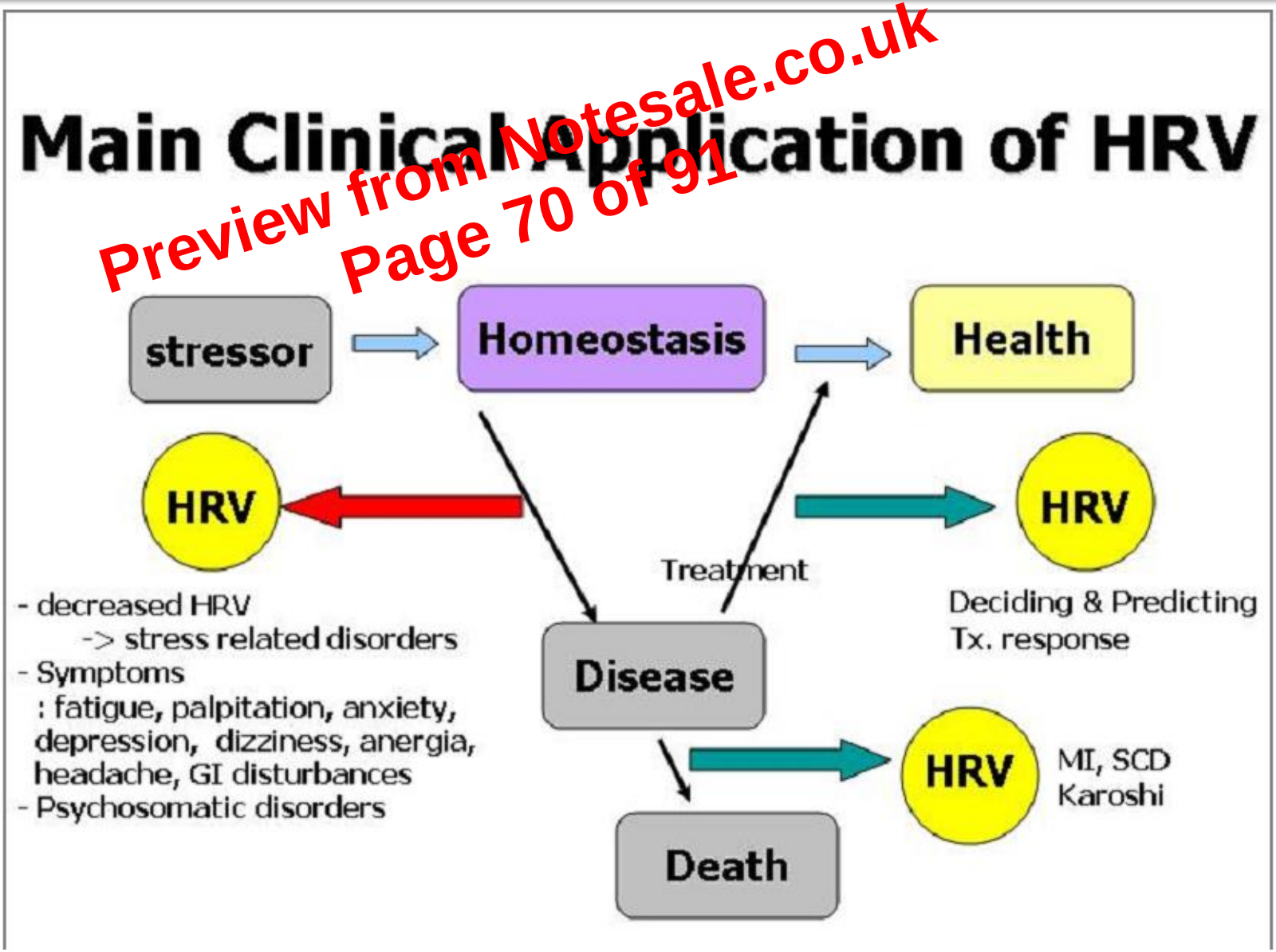


Interpretation

- **Non linear Methods**
- **Point care plot analysis**

Henri Poincaré (1854-1912)

USAGE OF HRV IN DAILY CLINICAL PRACTICE



R Virtanen et al,. 2003

Table 2 Measures of heart rate variability between hypertensive and normotensive subjects

	Men		*Women*		P-*value*[a]
	Hypertensive (n=*109*)	*Normotensive* (n=*49*)	*Hypertensive* (n=*82*)	*Normotensive* (n=*56*)	
Total power					
ms^2	1562.6 ± 138.5	2977.4 ± 394.1	1374.0 ± 118.8	2392.1 ± 263.3	
$ln(ms^2)$	7.00 ± 0.08	7.67 ± 0.13	6.92 ± 0.09	7.49 ± 0.10	<0.001
VLF power					
ms^2	832.6 ± 79.1	1424.9 ± 254.9	711.2 ± 67.4	1094.7 ± 123.5	
$ln(ms^2)$	6.31 ± 0.09	6.79 ± 0.14	6.22 ± 0.10	6.72 ± 0.10	<0.001
LF power					
ms^2	488.8 ± 54.2	1017.8 ± 130.7	372.2 ± 39.5	721.8 ± 105.1	
$ln(ms^2)$	5.79 ± 0.09	6.52 ± 0.14	5.52 ± 0.10	6.13 ± 0.13	<0.001
nu	68.8 ± 1.4	65.9 ± 2.3	57.9 ± 1.8	59.1 ± 2.4	0.657
HF power					
ms^2	221.8 ± 29.1	509.6 ± 90.5	272.4 ± 38.8	541.2 ± 93.9	
$ln(ms^2)$	4.83 ± 0.10	5.71 ± 0.16	5.09 ± 0.12	5.63 ± 0.16	<0.001
nu	28.8 ± 1.3	32.1 ± 2.2	39.1 ± 1.7	37.6 ± 2.3	0.622
LF : HF ratio					
%	327.6 ± 20.6	304.7 ± 35.8	199.5 ± 16.5	226.6 ± 25.0	
ln(%)	5.56 ± 0.07	5.42 ± 0.11	5.04 ± 0.08	5.11 ± 0.11	0.696
RMSSD					
ms	22 ± 1	35 ± 2	23 ± 1	33 ± 3	
ln(ms)	2.94 ± 0.05	3.42 ± 0.08	3.01 ± 0.06	3.35 ± 0.07	<0.001
SDNN					
ms	37.9 ± 1.4	55.7 ± 3.1	36.2 ± 1.6	49.3 ± 2.6	
ln(ms)	3.56 ± 0.04	3.93 ± 0.07	3.51 ± 0.05	3.83 ± 0.05	<0.001

HRV and Age

Donald H. Singer et al,. 1998

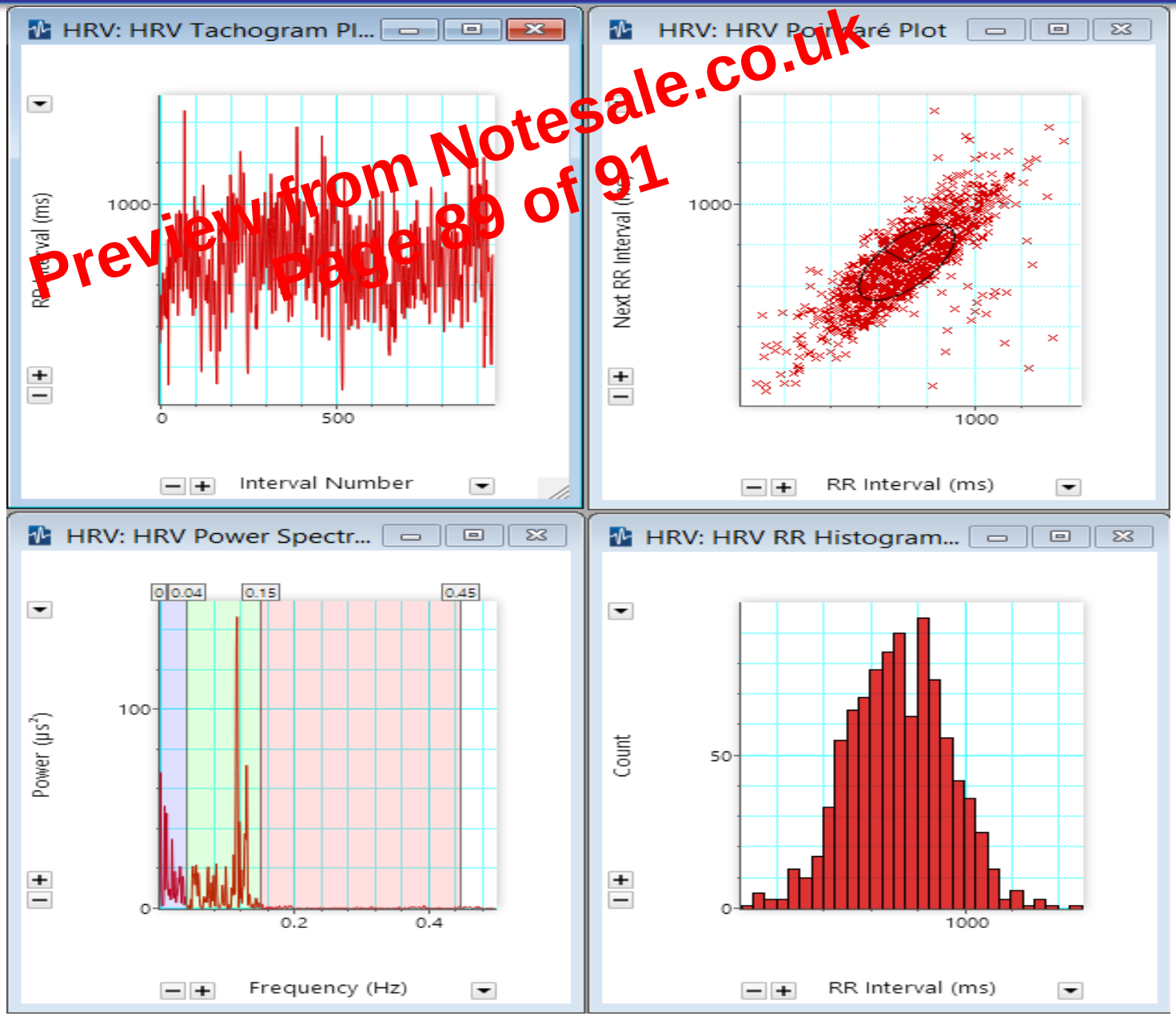
Table 2. Aging Effects on 24-h Heart Rate Variability and Heart Rate by Decade

Age (yr)	SDNN (ms)	SDANN (ms)	SDNN Index (ms)	rMSSD (ms)	pNN50 (%)	HR (beats/min)
10–19	176 ± 38	159 ± 35	81 ± 20	53 ± 17	25 ± 13	80 ± 10
20–29	153 ± 44	137 ± 43	72 ± 22	43 ± 19	18 ± 13	79 ± 10
30–39	143 ± 32*	130 ± 33	64 ± 15*	35 ± 11*	13 ± 9*	78 ± 7
40–49	132 ± 30*	116 ± 31*	60 ± 13*†	31 ± 11*†	10 ± 9*	78 ± 7
50–59	121 ± 27*	106 ± 27*	52 ± 15*†	25 ± 9*†	6 ± 6*†	76 ± 9
60–69	121 ± 32*	111 ± 31*	42 ± 13*†‡§	22 ± 6*†	4 ± 5*†	77 ± 9
70–79	124 ± 22*	114 ± 20*	43 ± 11*†‡§	24 ± 7*†	4 ± 5*†	72 ± 9
80–99	106 ± 23*†‡	95 ± 24*†‡	37 ± 12*†‡§	21 ± 6*†‡	3 ± 3*†‡	73 ± 10

Table 4. Gender Effects on 24-h Heart Rate Variability and Heart Rate for Four Age Groups

Age (yr) and Gender	SDNN (ms)	SDANN (ms)	SDNN Index (ms)	rMSSD (ms)	pNN50 (%)	HR (beats/min)
10–29						
M	*182 ± 35	*162 ± 33	*88 ± 20	*53 ± 18	*26 ± 13	*76 ± 10
F	*147 ± 43	*133 ± 42	*66 ± 18	*43 ± 18	*17 ± 12	*83 ± 8
30–49						
M	*146 ± 30†	*131 ± 31†	*65 ± 14†	34 ± 13†	13 ± 10†	*76 ± 7
F	*129 ± 30	*114 ± 31	*58 ± 13	31 ± 10†	10 ± 7†	*79 ± 7
50–69						
M	117 ± 30†‡	104 ± 28†‡	46 ± 18†‡	22 ± 8†‡	4 ± 5†‡	78 ± 11
F	125 ± 29	114 ± 29	49 ± 11†	25 ± 7†	5 ± 4†	74 ± 10†
70–99						
M	123 ± 24†	109 ± 28†	43 ± 12†‡	22 ± 5†‡	3 ± 2†‡	72 ± 11
F	114 ± 23†	102 ± 22†	38 ± 10†‡	22 ± 8†‡	4 ± 4†‡	73 ± 8†‡

Summary



HRV: HRV Report

GENERAL

Analysis Start	Block: 1, 0 s
Analysis End	Block: 1, 15:00
Total Included Beats	946
Included Normal Beats	946
Included Ectopic Beats	0

TIME-DOMAIN

Average RR	944 ms
Median RR	944 ms
SDRR	42.16 ms
SDARR	7.206 ms
CVRR	0.04466
Average Rate	63.69 BPM
SD Rate	2.863 BPM
SDSD	28.49 ms
RMSSD	28.47 ms
pRR50	4.017 %

FREQUENCY-DOMAIN

VLF Band	0 - 0.04 Hz
LF Band	0.04 - 0.15 Hz
HF Band	0.15 - 0.45 Hz

Band	Power(µs²)	Power(%)	Power(nu)
Total	1856		
VLF	536.1	28.89	
LF	1202	64.76	91.07
HF	101.6	5.476	7.7
LF/HF		11.83	

NONLINEAR

SD1	20.14 ms
SD2	56.12 ms