

**Optimised Measurement of Cardiovascular
Autonomic Response and the Assessment
of Changes in Autonomic Tone Resulting
From Inflammatory Response to
Immunisation**

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Autonomic Nervous System (ANS)

- Largely non-conscious nervous system
- Balance between sympathetic (acceleration) and parasympathetic (deceleration) branches of the ANS
- Involved in preparing the body for challenge (fight or flight mechanism) and maintaining body vegetative balance (housekeeping)

-Heart rate

- Blood Pressure

-Pupil size

-Respiration rate

- Digestion

- Salivation

-Perspiration

-Micturition

- Sexual arousal

Autonomic Neuropathy

- Mostly secondary to other diseases e.g Diabetes, Parkinson's Disease, Guillan-Barre syndrome
- Symptoms include:
 - Postural hypotension
 - Faints
 - Nausea
 - Bowel problems
 - Uncontrolled sweating
 - Sexual dysfunction
 - Bladder problems
- Evidence of reduction in autonomic tone due to acute inflammation e.g. pneumonia (Vassallo & Allen 1997)

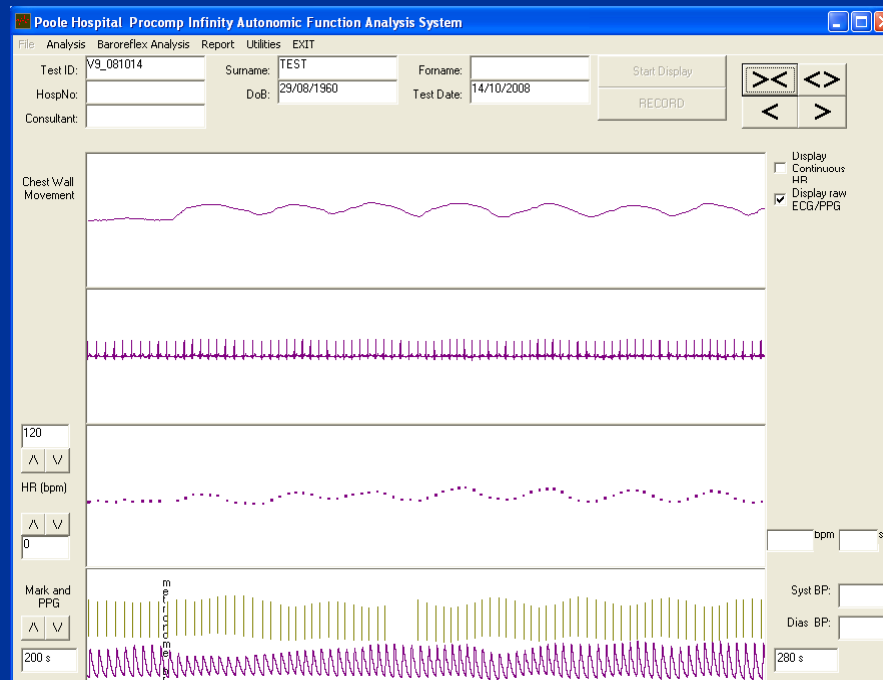
Aims of Project

- See if autonomic cardiovascular reflexes are significantly disrupted by a smaller inflammatory provocation (the influenza vaccination)
- Identify which parameters of autonomic function testing studies are optimal for detecting the small cardiovascular response expected from such an inflammatory provocation

Autonomic Clinical Assessment – Heart Rate Variability (HRV)

- Ewing provocation tests
- Long-term HRV studies (Holter). Typically measured in 5 min segments
- Short-term HRV studies with tight control of conditions
 - Lying down. Controlled environment
 - Metronome guided breathing
 - 6 breaths/ min gives maximum HRV
 - Extended resting period
 - Breathing, blood-pressure, finger PPG measured also

Equipment



Chest wall 256 Hz

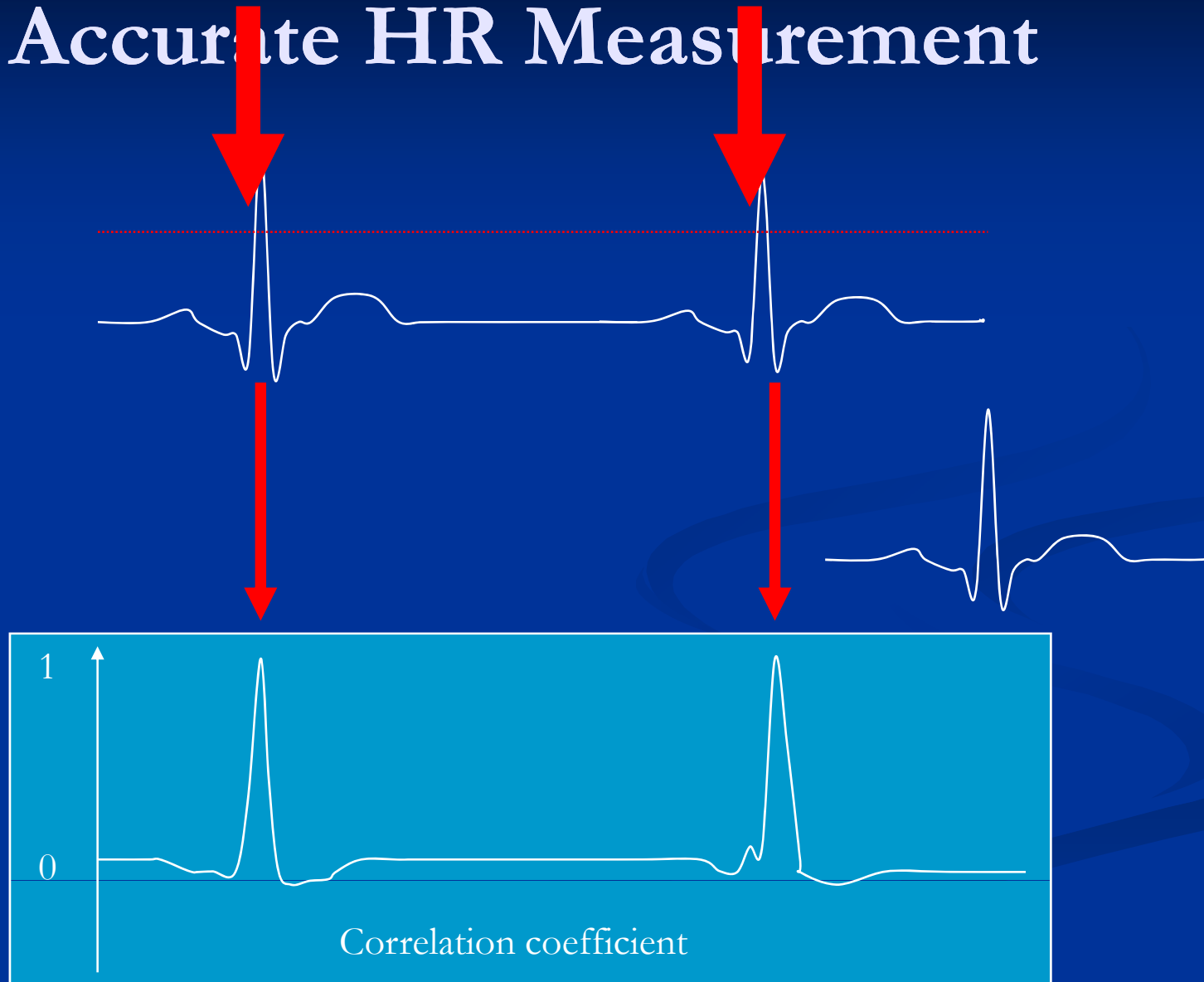
Raw ECG 1024 Hz

Instantaneous HR

B-B BP

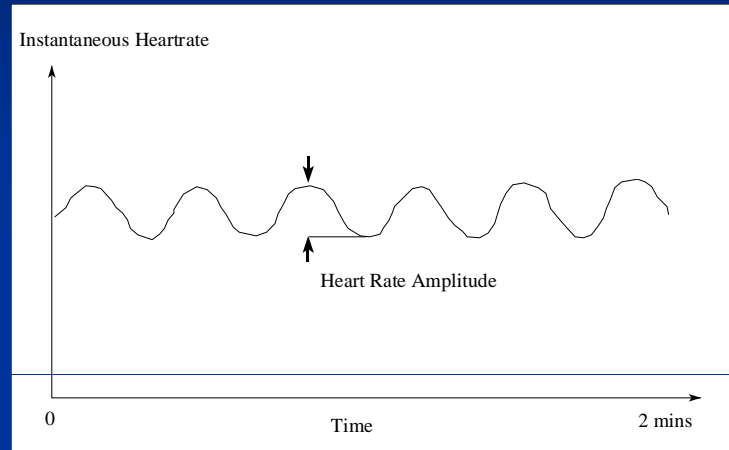
Raw PPG 1024 Hz

Rolling Correlation Method of Accurate HR Measurement

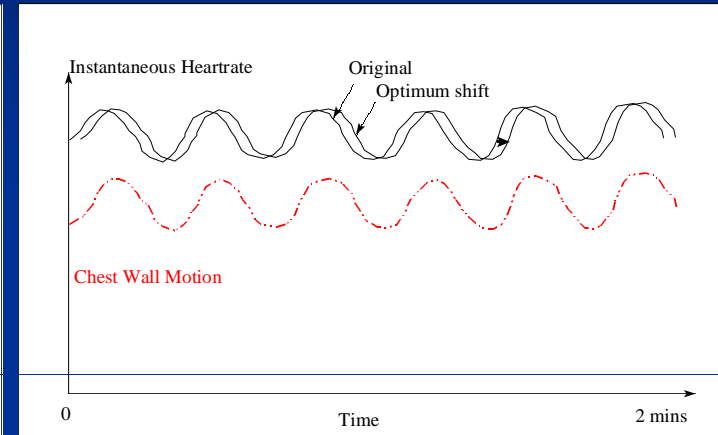


Metronome Breathing. HRV Analysis

Temporal Space

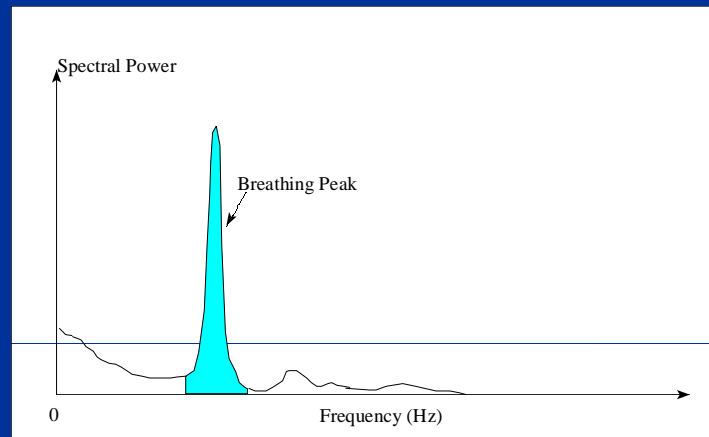


A SD

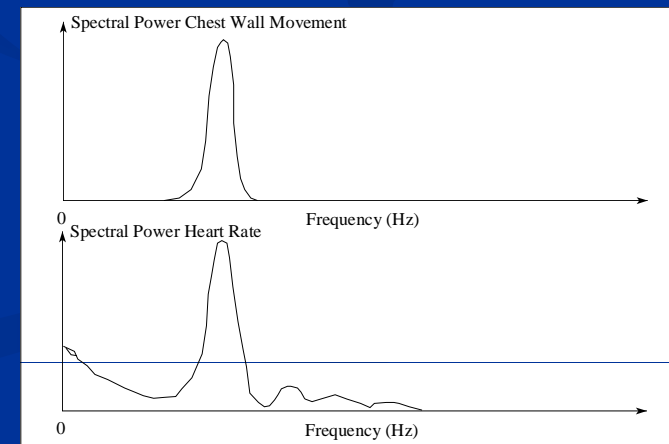


CORR

Frequency Space



LPP



FFTCOR

Previous Project

- 44 normal volunteers
- Established age-related normal ranges for these parameters including a composite score incorporating all parameters
- 40 asymptomatic diabetics
- Significant deterioration of heart rate variability in diabetics
- Perring and Jones 2003, *Physiol Meas* 745-751

Project Design

- 71 hospital employees or voluntary workers due to have occupational influenza vaccination
- No diabetes, heart disease, arthritis etc
- Age range 20-73 (mean 48.7)
- 18 male, 53 female
- Assessed 2-5 days prior to and 2 days post vaccination (when blood markers show peak of inflammatory response)
- Informed consent. Approved by LREC

Results

- 15 volunteers had significant response to vaccination
 - Sore arm > 24 hours
 - Head ache
 - Malaise
 - Raised temperature

Comparison of HRV pre-and post vaccination. Full group N=71

Parameter	Pre-jab (no of SD's from age-matched norm)	Post-jab (no of SD's from age-matched norm)	t val	P val
CORR	-0.380	-0.378	0.005	0.995
A	0.369	0.346	0.253	0.801
SD	0.632	0.537	0.935	0.353
LPP	0.656	0.553	1.112	0.27
FCORR	-0.111	-0.0707	0.264	0.792
Overall Deviation	0.290	0.252	0.363	0.718

Comparison of HRV pre-and post vaccination, symptomatic volunteers

N=15

Parameter	Pre-jab (no of SD's from age-matched norm)	Post-jab (no of SD's from age-matched norm)	t val	P val
CORR	-0.572	-0.89067	0.536	0.601
A	0.44067	-0.09733	2.574	0.022
SD	0.43467	-0.18	2.552	0.023
LPP	0.69333	0.14467	2.811	0.0139
FCORR	0.02533	-0.38267	1.368	0.1927
Overall Deviation	0.284	-0.287	4.71	<0.001

HRV other parameters

- No significant differences in the following:
 - Ewing parameters
 - Average heart rate or blood pressure
 - Metronome breathing at 10 cycles/ minute
 - Resting frequency parameters (High frequency amplitude, low frequency amplitude, HF/LF ratio)
 - Resting fractal dimension
 - Beat-to-beat blood pressure response to heart rate changes (baroreflex sensitivity)
 - Pupil response to dark

Discussion

- Results suggest a small but measureable decline in autonomic tone following influenza vaccination in volunteers who display a clinical response to the vaccination.
- This change is only detectable in studies with tight control of breathing at 6 breaths/min.
- This reduction does not appear to be biased towards either sympathetic or parasympathetic efferent arms of the ANS (no significant change in HR/ BP)

Implications

- It may well be that reduction in autonomic tone is a widespread response to non-acute inflammatory conditions
- Altered autonomic responses may contribute to the symptoms experienced as a result of inflammatory disease
- Altered autonomic tone may contribute to the long-term health implications of chronic inflammatory conditions

Thanks for listening

