# Preoperative heart rate variability predicts pain during local anaesthetic varicose vein procedures.
Pilot study.

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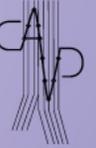
Disclosure

Speaker name:

Katarzyna Powezka

☐ I have the following potential conflicts of interest to report:

☐ Consulting

☐ Employment in industry

☐ Shareholder in a healthcare company

☐ Owner of a healthcare company

☐ Other(s)

■ I do not have any potential conflict of interest

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Aim of the study

Can we predict *intraoperative* pain during local anaesthesia varicose vein surgery using *preoperative* heart rate variability (HRV)?

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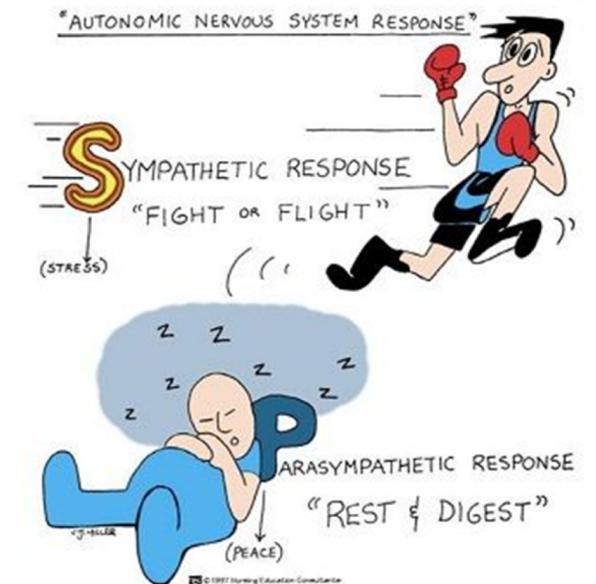PARIS, FRANCE   WWW.CACVS.ORG

Background

- Endovenous thermal ablation – the most frequently performed vascular day case procedure under local anaesthesia

- Around 25% of patients feel significant pain during local anaesthetic surgical procedures

- There is no current evidence regarding predictability of pain prior to local anaesthesia surgery

Background – Autonomic Nervous System (ANS) and Pain

- Autonomic nervous system is a key modulator of pain perception
- Balance between sympathetic nervous system (SNS) and parasympathetic nervous system (PNS) can be quantified using heart rate variability (HRV) indices
  - **High frequency (0.15-0.4) HRV component (HF)**
    - vagal modulation
  - **Low frequency (0.04-0.15) HRV component (LF)**
    - sympathetic or mixed sympathetic/vagal modulation
  - **HF/LF ratio**
    - A measure of sympatho-vagal activity balance

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Background: Heart rate variability (HRV)

- Heart rate variability (HRV) – reflects beat-to-beat changes in R-R intervals, which are related to ongoing interplay between two arms of the ANS

- HRV analysis can be based on:

  - Time-domain analysis – involving long recordings (min 18 hrs)

  - Frequency-domain analysis – involving short-term recordings

Background: Hormones and anxiety

- Age and gender are considered to be major determinants of HRV

- Correlation between perception of pain and anxiety is weak and can be affected by its context

Methodology

1. Consecutive patients undergoing local anaesthetic endovenous ablation with multiple phlebectomies using a standardised technique were enrolled for the study (Aug 2015 – Oct 2016)

2. Female group was divided into two subgroups – premenopausal and postmenopausal (aged 49 and above)

3. ECG signals were continuously recorded 20 minutes before and during the procedure using a custom made portable amplifier

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Methodology

4. Preoperatively patients were asked to complete:

    1. Stress questionnaires (Y1 and Y2 of Spielberger's STAI)

    2. Report anxiety level on 0 - 10 numeric scale

    3. Complete Aberdeen Varicose Veins Questionnaire (AVVQ)

5. Postoperatively patients were asked to report the pain they felt during the procedure on 0-10 numeric pain intensity scale – ***reported patients' pain score (rPPS)***

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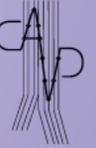# Methodology – predicted patients' pain score (pPPS)

MATLAB software was used to extract R-waves and generate HRV signals
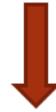
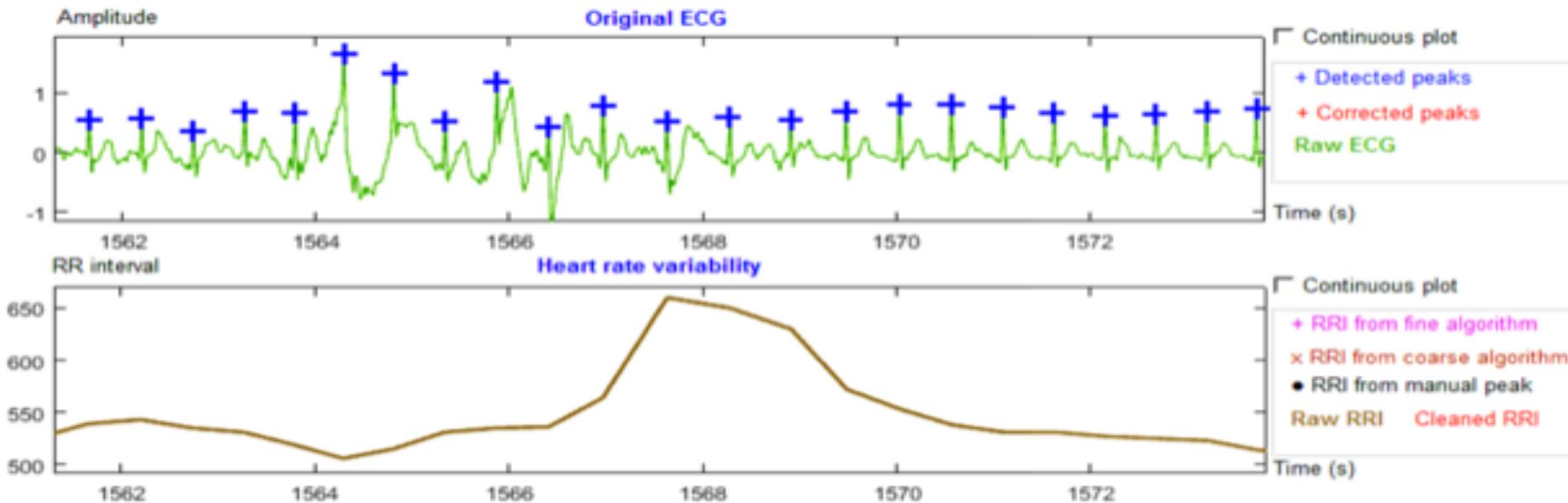LF and HF bands were computed and normalised by the power within considered 0.04-0.4 Hz band

Permutation entropy was used to examine change in structural complexity in HRV in response to pain

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Methodology – predicted patients' pain score (pPPS)

Block diagram of the HRV analysis framework

R-peak detection in noisy ECG and its extracted HRV

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Methodology – predicted patients' pain score (pPPS)

Signal features from HRV used in the modelling included:

1. Normalised low frequency (LF) powers
2. Normalised high frequency (HF) power
3. Low frequency permutation entropy (LFPE)
4. High frequency permutation entropy (HFPE)

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Methods – predicted patients' pain score (pPPS)

Objective – HRV components

and

Subjective - stress questionnaires

Mathematical models – linear regression (6 models) and polynomial surface fit (30 models)
(accuracy of models was evaluated using leave-one-out validation)

Pain prediction model (normalised HF and LFPE)

Methods – predicted patients' pain score (pPPS)

	Low pain reported	High pain reported
Low pain predicted	11	2
High pain predicted	0	4

Results

- 49 patients had continuous ECG recording

- 20 recordings were rejected due to corruptions (e.g. movements artefacts)

- 29 recordings were included in the study:

  - 10 males (34.5%)

  - 12 premenopausal females (41.4%)
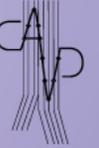
  - 7 postmenopausal females (24.1%)

Results

	Gender		
	Males	**Premenopausal females**	**Postmenopausal females**
	Mean	Mean	Mean
Age	54.8	37.5	60.0
AVVQ	13.06	11.41	20.3
rPPS	5.35	6.17	6.29
pPPS	5.51	5.83	5.48

Results

Multivariate analysis showed that **pPPS** is significantly positively associated with **rPPS** for males and postmenopausal females *(Pearson correlation coefficient R = 0.807, p < 0.001).*

After including premenopausal females association was less significant *(Pearson correlation coefficient R = 0.451, p < 0.014)*

Results

Linear regression showed that accuracy of pPPS is:

- 65.2% for males and postmenopausal females (p < .001)

- 20.4% for males, premenopausal and postmenopausal females (p=0.014)

Conclusions

1. Preoperative HRV can accurately predict pain during local anaesthetic procedures for males and postmenopausal females, but not for premenopausal females

2. Objective HRV measurement is superior to subjective qualitative measures of anxiety in predicting intraoperative pain

This model can be used to predict patient's suitability for procedures under local anaesthesia