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THE QUEST FOR AN OBJECTIVE MEASURE OF BLADDER SENSIBILITY: IS HEART RATE VARIABILITY (HRV) THE ANSWER? – A FEASIBILITY STUDY IN HEALTHY SUBJECTS

Hypothesis / aims of study

The bladder is closely coupled to the autonomic nervous system (ANS). Heart rate variability (HRV) measurement is a useful tool to monitor the ANS in short or long terms. The aim of this study was to evaluate the use of HRV as an objective measure for bladder sensibility during filling cystometry. This study presents first results and experiences.

Study design, materials and methods

11 healthy female subjects (mean age: 24±1.9 years, mean BMI: 21±1.2 kg/m^2) were included.
A standard filling cystometry at 25ml/min through a transurethral 8Ch filling catheter was performed with subjects lying comfortably on an urodynamic examination table in a quite ambience and with ear plugs to avoid possible distraction. A 3-lead electrocardiogramm (ECG) was continuously recorded. Room temperature was kept stable at 22°C. Special care was taken that all subjects felt comfortable with temperature and had not any disturbing perceptions from the catheter. To reduce artefacts and allow subjects to get used to the situation, they were lying relaxed for 15 min and the catheter was connected to a urine bag to keep the bladder empty until filling was started. During filling cystometry subjects had to indicate first filling sensation (FFS), first desire to void (FDV) and strong desire to void (SDV) by pressing a pushbutton.
The analysis of HRV, based on power spectrum analysis, was performed with a flexible scientific software (SOLEASY™) as follows: 1) detection of R-waves in ECG 2) calculation of RR-intervals and generation of discrete event series (DES) 3) calculation of power spectrum from DES 4) calculation of integral of very low frequency (VLF), low frequency (LF) and high frequency (HF) ranges. These 3 parameters were determined in a moving window of 5 minutes (short-term analysis). The HF fraction is supposed to reflect the parasympathetic component and the LF/HF ratio the sympathovagal balance. LF/HF ratio and normalized values of LF and HF were calculated and overlaid with the pushbutton signal.
Statistical analysis was performed between LF/HF ratios at different bladder sensations with Wilcoxon signed ranks test.

Results

In this study the LF/HF ratio showed significant increase from FFS to SDV ($p = 0.013$) and from FDV to SDV ($p = 0.013$).
In the overlay analysis (Fig. 1), the LF/HF ratio showed increasing peaks when subjects pressed the pushbutton at SDV in 9 of 11 cases, at FDV in 6 of 11 cases and at FFS in 2 of 11 cases.

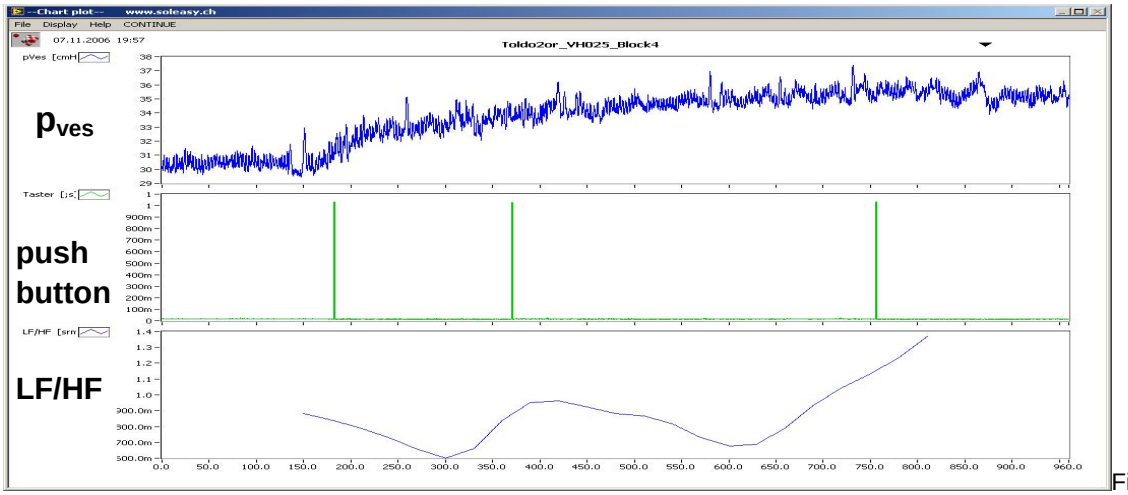

Fig. 1: This diagram shows three different signals recorded during measurement. The first signal is recorded from the intravesical pressure transducer (p_{ves}), the second signal from the push button and the third is the calculated LF/HF ratio from the ECG tracing. Parallel to the peaks of the push button indicating first filling sensation, normal desire to void and strong desire to void, the LF/HF ration shows corresponding increases.

Interpretation of results

The increasing LF/HF ratio towards SDV suggests a shift in sympathovagal balance towards the sympathetic component, which we would expect with increasing desire to void. LF/HF ratio seems to be a good indicator for ANS changes due to bladder sensations and a reliable marker for SDV. That the LF/HF ratio does not indicate the first filling sensation very well is probably due to the weak intensity of this sensation and the low level of arousal or excitement.

Concluding message

HRV is a simple, inexpensive, non painful and non invasive method to effectively monitor the ANS during urodynamic examinations and thereby obtain an reliable and objective measure of bladder sensations. It is important that the investigator is experienced in analysing HRV. Further studies are required to validate the method and to transfer the technique to subjects with disturbed bladder sensation.

References

FUNDING: Swiss National Science Foundation

HUMAN SUBJECTS: This study was approved by the Kantonale Ethikkommission Zürich and followed the Declaration of Helsinki Informed consent was obtained from the patients.