

## HEART RATE VARIABILITY IN PATIENTS WITH IDIOPATHIC OVERACTIVE BLADDER OR STRESS INCONTINENCE

### Hypothesis / aims of study

Overactive bladder (OAB) syndrome is a symptomatic diagnosis defined by the presence of urgency, with or without incontinence, often accompanied by urinary frequency and nocturia. The absence of urological or neurological disorders that would explain these symptoms leads to the diagnosis of idiopathic overactive bladder (IOAB). [1] As the etiology of IOAB is still unraveled, more knowledge of the mechanism of bladder overactivity will be useful. Imbalance of the autonomic nervous system is hypothesized to play a role in the pathophysiology. Autonomic nervous system function can be evaluated by assessing heart rate variability (HRV), a non-invasive measure of the autonomic modulation of heart rate. HRV is the variation over time of the period between consecutive heartbeats. The period between consecutive heartbeats can be derived from the electrocardiogram (ECG). Up till now only two studies compared HRV responses with empty bladder and with full bladder in women with OAB in small study populations. [2, 3]

The aim of this study is to evaluate sympathetic and parasympathetic nerve activity by HRV in women with IOAB compared with women with stress urinary incontinence (SUI) and healthy control subjects (CO) both with empty bladder and with full bladder. More insight into the role of the autonomic nervous system will direct future therapeutic studies.

### Study design, materials and methods

From January 2011 to March 2013 female patients between 18 and 75 years with the diagnosis isolated OAB or isolated SUI were included. All patients were diagnosed with bladder overactivity and detrusor overactivity (DO) on urodynamic study or stress urinary incontinence (SUI). A control group was composed of healthy women without urological complaints or incontinence. Exclusion criteria were neurologic disease, cardiac disease, pregnancy, urinary tract infection, bladder malignancy, or medication influencing heart rate (e.g. beta-receptor agonists or antagonists, anti-arrhythmia agents, etcetera). Thirty-three women (9 with isolated IOAB, 11 with isolated SUI, and 13 control subjects) were included. Continuous electrocardiography (ECG) monitoring was performed with both empty and full bladder. ECG signals were used to assess HRV, which were analyzed in time and frequency domains. The low frequency (LF) and high frequency (HF) spectral bands were used to assess sympathetic and parasympathetic activity, respectively. Low-to-high frequency (LF/HF) ratio was used to represent the balance between the two components of the ANS. A LF/HF ratio < 1 is considered to reflect a predominance of parasympathetic nerve activity and a LF/HF ratio > 1 a predominance of sympathetic nerve activity.

### Results

Results are shown in Table 1 and Figure 1. HRV parameters were in general lower in OAB than in SUI and CO, with empty bladder and with full bladder. Women with OAB had significantly lower HF values when measured with empty bladder ( $97,3 \text{ ms}^2$  (54,6 – 201,4) vs  $495,7 \text{ ms}^2$  (272,6 – 659,5) in SUI and  $312,7 \text{ ms}^2$  (197,7 – 741,2) in CO,  $p = 0.026$ ). Additionally, HF values increased at the end of bladder filling in the OAB group, whereas HF values decreased or remained similar in SUI and CO. In consequence, higher values were found in OAB for LF/HF ratio (LF/HF 1,9 (1,0 – 2,8) vs 0,8 (0,4 – 1,6) in SUI and 1,0 (0,6 – 2,1) in CO with bladder empty and 1,2 (0,9 – 3,8) vs 0,9 (0,7 – 3,4) in SUI and 0,9 (0,6 – 3,2) in CO with bladder full). Low-to-high frequency ratio did not differ significantly between groups.

### Interpretation of results

This study demonstrates significantly lower HF values (representing parasympathetic nerve activity) and therefore a predominance of sympathetic activity in women with OAB with empty bladder and with full bladder. A decrease in LF/HF ratio at the end of bladder filling in women with OAB indicates a relative increase in parasympathetic activity and a relative decrease of sympathetic activity. This is in contrast with an almost stable LF/HF ratio in women with SUI and control subjects, possibly indicating a better balance between sympathetic and parasympathetic nerve activity during bladder filling in these women.

This study has some limitations, which should be acknowledged. First, the study population is rather small. We experienced difficulties in the selection procedure, since mixed urinary incontinence is often present in OAB syndrome. Furthermore, the exclusion of patients using medication that influences heart rate has resulted in a smaller study population. However, even in this small population a pattern of lower heart rate variability parameters was seen in patients with idiopathic OAB. Significant differences between study groups were present, especially in the high frequency spectrum representing the parasympathetic nerve system.

**Table 1. HRV parameters, measured with empty and full bladder in women with OAB, SUI and control group.**

Values are presented as median (interquartile range), \* Kruskal Wallis test

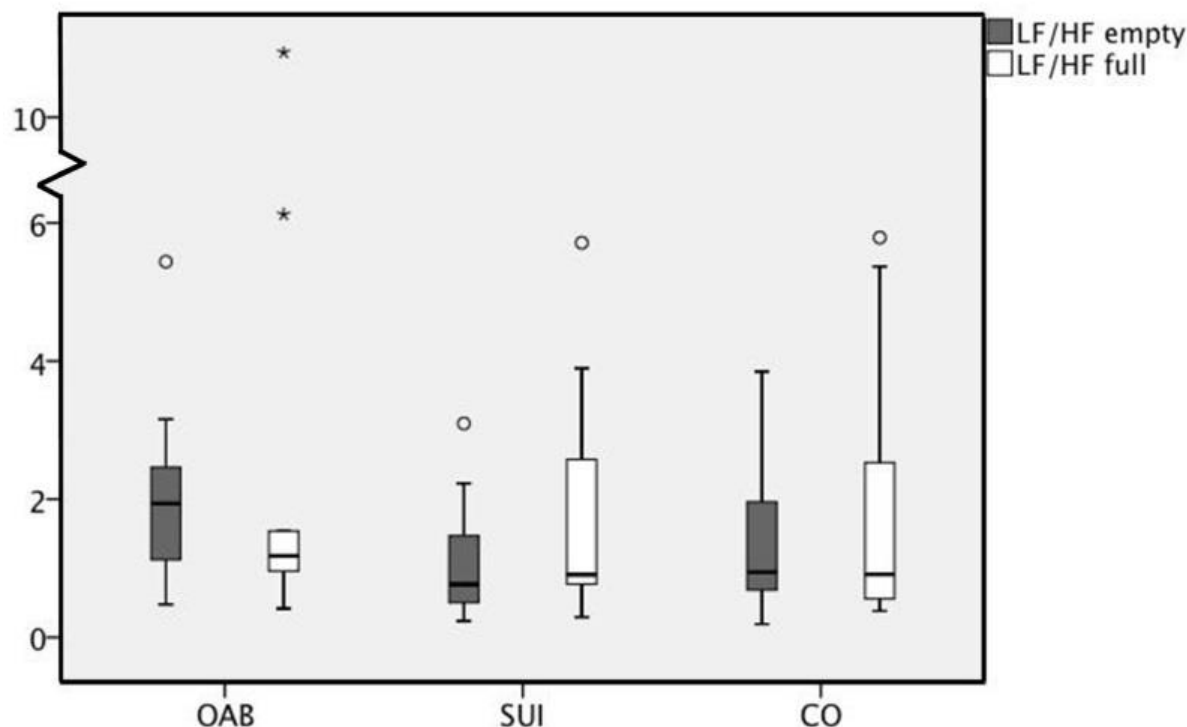
LF/HF: low-to-high frequency ratio, LF: low frequency, HF: high frequency

HRV-parameter	OAB <i>Empty bladder</i>	SUI <i>Empty bladder</i>	CO <i>Empty bladder</i>	<i>P value</i> *	OAB <i>Full bladder</i>	SUI <i>Full bladder</i>	CO <i>Full bladder</i>	<i>P value</i> *
LF/HF	1,9 (1,0 – 2,8)	0,8 (0,4 – 1,6)	1,0 (0,6 – 2,1)	0.132	1,2 (0,9 – 3,8)	0,9 (0,7 – 3,4)	0,9 (0,6 – 3,2)	0.551
LF	122,0 (104,6 – 238,3)	434,6 (185,4 – 843,9)	352,8 (149,3 – 670,5)	0.053	198,3 (153,8 – 341,8)	509,0 (136,8 – 735,9)	520,1 (217,3 – 761,3)	0.280
HF	97,3 (54,6 – 201,4)	495,7 (272,6 – 659,5)	312,7 (197,7 – 741,2)	0.026	168,3 (114,7 – 270,6)	464,7 (214,6 – 689,6)	323,1 (192,2 – 591,8)	0.069

#### Concluding message

Imbalance of the autonomic nervous system is seen in women with idiopathic OAB measured by heart rate variability. With empty bladder, patients with OAB had lower parasympathetic nerve activity than patients with SUI and than controls. With full bladder there was a relative predominance of parasympathetic nerve activity in OAB patients, whereas sympathetic activity is essential at the end of bladder filling to control the sphincter and to suppress bladder contractions. The parasympathetic predominance might explain the phenomenon of overactive bladder.

**Figure 1. LF/HF ratio in empty and full bladder in OAB, SUI and CO \* Extreme, ○ Outlier**



#### References

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#### Disclosures

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