The role of sympathetic and parasympathetic activation in Salivary Alpha Amylase secretion during exercise

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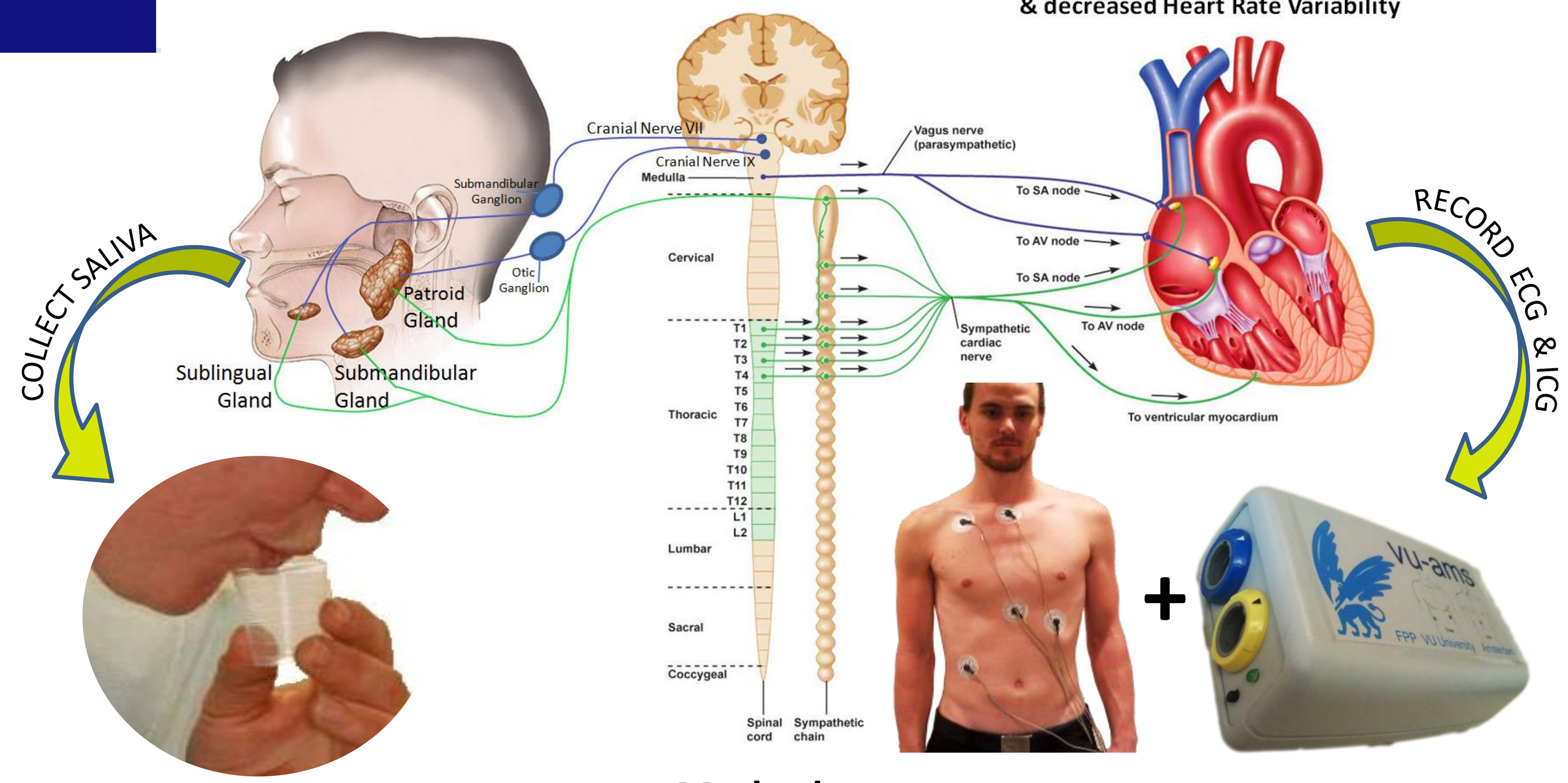
Introduction

Salivary alpha amylase (sAA) secretion has gained interest as a potential non-invasive biomarker for activity of the sympathetic nervous system (SNS). Changes in sAA secretion are often measured by changes in sAA enzymatic activity. However, the parasympathetic nervous system (PNS) can also affect sAA activity through its effects on salivary fluid secretion, sAA secretion in non-SNS innervated glands, and synergistic enhancement of SNS effects on sAA secretion. The current study examined the relative role of SNS and PNS activation in sAA secretion during exercise testing, which elicits a well-known pattern of autonomic activation.



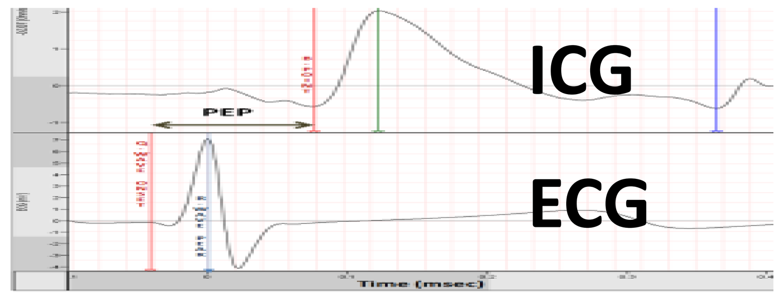
Methods

Twenty-eight subjects underwent a bicycle ergometer test with continuous recording of impedance-based cardiac SNS and PNS activity with the ***VU-Ambulatory Monitoring System***. Saliva was collected by using the spitting method right before and after the exercise test.

Salivary Alpha Amylase determination
Exercise-induced changes in sAA enzymatic activity as well as changes saliva secretion were collected. sAA activity was converted to reflect true changes in sAA secretion by multiplying with saliva fluid secretion (flow rate).

Cardiac response determination
SNS reactivity is reflected in increased left ventricular contraction and measured by a shortened Pre – Ejection Period (**PEP**). Respiratory Sinus Arrhythmia (**RSA**) is a common proxy for PNS activation and is defined as the difference between the maximum and minimum heart rate within a single breath.

sAA ACTIVITY (Units/ml)
X
SALIVA SECRETION (ml/min)
=
sAA SECRETION (Units/min)
VS. RSA msec **& PEP** msec



Results

sAA and cardiac autonomic reactivity to exercise

Table 1 shows reactivity to the exercise test. Although the exercise stressor significantly decreased both PEP and RSA, *figure 1* illustrates that there were substantial individual differences in the patterning of PEP and RSA reactivity.

All sAA measure significantly increased in reaction to the exercise test.

	Baseline	Bicycle Ergometer Exercise	Bicycle Ergometer Reactivity
HR (bpm)	69 (9)	111 (16)	-42*
RSA (msec)	66 (25)	18 (19)	-47*
PEP (msec)	122 (17)	72 (22)	-50*
Saliva Secretion (ml/min)	.41 (.25)	.46 (.27)	.05*
sAA Activity (U/ml)	97 (62)	113 (74)	16*
sAA Secretion (U/min)	45 (44)	52 (47)	7*

Table 1. *Means, standard deviations of IBI, PEP, RSA and sAA measures during the bicycle ergometer test (N=28) and their reactivity scores.*

** = significant at p<0.05.*

	Δ sAA Activity
Δ Saliva Secretion	-.32
Δ sAA Secretion	.68**

Table 2. *Spearman rank correlations of the sAA activity reactivity in response to exercise , with saliva secretion and sAA secretion reactivity. ** are significant at p <.01.*

sAA activity compared to sAA secretion

Table 2 shows that exercise-induced changes in flow were not significantly related to changes in sAA activity which caused the correlation between sAA activity and sAA secretion to be modest only, although still highly significant (r =0.68).

sAA activity seems to be a reasonable proxy for sAA secretion.

The association between autonomic and sAA reactivity to the exercise test.

Based on the concept of augmented secretion, subjects with an above-average increase in SNS activity with a below-average decrease in PNS should be expected to have the highest sAA secretion (like subject 1 in *figure 1*).

Table 3 shows a significant correlation between sAA activity and RSA. Non of the changes in ANS parameters were related to changes in sAA secretion.

These results suggest a dominant role for the PNS in sAA activity, but no clear role for SNS.

	Δ sAA Activity	Δ sAA Secretion
Δ IBI	-.11	-.05
Δ PEP	-.02	.28
Δ RSA	.36*	.18

Table 3. *Spearman Correlations for IBI, PEP and RSA reactivity with parallel reactivity of sAA activity and sAA secretion. *= One tailed significance at p < .1*

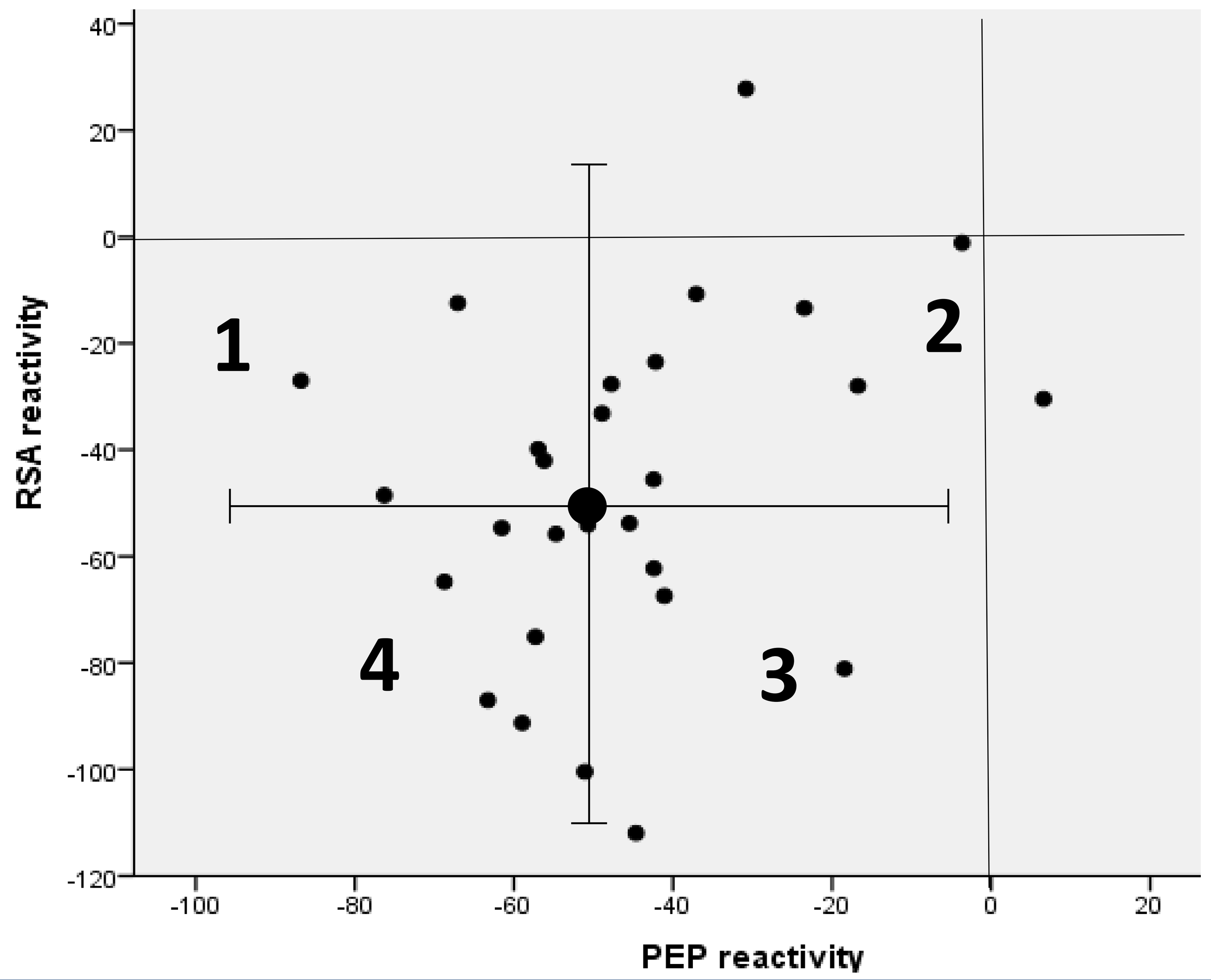


Figure 1. *Scatter plot of RSA and PEP reactivity to the bicycle ergometer test. Circles are the bivariate reactivity scores for the 28 subjects. The large filled circle is the group average with 2 SD bars for both RSA and PEP. Four subjects are highlighted for illustrative purposes:*

1. *Subject 1 has above average cardiac SNS reactivity but below average PNS reactivity.*
2. *Subject 2 has below average cardiac SNS reactivity and below average PNS reactivity.*
3. *Subject 3 has below average cardiac SNS reactivity but above average PNS reactivity.*
4. *Subject 4 has above average cardiac SNS reactivity and above average PNS reactivity.*

Conclusions

- **sAA secretion increases in response to exercise**
- **sAA enzymatic activity is a reasonable proxy for sAA secretion**
- **sAA reactivity does not reflect changes in SNS activity but instead is moderately associated with changes in PNS activity.**

VU medisch centrum
VU-AMS
Ambulatory Monitoring System

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