

# Can the Low-Frequency Component of the Maximal First Derivative of Arterial Pressure Waveform Indicate the Sympathetic Response to Isometric Exercise?

Alejandra Guillén-Mandujano, Salvador Carrasco-Sosa  
Universidad Autónoma Metropolitana-Iztapalapa, CDMX, México

We propose using the low-frequency component (LF) of the maximal first derivative of arterial pressure waveform ( $dAP/dt_{max}$ ) as a potential estimator of sympathetic activity ( $LF_{dAP/dt_{max}}$ ). This could expand the estimating capability of  $dAP/dt_{max}$ , used as a noninvasive index of left ventricular systolic function and a predictor of mortality in heart failure.

We assessed the effects of continuously increasing muscular force (CIMF) on the time courses of systolic pressure (SP),  $dAP/dt_{max}$ ,  $LF_{dAP/dt_{max}}$ , and LF of SP ( $LF_{SP}$ ). 34 healthy volunteers isometrically extended their right leg from 0 to 100% of their maximal force (%MF) at a rate of  $0.2 \text{ kg}\cdot\text{s}^{-1}$ . The spectral indexes were computed using the smoothed pseudo-Wigner-Ville time-frequency distribution. Coherence and correlations between spectral indexes were obtained. The threshold phenomenon was detected by the V-slope method.

The indexes' response to CIMF showed patterned dynamics, relative to their baseline. SP increased progressively from the onset to  $64.7\pm 8.8 \%$ MF, after which it increased more rapidly. The  $dAP/dt_{max}$  increased gradually from the beginning to  $53.5\pm 11.2 \%$ MF, reached a plateau for  $21\pm 6 \text{ s}$ , and then rose progressively until the end.  $LF_{dAP/dt_{max}}$  and  $LF_{SP}$  responses exhibited two phases: initially, they decreased until  $65.3\pm 11.3\%$  MF for  $LF_{SP}$  and  $64.7\pm 13.1\%$  MF for  $LF_{dAP/dt_{max}}$ , followed by an abrupt increase that continued until the end of CIMF. This behavior is considered a threshold phenomenon. The inflection %MF of  $LF_{SP}$ ,  $LF_{dAP/dt_{max}}$ , and SP were similar. The table shows the mean correlations and coherence between indexes in the post-threshold phase.

We found strong correlation and high coherence between our new indicator  $LF_{dAP/dt_{max}}$  and the well-known  $LF_{SP}$  sympathetic index. This supports the proper performance of  $LF_{dAP/dt_{max}}$  as a promising cardiac sympathetic activity measure. Furthermore, tracking the time courses of  $LF_{dAP/dt_{max}}$  and  $LF_{SP}$  during CIMF enabled us to show a sudden increase in sympathetic outflow, possibly associated with the metaboreflex activation threshold.

Table. Means  $\pm$  SD of correlations and coherence of the relations between indexes.

	SP- $dAP/dt_{max}$	$LF_{SP}$ - $LF_{dAP/dt_{max}}$
Correlation	$0.54\pm 0.35$	$0.91\pm 0.13$
Coherence	--	$0.84\pm 0.09$