

Frequency Domain Causal Analysis Allows the Detection of Baroreflex Control Recovery in Patients Undergoing Surgical Aortic Valve Replacement After a Three-month Follow-up

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Surgical aortic valve replacement (SAVR) can have an impact on cardiovascular control as assessed via the analysis of heart period (HP) and systolic arterial pressure (SAP) variability. Frequency domain causality techniques allow the exploration of HP-SAP closed-loop relation in frequency bands typical of the cardiovascular control.

A frequency-domain causality analysis was applied to HP and SAP variability acquired from 58 patients (age: 65 ± 13 yrs, 39 males) before SAVR (PRE), within one-week post-surgery (POST) and after a three-month follow-up (POST3). Analyses were carried out at rest in supine position (REST) and during an active standing test (STAND). Causal squared coherence (K^2) analysis [A. Porta et al, Biol Cybern, 86, 241-251, 2002] was performed along the baroreflex pathway from SAP to HP ($K^2_{SAP \rightarrow HP}$) and along the mechanical feedforward link from HP to SAP ($K^2_{HP \rightarrow SAP}$) in the low frequency (LF, 0.04-0.15 Hz) and high frequency (HF, 0.15-0.4 Hz) bands.

Results showed that $K^2_{SAP \rightarrow HP}$ in LF band increased during STAND compared to REST (0.19 ± 0.15 vs 0.06 ± 0.15) only in POST3, thus indicating that baroreflex control reacted to orthostatic stimulus in POST3. In addition, within STAND condition $K^2_{SAP \rightarrow HP}$ in LF band was higher in POST3 compared to PRE (0.08 ± 0.09) and POST (0.09 ± 0.10). Remarkably, $K^2_{SAP \rightarrow HP}$ in the HF band did not vary across time and experimental conditions. Similar conclusions held for $K^2_{HP \rightarrow SAP}$ in both LF and HF bands.

Findings suggested that baroreflex control was depressed just after SAVR but recovered after a three-month follow-up. Conversely, mechanical feedforward link was not affected. Future studies will be aimed to investigate a longer follow-up and to link results on the occurrence of post-surgery adverse outcomes.