Cerebral “hyperautoregulation” assessed with near-infrared spectroscopy during pharmacological induced pressure changes

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Background and Goal of Study. Previous studies have observed the occurrence of a paradoxical increase in cerebral blood flow with blood pressure fall, and a paradoxical decrease with blood pressure rise. It has been suggested that these paradoxical responses are indicative for a functional cerebral autoregulation mechanism. Accordingly, we hypothesized that paradoxical responses will occur exclusively in patients with intact cerebral autoregulation.

Materials and Methods. After ethical committee approval, data from 34 consenting elective cardiac surgery patients were included. Cerebral autoregulation was assessed with the near-infrared spectroscopy-derived cerebral oximetry index (COx), computed by calculating the correlation coefficient between MAP and cerebral saturation. COx <0.30 was previously defined as functional autoregulation. With the use of nitroprusside (SNP) and phenylephrine (PE), 20% changes in blood pressure were accomplished. Effects on COx were assessed. Data were analyzed using ANOVA, Kruskal-Wallis and Mann-Whitney U-test.

Results and Discussion. Thirty-five % of patients had a pressure passive circulation, with baseline and post-vasoactive agent COx of >0.30. In the remainder of patients (65%), cerebral autoregulation was intact at baseline (COx <0.30). In 25% of these patients, administration of SNP induced a COx >0.30. In 25%, the classic pattern of autoregulation was observed, while in 50%, COx became negative after vasoactive drug administration (From -0.04 [-0.25,0.16] to -0.63 [-0.83,-0.26], p<0.001 after PE, and from -0.05 [-0.19,0.17] to -0.55 [-0.94,-0.35], p<0.001 after SNP). A negative COx implies a decrease in S\textsubscript{c}O\textsubscript{2} with increase in pressure, and conversely, an increase in S\textsubscript{c}O\textsubscript{2} with decrease in pressure. It has been speculated that these paradoxical reactions might be part of a normal physiological autoregulatory response, due to an overcompensation of the autoregulatory response when perfusion pressures change abruptly. This has been termed “hyperautoregulation”.

Conclusion. In the present study, paradoxical changes in S\textsubscript{c}O\textsubscript{2} after pharmacological induced pressure changes occurred exclusively in patients with intact cerebral autoregulation. This observation supports the hypothesis that such paradoxical responses are indicative for a functional cerebral autoregulation.