Changes in regional cerebral oxygen saturation and cardiac output during sitting position in neurosurgical patients

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Introduction

Regional cerebral oxygen saturation (rSO₂/STO₂) is assessed using near infrared spectroscopy (NIRS). However, the influence of sitting position on rSO₂/STO₂ and the interaction with changes in global and regional hemodynamics remains to be clarified. Therefore, in the present study, the effect of sitting position on rSO₂/STO₂ and simultaneously on cardiac output (CO) was assessed in patients undergoing neurosurgical intervention in sitting position. Additionally, two clinically frequently used rSO₂/STO₂ monitors (INVOS® and FORE-SIGHT®) were compared to determine their comparability.

Methods

Following ethical care committee approval and informed consent, data were collected on 24 patients (ASA physical state I-III, 18-80 years) undergoing elective craniotomy in sitting position. All patients received 7.5 mg midazolam for premedication one hour before surgery. Anesthetic management was standardized using sufentanil 0.3 µg/kgBW, propofol 2.25 mg/kgBW and atracurium 0.5 mg/kgBW for induction. Propofol (5-8 mg/kgBW/h) and remifentanil (0.3-0.5 µg/kgBW/min) were administrated for maintenance of anesthesia. Before induction of anesthesia and before change to sitting position, volume bolus of 500 ml HES 6% 130/0.4 was infused. Regional cerebral oxygenation (rSO₂/STO₂) was assessed using both INVOS® (rSO₂; Somanetics) and FORE-SIGHT®(STO₂; Casmed) monitor in each patient. Standard monitoring consisted in measuring A-line blood pressure, ECG, SpO₂, etCO₂. Cardiac output (CO) was determined using transoesophageal echocardiography at different points of time. Pearsons correlation was calculated using GraphPad®.

Results I

Figure 1: Blue/red line: time course of cerebral oxygen saturation measured with INVOS® (blue) and FORE-SIGHT® (red). Arrows mark the beginning and the end of sitting position. Values are displayed in mean +/- SD.

Table 1: Changes of INVOS® rSO₂, FORE-SIGHT® STO₂, CO and MAP during positioning. Pearsons correlation shows: r=0.75/ p=0.14 for INVOS® /CO; r=0.69/p=0.28 for FORE-SIGHT® /CO. r=-0.10/p=0.58 for INVOS® /MAP and r=-0.01/p=0.49 for FORE-SIGHT® /MAP. Calculation for MAP/CO showed r=0.52/ p=0.19. Values represent a ten minute average of the particular position after the position was changed.

Results II

Table 2: Pearsons correlation shows a positive correlation of INVOS® and FORE-SIGHT® : r=0.65; p<0.0001

Discussion and Conclusion

While a decrease in rSO₂/STO₂ can be observed when patients are brought to sitting position (figure 1), this decrease remains in a dimension that is considered to be safe for patients¹. It may be hypothesized that the decrease in CO and not a change in MAP might contribute to cerebral saturation decrease in sitting position (table 1). However, the decrease in CO shown in table 1 is only temporary and CO recovers shortly after upright positioning, while rSO₂/STO₂ remains low (figure 1). Therefore, it is likely that other factors as e.g. an altered veno/arterial blood relation in sitting position also account for this effect. Despite a positive correlation coefficient for CO and rSO₂/STO₂, p-values suggest that a significant dependency cannot be postulated without a larger sample size and further research. INVOS® and FORE-SIGHT® cerebral oximeter seem to give comparable results (table 2) and might be used equally. But it is noticable, that FORE-SIGHT® oximeter continuously shows smaller SD than INVOS®. This might indicate more precise value recording.