

LETTER

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Intact cerebrovascular autoregulation in patients with refractory status epilepticus due to sufficient anesthetic treatment on a neurointensive care unit: a prospective cohort study

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Status epilepticus (SE) is a serious emergency requiring immediate therapy to prevent severe seizure-related brain damage and secondary complications. Cerebrovascular autoregulation (CA) is a key component of cerebral hemostasis and is interictally compromised in epilepsy patients [1]. An impairment of CA may cause further neuronal damage due to fluctuations in cerebral perfusion pressure with consecutive cerebral edema or ischemia. We recently explored the time course of CA in patients with refractory SE and the need for deep analgo-sedation after failure of basic treatment with benzodiazepines and high-dose levetiracetam. All patients received analgo-sedation using propofol or midazolam and sufentanil with the aim of a burst-suppression pattern in electroencephalography. Mechanical ventilation was adapted to normocapnia and blood pressure to normal values. CA was calculated once daily for the first 4 days after the onset of SE by correlation of cerebral blood flow velocities (CBFVs) in both middle cerebral arteries measured with transcranial Doppler ultrasound and invasively measured arterial blood pressure. CA was expressed as the mean velocity index (Mx) as previously described [2]. Mx is a variable with no defined cut-off, but Mx > 0.3 was

associated with poor clinical outcomes in traumatic brain injury patients [3]. Ten adults (six male, four female) with refractory SE and a mean age of 52 ± 16 years were included (Table 1). Initially, Mx was 0.30 ± 0.21 and did not significantly change during the measurement period (Fig. 1 Table 2). Four patients were extubated and transferred to the regular ward after less than four measurements. The collected data indicated that CA in patients with refractory SE after induction of analgo-sedation was intact and did not change in a relevant matter during the observational time. Moreover, Mx levels > 0.3 were not associated with poor clinical outcomes in the investigated cohort. Studies focusing on CA or CBFV in epilepsy patients are rare. In contrast to the presented data, a compromised CA was described in epilepsy patients in interictal states [1]. Furthermore, CBFV was increased during tonic-clonic seizures but was not observable during SE and nonconvulsive SE in comatose patients [4, 5]. Neither an increased CBFV nor alterations of CA were found; this may be attributable to sufficient seizure treatment due to analgo-sedation. In conclusion, cerebral hemostasis seems to be preserved in sufficiently treated patients with refractory SE.

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Table 1 Physiological data

Age (years)	52 ± 16
Sex	6 male, 4 female
BMI (kg/m ²)	27 ± 6
APACHE II	22.8 ± 3
GOS 4 + 5 (n)	6
GOS 2 + 3 (n)	3
GOS 1 (n)	1
ICU stay (days)	11 (9–18)

Parameters are expressed as mean ± standard deviation or median (minimum–maximum)

APACHE II Acute Physiology and Chronic Health Evaluation II, BMI body mass index, GOS Glasgow Outcome Scale, ICU intensive care unit

Table 2 Mean velocity index and clinical data

Day	n	Mx	SOFA	MAP (mmHg)	HR (beats/min)	CBFV _{mean} (cm/s)	PaO ₂ (kPa)	PaCO ₂ (kPa)
1	10	0.30 ± 0.21	10.5 ± 2.4	89 ± 14	65 ± 14	42 ± 15	20.5 ± 7.2	4.9 ± 0.7
2	9	0.34 ± 0.35	10.4 ± 1.6	84 ± 16	67 ± 23	55 ± 22	15.6 ± 2.4	5.1 ± 1.1
3	8	0.28 ± 0.34	10.0 ± 2.4	90 ± 11	74 ± 25	53 ± 23	14.4 ± 3.2	5.3 ± 0.9
4	6	0.32 ± 0.45	8.6 ± 4.6	97 ± 16	83 ± 21	56 ± 23	14.9 ± 2.8	6.9 ± 1.0

The number of patients with refractory status epilepticus is presented as count (n)

CBFV_{mean} mean cerebral blood flow velocity, HR heart rate, MAP mean arterial blood pressure, Mx mean velocity index, PaCO₂ partial pressure of carbon dioxide, PaO₂ partial pressure of oxygen, SOFA sequential organ failure assessment score

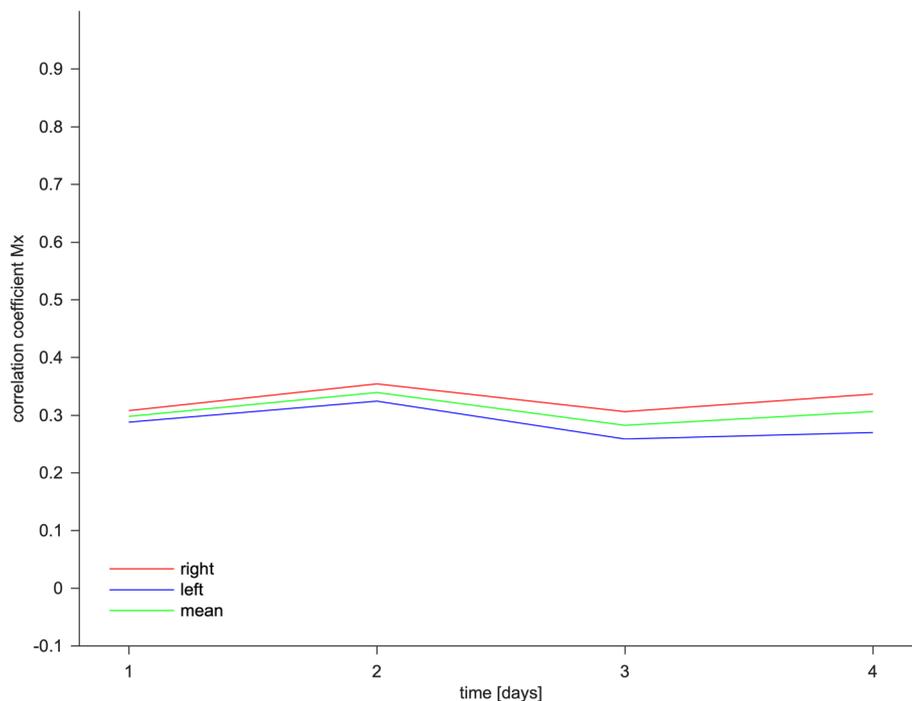


Fig. 1 Time course of cerebrovascular autoregulation index. The figure presents the index of the cerebrovascular autoregulation (mean velocity index; Mx) during the first 4 days after onset of status epilepticus. The red line represents Mx of the right hemisphere, the blue line represents the left hemisphere, and the yellow line represents mean Mx

Abbreviations

CA: Cerebrovascular autoregulation; CBFV: Cerebral blood flow velocity; Mx: Mean velocity index; SE: Status epilepticus

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Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

MM, IS, and PS: conceptualization. MM and PS: data collection. MM, MJ, TB, and PS: analysis of the data and statistics. MM and PS: preparation of original draft. All authors: review and editing. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The present study was approved by the ethics committee of the Justus Liebig University, Giessen, Germany (No. 185/16). The informed consent of the patient or the legal representative was obtained before individual data were entered into the analysis.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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