ELECTRONIC SUPPLEMENTARY MATERIAL

Walter U *et al.*: A red flag for diagnosing brain death: decompressive craniectomy of the posterior fossa

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eAppendix Case description. Valuation of plasma sufentanil concentration

Sufentanil was given IV as analgesic co-medication in 3 boluses: 0.25/0.125/0.125µg/kg (day 1, 19:55/20:15/21:25). The cumulative dose of 3 boluses of sufentanil administered IV was low (0.50 µg/kg) and results in a concentration of 0.18-0.2 µg/L when a similar equilibration time as under normothermia and a distribution volume of 2.5-3 L/kg are assumed.[1-4] Since hypothermia decreases hepatic elimination of sufentanil significantly,[2,5] its concentration might have decreased only during the 12h-period of normothermia (day 2, 07:20-19:30). Based on a study with similar preconditions of sufentanil application an elimination half-life of approximately 12h can be assumed,[6] yielding an estimated concentration of just less than 0.1 µg/L in our case at start of the BD/DNC protocol (day 2, 20:25). This concentration is clearly below the therapeutic range for anesthesia during surgical procedures (0.5-10 µg/L), albeit above the range sufficient for mere analgesia (0.02-0.05 µg/L).[7] The additional naloxone administration makes an influence of sufentanil on the clinical findings obtained during investigation according to the BD/DNC protocol in our case unlikely.

References

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eTable Results of arterial blood gas analyses at start and end of apnea testing

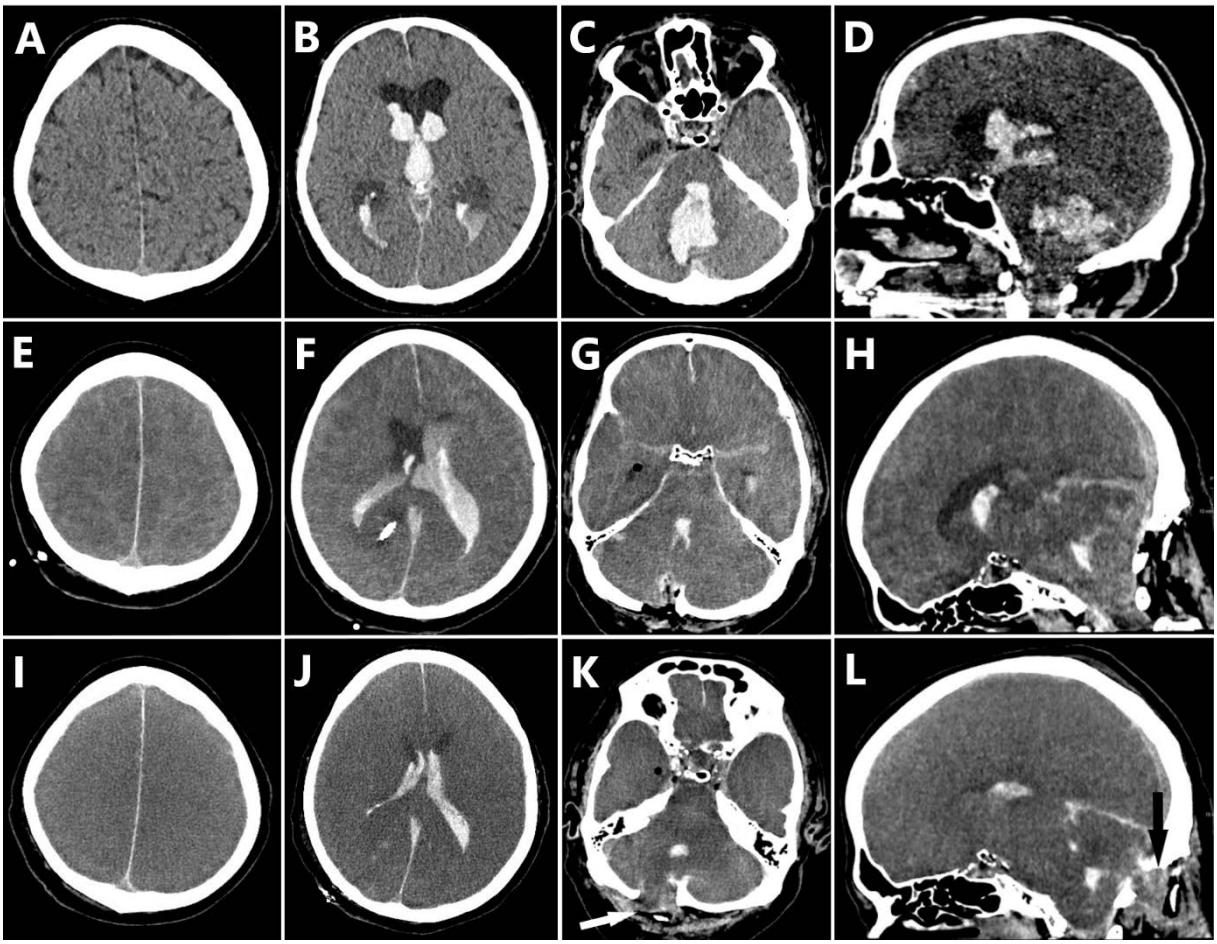
Laboratory parameter (normal ranges)	Start of apnea testing *	End of apnea testing †
pH (7.37–7.45) ‡	7.44	7.21
pCO_2 (4.7–6.1), kPa ‡	5.39	9.83
pO_2 (9.5–13.9), kPa	33.4	40.3
Bicarbonate (21–26), mmol/L	27.3	24.7
Base excess ([-2]–3), mmol/L	3.2	0.2
Sodium (136–146), mmol/L	145	147
Potassium (3.4–4.5), mmol/L	3.8	3.7
Chloride (98–106), mmol/L	110	111
Lactate (0.5–1.6), mmol/L	0.7	0.5
Glucose (3.9–5.8), mmol/L	6.5	6.5
Hemoglobin (8.6–12), mmol/L	6.4	6.4
CO-hemoglobin (<0.8), %	0.9	0.7

* Last measure before stop of regular respiration (day 2, 20:29).

† Last measure during disconnection from respirator (day 2, 21:01).

‡ Corrected for core temperature (35.7 °C).

eFig. 1 Non-enhanced computed tomography (CT) of the head at different time points



A-D) Head CT findings on day 1 (17:45) 100 min after cardiopulmonary resuscitation (CPR), showing cerebellar hemorrhage (C, D) and secondary intraventricular hemorrhage with beginning obstructive hydrocephalus (B), early signs of global hypoxic-ischemic injury with decreased attenuation of basal ganglia (B) and cortical gray matter with diminished gray-white differentiation (A).
E-H) Head CT findings on day 1 (22:01) 6 hours after CPR, after neurosurgical intervention. While the cerebellar hemorrhage is largely evacuated (G), there are worsening signs of global hypoxic-ischemic injury: diffuse edema with effacement of all outer cerebrospinal fluid-containing spaces, reversal sign of the gray and white matter attenuation, and pseudo-subarachnoid hemorrhage (E-G). Grey matter/white matter ratio of basal ganglia (GWR-BG) was 0.93,[1] clearly below a cut-off value of 1.10 reported to indicate poor outcome (brain death or persistent coma or vegetative state);[2] note that in an earlier study, of the patients with a GWR-BG <1.10 on head CT performed within 24 hours after CPR, 33% exhibited electro-cortical inactivity on electroencephalography, as did only 5% of patients with a GWR-BG >1.10.[3,4] There was also transforaminal and beginning transtentorial herniation (H).
I-L) Head CT findings on day 3 (01:30) 33.5 hours after CPR, showing partial herniation of the cerebellum through the craniectomy gap of posterior fossa (K: white arrow; L: black arrow), alleviating brain stem compression by some amount.

References

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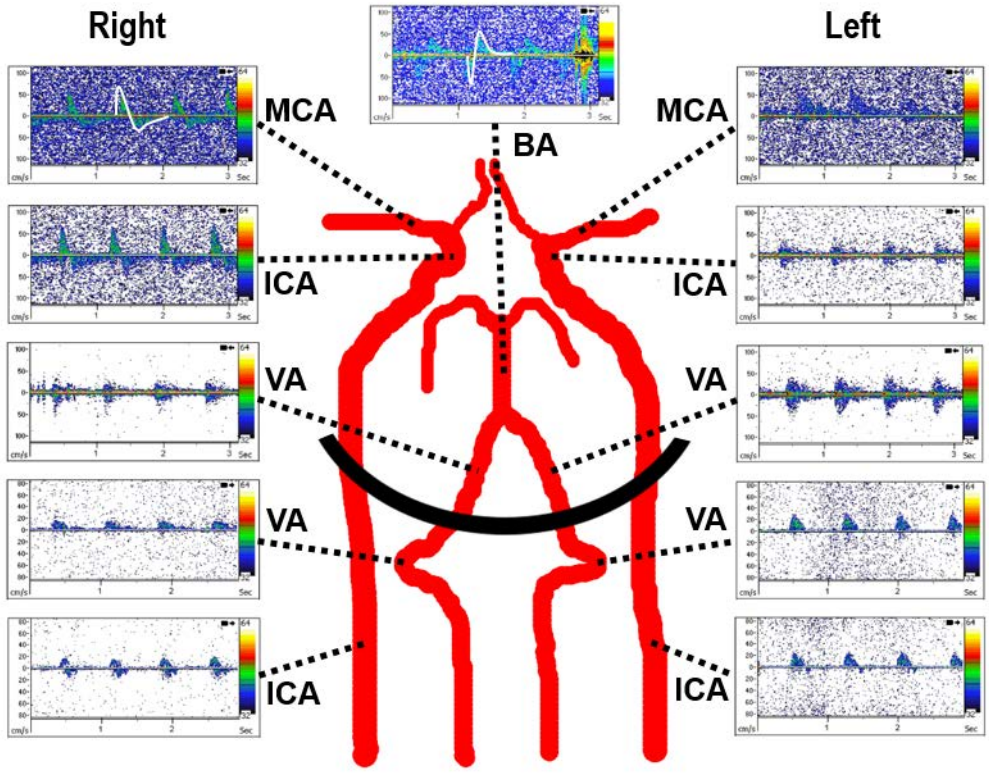
eFig. 2 Doppler ultrasonography of extra- and intracranial brain-supplying arteries



Doppler ultrasonography on day 2 (21:25) showed preserved antegrade net blood flow in the left internal carotid artery (ICA), the left middle cerebral artery (MCA) and bilateral vertebral arteries (VA), a finding which does not allow for the diagnosis of brain death/death by neurologic criteria in patients with a primary infratentorial brain lesion according to the German guideline.[1,2] Only in the right ICA, the right MCA and the basilar artery (BA) reverberating flow patterns were found, compatible with imminent circulatory arrest in these vessels.

References

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