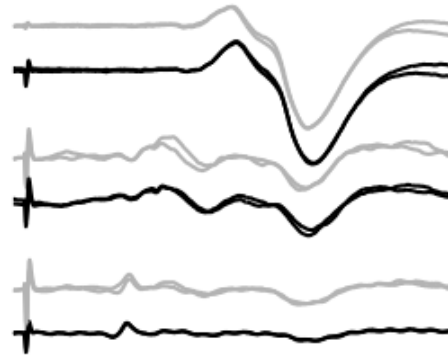


SSEP and prognostication after cardiac arrest



Christoph Leithner

Why can we use SSEPs as a prognostic marker?

Cardiac arrest -> (transient) global hypoxia

selective vulnerability of the brain: cortex > brainstem

Unresponsive Wakefulness Syndrome (UWS, = vegetative state, CPC4)

diffuse cortical neuronal damage, brainstem intact

„Pars pro Toto“-principle of prognostication by SSEP

Proof of severe damage of one cortical region (bilaterally)

-> diffuse damage of entire cortex highly likely

-> SSEPs less useful in patients with traumatic brain injury

Somatosensory evoked potentials – recording technique

electrical stimulation of median nerve at wrist

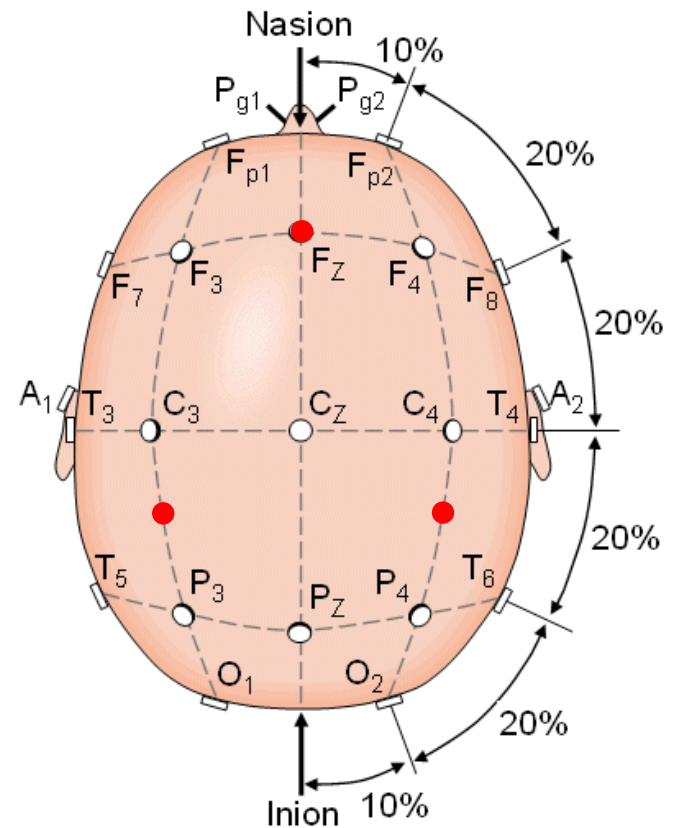
averaging of 100-1.000 stimuli per recording

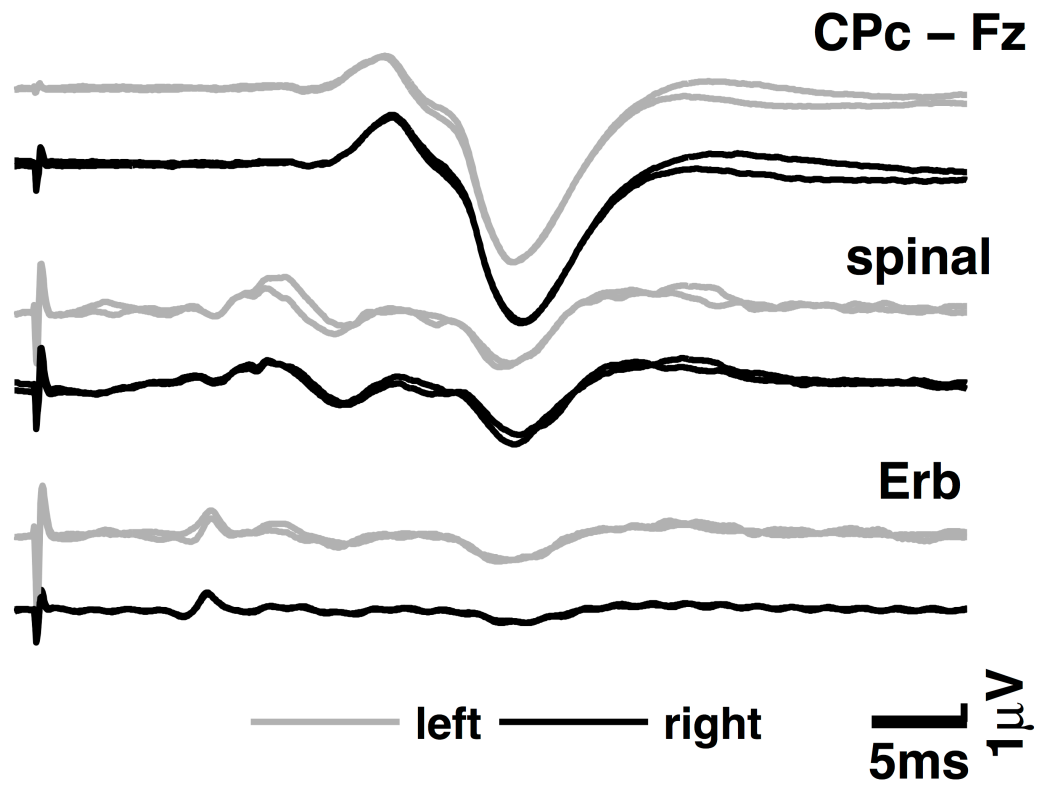
peripheral (Erb), spinal (C2-C7) and cortical recordings

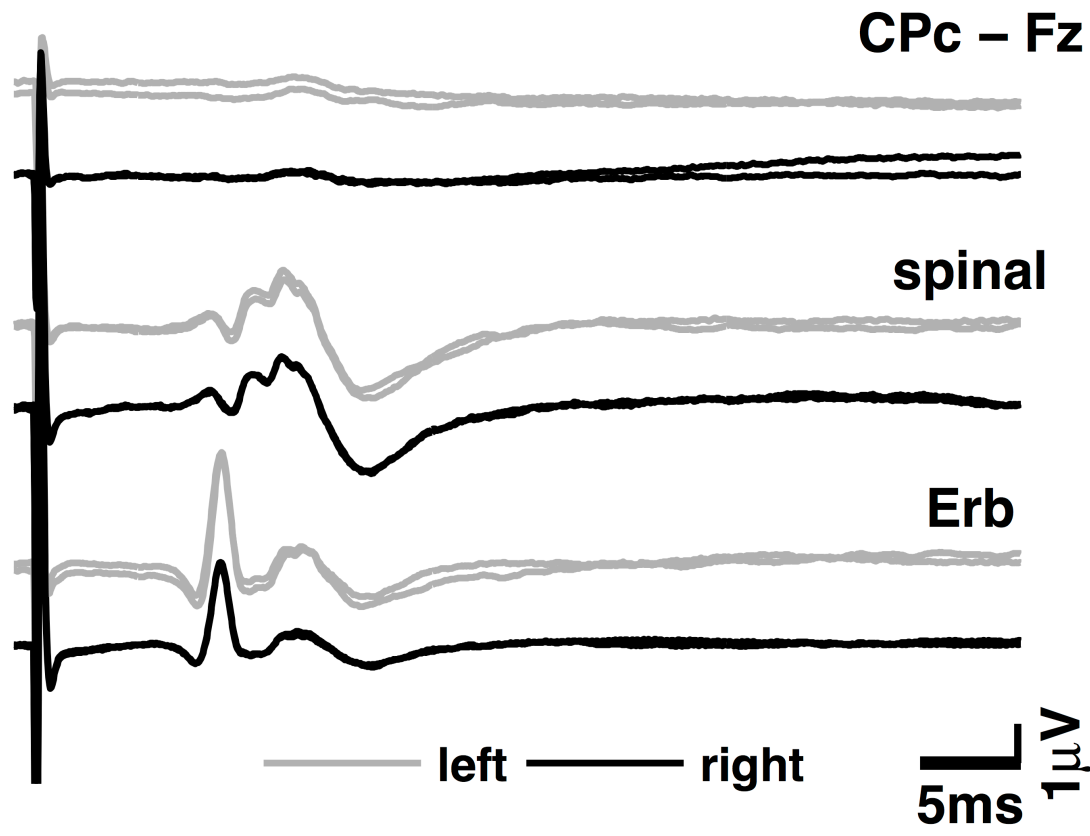
cortical recording CPc-CPi or CPc-Fz

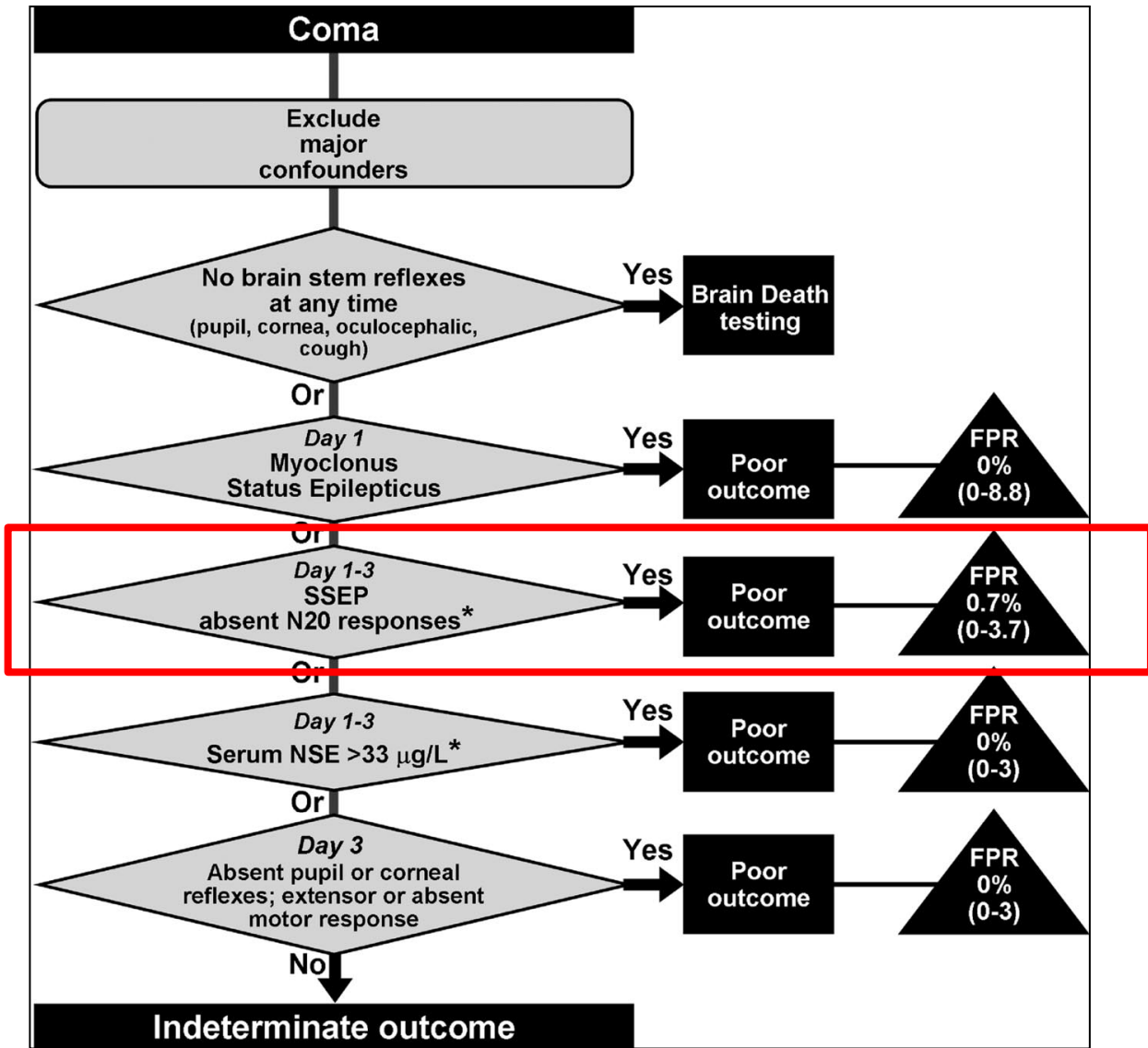
first cortical potential: N20

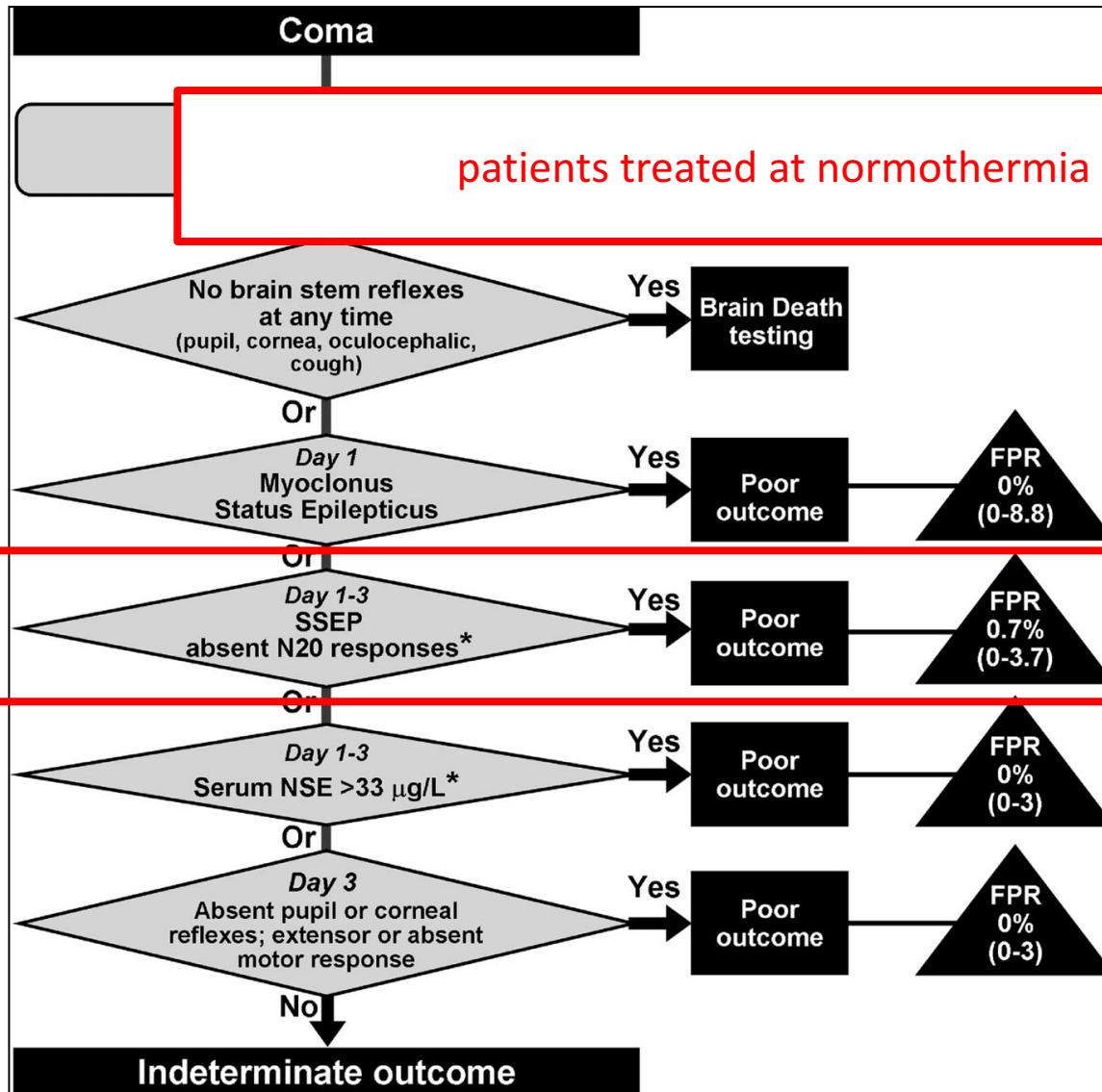
stable under sedation, mild hypothermia



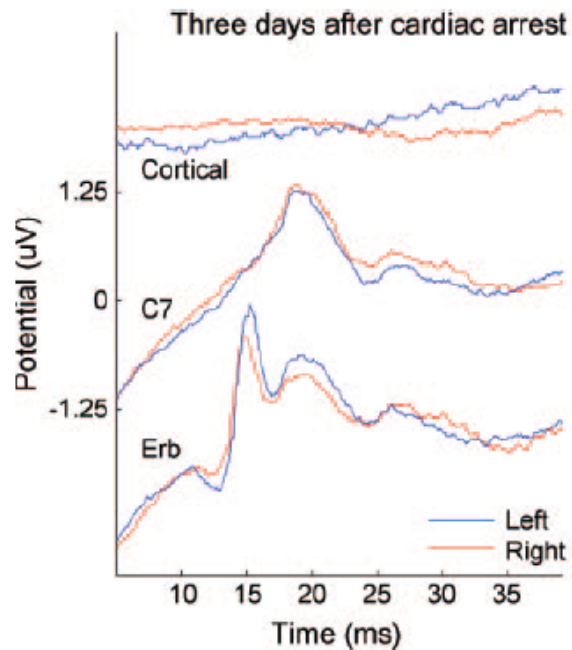








Does hypothermia influence the predictive value of bilateral absent N20 after cardiac arrest?



retrospective study

112 among 185 consecutive CA patients received SSEP

one among 36 patients (3%) with bilaterally absent N20 recovered (CPC1)

Prognosis of Coma After Therapeutic Hypothermia: A Prospective Cohort Study

	Patients tested, n	Positive test result, n (%)	Patients with positive test result and good outcome, n	Sensitivity	Specificity	FPR
Absent N20s SEP hypothermia	263	43 (16)	3	28 (21–36)	98 (93–99)	3 (1–7)
Absent N20s SEP normothermia	128	42 (33)	0	38 (30–48)	100 (82–100)	0 (0–18)

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3 of 43 patients (7%) with absent N20 at 24h after CA had good outcome

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retrospective analysis of these 3 SSEP: too much noise in the recording

-> *quality/reliability of SSEP for prognostication in everyday clinical routine?*

TTM trial subgroup analysis

	Patients tested, <i>n</i> (%)	TP <i>n</i>	FP <i>n</i>	TN <i>n</i>	FN <i>n</i>	Sensitivity % (95% CI)	<i>p</i> -Value	FPR % (CI)
Bilateral absent SSEP (N20)							0.27	
33 °C	110 (23)	35	0	24	50	41.2 (31.3–51.9)		0.0 (0.0–13.9)
36 °C	94 (20)	39	1	14	38	50.0 (39.0–61.0)		6.7 (1.1–29.9)
All tested	204 (22)	74	1	38	88	45.3 (37.8–53.1)		2.6 (0.4–13.2)

Rehabilitation outcome of anoxic-ischaemic encephalopathy survivors with prolonged disorders of consciousness[☆]

Kaitlen Howell^{a,1}, Eva Grill^{b,c,1,2}, Anke-Maria Klein^a, Andreas Straube^a,
Andreas Bender^{a,d,*,2}

Bilateral loss of cortical SSEP responses is compatible with good outcome after cardiac arrest

Andreas Bender · Kaitlen Howell · Marcel Frey ·
Ansgar Berlis · Markus Naumann ·
Gernot Buheitel

CASE REPORT

Open Access

Cerebral hypoxia, missing cortical somatosensory evoked potentials and recovery of consciousness

Gustav Pfeiffer^{1*}, Rüdiger Pfeifer² and Stefan Isenmann³

Letter to the Editor

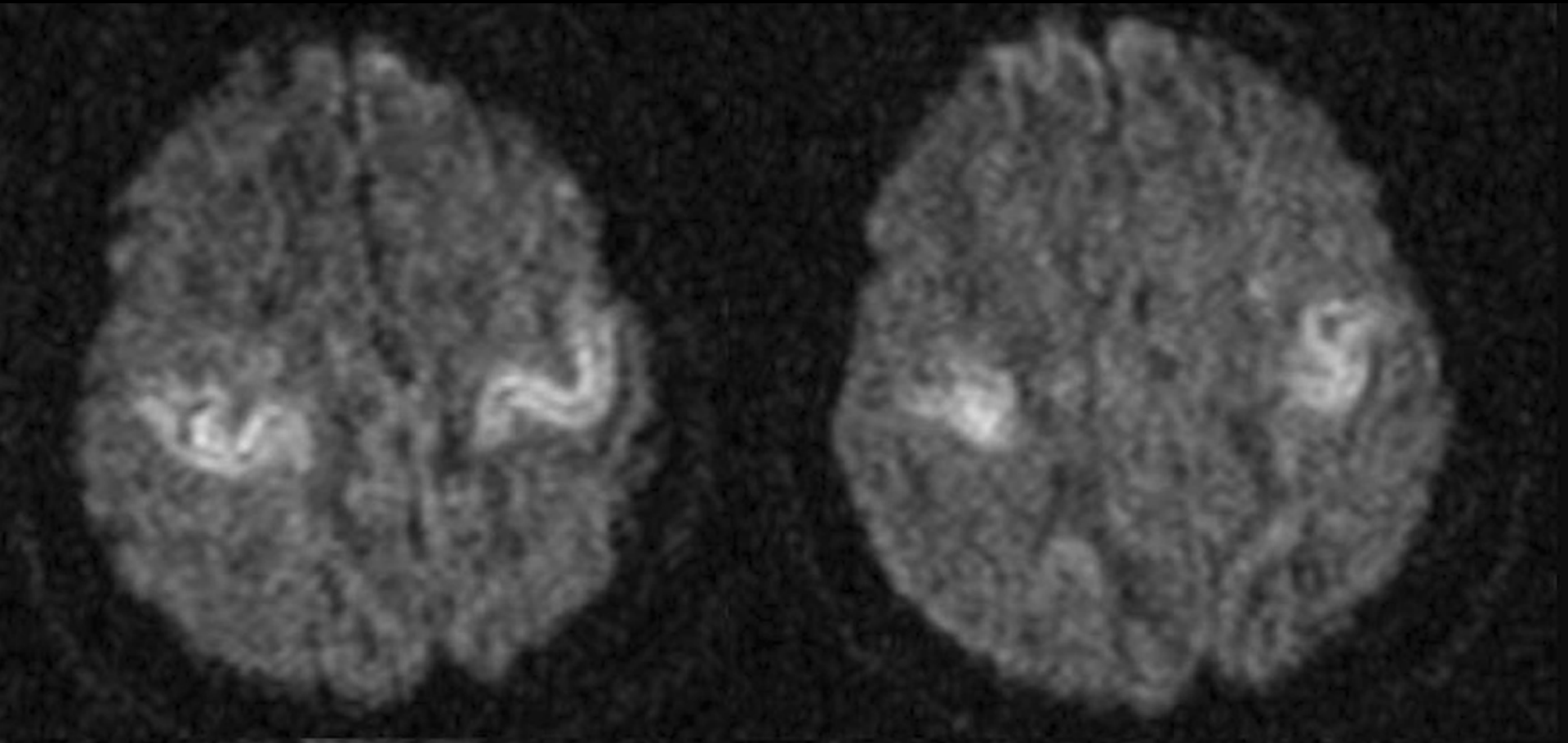
False positive absent somatosensory evoked potentials in cardiac arrest with therapeutic hypothermia



Sir,

Somatosensory evoked potentials (SSEPs) are commonly uti-

Weinstein et al., *Resuscitation* 2017
Arch et al., *Resuscitation* 2014
Pfeiffer et al., *BMC Neurol* 2014
Howell et al., *Resuscitation* 2013
Bender et al., *J Neurol* 2012



absent SSEP and recovery of consciousness

1) error in interpretation of SSEP, e.g. cortical noise level too high

2) rare cases with correct recording/interpretation

-> for the patient, this probably makes no difference ...

-> *never rely on only one prognostic investigation!*

Investigation of the inter-observer variability effect on the prognostic value of somatosensory evoked potentials of the median nerve (SSEP) in cardiac arrest survivors using an SSEP classification[☆]

Examination results of the SSEP recordings ($n = 163$) from each observer.

	Observer I	Observer II	Observer III	Observer IV
SSEP not-evaluable (n)	9/163 (5.5%)	22/163 (13.5%)	9/163 (5.5%)	0/163 (0%)

Investigation of the inter-observer variability effect on the prognostic value of somatosensory evoked potentials of the median nerve (SSEP) in cardiac arrest survivors using an SSEP classification[☆]

Examination results of the SSEP recordings ($n = 163$) from each observer.

SSEP not-evaluable (n)

tolerable cortical noise level?

lowest SSEP amplitudes in good outcome patients?

observer
✓
/163 (0%)

SSEP amplitudes and outcome

prospective study

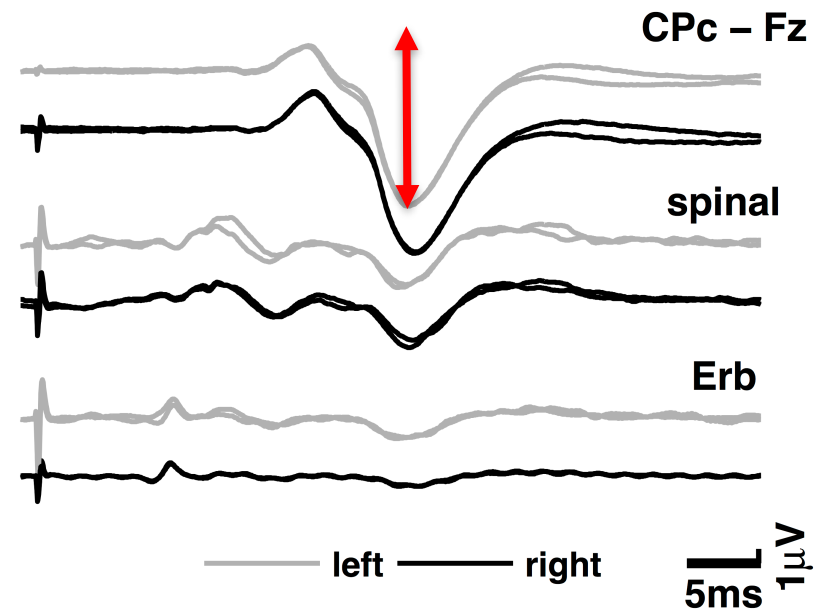
33°C for 24 hours

293 patients with SSEP after CA

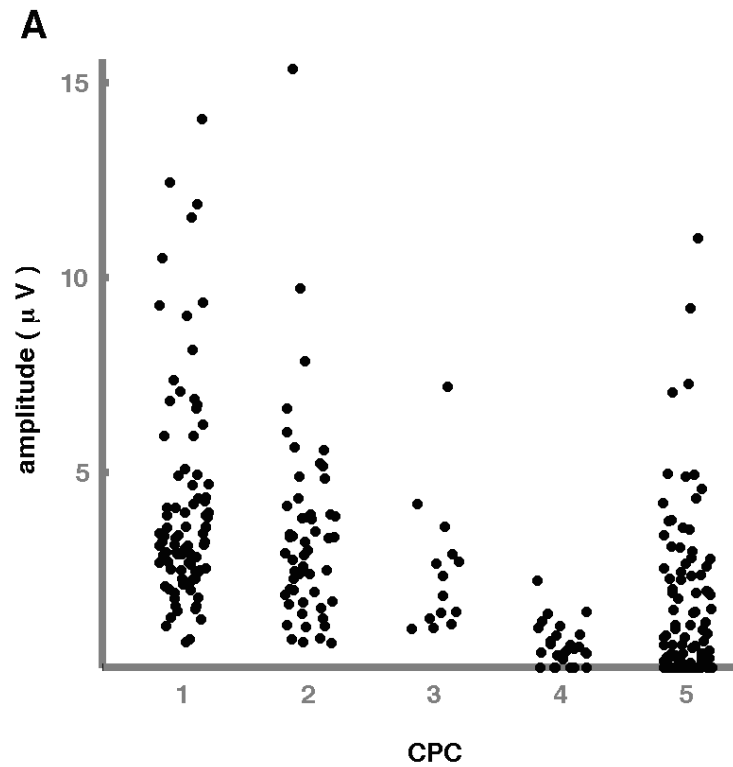
SSEP >24 hours – 7 days after CA

n=156 CPC1-3

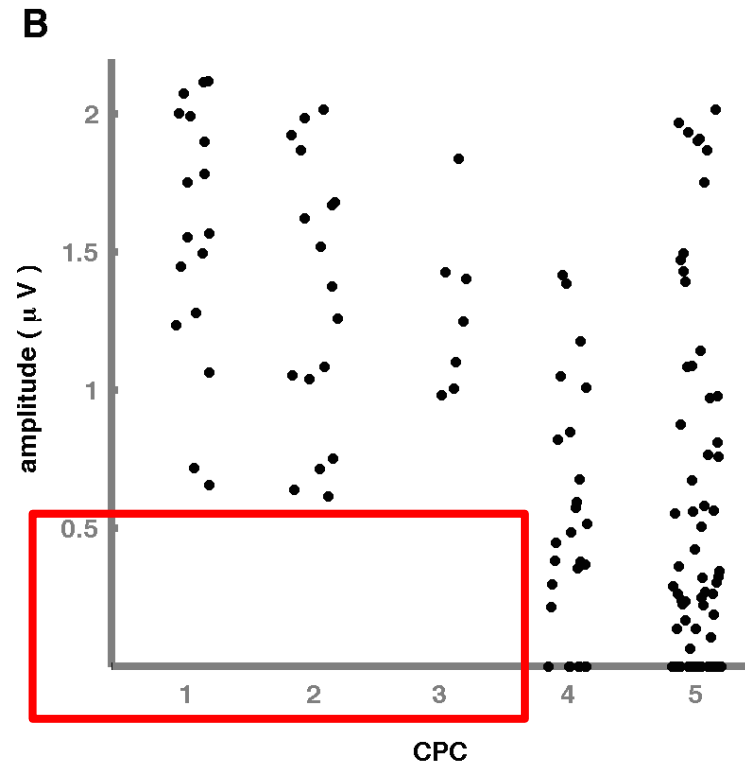
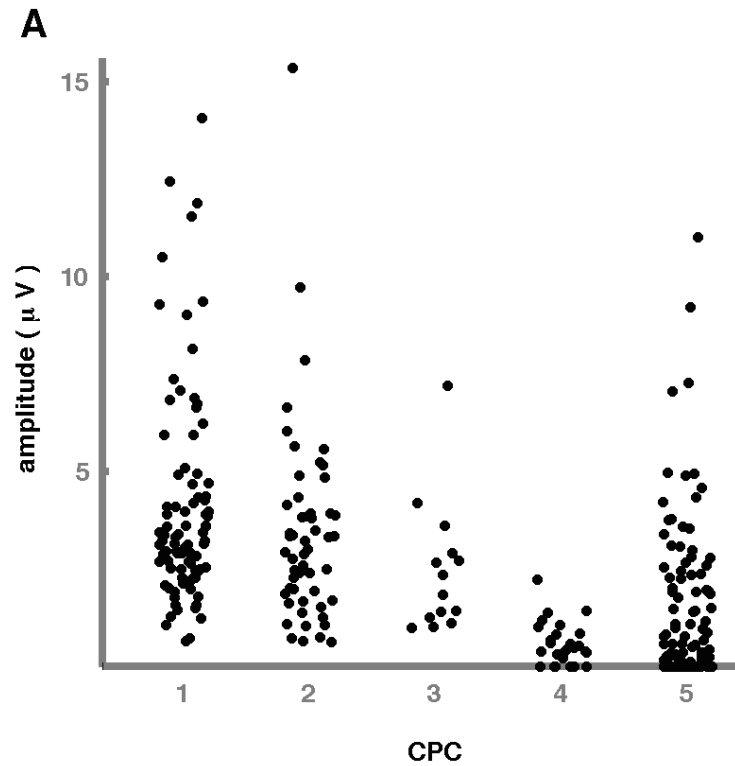
n=137 CPC4-5



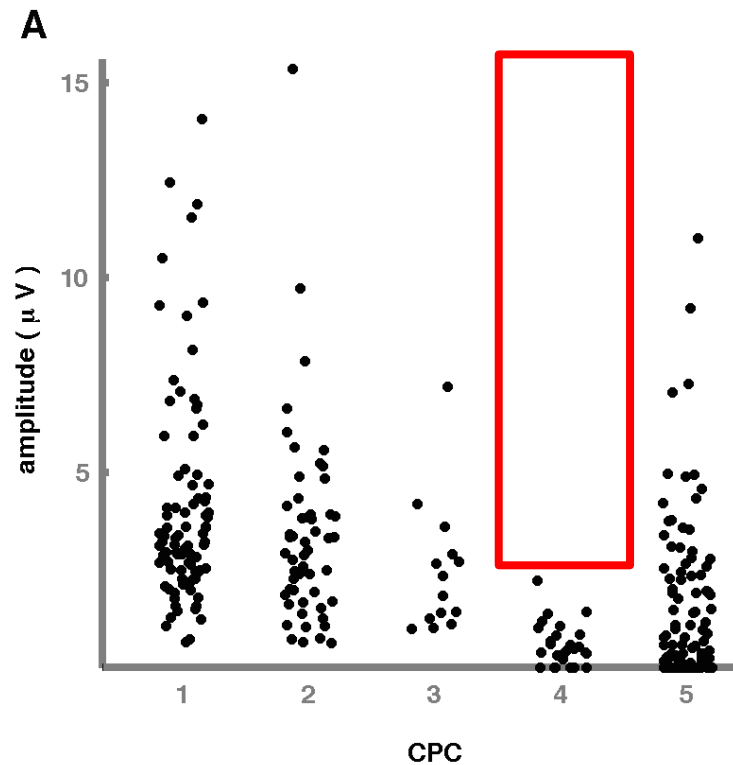
SSEP amplitudes and outcome



SSEP amplitudes and outcome

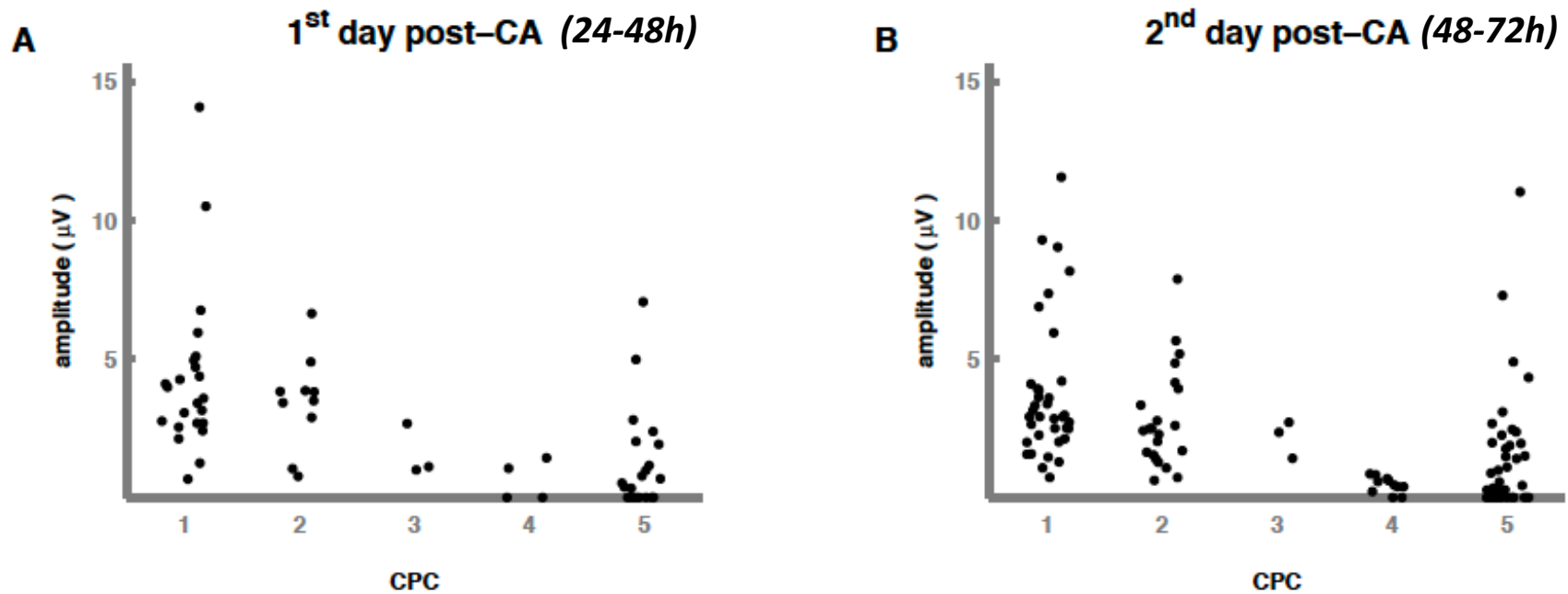


SSEP amplitudes and outcome

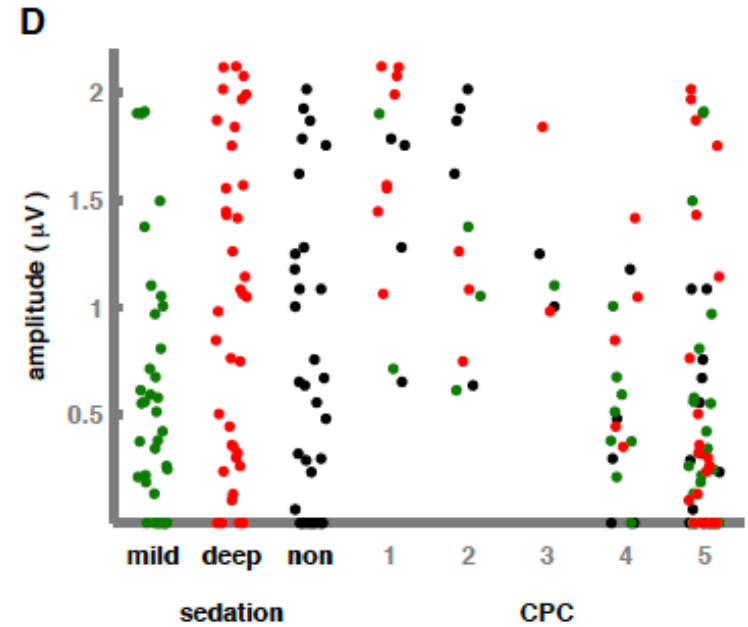
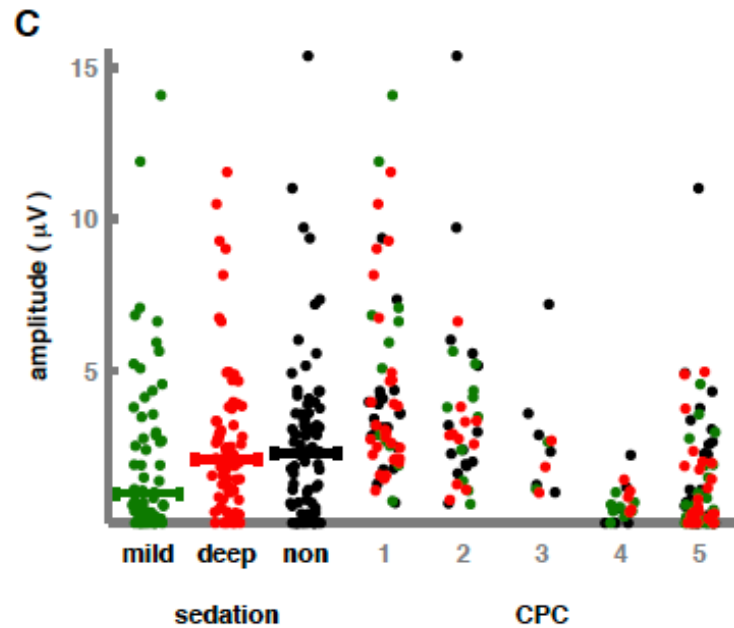


-> high cortical SSEP ($>2.5\mu\text{V}$) rare in patients with severe HIE

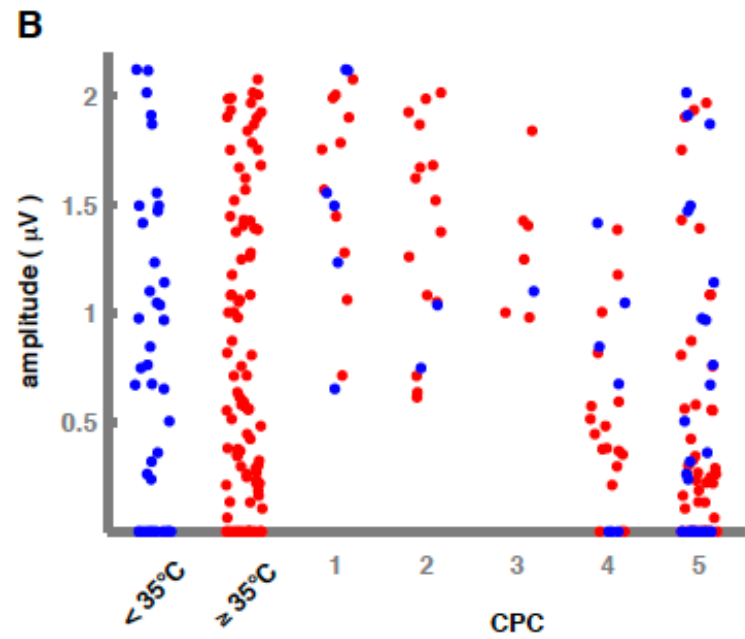
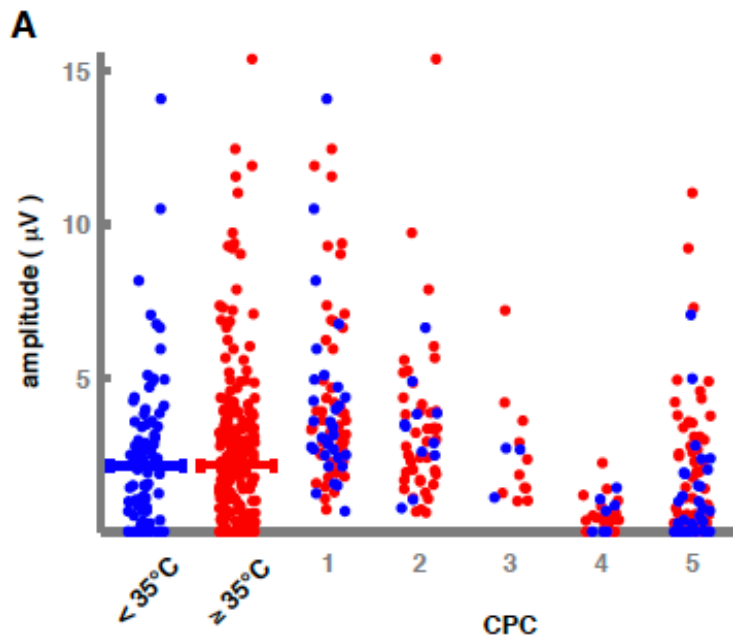
SSEP timing and amplitudes ...

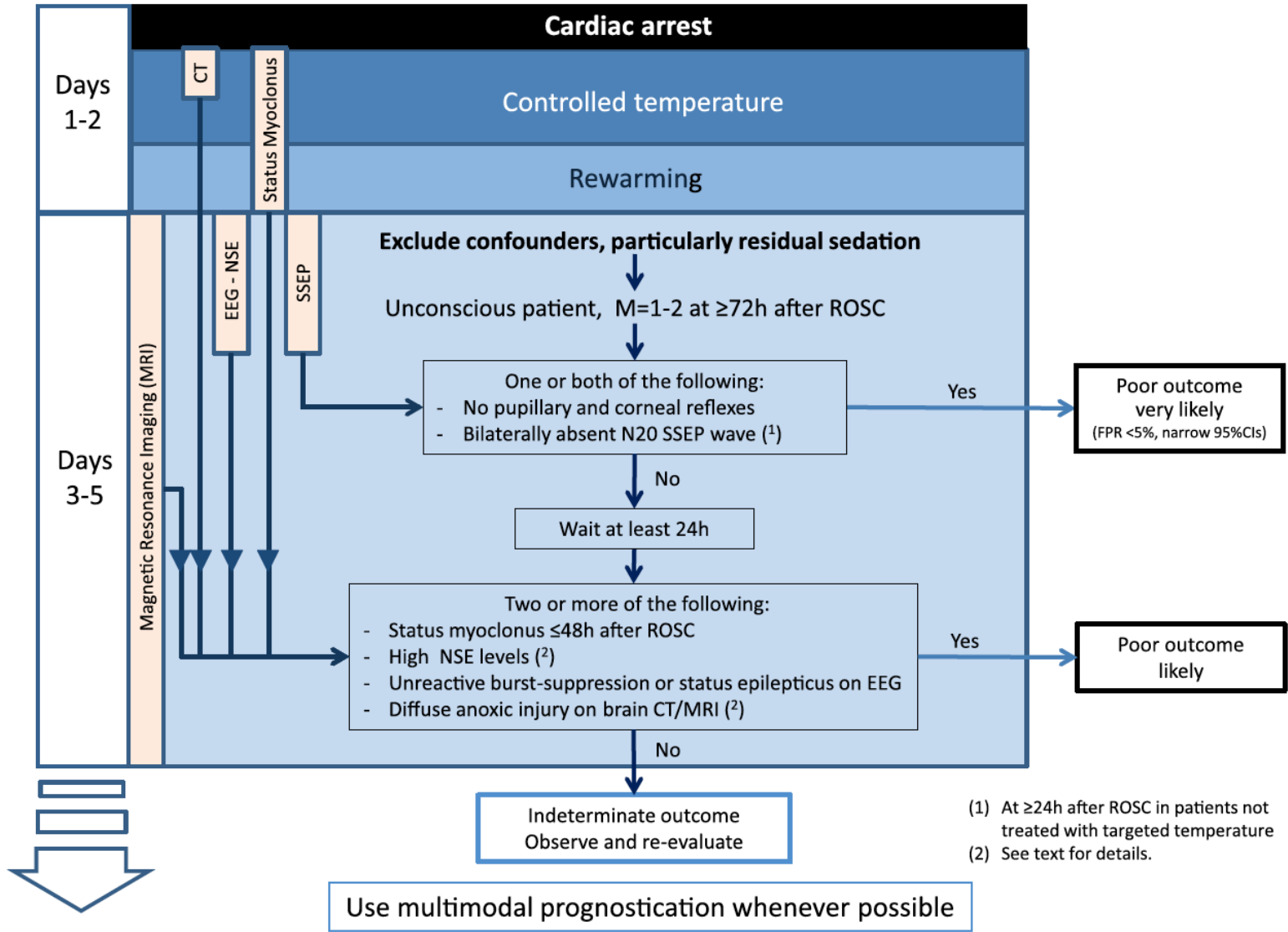


Sedation and SSEP amplitudes



Hypothermia and SSEP amplitudes





Summary

SSEP among most reliable prognostic parameters after CA

bilaterally absent cortical SSEP -> high specificity/PPV for poor outcome

exceptional cases with good outcome -> multimodal prognostication

quality of recording and interpretation (spinal/periph. potentials, cortical noise level)
-> establish local SOP for recording and interpretation

high cortical amplitudes rare in patients with severe HIE