

Does Hyperbaric Oxygen Treatment Improves Neurophysiological Performance in Brain Tumor Patients after Neurosurgery and Radiotherapy?

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Introduction

Patient's disorders:

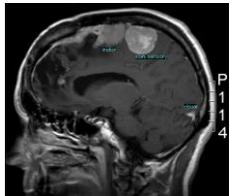
- short and working memory malfunction;
- chronic fatigue;
- often motoric dysfunction.

Hypothesis

HBO induces (via neo-angiogenesis) better neuronal functionality (amplitude increase) and myelination (increase of propagation speed). As a result, brain and motor performance is expected to improve.

All patients: history and characteristics documented

#	Age in years	Sex	Tumor histology	Location	Surgery	Radiation dose	Chronic fatigue	Memory capabilities	General mental performance	Sensory or motor function	Interval in years	No. of radiotherapy-HBOT sessions	Clinical response after HBO	Survival status (as of 22 Jan 2010)	Present status (as of 22 Jan 2010)
1	32.9	M	Atypical meningioma	Left fronto-temporal	GTR	As child: 26 Gy 30x1.8 Gy	+	Slightly impaired, slow	Rather impaired	Impaired	0.23	30	Improved	5.9	Alive & worse
2	41.8	M	Anaplastisch oligodendroglioma	Midbrain	Bx	33x1.8 Gy	+	Severely impaired	Impaired	Normal	10	40	Not improved	3.7	Alive & stable
3	49.5	M	Non-Hodgkin lymphoma	Right occipital	Bx	20x2 Gy	+	Impaired	Impaired	Normal	5.9	31	Marginally improved	6.2	Alive & well
4	51.1	F	Meningioma "en plaque"	Extensive surface right fronto-parietal	STR	30x1.8 Gy	+	Impaired	Impaired	Impaired	0.3	45	Much and durably improved	10.1	Alive & stable
5	51.5	F	Glioblastoma	Left parieto-frontal	GTR	4x7 Gy	++	Slightly impaired	Rather impaired	Impaired	12	29	Transient improvement	9.6	Alive & very well
6	55.0	F	Solitary brain metastasis	Right occipital	GTR	12x2.5 Gy + 4x6 Gy boost	+	Severely impaired	Impaired	Impaired	0.6	29	Much and durably improved	6.4	Alive & stable
7	57.5	F	Non-Hodgkin lymphoma	Left parietal	Bx	20x2 Gy + 5x2 Gy boost	+	Impaired	Severely impaired	Severely impaired	8	40	Transient strong improvement	12.0	Alive & stable
8	58.2	M	Oligodendroglioma	Right frontal	STR + chemo	30x1.8 Gy	++	Impaired	Rather impaired	Normal	0.3	30	Not improved	6.3	Alive & stable
9	59.0	M	Solitary brain metastasis (primary: kidney)	Right fronto-temporal	GTR	12x2.5 Gy + 4x6 Gy boost	++	Nearly normal	Impaired	Normal	0.3	52	Transient improvement	1.0	Deceased
10	75.0	M	Solitary metastasis of unknown primary	Left occipital	GTR	12x2.5 Gy + 4x6 Gy boost	+	Impaired	Impaired	Impaired	1	30	Transient improvement	0.9	Deceased



Patient#4, 49 years, female

- meningioma, (right) fronto-central, falx cerebri and cerebelli;
- extirpation and after 3 years radiotherapy (inoperable);
- anti-epilepticum.

Methods

Number connection test (NCT, 1-25)

Continuous reaction time test (CRTT; button pressing)

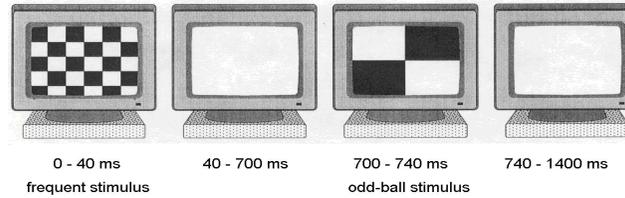
Informant Questionnaire on Cognitive Decline in the Elderly (IQCOD)

EEG mapping (64 electrodes, averaging → evoked response maps)

- Visual odd-ball paradigm (cognition)
- Somatosensory potentials
- Button pressing (motor & somatosensory)

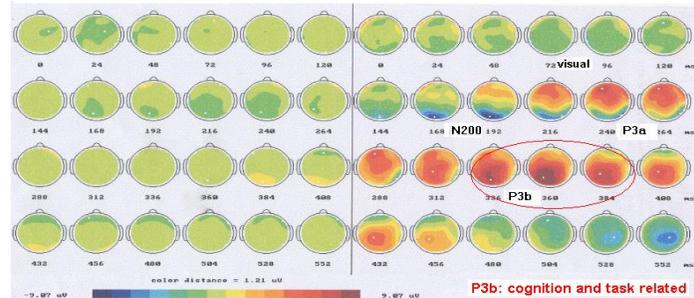
Patient with electrode cap

Visual odd-ball stimulus examines attention & working memory

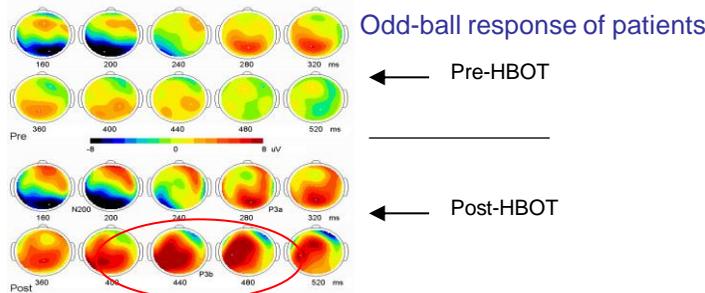


Coarse checkerboard, the odd-ball, was randomly presented in sequence of fine boards with 1/6 chance. Coarse boards were silently counted.

Fine, frequent stimulus EEG maps healthy subject Coarse, odd-ball stimulus



Results



P3b relative amplitude change of patients



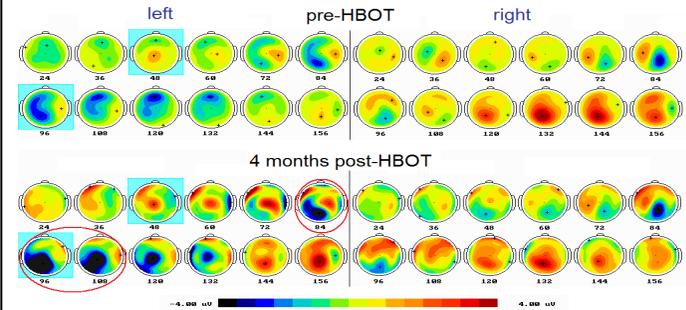
P3b
rmANOVA
6 weeks and
4 months
after HBO:
P = 0.0046

Quantitative mean relative change after HBOT

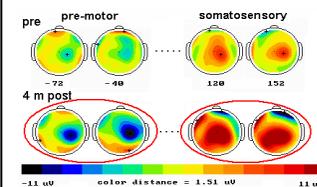
Test number	Test name	mean	SD	n	P-value (t-test)
1	averaged log-ratio NCT	0.047	0.059	9	0.0452
2	averaged log-ratio CRTT	0.042	0.122	9	0.3279
3	averaged log-ratio P3b	0.149	0.167	10	0.0200
4	averaged fraction IQCODE	0.042	0.040	9	0.0138
grand mean 1-4		0.072	0.117	37	0.0013

Cortical somatosensory and pre-motor performance

Electrical stimulation left posterior tibial nerve



Thumb pressing left



Somatosensory responses of left thumb and pre-motor responses of left thumb-pressing (CRTT) show similar improvements as left toes.

Conclusions

EEG mapping, NCT, CRTT and IQCODE

show improved cognitive performance mediated by HBO. This seems to be mainly based on improved functionality of neurons, reflected by the P3b-amplitude increase, not on faster processing (better myelination).

Some patients showed improved somatosensory processing and motor control; better grasping and walking

Remaining questions: what is the relevance of age, tumor type, RT-HBOT interval,?