

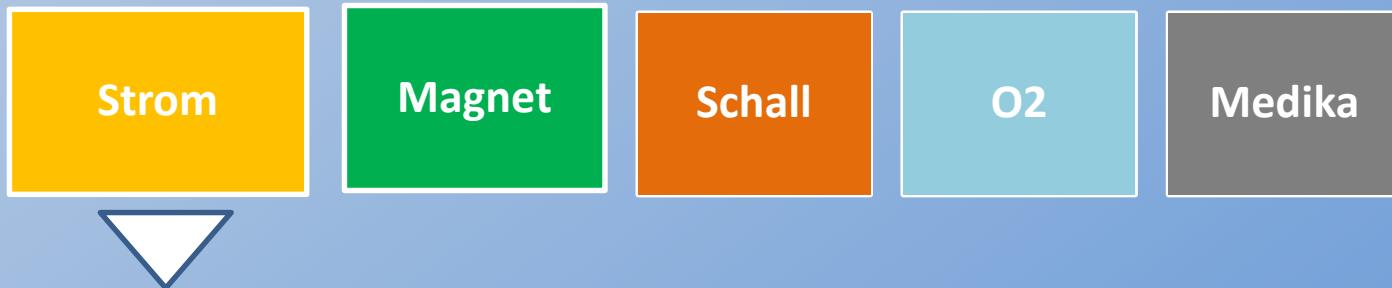


INNOVATIVE ASPEKTE DER GEHIRNSTIMULATION

G. Pichler



GEHIRNSTIMULATION – ABER WIE?



- Tiefe Hirnstimulation
- Nervus Vagus-Stimulation
- tDCS

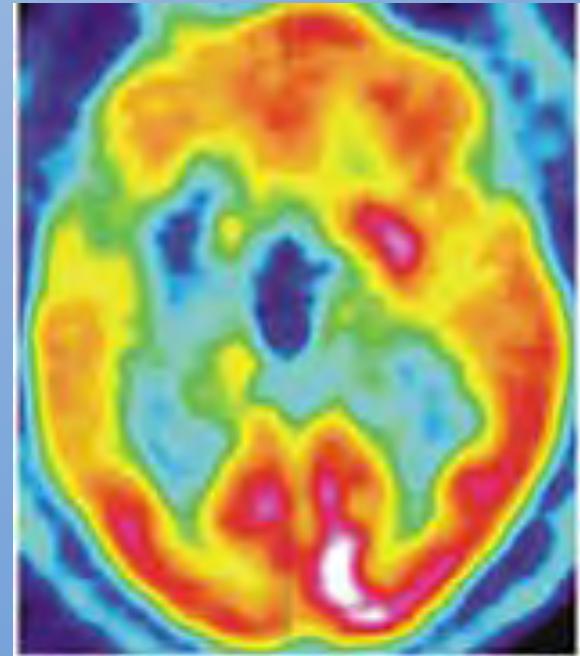
TIEFE HIRNSTIMULATION

Patienten (> 6 Mo)	1 UWS (Trauma)	4 MCS (2 Trauma, 2 Insult)
Bewertung	CRS-R	FDG-PET

Lemaire J et al. (2018) Deep brain stimulation in five patients with severe disorders of consciousness. Annals of Clinical and Translational Neurology 5(11): 1372-1384

TIEFE HIRNSTIMULATION

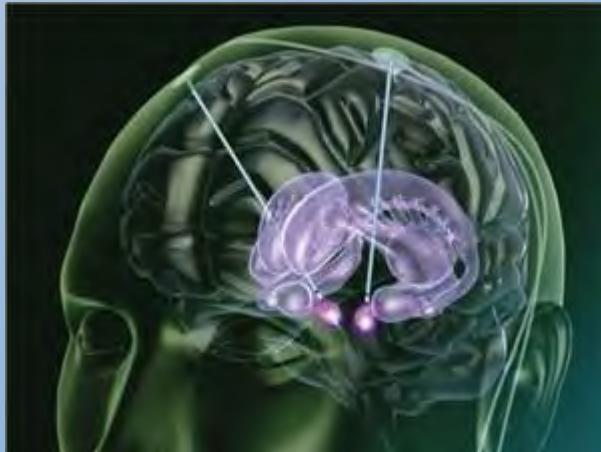
Patienten	1 UWS (Trauma)	4 MCS (2 Trauma, 2 Insult)
Bewertung	CRS-R	FDG-PET



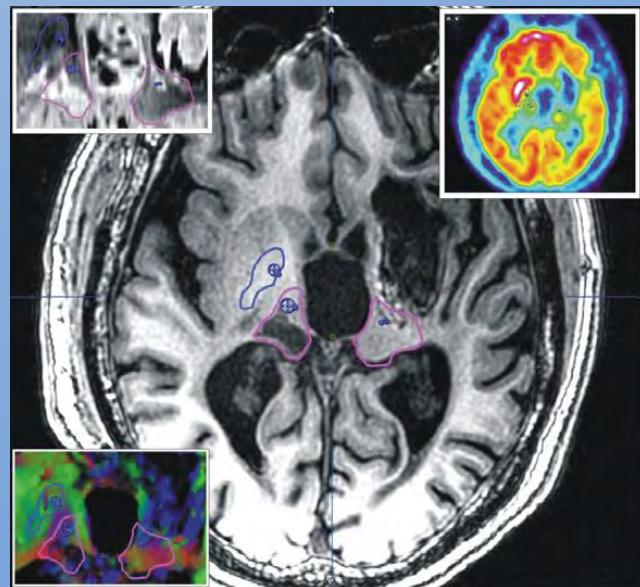
Lemaire J et al. (2018) Deep brain stimulation in five patients with severe disorders of consciousness. Annals of Clinical and Translational Neurology 5(11): 1372-1384

TIEFE HIRNSTIMULATION

Patienten	1 UWS (Trauma)	4 MCS (2 Trauma, 2 Insult)
Bewertung	CRS-R	FDG-PET
Stimulation	5 Mo; bilat. 30-Hz; Pallidum u. Thalamus	



© Foto: Medtronic



Lemaire J et al. (2018) Deep brain stimulation in five patients with severe disorders of consciousness. Annals of Clinical and Translational Neurology 5(11): 1372-1384

TIEFE HIRNSTIMULATION

Patienten	1 UWS (Trauma)	4 MCS (2 Trauma, 2 Insult)
Bewertung	CRS-R	FDG-PET
Stimulation	5 Mo; bilat. 30-Hz; Pallidum u. Thalamus	
Ergebnis	1 MCS u. 1 UWS verbesserten sich in CRS u. FDG	

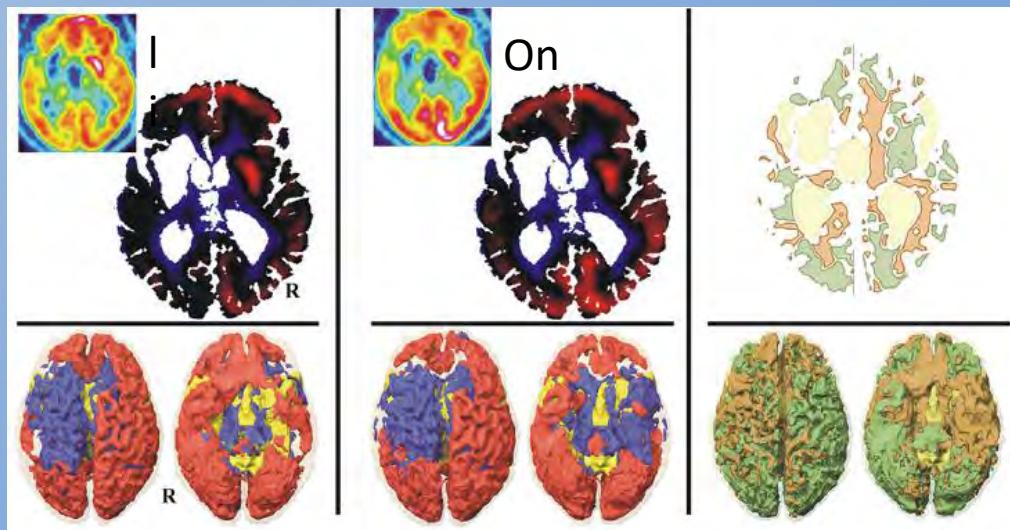
Patient	Baseline	DBS-ON
P1	6.1 ± 1.3 (15)	8.4 ± 1.8 (41) ¹
P2	9.6 ± 2.7 (17)	9.5 ± 1.5 (34)
P3	11.7 ± 1.6 (18)	13.8 ± 2.2 (40) ¹
P4	4.8 ± 1.8 (57)	4.3 ± 1.8 (28)
P5	4.2 ± 3.3 (34)	3.0 ± 1.7 (27)
All	6.3 ± 3.5 (141)	8.4 ± 4.2 (170)
All - P5	6.9 ± 3.3 (107)	9.4 ± 3.8 (143) ¹

¹Significant difference ($P < 0.05$) with baseline

Lemaire J et al. (2018) Deep brain stimulation in five patients with severe disorders of consciousness. Annals of Clinical and Translational Neurology 5(11): 1372-1384

TIEFE HIRNSTIMULATION

Patienten	1 UWS (Trauma)	4 MCS (2 Trauma, 2 Insult)
Bewertung	CRS-R	FDG-PET
Stimulation	5 Mo; bilat. 30-Hz; Pallidum u. Thalamus	
Ergebnis	1 MCS u. 1 UWS verbesserten sich in CRS u. FDG	



Lemaire J et al. (2018) Deep brain stimulation in five patients with severe disorders of consciousness. Annals of Clinical and Translational Neurology 5(11): 1372-1384

TIEFE HIRNSTIMULATION

Patienten	1 UWS (Trauma)	4 MCS (2 Trauma, 2 Insult)
Bewertung	CRS-R	FDG-PET
Stimulation	5 Mo; bilat. 30-Hz; Pallidum u. Thalamus	
Ergebnis	1 MCS u. 1 UWS verbesserten sich in CRS u. FDG	
Nebenwirkungen	Keine schweren Komplikationen bei OP 1 Pat. Bronchopneumonie (12 Tage Intensiv) 1 + während Studie (15 Mo post Intervention)	

Lemaire J et al. (2018) Deep brain stimulation in five patients with severe disorders of consciousness. Annals of Clinical and Translational Neurology 5(11): 1372-1384

STIMULATION DES NERVUS VAGUS



Cyberonics Inc., VNS Therapy®

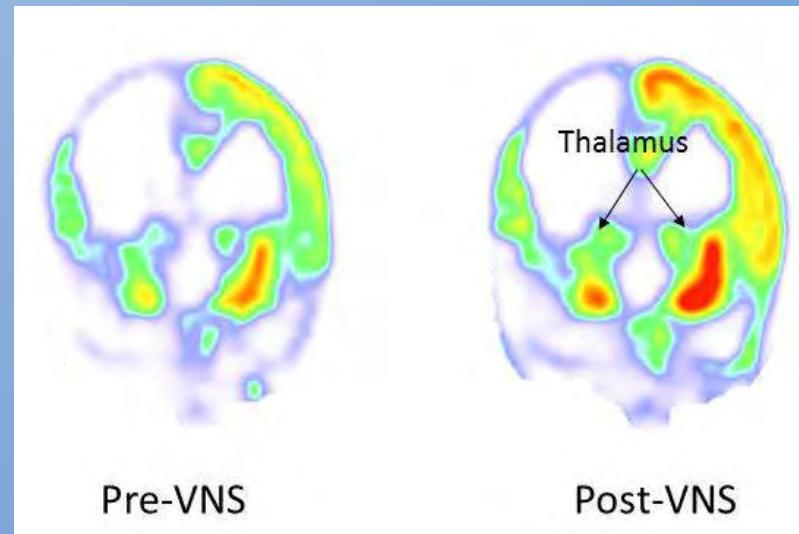
STIMULATION DES NERVUS VAGUS

Patient	1 UWS (Trauma)	15a nach Ereignis
Bewertung	CRS-R	FDG-PET
Stimulation	Ansteigend bis 1,5 mA über 6 Mo	

Corazzol M et al. (2017) Restoring consciousness with vagus nerve stimulation.
Current Biology 27, 979-1001

STIMULATION DES NERVUS VAGUS

Patient	1 UWS (Trauma)	15a nach Ereignis
Bewertung	CRS-R	FDG-PET
Stimulation	Ansteigend bis 1,5 mA über 6 Mo	
Ergebnis	CRS-R 5 -> 10 (UWS->MCS)	



Corazzol M et al. (2017) Restoring consciousness with vagus nerve stimulation.
Current Biology 27, 979-1001

TRANSKRANIALE GLEICHSTROMSTIMULATION (TDCS)

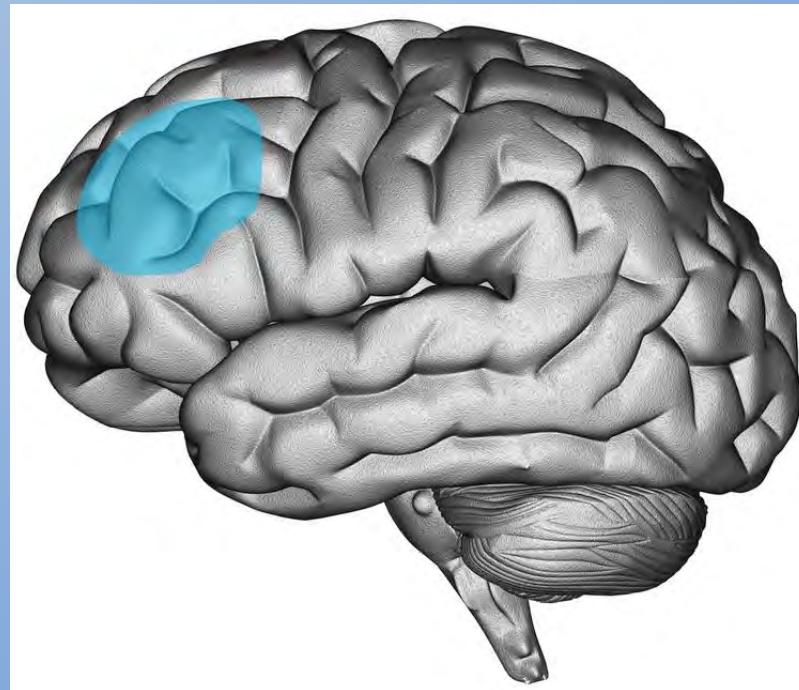


® WordPress.com

Liu S et al. (2022) Effectiveness of transcranial direct current stimulation over dorsolateral prefrontal cortex in patients with prolonged DOC: A systematic review and meta-analysis. *Front. Neurol.* 13:998953

TRANSKRANIALE GLEICHSTROMSTIMULATION (tDCS)

Meta-Analyse
8 Studien
Effekte bei MCS (CRS-R)
Keine Langzeitergebnisse



® Martin Arns, Psychiatry & Brain Stimulation

Liu S et al. (2022) Effectiveness of transcranial direct current stimulation over dorsolateral prefrontal cortex in patients with prolonged DOC: A systematic review and meta-analysis. *Front. Neurol.* 13:998953

TRANSKRANIELLE MAGNETSTIMULATION (TMS)

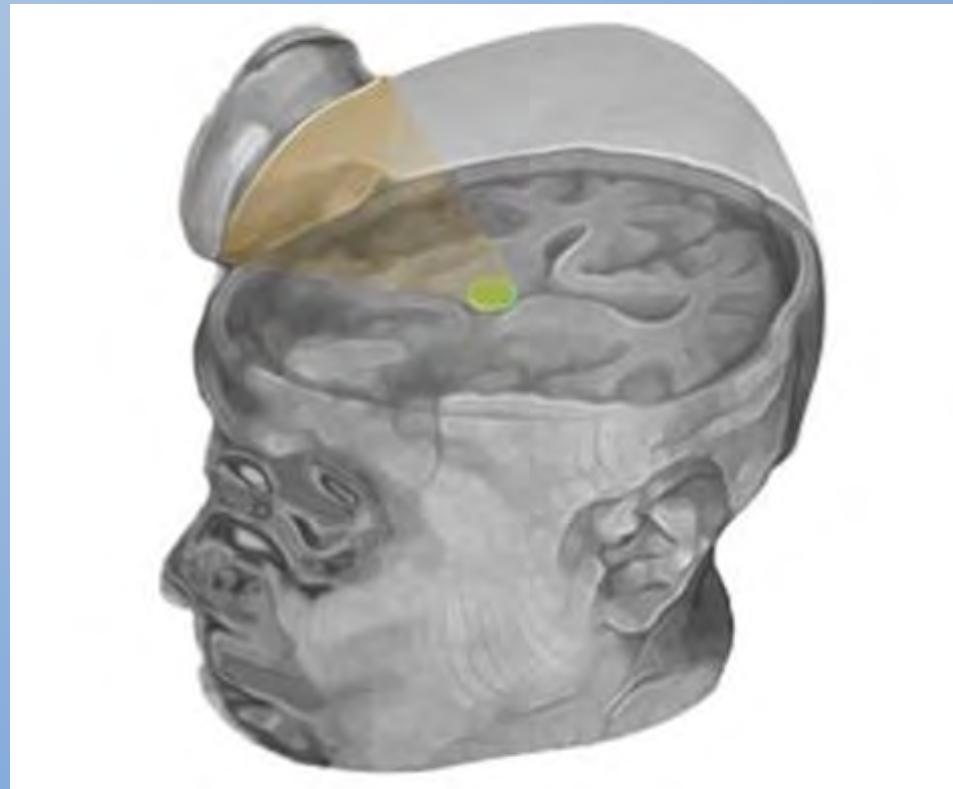


TRANSKRANIELLE MAGNETSTIMULATION (TMS)

Patienten	11 UWS	5 MCS
Bewertung		CRS-R
Stimulation		DLPFC; 10 Hz; 1000 Impulse/d; 20 Tage
Ergebnis		5 MCS u. 4 UWS verbesserten sich in CRS
NW		Krampfanfälle

Xiaoyu Xia et al. (2017) Effects of 10 Hz Repetitive Transcranial Magnetic Stimulation of the Left Dorsolateral Prefrontal Cortex in DOC. Front. Neurol. 8:182

ULTRASCHALLSTIMULATION DES THALAMUS



ULTRASCHALLSTIMULATION DES THALAMUS

Patienten	3 MCS
Bewertung	CRS-R
Stimulation	LIFU Thalamus; 650 KHz; 10x30 sec.
Ergebnis	Besserung bei 2 von 3
NW	keine

HYPERBARE OXYGENIERUNG (HBO)



HYPERBARE OXYGENIERUNG (HBO)

O₂ löst sich im Plasma (\uparrow art. pO₂)

\downarrow Ödem

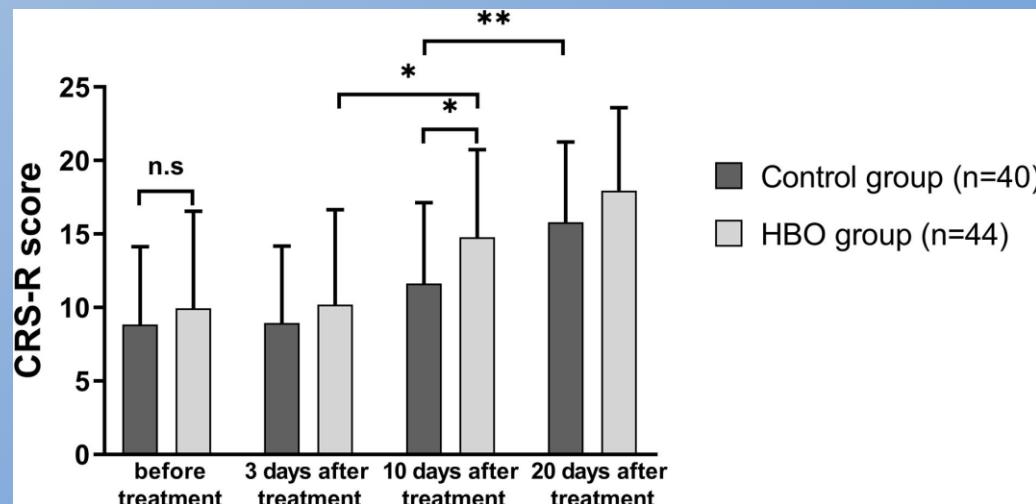
\downarrow Entzündungsmediatoren

\downarrow Ischämieschäden

\downarrow Lipidperoxidation an Myelinscheden

HYPERBARE OXYGENIERUNG (HBO)

Patienten	44 HBO, sTBI	40 Kontrolle, sTBI
Bewertung	CRS-R	u.a.
Stimulation	2.0 atmosphere; 60 min; 20 Therapien	
Ergebnis	1 MCS u. 1 UWS verbesserten sich in CRS u. FDG	



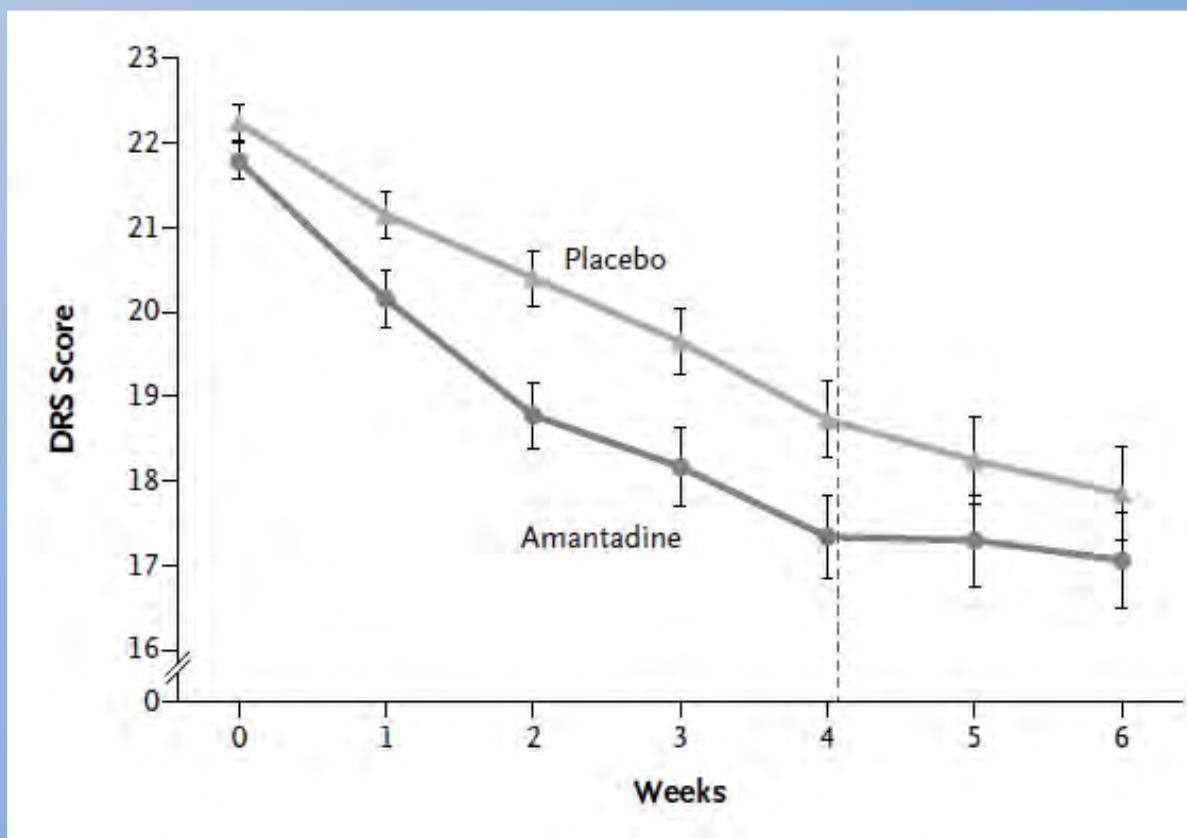
Chen Yuwen et al. (2022) Hyperbaric oxygen therapy promotes consciousness, cognitive function, and prognosis recovery in patients following TBI through various pathways. Front. Neurol. 13:929386

AMANTADIN

Patienten	184 TBI (120 MCS, 64 UWS) / 1-4 Mo nach TBI
Bewertung	DRS (0-29)
Stimulation	2 x 100-200mg für 4 Wochen

Giacino J.T. et al. (2012) Placebo-Controlled Trial of Amantadine for Severe Traumatic Brain Injury. N Engl J Med 366:819-26

AMANTADIN



Giacino J.T. et al. (2012) Placebo-Controlled Trial of Amantadine for Severe Traumatic Brain Injury. N Engl J Med 366:819-26

AMANTADIN

Empfehlung der American Academy of Neurology

- 100-200mg 2x täglich über 4 Wochen
 - 1-4 Monate nach TBI
 - 16-65 Lbj

Giacino JT et al. (2018) Practice guideline update recommendations summary:
Disorders of Consciousness. Neurology 91:450-460

AMANTADIN

Nebenwirkungen	Übelkeit, Unruhe, Schlafstörungen, Konzentrationsstörungen, Leukozytopenie
Kontraindikationen	Schwangerschaft, Epilepsie, NI, HI, Glaukom

Empfehlung der American Academy of Neurology

- 100-200mg 2x täglich über 4 Wochen
 - 1-4 Monate nach TBI
 - 16-65 Lbj

Giacino JT et al. (2018) Practice guideline update recommendations summary:
Disorders of Consciousness. Neurology 91:450-460

ZOLPIDEM

Patienten	84 (UWS u. MCS / TBI u. nTBI / > 4 Mo nach Ereignis)
Bewertung	CRS
Stimulation	10 mg Zolpidem 1x
Ergebnis	~ 5 % (> 5 Punkte in CRS für wenige Stunden)
NW	Danach manchmal verstärkte Somnolenz Agitation (Dekanülierung)

Whyte J et al. (2014) Zolpidem and restoration of consciousness. Am J Phys Med Rehabil. 93(2):101-13



GERIATRISCHE GESUNDHEITSZENTREN DER STADT GRAZ ALBERT SCHWEITZER KLINIK

PRIM. DR. GERALD PICHLER MSc
GERALD.PICHLER@STADT.GRAZ.AT

