Characterization of Late Cognitive Recovery After Cardiac Arrest and Prolonged Coma

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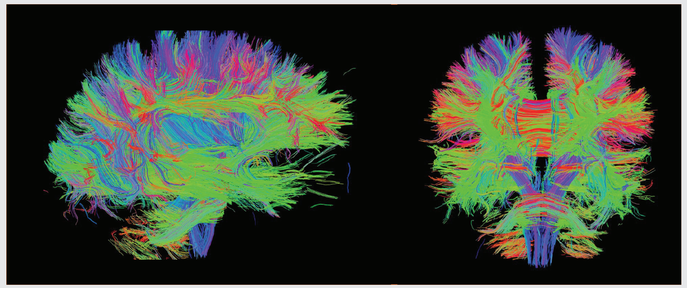
Motivation

- Understanding the extent of potential neurological recovery in post-cardiac arrest patients in prolonged coma following global hypoxic injury remains clinically challenging; cases are rarely reported and recovery is not well characterized.[1]
- In general, functional recovery beyond that achieved in the first 6 months after hypoxic brain injury is expected to be minimal.[2]
- Case studies may ultimately provide insights into the mechanisms[3] and overall capacity for late-recovery in some post-cardiac arrest patients.[4,5]

Case History

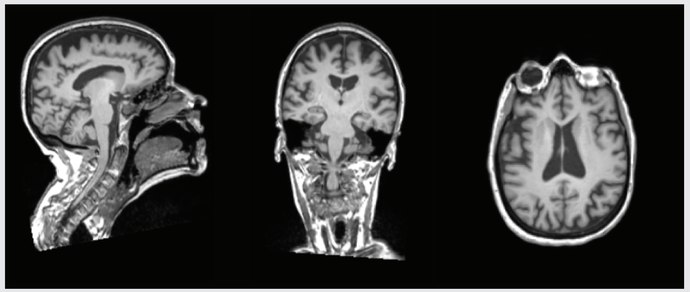
- A 51 year-old female ("IN459") suffered a cardiac arrest after an occipital nerve block injection to treat migraines. Immediate CPR was performed. Initial rhythm was PEA, ROSC after 12 minutes.
- Therapeutic Hypothermia was initiated, with 24hrs cooling (33˚C) & 24hrs rewarming. Early continuous EEG monitoring revealed burst-suppression and super-refractory status epilepticus.
- Patient had no response to painful stimuli, and remained in eyes-closed coma for more than two weeks. No command following was observed until approximately 2 months.
- We evaluated her long-term recovery over 3 research admissions: at 7, 19, and 31 months post-arrest.

Neuroimaging



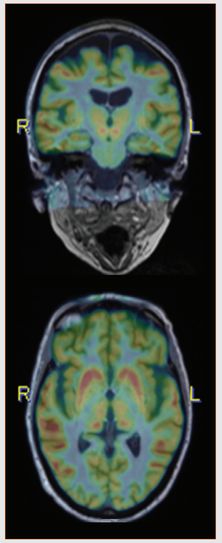
Diffusion Texture Map. *Representative of the fiber direction and Fractional anisotropy (FA). Red: right-left, blue: superior-inferior, green: anterior-posterior, brightness: degree of anisotropy.*

Diffusion Tensor Imaging. Visualization of white-matter tractography at Month 7 demonstrates widespread conservation of intra- & inter-hemispheric connectivity and strength of network integrity.

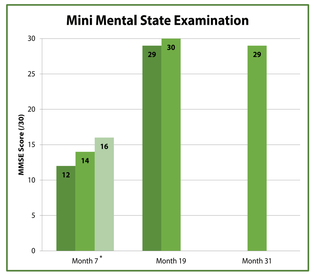


MRI Imaging. Imaging studies at Month 7 show preservation of cortical volume and maintenance of grey-white differentiation.

^{18}F-FDG PET. Study of resting state brain metabolism at Month 7 admission reveals symmetry across hemispheres, bilateral striatal & thalamic activity (SUV 6-8, normal range).



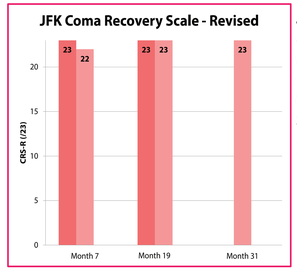
Cognitive and Behavioral Assessments



**Select questions not tested due to motor impairments.*

MMSE. *Assesses visual-spatial skill, language, object identification, attention, writing, and orientation.*

- The patient was unable to orient (believed the year to be 1985) on 1st admission. She required prompting with categories or multiple choices to answer short term memory questions (e.g. Recall 3 unrelated objects named earlier) on all three visits.

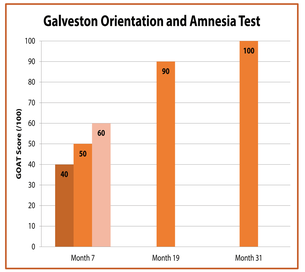


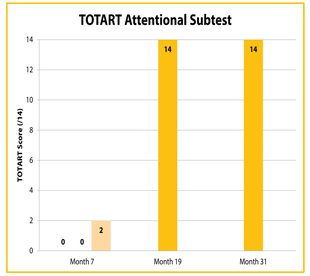
JFK CRS-R. *Assesses auditory, visual, motor, and verbal function, arousal and communication channels. Distinguishes Coma, VS, and MCS.*

- The patient was in the Confusional State by the 1st research visit (maximal scores). Only 1 point lost on 1st admission for reliable communication.

GOAT. *CAP Subscale. Assesses memory of injury and orientation to person, time, and place.*

- The patient's memory deficits led to no recall (1st research admission) then inconsistent recall (2nd admission) of events immediately pre- and post-injury, as well as of the injury event itself. She failed to orient correctly to time (month/year) on 1st admission, improved by 2nd admission.



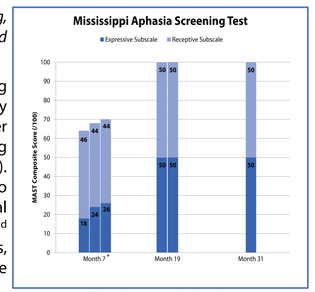


TAS. *CAP Subscale. Count to 20 forward and backward, repeat for months of the year.*

- The patient frequently trailed off after first few responses or failed to begin during testing on both numbers and months at 1st research admission. Task competence achieved by 2nd admission. Examiners noted focus and reaction time improved between 2nd and 3rd admission.

MAST. *Assesses changes in reading, writing, automatic speech and language fluency.*

- Points lost on 1st testing involved short term memory (failure to repeat phrase longer than 5 words and following serial movement instructions). The patient was able to complete testing of verbal fluency and writing by the 2nd and 3rd research admissions, writing completely the phrase "under the black bridge."



**Verbal fluency + writing/spelling not tested due to functional impairments.*

Summary

- Patient IN459 initially demonstrated several unfavorable prognostic signs in the setting of hypoxic brain injury after cardiac arrest. Only minimal meaningful neurological recovery was expected.
- We provide evidence of her significant and continued recovery throughout our observation period (up to 31 months), ultimately achieving sufficient functional independence to perform activities of daily living.
- Cognitive and behavioral assessments showed marked improvement across tested domains, including: attention, orientation, and operative language use, though short term memory deficits persist. Patient now referred for full neuropsychological evaluation.
- This case demonstrates remarkable ongoing recovery for years following cardiac arrest and prolonged coma. These findings invite broad consideration of the underlying mechanisms of slow neuronal recovery following severe hypoxic brain injury.

MRI Shows No Hypoxic Injury Above Tentorium (Day 13)

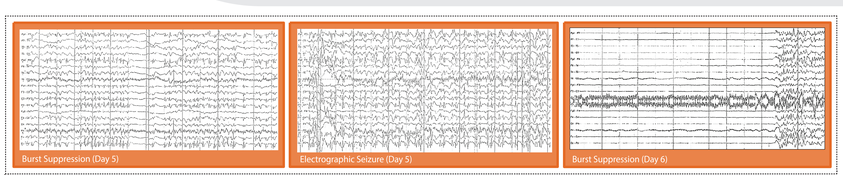
SSEP: N20 R&L Present (Day 13)

EEG Unreactive (Day 1-3) , Burst-Suppressed (Day 1-11, 14-15), Super-Refractory Status Epilepticus (Day3-6, 11-14), SIRPIDs (Day 2-17)

Spont. Eye Opening (Day 17)

Pupils+ Cough+ Gag+ Throughout, Corneal- (<Day 21)

Command Following (>Day 54)

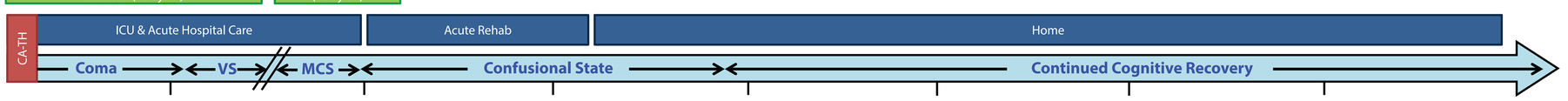


AT HOSPITAL DISCHARGE: Patient is alert, but with severe dysarthria. She can transfer to chair but imbalance prevents walking or standing. (Day 92)

RESEARCH ADMISSION 1: Patient is not oriented to place or time. She is conversant, but confused, suffering severe short-term memory deficits. (Month 7)

RESEARCH ADMISSION 2: Patient is oriented x3, approaching baseline cognitive function. Her fine motor skills are limited, but she attempted writing phrases. (Month 19)

RESEARCH ADMISSION 3: Patient performs activities of daily living mostly independently. She is animated and spontaneous in conversation. Imbalance & short term memory deficits persist, and prevent return to employment. (Month 31)



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