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Multi-centric Gliomas: Exploring the Feasibility of Multi-modal Sensory Stimulation in Rehabilitation- A Case Study

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Abstract

Multi-centric gliomas, characterized by tumors located in different brain lobes and hemispheres, makes significant treatment challenges and lead to poor patient outcomes. This study explores the use of Multi-modal Sensory Stimulation (MSS) in the rehabilitation of patients with these complex tumors. Due to the dispersed nature of the gliomas, traditional treatments often struggle to effectively target the affected areas, resulting in limited success. MSS showed promising results by improving altered sensorium, a common issue in patients with multi-centric gliomas. The integration of coma stimulation programs into rehabilitation protocols led to notable cognitive and functional recovery. This study suggests that MSS can provide a valuable rehabilitative approach, potentially improving the quality of life and prognosis for patients with multi-centric gliomas. As traditional treatments continue to face challenges, innovative approaches like MSS offer new hope for enhancing patient outcomes.

Keywords: Coma stimulation • Multi-centric glioma • Neuro-rehabilitation • Multi modal sensory stimulation • Brain tumors • Sensory stimulation

Introduction

This study presents a rare case of high-grade multi-centric glioma, characterized by multiple independently arising tumors across different brain lobes [1,2] Unlike solitary gliomas, these non- metastatic tumors represent only 2-5% of all gliomas and pose significant treatment challenges with a generally poor prognosis. This case explores the innovative use of Multi-modal Sensory Stimulation (MSS), particularly coma stimulation, to address severe sensorium deficits in these patients. While MSS has been used in other neurological conditions, [3] its application in multi-centric gliomas remains underexplored. This study highlights MSS as a promising rehabilitative strategy, potentially improving outcomes where traditional treatments are limited.

Case Presentation

A 44-year-old male was admitted to the hospital on March 28, 2021, presenting with a 19-day history of altered sensorium. His symptoms initially began in 2019, marked by recurring episodes of nausea and vomiting. A general physician diagnosed gastritis, but despite regular medication, the symptoms persisted. Over time, the patient developed generalized weakness and balance issues, leading to a week-long hospitalization where blood tests and an endoscopy led to a diagnosis of peptic ulcer. While vomiting subsided and there was some improvement in balance, he was discharged without a clear resolution of his underlying issues. Over the next three months, the patient's condition continued to decline, with increasing weakness, sensitivity to light, worsening balance, mood changes, slurred speech, and hallucinations. Upon readmission, treatment was initiated for both the peptic ulcer and an apparent psychiatric condition, but his health deteriorated further. He experienced worsening balance and an epileptic episode, eventually becoming bedridden by December 2020.

In a surprising twist, the patient showed spontaneous recovery over the following three months. His speech and vision improved, weakness decreased, and his balance and appetite normalized. However, by March 2021, his symptoms returned, culminating in a comatose state, which led to another hospitalization. Extensive diagnostic testing, including High-Resolution Computerized Tomography (HRCT) and MRI scans, Figure 1 revealed significant brain abnormalities. MRI findings showed an extension

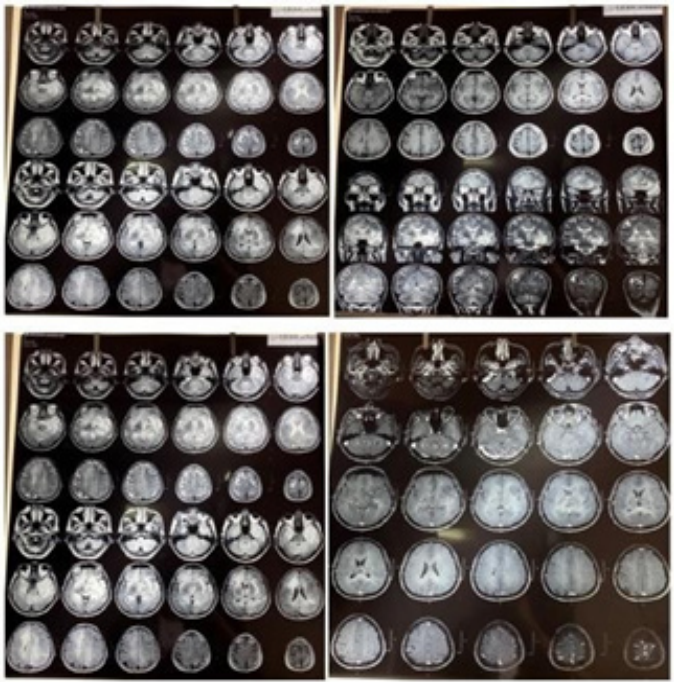

Figure 1. MRI findings.

of the brainstem lesion up to the cervico-medullary junction, effacement of the left lateral ventricle with a slight midline shift, and a well-defined lesion

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in the cerebellum with hyper-intensity and diffusion restriction. Additionally, hyper-intensity was detected across several regions of the brain, including the bilateral parietal, right frontal, and temporal lobes, insular cortices, optic pathways, thalami, splenium, cerebral peduncle, and the pontine region.

A follow-up MRI two months later showed persistent hyper-intense signals in the temporal and limbic lobes, with patchy enhancement in the left side, prompting a biopsy. The patient was ultimately diagnosed with high-grade multi-centric glioma. Surgical intervention was deemed infeasible, and he was transferred to Father Muller Medical Hospital, where he underwent posterior fossa exploration *via* retro-mastoid suboccipital craniectomy on April 15, 2021, under general anesthesia. Physiotherapy began on April 3, 2021, prior to surgery, when the patient had a Glasgow Coma Scale (GCS) score of 7/15 and was rated at level 2 on the Rancho Los Amigos (RLA) scale. Initial treatment included positioning, Passive Range Of Motion (PROM) exercises for the upper and lower limbs, and chest physiotherapy to support respiratory function.

Following the surgery patient's post-operative GCS improved to 8/15, with RLA remaining at stage 2. A patient-centered multimodal sensory stimulation approach was then introduced, designed to stimulate coma arousal and prevent secondary complications. This approach involved 7-8 hours of daily sensory stimulation across five sensory domains: visual, gustatory, tactile, proprioceptive, and auditory. Visual stimulation (Figure 2) involved tracking a flashlight, while gustatory stimulation was achieved using honey and lemon-dipped swabs. Tactile stimulation (Figure 3) utilized textured cloths, and the patient's position was adjusted every two hours to prevent pressure sores. Proprioceptive stimulation involved (Figure 4) passive joint movements, and auditory stimulation included family members speaking to the patient about daily life. By the sixth day, the patient began responding to family members' voices, demonstrating early signs of progress (Table 1). This comprehensive, structured approach was crucial in fostering recovery.

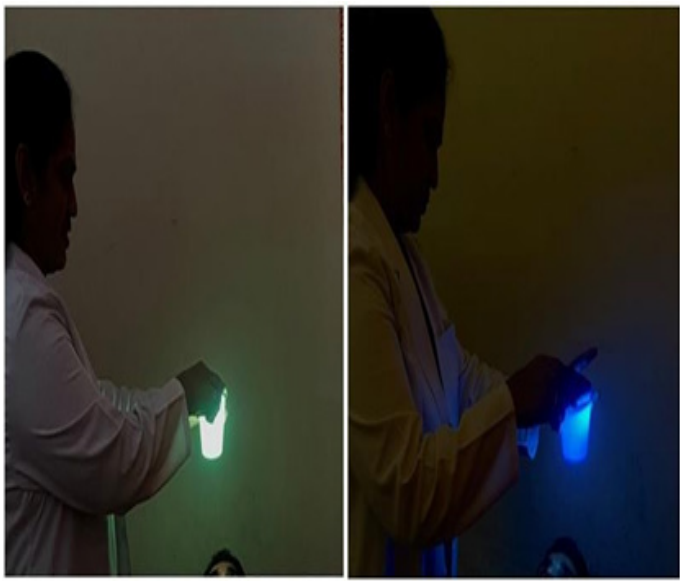

Figure 2. Visual stimulation.

Figure 3. Tactile stimulation.

Figure 4. Proprioceptive stimulation.

Table 1. Treatment techniques and values on scales of level of consciousness.

DOT	Treatment Given	GCS	RLA	MMSE
Preop	PROM B/L UL, LL, Stretching, Positioning	E2VTM5	Level 2	0
	Postop			
Day 2	PDV, Segmental expansion exercises, Tracheal tickle, PROM B/L UL, LL, Stretching, Positioning	E2V1M5	Level 2	0
Day 3	PDV, Segmental expansion exercises, Tracheal tickle, PROM B/L UL, LL, Stretching, Positioning	E2V1M5	Level 2	0
Day 4	Coma Stimulation, PDV, Segmental expansion exercises, Tracheal tickle, PROM B/L UL, LL, Stretching,Positioning	E2V1M5	Level 2	0
Day 5	Coma Stimulation, PDV, Segmental expansion exercises, Tracheal tickle, PROM B/L UL, LL, Stretching, Positioning	E2V1M5	Level 2	0
Day 6	Coma Stimulation, PROM right UL, LL, AAROM left UL, LL, Stretching, Positioning	E3V1M5	Level 3	0
Day 7	Coma Stimulation, PROM right UL,LL, AAROM left UL, LL, Stretching, Positioning	E3V2M5	Level 3	0
Day 8	Coma Stimulation, PROM right UL, LL, AAROM left UL, LL, Stretching, Positioning	E3V2M5	Level 3	0
Day 9	Coma Stimulation, PROM right UL, LL, AAROM left UL, LL, Short sitting with maximum support, Stretching, Positioning	E3V2M5	Level 3	0
Day 10	Coma Stimulation, PROM right UL, LL, AAROM left UL, LL, Short sitting with maximum support, Stretching, Positioning	E3V3M5	Level 4	0

Day 11	Coma Stimulation, PROM right UL, LL, AAROM left UL, LL, Short sitting with maximum support, Stretching, Positioning	E4V3M5	Level 4	0
Day 12	Coma Stimulation, PROM right UL, LL, AAROM left UL, LL, Short sitting with maximum support, Stretching, Positioning	E4V3M5	Level 4	0
Day 13	AAROM B/L UL, LL, Sit to stand with maximum support, Sitting on chair with maximum support, Stretching, Positioning	E4V3M5	Level4	0
Day 14	AAROM B/L UL, LL, Sit to stand with maximum support, Sitting on chair with maximum support, Stretching, Positioning	E4V3M5	Level 4	0
Day 15	AAROM B/L UL, LL, Sitting on chair with moderate support, Stretching, Positioning	E4V3M5	Level 5	0
Week 3-4	AROM B/L UL and LL, Supine to sit (min), Short sit (min), Sit to stand (mod), Wheelchair mobilization (transfer- max)	E4V3M6	Level 6	0
Week 5	AROM B/L UL and LL, Supine to sit, Short sit, Sit to stand (mod), Wheelchair mobilization (transfer-mod)	E4V3M6	Level 6	0
Week 6	Strengthening B/L UL and LL, Supine to sit, Short sit, Sit to stand (min),Marching, Stepping	E4V4M6	Level 7	19

DOT: Day Of Treatment, GCS: Glasgow Coma Scale, RLA: Rancho Los Amigos Scale, MMSE: Mini-Mental Status Examination, PROM: Passive Range Of Motion, UL: Upper Limb, LL: Lower Limb, PDV: Postural Drainage with vibration, AAROM: Active Assisted Range of Motion, AROM: Active Range of Motion, Max: Maximum support, Mod: Moderate support, Min: Minimum support

Discussion

This case study aimed to investigate the impact of a structured multimodal sensory stimulation program on a patient in a comatose state following surgery for multi-centric glioma. The results of this study revealed that intensive and targeted multisensory stimulation contributed to the patient's gradual recovery of consciousness over a period of six weeks. Coma, characterized by a complete lack of responsiveness to external and internal stimuli, is a state of impaired arousal and represents a failure of the brain's ability to engage with its environment [4]. It is important to differentiate between arousal and consciousness, as the latter encompasses both arousal and awareness, requiring functional cortical and brainstem pathways. Sensory stimulation is a strategic approach to enhancing consciousness by activating various sensory pathways, facilitating stimulus transmission, and thereby promoting a more rapid and comprehensive recovery of consciousness [3,5]. While the effectiveness of coma stimulation programs is acknowledged in the rehabilitation context, the scientific establishment of their efficacy remains complex due to the variability in states of reduced consciousness and the challenges in conducting standardized studies.

The structured multimodal sensory stimulation program implemented in this study involved a collaborative effort between healthcare professionals and family members [4-7]. Mobilization was a key component of the program to counter the negative effects of immobility associated with a vegetative state. Visual stimulation was employed using a flashlight and bright objects to elicit visual tracking responses. Auditory stimulation utilized the voices of family members to engage the patient's auditory senses. Gustatory stimulation involved using honey and lemon-dipped swabs, while tactile stimulation encompassed textured materials applied to different body surfaces. This multimodal approach not only facilitated cognitive improvement but also enhanced the patient's interaction with their environment. The patient's progress was measured using the Glasgow Coma Scale (GCS), Rancho Los Amigos Scale (RLA), and Mini-Mental Status Examination [8] (MMSE). The results were encouraging, indicating a shift from minimal responsiveness and cognitive impairment to heightened consciousness and cognitive function. Over the treatment period, the patient's GCS improved from 8/15 to 14/15, RLA progressed from the second stage to the sixth stage, and the MMSE score reached 19/30.

While the multimodal sensory stimulation program yielded positive outcomes in this case, it is essential to acknowledge the limitations of this study, including the uniqueness of each patient's response to stimulation and the complexity of interpreting results in a comatose state. Additionally, the lack of established benchmarks for the effectiveness of coma stimulation programs adds to the challenge of evaluating their impact.

Conclusion

In conclusion, this study provides valuable insights into the potential benefits of a structured multimodal sensory stimulation program for patients in a comatose state. While the precise mechanisms underlying consciousness recovery remain intricate, the positive trends observed in this case warrant further exploration through larger-scale studies. As the scientific understanding of consciousness and rehabilitation evolves, approaches like multimodal sensory stimulation hold promise as valuable tools in aiding the recovery of individuals in states of reduced consciousness.

Acknowledgement

None.

Conflict of Interest

None.

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