Impact of eclectic cognitive retraining in a case of high-altitude cerebral edema

Amit Chail, Sojan Baby, Rachit Sharma, Amresh Dubey

Department of Psychiatry, Command Hospital (SC), Pune, Maharashtra, Department of Psychiatry, Military Hospital, Barrackpore, West Bengal, India

Address for correspondence:
Dr. Sojan Baby,
Department of Psychiatry,
Military Hospital, Barrackpore,
West Bengal, India.
E-mail: sojan.baby@gmail.com

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Abstract
Cognitive impairment in cases of high-altitude cerebral edema is a less researched area of neuropsychiatry. Usually, it presents with depressive symptoms and can sway the treatment on the lines of organic depressive disorder and pseudodementia. We report one such case of which presented with depressive symptoms with cognitive dysfunction. The diagnosis was later revised to organic amnesic syndrome. His cognitive deficits improved with the use of cognitive retraining, especially with the use of mobile-based applications.

Keywords: App-based cognitive retraining, cognitive remediation, high-altitude cerebral edema, high-altitude illness, organic amnesic syndrome

High-altitude cerebral edema (HACE) is a severe and potentially fatal manifestation of high-altitude illness. It involves the generation of free radicals (due to hypoxia), which further results in neuronal death and cerebral edema. The clinical picture is initially of acute mountain sickness which abruptly progress to unexplained ataxia, confusion, and encephalopathy with nonspecific changes on magnetic resonance imaging (MRI). The resolution may be associated with a decline in cognitive function in the form of transient global amnesia, working memory deficits, or long-term memory deficits. A recent review supported the role of smartphone applications (apps) as intervention tools for cognitive training of older individuals.

We report a case of HACE with cognitive impairment that initially presented as a therapeutic challenge but responded well to an individualized eclectic cognitive retraining involving pharmacological therapy, behavioral therapy, and mobile apps.

Case report
A 40-year-old security personnel, developed sudden onset confusion and ataxia after a week of reaching Leh in December 2016. He was diagnosed with a case of HACE. He was managed in the hyperbaric chamber, given supplemental...
oxygen followed by immediate descent to plains. His initial symptoms (confusion and ataxia) resolved in the next 2–3 weeks. However, he was noted to have amnesia (both retrograde and anterograde). He could not recognize even his family members and was aloof and apathetic.

Over the next 2–3 months, he was preoccupied about his memory deficits and had depressive symptoms. In March 2017, he had visual and auditory hallucinations lasting 2–3 days, which led to psychiatric consult. He also had cognitive deficits, which were initially attributed to his affective and psychotic symptoms. He was treated with injection haloperidol SOS and tablet nortriptyline 75 mg with which his mood symptoms improved partially over the next 5–6 weeks.

Subsequent evaluation revealed Mini-Mental State Examination (MMSE) score of 19/30 and Addenbrooke’s Cognitive Examination (ACE-III) score was 35/100 (suggestive of significant dysfunction). In addition, he had deficits in arithmetic, verbal fluency, and Motor Luria test. His relevant hematological and biochemical investigations and MRI of the brain were normal.

He was diagnosed with a case of Organic amnesic syndrome not induced by alcohol and other psychoactive substance. He also had low backache, difficulty in assuming a straight posture and walked with a stick. Consultation at the orthopedic center did not reveal any bone or joint pathology or any neurovascular compromise.

In April 2017, a personalized, eclectic approach was implemented using the following:

- Mobile apps (Luminosity, Mind Games, and CogniFit Brain): 5–10 min each, twice a day
- Sudoku: once a day. It was started at the beginner level and the level of difficulty was increased after he successfully completed five consecutive games of the previous level
- Newspaper reading and writing comprehension passages
- Supervised scheduled physical training and Yoga: He began at 15 min exercise and yoga daily and progressed to 30 min twice daily after 6 months
- Occupational therapy: He was trained in technical skills of his trade by another colleague
- Pharmacological treatment. Tablet piribedil (150 mg daily in divided doses) and antidepressants
- In addition, his family members and workplace were sensitized about the environmental modifications required for his faster recovery.

### Course of illness

Treatment commenced in inpatient setting and was closely monitored by the treating team for initial 5–6 weeks. Subsequently, the individual was discharged, and his family members and colleagues took over the daily supervision of his activities. He was followed regularly in OPD.

He continued with this regime for the next 1½ year. Tablet nortriptyline was tapered off and stopped after 9 months. Table 1 shows the progress of his MMSE and ACE-III scores. By August 2018, his cognitive performance improved significantly. His arithmetic skills and verbal fluency also improved. His backache resolved, and he could again walk normally without any support. He had improvement at vocational and social fronts. He relearned technical work and his self-confidence improved.

### DISCUSSION

Cognitive impairments coexisting with mood symptoms cause significant socio-occupational impairment. They often get misdiagnosed as a part of the depressive symptomatology. In the index case, HACE was followed by significant cognitive impairments, affective, and psychotic symptoms.

The persistent cognitive deficits and the resultant socio-occupational dysfunction would have led to him to lose his job, which would have resulted in further deterioration of his psychological and social functioning. There is limited Indian data on cognitive retraining in cases of HACE and long-term follow-up. In the absence of any published protocols for such eclectic cognitive retraining, the treating team improvised and personalized the therapy. This unique therapeutic trial in a resource limited setting makes it a learning case.

In our case, cognitive retraining apps were chosen based on their ratings and target domains. These were administered under the supervision of the treating team. Like most other therapies, matching the patient requirements with the app needs to be done by the therapist.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will

| Scale   | April 2017 | August 2017 | February 2018 | August 2018 |
|---------|------------|-------------|---------------|-------------|
| MMSE    | 19         | 20          | 23            | 24          |
| ACE-III | 35         | 43          | 68            | 82          |

MMSE – Mini-Mental State Examination; ACE-III – Addenbrooke’s Cognitive Examination III
not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**
There are no conflicts of interest.

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