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Impact of early physiotherapy intervention in managing homonymous hemianopia due to posterior cerebral artery infarct—a case report

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Abstract

Homonymous hemianopia field loss can develop as a result of injury to any part of the retro chiasmal visual pathway and is frequently fatal for subjects. The most common cause of homonymous hemianopia in older persons is ischemic infarction of the occipital lobe and its causes are multifactorial, frequently providing a diagnostic challenge to the clinician and signaling the necessity for a thorough systemic health review. Hemianopia is a loss of half of the visual field in each eye in which the inner or nasal half of one eye and the outer or temporal half of the other eye is affected. We report a case of a 72-year-old male subject who visited our department with complaints of weakness on the right side with difficulty seeing on the right side for 3 days. After undergoing various investigations, it was found that there is an acute infarct in the posterior cerebral artery territory supplying the left medial temporal lobe, medial occipital lobe, left thalamus, and splenium of the corpus callosum. After a physiotherapeutic examination provisionally, he was diagnosed with right hemiparesis and homonymous hemianopia, and thus, we administered an early physical therapy intervention which was found to be effective.

Keywords Homonymous hemianopia, Stroke, Physiotherapy, Rehabilitation

Background

Hemianopia is defined as a loss of the left or right hemifield in both eyes. Homonymous hemianopia affects both the inner or nasal half and the outside or temporal half of each eye [1]. In homonymous hemianopia, the retina is not damaged, but a neurological lesion prevents the primary visual cortex from recognizing the image. Visual field loss in this case may suggest pre-chiasmic, optic chiasmic, post-chiasmic, thalamic visual radiations, or visual cortical damage. The common acquired cause of retrochiasmal lesion is ischaemic stroke which accounts for around 20% of post-stroke complications [1]. The visual field loss pattern will often mirror the site of the lesion [2].

It could be bi-temporal (outer half of each field), half-field loss (Hemianopia) with or without macular involvement, or quarter-field loss. Vision processing may occur in lower areas, such as the lateral geniculate body, but if signals are not received by the cortex, they are not acknowledged as "seen." Impaired visual fields could be taught by continually presenting a light stimulus at the defect's border [3].

Visual field deficiency is the most prevalent visual deficit in individuals with hemiplegia, and it usually arises after damage to the middle cerebral artery near the internal capsule. The prevalence of hemianopia after a

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Fig. 1 Therapist assessing for homonymous hemianopia

right-hemisphere stroke is around 17%. Furthermore, there is a link between the occurrence of visual field deficiencies and visual neglect [4]. The homonymous hemianopia lesion disrupts input to the optic pathways on one side of the brain. This results in the loss of the outside half of one eye's visual field and the inner half of the other eye's visual field. As a result, incoming information from half of the visual environment (left or right) contralateral to the lesion is lost [5].

Homonymous hemianopia subjects may or may not be aware of their visual field loss. While visual acuity is preserved in many subjects, they usually face difficulty in their daily life activities involving the blind side. Infarction affecting the occipital lobe functions is the major cause of hemianopia and this primarily causes visual field loss without any other deficit. Damage to the optic tract also causes impairment in incoming sensory information from the pupil of the eye contralateral to the lesion. Lesions of the optic tract may also lead to pupillary hemiakinesia [6].

Diagnosis of hemianopia is clinically confirmed by visual confrontation, automated perimetry, and MRI [7].

This study presents an unusual case of reversible homonymous hemianopia which was associated with right-side hemiparesis. Rehabilitation strategies aimed to reverse hemianopia showed positive results. The detailed case report, its findings, and treatment strategies are described below.

Case presentation

Informed consent was taken from the subject's attendant in order to use his information for the case report. A 72-year-old male came to the emergency ward of a private hospital in Bhubaneswar with complaints of difficulty in walking, head reeling with difficulty in vision on the right side. The subject was apparently alright before 3 days when he felt weakness over his right side while coming out of the washroom. He was taken to a nearby hospital for primary treatment, where he was diagnosed with CVA (infraction). The subject was a known case of hypertension and type II diabetes mellitus for 5 years.

The subject was referred to a neurological team and a detailed neurological examination was carried out by the team.

On observation, the findings revealed an ectomorphic body type with normal posture. The subject could ambulate independently with a Glasgow Coma Scale (GCS) score of 15 and mini-mental status examination (MMSE) score of 30. On palpation, no tenderness and swelling was present. There was no history of recent trauma or loss of appetite but he had a complaint of disturbed sleep cycle due to head reeling. An examination of the cranial nerve showed an impaired right optic nerve while other nerves were intact.

Snellen chart test score was 20/25. The visual confrontation field test was found to be positive on the right side (Fig. 1). The score of National Eye Institute Visual Function Questionnaire-25 (NEI VFQ-25)[8] was 85 (Table 1). Sensory examination revealed intact superficial, deep, and combined cortical sensation. On motor examination, deep tendon reflexes were normal (2+DTR) and the right-side biceps, wrist flexors, and long finger flexors had a muscle grading score of 3+/5 and lower limb had 4/5 according to Oxford grading of manual muscle testing.

On coordination assessment, mass grasp and circle drawing (non-equilibrium coordination tests) with hand and foot was difficult to achieve with decreased speed and unsteadiness (grade 3 on coordination examination form). On equilibrium tests like standing on one foot,

Table 1 Pre–post score of the case for visual field and ADL

	Pre	Post
NEI VFQ-25	85	36
FIM	5	6

Table 2 A six-week physiotherapy regime

Weeks	Interventions
1	HH intervention:—blind sight training, presenting items on the unaffected visual field (left side visual field), and gradually moving them to midline and then to the affected side Limb intervention:—active movements upper limb 5 times × 3 reps, active movement lower limb 5 times × 3reps
2	HH:—Training was started with adequate extrinsic feedback consisting of verbal cues (turn head to the left) Visual cues (red line marked on the right side of the book, red tape placed on the right-side bed and floor) Limb intervention:—active movements upper limb 10 times × 3 reps, active movement lower limb 10 times × 3 reps, coordination exercise:—finger to nose; finger to finger; finger to doctors finger 10 times exercises for the legs in lying; heel of one leg to opposite leg (shin of the tibia from knee to toe); move the heel of one limb to the opposite leg in a downward direction (knee, sliding down the crest of the tibia to ankle); maintaining sitting; -half-kneeling; -tall kneeling
3	HH:—typoscope training (reading with a slit card between lines):—5 sentence with large font size (according to Snellen chart 20/40) A projected stimulus is given to the blind hemifield and asked to respond as soon as possible Limb intervention:- active movements with minimal resistance upper limb 5 times × 3 reps, active movement with minimal resistance lower limb 5 times × 3 reps, coordination exercise:—finger to nose; finger to finger; finger to therapist finger 10 times and lower limb coordination exercise in sitting -alternate leg is stretched to slide the heel to a position indicated by a mark point on the floor -patient in stride sitting posture and asked to stand and then sit -sit to stand with knees together -in sitting do hip abduction and adduction
4	HH:—typoscope training (reading with a slit card between lines):- 5 to 10 sentence with font size (according to Snellen chart 20/30) gradually increases within a week An audio-visual stimulation, i.e., multisensory stimulation and integration, on which bottom-up strategy is based and it is the part of the compensation technique which is applied to the subject [10] In visual stimulation, a bottom-up strategy refers to the processing of sensory information from the basic features of stimuli, such as colors, shapes, and motion, up to more complex cognitive processing. This approach involves the brain initially responding to the individual features of visual stimuli before integrating them into a higher-level perception. It contrasts with a top-down strategy, where pre-existing knowledge and expectations influence perception Limb intervention:—active movements with minimal resistance upper limb 10 times × 3 reps, active movement with minimal resistance lower limb 10 times × 3 reps, coordination exercise:—finger to nose; finger to finger; finger to therapist finger 10 times; adiokokinesia; patient in stride standing weight is transferred from one leg to other legs -place one foot forward and backward in a straight line and repeat on the other leg
5	HH:- typoscope training (reading with a slit card between lines):- 10–15 sentences with small font size (according to Snellen chart 20/25) gradually increases within week Visual restoration therapy, i.e., near and far focus, pencil exercises, figure eight, tromboning, blinking, clock rotations Limbs intervention:—active movements with moderate resistance upper limb 5 times × 3 reps, active movement with moderate resistance lower limb 5 times × 3 reps, -walk along a winding strip -patient does walk between two parallel lines -patient does walk sideways by placing feet on the marked point

Table 2 (continued)

Weeks	Interventions
6	HH:—typoscope training (reading with a slit card between lines):—15–20 sentence with small font size (according to Snellen chart 20/20) Limbs intervention:—active movements with moderate resistance upper limb 10 times × 3 reps, active movement with moderate resistance lower limb 10 times × 3 reps, LL:—walk and turn around -Walk and change direction to avoid obstacles

sitting forward trunk flexion, walking- tandem, walking in a straight line, and backward walking, the subject was able to maintain balance without handhold support and was able to accept moderate challenges (grade 3 on coordination examination form).

In standing, dynamic balance is affected. Balance examination showed good static and poor dynamic balance. On functional evaluation, subject's Functional Independence Measure (FIM) [9] score was 5 (supervision) for his activities of daily living (ADL) (Table 1).

Investigation

MRI findings showed PCA territory acute infarct in the left medial temporal lobe, medial occipital lobe, left thalamus, and splenium corpus callosum. The CT scan findings suggested left PCA territory acute non-hemorrhagic infarct and mass effect in the form of effacement of occipital and temporal horns of left lateral ventricle and adjacent sulcal spaces along with generalized age-related mild cerebral and cerebellar atrophy.

Functional diagnosis

Based on the above findings, a detailed physiotherapy management was planned for 6 weeks for a case of right hemiparesis with right homonymous hemianopia.

Physiotherapy intervention

A six-week physiotherapy regime was planned as shown in Table 2 and Figs. 2 and 3.

Fig. 2 Balance training

Discussion

HH is a disabling condition that can affect the quality of life of a patient. Physical therapy strategies for HH and their application are limited. Most of the studies use visual restoration therapies as a part of the compensatory technique for the ocular rehabilitation of HH. In this case, we combined visual restoration therapy and balance exercises focusing on the hemiparesis and poor dynamic balance of the case as well [11]. Most of the cases of HH delay starting rehabilitation [4] which leads to a poorer prognosis. We administered an early rehabilitation program focusing on physical therapy intervention. Visual restoration therapy involves neural plasticity-based approaches. Our subject after being given these exercises showed reversal of homonymous hemianopia. This could have been due to the adaptive changes in the brain's visual processing areas that must have encouraged development of new neural connections and enhancing existing ones to compensate for the visual field loss. There are very few studies that focus on the physical therapist's role in the rehabilitation of homonymous hemianopia. The physical therapist plays an important role in the rehabilitation of stroke and at least 60.5% of CVA cases [12] present with visual impairments. Patients can develop effective oculomotor strategies to compensate for their vision field loss by applying systematic audio-visual stimulation of the blind hemifield for a brief duration. This improves oculomotor visual exploration and cross modal spatial attention [10]. And, if these visual impairments are not administered during physical rehabilitation, it can result in frequent falls and disability which will lead to a poorer prognosis of the case. Visual rehabilitation is

Fig. 3 Balance training (tandem standing) (standing on one foot)

often ignored in most of the cases. So, there is a need for the development of newer protocols for physical therapy rehabilitation of homonymous hemianopia.

As a result, and as has been advocated for spatial neglect rehabilitation, we propose that hemianopia rehabilitation involves a combination of compensatory and restorative strategies suited to each subject. Moreover, the majority of research has demonstrated that using both sorts of treatments should help subjects enhance their daily tasks [13].

Conclusion

Because hemianopia involves disruption in early perceptual processes, rehabilitation was formerly thought to be impossible. In this case after a physiotherapeutic examination provisionally, he was diagnosed with right hemiparesis and homonymous hemianopia and a planned interdisciplinary rehabilitation was given which was found to be effective. Early diagnosis and management plays a key role in recovery.

Abbreviations

HH Homonymous hemianopia
MRI Magnetic resonance imaging
CVA Cerebrovascular accident
FIM Functional independence measure
ADL Activities of daily living
PCA Posterior cerebral artery

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Authors' contributions
We affirm that the submission represents an original work that has not been published previously and is not currently being considered by another journal. Also, we confirm that each author has seen and approved the contents of the submitted manuscript. This work was carried out in collaboration with all authors. AA and SC designed the study, wrote the protocol, and wrote the first draft of the manuscript. SS and DB managed the data collection for the study. All authors read and approved the final manuscript.

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Availability of data and materials
The data collected and/or analyzed during the study are available with the corresponding author.

Declarations

Ethics approval and consent to participate
The study was done at Abhinav Bindra Sports Medicine and Research Institute, Bhubaneswar, Odisha, India. Ethical clearance was taken from the ethical committee of the institute and informed consent was taken from all the participants. The study is not a clinical trial, so no clinical trial registration was done. The participants were aware of all procedures involved in the study and a written consent was taken for the same.

Competing interests
The authors declare no competing interests.

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