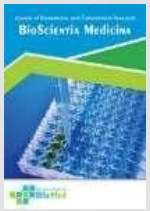
eISSN (Online): 2598-0580



Bioscientia Medicina: Journal of Biomedicine & Translational Research

Journal Homepage: www.bioscmed.com

One and a Half Syndrome and Internuclear Ophthalmoplegia as Neuro-Ophthalmological Manifestations in Patients with Brainstem Stroke: A Case Series

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ARTICLE INFO

Keywords:
Brainstem stroke
Internuclear ophthalmoplegia
Neuroophthalmology
One-and-a-half syndrome

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All authors have reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/bsm.v8i4.969

A B S T R A C T

Background: Brainstem stroke syndrome accounts for 10-15% of all types of strokes, which may result in relatively rare neuroophthalmological manifestations. The aim of this case report is to report findings of one and a half syndrome (OAHS) and internuclear ophthalmoplegia in a patient with brainstem stroke. **Case presentation:** First case, female, 56 years old, came with sudden weakness on the right side of the body. One and a half syndrome was found, namely when asked to glance to the left, conjugate gaze palsy was obtained horizontally, and when asked to glance to the right, there was adduction inability of the left eye (ipsilateral). Right eye abduction was normal with present nystagmus. Paresis of right central CN. VII, XII was present, along with hemiparesis dextra (contralateral). Head CT scan shows hemorrhage in pons and intraventricular. Second case, female, 65 years old, came with a protruding mouth, vertigo, and sudden double vision Internuclear ophthalmoplegia was present, namely an adduction inability of the left eye (ipsilateral) when asked to glance to the right. Right eye abduction was normal with present nystagmus. no abnormalities were seen in the primary position and when asked to glance to the left. Paresis of right peripheral CN. VII, hemiparesis and right (contralateral) hemihypesthesia was present. MRI shows multiple chronic infarcts as well as subacute infarcts in bilateral parietal and pons. **Conclusion:** Clinical knowledge is necessary for topic determination, rehabilitation process and evaluation.

1. Introduction

Brainstem stroke syndromes, also known as crossed brainstem syndromes, refer to a group of syndromes resulting from secondary lesions, most commonly caused by infarction in the brainstem. Brainstem stroke syndromes are classified based on their anatomy. Among all types of brainstem stroke syndromes, the most common type is lateral medullary syndrome (Wallenberg syndrome). However, it is possible for other brainstem stroke syndromes to occur besides Wallenberg syndrome. Posterior circulation strokes involving the brainstem can manifest in ophthalmology. Approximately 20-25% of ischemic strokes involve posterior circulation.[1,2]

One-and-a-half syndrome is a term coined by Fisher in 1976 to describe a syndrome characterized by horizontal movement disorders of the eyeballs, presenting with a combination of ipsilateral conjugate horizontal gaze palsy (one) and ipsilateral internuclear ophthalmoplegia (INO) (half).[3,4] Internuclear ophthalmoplegia (INO) is an ocular movement disorder caused by lesions in the medial longitudinal fasciculus. It is characterized by impaired adduction in the ipsilateral eye of the affected medial longitudinal

fasciculus, accompanied by nystagmus in the normal eye. Approximately 30% of INO cases are caused by infarction and are generally unilateral, occurring in older individuals.[4-6] The objective of this case series is to report the occurrence of one-and-a-half syndrome and internuclear ophthalmoplegia as manifestations of neuro-ophthalmoplegia in patients with brainstem stroke, along with signs, symptoms, physical examination, and diagnostic tests conducted.[1,2,5]

2. Case Presentation

Case report 1

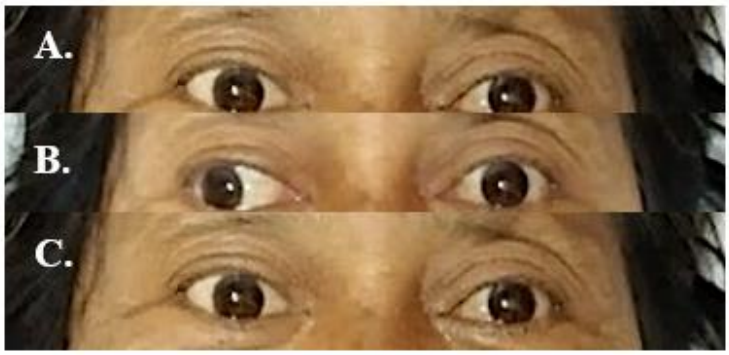

Figure 1. Position of both patient's eyeballs. A) Primary position. B) Right gaze. C) Left gaze.

A 56-year-old woman presented to the Emergency Department of Ciawi General Hospital in January 2023 with complaints of sudden onset right-sided body weakness 12 hours prior to admission, accompanied by drooping of the right corner of the mouth, headache, and blurred vision in the left eye. The headache felt throbbing on the right side of the head, intermittently occurring for the past 5 hours before admission, with a pain scale of 7 exacerbated by activity and slightly relieved by rest. She reported nausea (+), vomiting (+) once with food, photophobia (+), sensitivity to sound (+), and slurred speech (+). The patient has had hypertension for the past 15 years but has not been regularly taking medication for high blood pressure. She only takes amlodipine 1x5 mg when feeling dizzy. The patient is exposed to passive smoking (+) and frequently consumes fried foods and Padang rice dishes. The patient's family history includes hypertension and stroke in her father, who passed away in 2006.

On physical examination, the patient appeared moderately ill, with a conscious level of GCS E4V5M6. Vital signs included blood pressure of 160/90 mmHg (grade 2 hypertension), heart rate of 100 beats per minute (regular, adequate volume, strong pulse), respiratory rate of 22 breaths per minute, thoracoabdominal breathing (no signs of respiratory distress), temperature of 37°C, and SpO_2 of 96%. The patient's BMI was 26.64 kg/m^2 (grade I obesity according to WHO-Asia Pacific and mild obesity according to the Indonesian Ministry of Health).

Upon thoracic examination, rhonchi (+/+) were detected bilaterally in both lung fields. Cardiac impulse pulsation was palpated 3 fingers lateral to the midclavicular line at the fifth intercostal space on the left side, and the left heart border was enlarged, extending 3 fingers lateral to the midclavicular line at the fifth intercostal space on the left side. On neurological examination of the cranial nerves, CN II revealed visual acuity of 6/12 in the right eye, while in the left eye, there was no light perception (NLP) and both visual fields were narrowed. Examination of CN III, IV, and VI showed symmetric positions of both eyeballs, but asymmetric movements of the eyeballs were observed, with nystagmus (+/-). Examination of CN VII revealed central paresis of the right facial nerve. In CN VIII examination, the patient could only hear sounds up to 4 meters with whispered voice testing,

but tuning fork testing was not performed. Examination of CN XII showed right-sided paresis of the hypoglossal nerve. Motor examination revealed the patient's motor strength to be (3333/5555)/(3333/5555) with physiological reflexes ++/++ in the biceps, triceps, patellar, and Achilles tendons, and no pathological reflexes or signs of meningeal irritation were found in the patient.

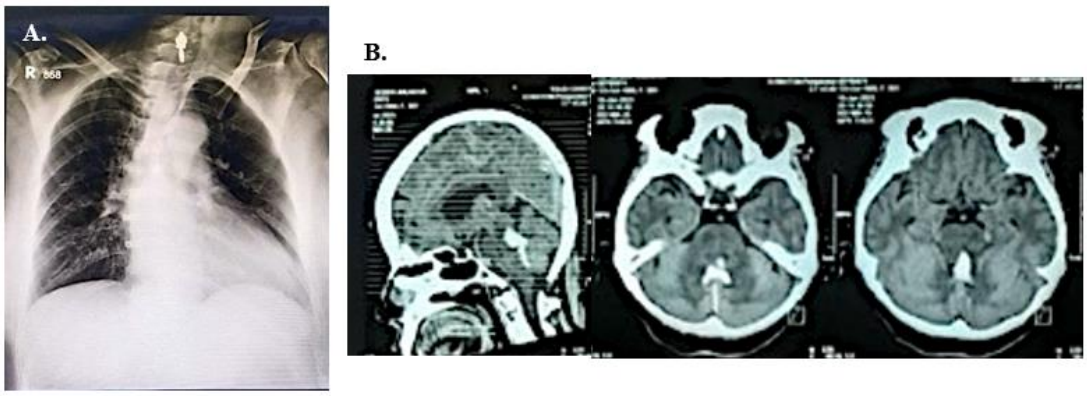

Figure 2. Diagnostic tests for the first patient. A) Chest X-ray results. B) Non-contrast head CT-scan results.

The EKG examination revealed sinus tachycardia accompanied by left axis deviation (LAD). Laboratory tests showed leukocytosis (13,900/µL) and an elevated erythrocyte sedimentation rate (ESR) of 41 mm/hour. Lipid profile examination revealed dyslipidemia characterized by elevated LDL (188 mg/dL) and total cholesterol (227 mg/dL). Chest X-ray showed cardiomegaly with suspected congestive pulmonary edema and bronchopneumonia. Non-contrast head CT-scan revealed intracerebral hemorrhage in the pons with a volume of 0.86 cc, intraventricular hemorrhage, and ischemic cerebral infarction in the pons, left corona radiata, and right thalamus. The patient was managed with a head-up position of 30°, administration of antihypertensive medication in the form of amlodipine 1x5 mg tablet, antibiotics in the form of IV cefotaxime 2x1 gram, tranexamic acid 3x500 mg tablet, neuroprotector in the form of IV citicoline 2x500 mg, IV mecobalamin 2x500 mcg, lipid-lowering medication in the form of atorvastatin 1x20 mg, and IV omeprazole 1x50 mg as a proton pump inhibitor (PPI). The patient was also scheduled for physiotherapy by a rehabilitation medicine specialist and joint consultation and care with neurologists and pulmonologist. There was no specific management for one and a half syndrome in the patient, but lumbar puncture tapping could be considered.

Case report 2

A 65-year-old woman presented to the outpatient clinic of Ciawi General Hospital in March 2023 with complaints of left-sided facial droop accompanied by weakness in the right limbs for the past 4 days. The symptoms occurred suddenly and were not perceived as worsening. She denied experiencing numbness or tingling in the right limbs. The patient also complained of crossed eyes in the left eye. She experienced vertigo without associated tinnitus or hearing impairment for the past 4 days. The vertigo was intermittent and unaffected by head movements. The patient has had hypertension for 3 years and regularly takes amlodipine 1x5 mg and attends regular follow-ups at the internal medicine clinic. Additionally, she has had diabetes mellitus for 3 years and takes metformin 3x500 mg daily.

Figure 3. Position of the patient's eyeballs. A) Primary position. B) Left gaze. C) Right gaze.

Upon physical examination, the patient's vital signs were stable with a blood pressure of 120/80 mmHg, heart rate of 86 beats per minute, respiratory rate of 20 breaths per minute, and body temperature of 36.5°C. Examination of the patient's eyes revealed ipsilateral internuclear ophthalmoplegia (impairment of horizontal eye movements), with the left eye unable to move medially and nystagmus present in the right eye. Examination of other cranial nerves revealed peripheral left CN VII paresis and a positive Romberg test. Motor strength of the patient's extremities was (4444/5555)/(4444/5555), with normal physiological reflexes in the biceps, triceps, patellar, and Achilles tendons. There were no signs of meningeal irritation or pathological reflexes. Sensory examination revealed hypesthesia in the L5-S1 dermatome area on the right side. Laboratory findings showed decreased hemoglobin (11.4 g/dL) and hematocrit (31.9%), as well as increased leukocytes (13,000/µL) on routine blood tests. Fasting blood sugar was normal (102 mg/dL), but the patient's HbA1C level was elevated (10.3 mg/dL). Lipid profile examination revealed elevated LDL (128 mg/dL). Non-contrast head MRI revealed multiple chronic infarctions and subacute bilateral parietal and pontine infarctions.

The management for the patient included administration of neuroprotectors such as IV citicoline 2x500 mg and mecobalamin 2x500 mg, antiplatelet therapy with clopidogrel 1x75 mg, and antihypertensive medications including ramipril 1x10 mg and amlodipine 1x10 mg. The patient was referred to the Rehabilitation Medicine department for physiotherapy by a Rehabilitation Medicine Specialist. There was no specific management for addressing the internuclear ophthalmoplegia experienced by the patient.

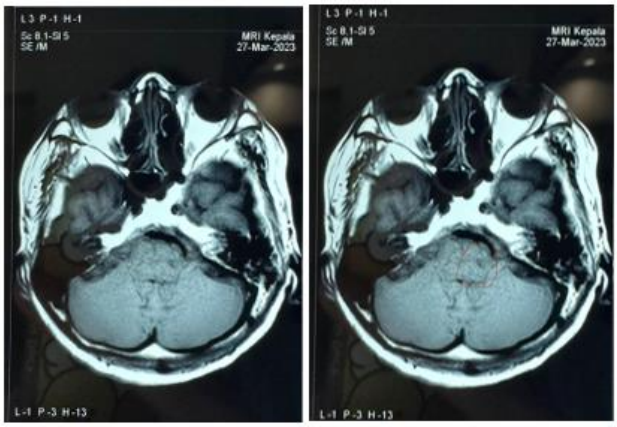

Figure 4. Diagnostic tests for the second patient. results of non-contrast MRI examination for the patient.

3. Discussion

Brainstem stroke syndrome occurs due to ischemia in the structures of the brainstem. The midbrain, pons, and medulla oblongata are components of the brainstem that control basic bodily functions such as consciousness, respiration, proprioception, heart rate, and blood pressure. Therefore, any dysfunction can lead to various symptoms including cranial nerve III – XII disorders, respiratory and cardiac dysfunction, decreased consciousness, and even death.[7–9]

Brain structures involved in horizontal eye movement primarily include the paramedian pontine reticular formation (PPRF), abducens nucleus, and medial longitudinal fasciculus (MLF). Impairment of horizontal eye movement due to damage to these brain structures can be categorized into three main types: (I) horizontal gaze palsy; (II) Ipsilateral internuclear ophthalmoplegia (INO); (III) one and a half syndrome.[3,10-13]

One and a half syndrome is caused by a unilateral lesion in the tegmentum of the pons, leading to damage to the PPRF (or abducens nucleus) and MLF. The most common cause of this syndrome is cerebrovascular disease, followed by lacunar infarcts in the brainstem, demyelination (multiple sclerosis), and infectious etiologies including neurocysticercosis and brainstem encephalitis. Uncommon causes include head trauma, brainstem tumors (primary or metastatic), and astrocytomas. Symptoms of one and a half syndrome are related to visual impairment, and there are no specific symptoms attributed solely to one and a half syndrome; symptoms depend on the underlying cause of the syndrome.[3,14,15]

The primary management of one and a half syndrome is directed towards addressing its underlying cause. Various interventions are undertaken to alleviate symptoms such as diplopia, oscillopsia, or blurred vision. Conservative symptom management includes eye patching/single eye occlusion to manage diplopia. Prisms can also be utilized to minimize diplopia. Although unable to restore eye movements, surgical interventions involving extraocular muscle recession and adjustable sutures may be considered to improve binocular vision, head posture, and as a cosmetic measure.[16,17]

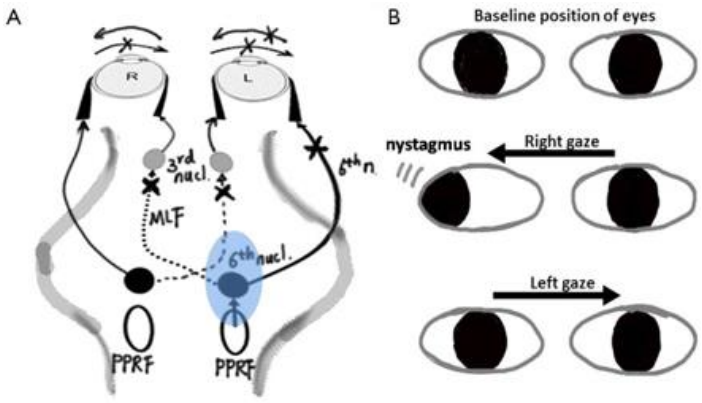

Figure 5. Neuro-ophthalmological Manifestations in OAHS Patients (A) Pathological lesions in the pontine tegmentum can cause damage to the PPRF and MLF; (B) Eye positions, with right gaze, the left eye experiences adduction impairment, while abduction of the right eye is normal with nystagmus, and with left gaze, both eyes experience impaired horizontal movement.

In the first patient, the occurrence of one and a half syndrome is attributed to ischemic cerebral infarction in the pons, left corona radiata, and right thalamus as seen on the patient's head CT-scan. The patient experienced cerebrovascular disease associated with risk factors including uncontrolled hypertension, dyslipidemia, and passive smoking history. Clinical manifestations related to the patient's cerebrovascular disease included headache, right-sided hemiparesis, central right facial nerve (CN VII) paresis, right-sided

hypoglossal nerve (CN XII) paresis, visual impairment, horizontal gaze palsy, and ipsilateral internuclear ophthalmoplegia in the right eye. There was no specific management for the patient, as treatment was focused solely on the cerebrovascular disease experienced by the patient.[3,16-18]

Internuclear ophthalmoplegia (INO) is an eye movement disorder caused by lesions in the medial longitudinal fasciculus (MLF) located in the brainstem. The MLF is a bundle of nerve fibers responsible for transmitting information related to the coordination of eye movements, such as saccadic movements (rapid movements), smooth pursuit movements, and the vestibulo-ocular reflex. The MLF serves as the pathway for all ocular motor nuclei communication and for conjugate gaze (the ability of the eyes to move together smoothly). The main feature of INO is impaired horizontal eye movement, which includes weak adduction in the affected eye and nystagmus in the normal eye.[6,19,20]

In the second patient, physical examination revealed peripheral left CN VII paresis, right-sided hemiparesis, and ipsilateral internuclear ophthalmoplegia (including weak adduction in the left eye and nystagmus in the right eye). Risk factors identified included hypertension and type 2 diabetes mellitus. Non-contrast head MRI revealed multiple chronic infarctions and subacute bilateral parietal and pontine infarctions. Management of the patient was focused on addressing the cerebrovascular disease experienced by the patient. No specific interventions were performed for the patient.[5,20,21]

4. Conclusion

The presented cases highlight the intricate neuro-ophthalmological effects of brainstem stroke, specifically one-and-a-half syndrome (OAHS) and internuclear ophthalmoplegia (INO), underlining the essential role of the brainstem in eye movement coordination. These conditions, resulting from disruptions in the paramedian pontine reticular formation (PPRF) and the medial longitudinal fasciculus (MLF) due to vascular events, exemplify the complex outcomes of brainstem lesions.

5. References

1. Beucler N, Boissonneau S, Ruf A, Fuentes S, Carron R, Dufour H. Crossed brainstem syndrome revealing bleeding brainstem cavernous malformation: an illustrative case. BMC Neurol. 2021; 21: 204.
2. Das JM. Weber syndrome. StatPearls. 2023.
3. Xue F, Zhang L, Zhang L, Ying Z, Al E. One-and-a-half syndrome with its spectrum disorders. Quant Imaging Med Surg. 2017; 7(6): 691–7.
4. Simmons J, Rhodes M. Conservative and surgical management of unilateral and bilateral internuclear ophthalmoplegia (INO)—A Retrospective Analysis. Br Ir Orthopt J. 2022; 18(1): 152–8.
5. Feroze KB, Wang J. Internuclear ophthalmoplegia. StatPearls. 2023.
6. Vasanthapuram VH, Badakere A. Internuclear ophthalmoplegia as a presenting feature in a COVID-19-positive patient. BMJ Case Rep. 2021; 14(4): 10–2.
7. Gowda SN, Munakomi S, Jesus O De. Brainstem stroke. StatPearls. 2023.
8. Tadi P, Lui F. Acute stroke. StatPearls. 2023.
9. Murphy SJ, Werring DJ. Stroke: causes and clinical features. Med (United Kingdom). 2020; 48(9): 561–6.
10. Defran AJ, Forestier C, Morgan E, Al E. Uterine leiomyoma in the context of uterine didelphys: a case report. Cureus. 2023; 15(9): e44791.
11. Akhavan Sigari A, Etemadifar M, Salari M. Complete horizontal gaze palsy due to bilateral paramedian pontine reticular formation involvement as a presentation of multiple sclerosis: A case report. BMC Neurol. 2019; 19(1): 2017–20.
12. Alshahrani AM. Horizontal gaze defect as a result of subcortical stroke: case report and

review of the literature. Case Rep Neurol. 2021; 13(1): 140–4.
13. Chu N, Beecher G, Hussain MW. Supranuclear horizontal gaze palsy following anterior internal capsule hemorrhage. Can J Neurol Sci. 2020; 47(6) :822–3.
14. Almutlaq A, Richard A. Eight-and-a-half syndrome: one-and-a-half syndrome with peripheral facial nerve palsy. Cmaj. 2018; 190(16): E510.
15. Goncalves DB, Barreira RP, Torres TZM, Correa BM, Al E. Vertical one-and-a-half syndrome in a patient with pecheron artery ischemia: a case report. Radiol Case Rep. 2021; 16(12): 3908-3910.
16. Uthman M, Kamran M. Case report of a patient with 'one-and-a-half plus syndrome: nine syndrome.' Oxford Med Case Reports. 2018; 2018(1): 27–9.
17. Dube M, Dani R, Dubey A, Chouksey D. Twenty-and-a-half syndrome: a case report. J Med Case Rep. 2019; 13(1): 1–4.
18. Malla G, Jillella D V. Pontine Infarction. StatPearls. 2023.
19. Fiester P, Rao D, Soule E, Andreou S, Haymes D. The medial longitudinal fasciculus and internuclear opthalmoparesis: there's more than meets the eye. Cureus. 2020; 12(8): e9959.
20. Nourbakhsh B. Determining the etiology of internuclear ophthalmoplegia in a patient with a cardiac pacemaker and complex neurological presentation. J Clin Neurol. 2018; 14(4): 574–6.
21. Hassan MS, Sidow NO, Adam BA, Adani AA. Superior alternating hemiplegia (Weber's syndrome)- Case report. Ann Med Surg (Lond). 2022: 77: 103674.