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Exploring Radiological Findings In Benign Intracranial Hypotension: The Role Of Radiology In Diagnosing And Management

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ABSTRACT

Intracranial hypotension (IH) is a rare, benign, and typically self-limiting condition brought on by low cerebrospinal fluid (CSF) pressure, which is typically the result of CSF leakage. One orthostatic headache is the most common clinical finding. A few other typical clinical symptoms are fever, nausea, vomiting, and tinnitus.

In order to diagnose and monitor patients with Intracranial hypotension (IH), magnetic resonance imaging (MRI) is crucial. The brain sagging, pituitary enlargement, intracranial pachymeningeal enhancement, and subdural fluid collections are examples of specific MRI findings.
This case report aims to identify the signs of intracranial hypotension for its early detection and give a thorough understanding of a particular case while also reviewing pertinent medical knowledge and practices to advance our understanding of Intracranial hypotension (IH).

KEYWORDS: Mild bilateral subdural fluid collections, Decreased interpeduncular distance.

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INTRODUCTION

Spontaneous intracranial hypotension (SIH) is a recognized cause of secondary headaches, primarily resulting from the spontaneous leakage of cerebrospinal fluid (CSF) from the spinal canal.[1] The condition has an estimated annual incidence of approximately five cases per 100,000 individuals, though this is likely an underestimation due to frequent misdiagnosis.[2] SIH typically affects middle-aged adults, with a noted female predominance.[3]

The hallmark clinical presentation is an orthostatic headache, which worsens in the upright position and improves with recumbency.[1] However, a subset of patients may exhibit non-orthostatic headaches or other symptoms such as nausea, neck stiffness, tinnitus, dizziness, cognitive impairment, and cranial nerve palsies.[2] The variability in symptomatology often leads to diagnostic delays, making imaging an essential tool in identifying SIH.[4]

Magnetic resonance imaging (MRI) plays a crucial role in diagnosing SIH, with classic findings including diffuse pachymeningeal enhancement, subdural fluid collections, venous distension, brain sagging, and pituitary enlargement.[1] Additionally, objective markers such as the interpeduncular angle and ponto-mesencephalic angle have been suggested as reliable indicators of intracranial hypotension.[5]

This case report aims to highlight the radiological findings associated with SIH and emphasize the role of imaging in the diagnosis and management of this condition.

CASE REPORT

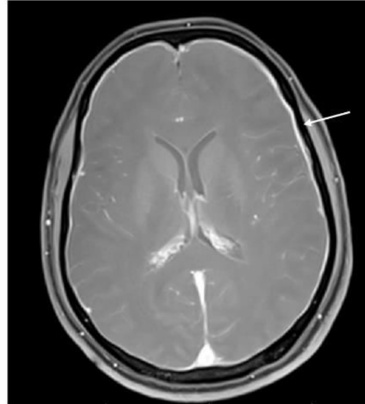
A 35-year-old man presented to the outpatient department (OPD) at KLE's Dr Prabhakar Kore Hospital, Belagavi with complaints of persistent orthostatic headache, dizziness, and tinnitus for the past several weeks. The headache was characteristically worse when in an upright position and showed partial relief when lying down. The patient reported no history of head trauma, recent lumbar puncture, spinal surgery, or connective tissue disorders. There was no associated fever, visual disturbances, or focal neurological deficits. Despite symptomatic treatment with analgesics and hydration, his symptoms persisted, prompting further evaluation.

Given the chronicity and orthostatic nature of the headache, an MRI of the brain (Plain & contrast) was performed to assess for

potential secondary causes

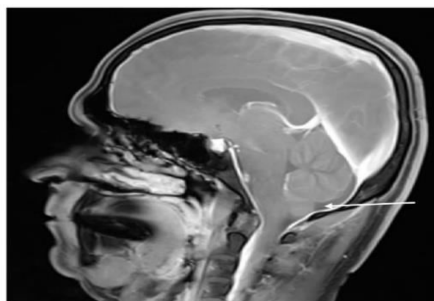
MRI findings included:

- **Diffuse pachymeningeal enhancement** on contrast-enhanced T1-weighted imaging, indicative of meningeal irritation due to low cerebrospinal fluid (CSF) volume. **(Figure 1)**



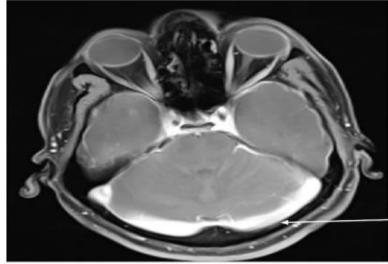
T1-weighted contrast-enhanced MRI showing diffuse pachymeningeal enhancement

- **Descent of the cerebellar tonsils ("brain sagging")**, along with effacement of the prepontine cistern and reduction in ponto-mamillary distance, suggesting intracranial hypotension**. (Figure 2)**



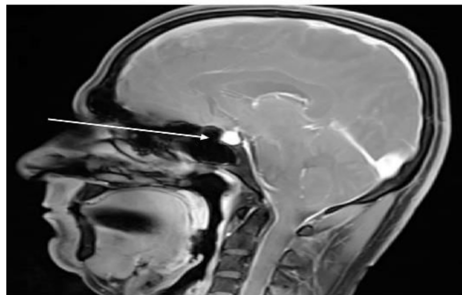
T1-weighted contrast-enhanced MRI showing sagging of cerebellar tonsils with effacement of pre pontine cistern and reduction in ponto-mamillary distance

- **Engorgement of the venous sinuses ("venous distension sign")**, particularly noted in straight sinuses. **(Figure 3)**



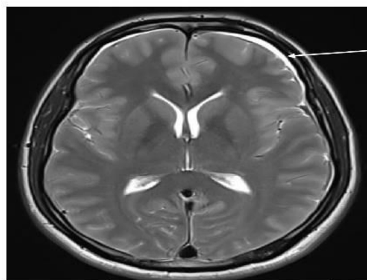
T1-weighted contrast-enhanced MRI showing venous distension sign in straight sinuses on both sides

- **Enlargement of the pituitary gland**, secondary to compensatory venous dilation. **(Figure 4)**



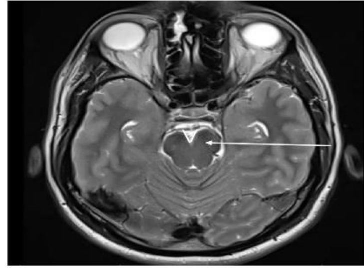
T1-weighted contrast-enhanced MRI showing enlarged pituitary gland

- **Mild bilateral subdural fluid collections**, likely reflecting secondary CSF leakage effects, though without significant mass effect. **(Figure 5)**



T2-weighted MRI showing bilateral subdural collections

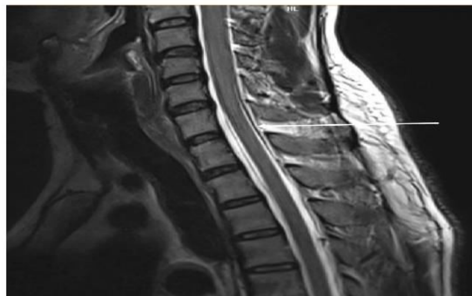
- **Decreased interpeduncular distance,** likely due to brain sagging secondary to cerebrospinal fluid (CSF) volume depletion. **(Figure 6)**



T2-weighted MRI showing reduced interpeduncular angle

Further MRI spine was performed to evaluate for the presence of a dural tear or cerebrospinal fluid (CSF) leak, which are common causes of spontaneous intracranial hypotension.

- **Evidence of a dural tear** in the cervical & dorsal spine with CSF leakage, identified on spinal MRI, further confirming the diagnosis of spontaneous intracranial hypotension. **(Figure 7)**



T2-weighted MRI spine showing evidence of a dural tear in the cervical & dorsal spine with CSF leakage

No significant hydrocephalus, structural brain lesions, or evidence of intracranial haemorrhage was detected. At this stage, no additional investigations such as lumbar puncture or spinal myelography were performed.

Based on the clinical presentation and characteristic imaging findings, a diagnosis of spontaneous intracranial hypotension (SIH) was made. The patient was advised strict bed rest, increased oral hydration, caffeine intake, and the possibility of an epidural blood patch if symptoms persisted. He was scheduled for close follow-up to monitor symptom progression and assess the need for further intervention.

DISCUSSION

Spontaneous intracranial hypotension (SIH) remains a diagnostic challenge due to its varied clinical and radiological presentation. The hallmark imaging findings, including pachymeningeal enhancement, brain sagging, subdural collections, and venous distension, are frequently observed but not universally present in all cases.[4] Furthermore, these features can be mimicked by other conditions such as meningitis, cerebral venous thrombosis, and post-lumbar puncture changes, necessitating a comprehensive diagnostic approach.[5]

The interpeduncular angle and mamillo-pontine distance have been proposed as objective MRI markers for SIH, with studies indicating their potential utility in differentiating SIH from normal and other pathological states. [5] Additionally, venous distension, particularly in the transverse and straight sinuses, has been identified as a reliable sign, offering high sensitivity and specificity in SIH diagnosis.[6] However, the utility of these findings in routine clinical practice remains variable, as anatomical variations and imaging artifacts can affect interpretation.

Despite the advances in imaging, the management of SIH remains complex. Epidural blood patches (EBP) are considered the first-line intervention for persistent symptoms, with success rates of approximately 64%, and larger-volume patches showing

better outcomes.[2] In refractory cases, surgical repair of dural defects or CSF-venous fistulas may be required.[2] However, post-treatment complications such as rebound intracranial hypertension have been reported, affecting up to 27.4% of patients.[2]

Overall, SIH is a dynamic condition that requires an integrated clinical and radiological approach for accurate diagnosis and effective treatment. Further research into quantitative imaging markers and targeted therapeutic strategies is warranted to improve patient outcomes.

CONCLUSION

Spontaneous intracranial hypotension (SIH) is a condition with diverse clinical presentations and radiological findings, often leading to diagnostic challenges.[7] While classic imaging features such as pachymeningeal enhancement, brain sagging, and venous distension are commonly associated with SIH, these findings are not always present, necessitating a comprehensive approach that integrates clinical and imaging criteria.[1]

Recent advancements in MRI techniques, including quantitative assessments such as the pontomesencephalic angle and mamillopontine distance, have shown promise in improving diagnostic accuracy.[5] The straight sinus distention sign has also emerged as a valuable marker with high specificity for SIH.[6]

Management of SIH varies based on severity, with conservative measures effective in some cases, while others require epidural blood patching or surgical intervention.[2] Given the risk of misdiagnosis and potential complications, early recognition and targeted imaging strategies remain essential in optimizing patient outcomes.[7]

Future research should focus on refining imaging criteria, developing standardized diagnostic protocols, and exploring novel therapeutic approaches to enhance the management of SIH.[6]

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Legends of figures-
Figure 1- T1-weighted contrast-enhanced MRI showing diffuse pachymeningeal enhancement
Figure 2 – T1-weighted contrast-enhanced MRI showing sagging of cerebellar tonsils with effacement of pre pontine cistern and reduction in ponto-mamillary distance.
Figure 3- T1-weighted contrast-enhanced MRI showing venous distension sign in straight sinuses on both sides.
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