International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Utility of Four-Vessel Cerebral Angiography in the Evaluation of Idiopathic Intracranial Hypertension

Dr. Md Sarif Ahmed[1], Dr Sanghamitra Sarkar[2], Dr. Aniruddha Chattopadhyay[3*], Dr. Sumit Deb[4]

[1]Resident, Department of Neurosurgery, Calcutta National Medical College, Kolkata, West Bengal, India
[2]Associate Professor, Department of Neurosurgery, Calcutta National Medical College, Kolkata, West Bengal, India
[3]Associate Professor, Department of Neurosurgery, Calcutta National Medical College, Kolkata, West Bengal, India
[4]Professor and Head, Department of Neurosurgery, Calcutta National Medical College, Kolkata, West Bengal, India

Corresponding Author:

Dr. Aniruddha Chattopadhyay
Associate Professor, Department of Neurosurgery, Calcutta National Medical College, Kolkata, West Bengal, India.

Received: 17-05-2026
Accepted: 10-06-2026
Available online: 24-06-2026

ABSTRACT

Background: Idiopathic intracranial hypertension (IIH) is a syndrome of raised intracranial pressure of unknown cause, occurring predominantly in obese women of childbearing age. Cerebral venous sinus stenosis and hypoplasia have emerged as important factors in its pathophysiology. This study evaluated the prevalence of venous sinus disease in IIH using four-vessel digital subtraction cerebral angiography (DSA) in the venous phase and compared it with magnetic resonance venography (MRV).

Materials and Methods: Eighteen patients fulfilling the Modified Dandy criteria for IIH, admitted to the Department of Neurosurgery and Neurology, Calcutta National Medical College and Hospital, Kolkata, between January 2023 and December 2024, were enrolled by complete enumeration. All patients underwent complete general, neurological and ophthalmological assessment, lumbar puncture with opening pressure measurement, cross-sectional neuroimaging, MRV and four-vessel DSA in the venous phase. Data were analysed using simple proportions, and MRV findings were compared with DSA using the chi-square test.

Results: The mean age was 30.4 ± 6.24 years, with most patients (50%) in the 21–30 year group. Females predominated (88.9%; female-to-male ratio 8:1) and 77.8% were overweight or obese (BMI > 25 kg/m²). Papilledema was present in all patients, with Frisen grade 2 (44.4%) and grade 3 (38.9%) most common. CSF opening pressure exceeded 250 mm H_2O in all cases. MRV demonstrated dural venous sinus narrowing in 14 (77.8%) patients, while DSA demonstrated stenosis or hypoplasia in 12 (66.7%) patients; DSA additionally detected left transverse sinus thrombosis in one MRV-negative patient. Taking DSA as the reference standard, MRV showed a sensitivity of 91.66%, specificity of 50%, positive predictive value of 78.57% and negative predictive value of 75% ($\chi^2 = 4.0179$, $p < 0.045$).

Conclusion: Intracranial venous sinus stenosis is a frequent finding in IIH and appears to be an important contributing factor. MRV is a useful, non-invasive screening tool with high sensitivity but moderate specificity; four-vessel DSA in the venous phase remains the gold standard for definitive evaluation of intracranial venous pathology and should be incorporated into the work-up of selected patients with IIH.

Keywords: Idiopathic intracranial hypertension; Pseudotumor cerebri; Digital subtraction angiography; Magnetic resonance venography; Transverse sinus stenosis; Papilledema.

INTRODUCTION

Idiopathic intracranial hypertension (IIH) is a well-recognised but underinvestigated clinical entity with an incompletely understood pathophysiological basis, and its diagnosis and optimal management frequently pose difficulties for clinicians. The terms “pseudotumor cerebri” and “benign intracranial hypertension” were originally applied to patients with raised

intracranial pressure (ICP) in whom no tumour was found and whose clinical course was considered benign.[1] IIH is characterised by elevated intracranial pressure occurring typically in obese women of childbearing age, in an alert and oriented patient with no localising neurological signs and with normal neuroimaging apart from features attributable to the raised pressure itself.

There is no evidence of deformity or obstruction of the ventricular system, and neurodiagnostic studies are otherwise normal except for an increased cerebrospinal fluid (CSF) opening pressure (greater than 200 mm H_2O in the non-obese and greater than 250 mm H_2O in the obese patient).[2] The annual incidence of IIH is approximately 0.9 per 100,000 persons, rising to 3.5 per 100,000 in women aged 15 to 44 years, and is increasing in parallel with the current epidemic of obesity. In obese women aged 20 to 44 years who are 20% or more above ideal body weight, the incidence approaches 19 per 100,000.[4] More than 90% of patients are obese, over 90% are women of childbearing age, and the mean age at diagnosis is approximately 30 years.[5]

The diagnostic characteristics of this syndrome were first defined by Dandy in 1937 and were subsequently formulated as the "Modified Dandy Criteria."[6,7] These criteria comprise symptoms and signs of raised ICP; absence of localising neurological signs (except sixth cranial nerve palsy or other false localising signs); normal neuroimaging; raised CSF opening pressure on lumbar puncture; normal CSF constituents; an awake, alert patient; absence of other causes of raised ICP; and a benign clinical course apart from the risk of visual deterioration.

Although recognised for more than a century, the pathogenesis of IIH remains unclear. Among the various proposed mechanisms, increased intracranial venous pressure secondary to stenosis or hypoplasia of one or both transverse sinuses has attracted substantial recent interest.[9,10] Since CSF is passively reabsorbed into the intracranial venous sinuses through the arachnoid granulations, stenosis of a dominant transverse sinus, or of both transverse sinuses, can impair venous drainage and CSF absorption, resulting in cerebral venous hypertension and a consequent rise in ICP. The venous phase of conventional catheter digital subtraction angiography (DSA) is regarded as the gold standard for analysing intracranial venous anatomy and for diagnosing intracranial venous pathology, although it is an invasive procedure with associated risks.[15,16] The present study was undertaken to evaluate the prevalence of venous sinus disease in the aetiology of IIH using four-vessel digital subtraction cerebral angiography in the venous phase, and to compare these findings with magnetic resonance venography (MRV).

Aim and Objectives

To evaluate the prevalence of venous sinus disease in the aetiology of idiopathic intracranial hypertension using four-vessel digital subtraction cerebral angiography (DSA) in the venous phase, and to compare the diagnostic performance of magnetic resonance venography against DSA.

MATERIALS AND METHODS

Study setting and population

This study was conducted in the Department of Neurosurgery and Neurology, Calcutta National Medical College and Hospital (CNMC&H), Kolkata. All patients admitted with symptoms and signs of idiopathic intracranial hypertension during the study period from January 2023 to December 2024 were considered for inclusion.

Sample size

A complete enumeration method was used. All patients admitted with symptoms and signs of IIH in the Department of Neurosurgery and Neurology, CNMC&H, during the study period were included. A total of 18 patients fulfilled the criteria and were enrolled.

Inclusion criteria

Patients satisfying the Modified Dandy criteria for idiopathic intracranial hypertension.

Exclusion criteria

1. Patients with true localising findings on examination denoting focal brain dysfunction.
2. Patients with traumatic, neoplastic, infectious, structural or iatrogenic causes of intracranial hypertension.
3. Patients with clinical and neuroimaging evidence of acute primary dural sinus thrombosis or cortical vein thrombosis.

Study technique

All patients underwent the following evaluations:

- Complete general and neurological assessment.
- Lumbar puncture with measurement of CSF opening pressure in the lateral decubitus position, and analysis of CSF constituents.
- Full ophthalmological assessment, including visual acuity measurement using the Snellen chart, and direct and indirect ophthalmoscopic fundus examination with grading of papilledema using the Frisen scale.

- Radiological investigations: CT brain with or without MRI brain without contrast; magnetic resonance venography (MRV); and four-vessel digital subtraction angiography (DSA) in the venous phase.

Statistical analysis

Data were analysed using simple proportions and presented in tables and figures. The chi-square test was applied to assess the association between MRV and DSA findings. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of MRV were calculated taking DSA as the reference standard. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Eighteen patients with idiopathic intracranial hypertension, diagnosed according to the Modified Dandy criteria, were enrolled after applying the inclusion and exclusion criteria. The findings are presented below.

Age distribution

Table 1. Age distribution of the study population (n = 18)

Age (years)	No. of cases	Percentage (%)
< 20	1	5.5
21–30	9	50.0
31–40	6	33.4
> 40	2	11.1
Total	18	100.0

The age of patients ranged from 18 to 42 years, with a mean of 30.4 ± 6.24 years. The maximum number of cases occurred in the 21–30 year age group (50%), consistent with the recognised predilection of IIH for the childbearing age group in women.

Sex distribution

Table 2. Sex distribution of the study population (n = 18)

Sex	No. of cases	Percentage (%)
Male	2	11.1
Female	16	88.9
Total	18	100.0

Idiopathic intracranial hypertension was found predominantly in females (88.9%), with a female-to-male ratio of 8:1.

Body mass index distribution

Table 3. Body mass index (BMI) distribution in IIH patients (n = 18)

BMI (kg/m²)	Male n (%)	Female n (%)	Total n (%)
< 25	0 (0.0)	4 (22.2)	4 (22.2)
25–30 (overweight)	1 (5.5)	8 (44.4)	9 (50.0)
> 30 (obese)	1 (5.5)	4 (22.2)	5 (27.8)
Total	2 (11.1)	16 (88.9)	18 (100.0)

IIH was predominantly associated with a BMI greater than 25 kg/m² (overweight and obese; 77.8% of cases). Of the four patients (22.2%) with a BMI below 25 kg/m², all had a history of recent increase in body weight within the preceding year.

Grade of papilledema

Table 4. Frisen grade of papilledema in IIH patients (higher grade in either eye; n = 18)

Frisen grade	Male n (%)	Female n (%)	Total n (%)
Grade 1	0 (0.0)	1 (5.5)	1 (5.5)
Grade 2	0 (0.0)	8 (44.4)	8 (44.4)
Grade 3	1 (5.5)	6 (33.3)	7 (38.9)
Grade 4	1 (5.5)	1 (5.5)	2 (11.1)
Total	2 (11.1)	16 (88.9)	18 (100.0)

Most patients presented with Frisen grade 2 (44.4%) and grade 3 (38.9%) papilledema. No patient was found to be without papilledema. Higher grades of papilledema were observed among male patients and patients with higher BMI.

CSF opening pressure

Table 5. CSF opening pressure in IIH patients (cm H_2O; n = 18)

CSF opening pressure	Male n (%)	Female n (%)	Total n (%)
25–30	0 (0.0)	3 (16.7)	3 (16.7)
31–35	0 (0.0)	5 (27.8)	5 (27.8)
> 35	2 (11.1)	8 (44.4)	10 (55.5)

Total	2 (11.1)	16 (88.9)	18 (100.0)

CSF opening pressure measured in the lateral decubitus position exceeded 250 mm H_2O (25 cm H_2O) in all cases. Male patients tended to have higher opening pressures, and female patients with high-grade papilledema demonstrated higher CSF opening pressures.

Relationship between papilledema grade and CSF opening pressure

Table 6. Grade of papilledema versus CSF opening pressure in IIH patients (n = 18)

Frisen grade	25–30	31–35	> 35	Total n (%)
Grade 1	1	0	0	1 (5.5)
Grade 2	3	5	0	8 (44.4)
Grade 3	0	1	6	7 (38.9)
Grade 4	0	0	2	2 (11.1)
Total	4 (22.2)	6 (33.3)	8 (44.4)	18 (100.0)

CSF opening pressure expressed in cm H_2O.

Patients with a higher grade of papilledema were observed to have a higher CSF opening pressure.

Venous sinus stenosis or hypoplasia on MR venography

Table 7. Venous sinus stenosis or hypoplasia on MR venography (n = 18)

MRV	Male n (%)	Female n (%)	Total n (%)
Positive	2 (11.1)	12 (66.7)	14 (77.8)
Negative	0 (0.0)	4 (22.2)	4 (22.2)
Total	2 (11.1)	16 (88.9)	18 (100.0)

MR venography, performed in all cases, demonstrated narrowing of the dural venous sinuses in 14 patients (77.8%) and was normal in 4 patients (22.2%).

Site of dural venous sinus stenosis on MR venography

Table 8. Site of dural venous sinus narrowing on MR venography (n = 18)

Site of dural venous sinus narrowing	No. of cases (%)
Left transverse sinus	4 (22.2)
Right transverse sinus	6 (33.3)
Bilateral transverse sinus	3 (16.7)
Superior sagittal sinus	1 (5.5)
Normal findings	4 (22.2)

Narrowing of the left transverse sinus was found in 4 cases (22.2%), the right transverse sinus in 6 cases (33.3%), bilateral transverse sinuses in 3 cases (16.7%) and the superior sagittal sinus in 1 case (5.5%). MR venography was normal in 4 patients (22.2%).

Venous sinus stenosis or hypoplasia on cerebral angiography (DSA)

Table 9. Venous sinus stenosis or hypoplasia on four-vessel DSA (n = 18)

DSA finding	Male n (%)	Female n (%)	Total n (%)
Positive	2 (11.1)	10 (55.6)	12 (66.7)
Negative	0 (0.0)	6 (33.3)	6 (33.3)
Total	2 (11.1)	16 (88.9)	18 (100.0)

Dural venous sinus stenosis or hypoplasia on four-vessel DSA was present in 12 patients (66.7%). In addition, one MRV-negative patient was found to have left transverse sinus thrombosis on DSA, a finding that had not been detected on MR venography.

Comparison of MR venography and DSA

Table 10. MR venography versus four-vessel DSA findings in IIH patients (n = 18)

Venous sinus stenosis / hypoplasia	DSA positive n (%)	DSA negative n (%)	Total n (%)
MRV positive	11 (61.1)	3 (16.7)	14 (77.8)
MRV negative	1 (5.5)	3 (16.7)	4 (22.2)
Total	12 (66.7)	6 (33.3)	18 (100.0)

$\chi^2 = 4.0179$; $p < 0.045$. Sensitivity = 91.66%; Specificity = 50%; PPV = 78.57%; NPV = 75%.

Narrowing of the dural venous sinuses (stenosis or hypoplasia) was present in 14 patients (77.8%) on MR venography and in 12 patients (66.7%) on cerebral angiography. Of the 14 MRV-positive patients, DSA did not reveal any sinus narrowing in 3 (16.7%). Taking DSA as the reference standard, MR venography demonstrated a sensitivity of 91.66%, specificity of 50%, positive predictive value of 78.57% and negative predictive value of 75%. On applying the chi-square test, the difference was statistically significant ($p < 0.045$).

DISCUSSION

Idiopathic intracranial hypertension is a neurological disorder presenting with features of raised intracranial pressure—headache, visual disturbance and papilledema—without localising neurological signs in an alert patient. The mechanism of raised ICP remains incompletely understood. One of the most widely accepted hypotheses is that of intracranial venous hypertension secondary to stenosis or hypoplasia of one or both transverse sinuses. Karahalios *et al.* suggested that increased intracranial venous pressure may be a universal mechanism in IIH of differing aetiologies, and that this is secondary to venous sinus stenosis.[11]

In the present series, the age of patients ranged from 18 to 42 years, with a mean of 30.4 ± 6.24 years and a peak incidence in the 21–30 year group (50%). This corroborates earlier reports describing a mean age of onset of 28 to 35 years and a predilection for the childbearing age group.[17] The marked female predominance observed (88.9%; female-to-male ratio 8:1) is consistent with the reported range of 3:1 to 15:1 in the literature.[3,4]

A clear association with elevated body mass index was observed, with 77.8% of patients overweight or obese; all four patients with a normal BMI reported recent weight gain. Daniels *et al.* demonstrated a correlation between BMI and the risk of IIH, and recent rapid weight gain has been associated with an increased risk in both obese and non-obese individuals.[19]

Papilledema, the diagnostic hallmark of IIH, was present in all patients, most commonly Frisen grade 2 (44.4%) and grade 3 (38.9%). Higher grades were associated with male sex and higher BMI in this series, in keeping with reports that severely obese patients have more advanced papilledema and worse visual outcomes.[20] CSF opening pressure exceeded 250 mm H_2O in all cases, and higher opening pressures were associated with higher grades of papilledema, consistent with previous case series correlating CSF pressure with the severity of optic nerve head swelling.[22]

MR venography demonstrated dural sinus narrowing in 77.8% of patients, most frequently involving the transverse sinuses. Improvements in venographic imaging have shown that the majority of patients with IIH harbour anatomical abnormalities of the cerebral venous sinus system, predominantly stenosis of the dominant or both transverse sinuses, near the junction with the sigmoid sinus.[21,9] Two morphological types of stenosis are recognised—an extrinsic, smoothly tapering type and an intrinsic type attributable to arachnoid granulations or fibrous septae—and both may coexist in the same patient.[9]

Four-vessel DSA in the venous phase demonstrated stenosis or hypoplasia in 66.7% of patients. Importantly, DSA detected left transverse sinus thrombosis in one patient whose MR venography had been reported as negative, illustrating the additional diagnostic yield of catheter angiography. When compared against DSA as the reference standard, MR venography demonstrated a high sensitivity (91.66%) and negative predictive value (75%), but only moderate specificity (50%) and a positive predictive value of 78.57%. These figures indicate that MRV is a valuable screening tool but that abnormalities detected on MRV should be confirmed by digital subtraction cerebral angiography in the venous phase. The difference between the two modalities was statistically significant ($\chi^2 = 4.0179$; $p < 0.045$).

These observations support the view that the venous phase of conventional catheter DSA remains the gold standard for the evaluation of intracranial venous anatomy and pathology, providing dynamic, high-resolution imaging with the additional ability to perform manometry where indicated.[15,10] The principal limitation of the present study is its small sample size, derived from a single centre; larger, multicentric studies with manometric correlation are warranted to confirm these findings.

CONCLUSION

Intracranial venous sinus stenosis appears to be an important contributing factor in idiopathic intracranial hypertension. Four-vessel digital subtraction angiography in the venous phase is a cornerstone investigation in the evaluation of IIH and remains the gold standard for the assessment of intracranial venous pathology. MR venography, with its high sensitivity, is a valuable non-invasive screening tool; however, in view of its lower specificity, the inclusion of DSA in the work-up of selected patients with suspected IIH is beneficial. These conclusions should be confirmed by larger, multicentric studies.

Declarations

Conflict of interest: The authors declare that they have no conflict of interest.

Funding: This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Informed consent: Written informed consent was obtained from all individual participants included in the study.

REFERENCES

1. Corbett JJ, Thompson HS. The rational management of idiopathic intracranial hypertension. Arch Neurol. 1989;46(10):1049–51.
2. Corbett JJ, Mehta MP. Cerebrospinal fluid pressure in normal obese subjects and patients with pseudotumor cerebri. Neurology. 1983;33:1386–88.

3. Durcan FJ, Corbett JJ, Wall M. The incidence of pseudotumor cerebri: population studies in Iowa and Louisiana. Arch Neurol. 1988;45(8):875–77.
4. Radhakrishnan K, Ahlskog JE, Cross SA, Kurland LT, O'Fallon WM. Idiopathic intracranial hypertension (pseudotumor cerebri): descriptive epidemiology in Rochester, Minnesota, 1976 to 1990. Arch Neurol. 1993;50:78–80.
5. Wall M, George D. Idiopathic intracranial hypertension: a prospective study of 50 patients. Brain. 1991;114:155–80.
6. Dandy WE. Intracranial pressure without brain tumor: diagnosis and treatment. Ann Surg. 1937;106(4):492–513.
7. Friedman DI, Liu GT, Digre KB. Revised diagnostic criteria for the pseudotumor cerebri syndrome in adults and children. Neurology. 2013;81(13):1159–65.
8. Binder DK, Horton JC, Lawton MT, McDermott MW. Idiopathic intracranial hypertension. Neurosurgery. 2004;54(3):538–52.
9. Farb RI, Vanek I, Scott JN, Mikulis DJ, Willinsky RA, Tomlinson G, et al. Idiopathic intracranial hypertension: the prevalence and morphology of sinovenous stenosis. Neurology. 2003;60(9):1418–24.
10. King JO, Mitchell PJ, Thomson KR, Tress BM. Cerebral venography and manometry in idiopathic intracranial hypertension. Neurology. 1995;45(12):2224–28.
11. Karahalios DG, Rekate HL, Khayata MH, et al. Elevated intracranial venous pressure as a universal mechanism in pseudotumor cerebri of varying aetiologies. Neurology. 1996;46:198–202.
12. Higgins JN, Owler BK, Cousins C, Pickard JD. Venous sinus stenting for refractory benign intracranial hypertension. Lancet. 2002;359:228–30.
13. Higgins JNP, Cousins C, Owler BK, et al. Idiopathic intracranial hypertension: 12 cases treated by venous sinus stenting. J NeurolNeurosurg Psychiatry. 2003;74:1662–66.
14. Ahmed RM, Wilkinson M, Parker GD, Thurtell MJ, Macdonald J, McCluskey PJ, et al. Transverse sinus stenting for idiopathic intracranial hypertension: a review of 52 patients and of model predictions. AJNR Am J Neuroradiol. 2011;32(8):1408–14.
15. Agid R, Shelef I, Scott JN, Farb RI. Imaging of the intracranial venous system. Neurologist. 2008;14:12–22.
16. Willinsky RA, Taylor SM, TerBrugge K, Farb RI, Tomlinson G, Montanera W. Neurologic complications of cerebral angiography: prospective analysis of 2,899 procedures and review of the literature. Radiology. 2003;227:522–28.
17. Ahlskog JE, O'Neill BP. Pseudotumor cerebri. Ann Intern Med. 1982;97(2):249–56.
18. Sugerman HJ, DeMaria EJ, Felton WL, Nakatsuka M, Sismanis A. Increased intra-abdominal pressure and cardiac filling pressures in obesity-associated pseudotumor cerebri. Neurology. 1997;49:507–11.
19. Daniels AB, Liu GT, Volpe NJ, Galetta SL, Moster ML, Newman NJ, et al. Profiles of obesity, weight gain, and quality of life in idiopathic intracranial hypertension (pseudotumor cerebri). Am J Ophthalmol. 2007;143(4):635–41.
20. Szewka AJ, Bruce BB, Newman NJ, Biousse V. Idiopathic intracranial hypertension: relation between obesity and visual outcomes. J Neuroophthalmol. 2013;33(1):4–8.
21. Riggeal BD, Bruce BB, Saindane AM, et al. Clinical course of idiopathic intracranial hypertension with transverse sinus stenosis. Neurology. 2013;80:289–95.
22. Heckmann JG, Weber M, Jünemann AG, Neundörfer B, Mardin CY. Laser scanning tomography of the optic nerve vs CSF opening pressure in idiopathic intracranial hypertension. Neurology. 2004;62:1221–23.