Transverse sinus stenting for idiopathic intracranial hypertension

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Transverse sinus stenting is a medical procedure that is sometimes used in the idiopathic intracranial hypertension treatment.

In some cases of IIH, there may be abnormalities in the venous drainage, leading to increased intracranial pressure. Transverse sinus stenting is designed to improve venous drainage and reduce intracranial pressure by placing a stent in the affected transverse sinus.

Procedure

Diagnostic Imaging: Before the stenting procedure, imaging studies such as magnetic resonance venography (MRV) or digital subtraction angiography (DSA) are typically performed to assess the venous anatomy and identify any obstructions or abnormalities.

Stent Placement: A small catheter is inserted into the affected transverse sinus under fluoroscopic guidance. A stent (a mesh-like tube) is then placed in the narrowed or blocked segment of the sinus to help maintain an open pathway for venous drainage.

Post-Procedure Monitoring: After the stent is placed, patients are typically monitored for any complications and to ensure that blood flow is improved. Close follow-up care and imaging may be necessary to assess the effectiveness of the stenting procedure.

It's important to note that while transverse sinus stenting may be considered in certain cases of IIH, the decision to undergo this procedure is made on an individual basis, taking into account factors such as the severity of symptoms, response to other treatments,

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Since 2005, transverse sinus stenting for idiopathic intracranial hypertension has grown in popularity, suggesting that Dural venous sinus stenosis should be viewed as a causative factor rather than a secondary phenomenon.

Although long-term studies are needed in this field, the current reports indicate a favorable outcome for preventing vision loss and symptom control [1].

Venous stenting costs significantly less per 100 procedures than does CSF shunting, due largely to the high cost of treating shunt infections and the need for repeated shunt revisions [2].

In conjunction with temporary CSF diversion, represents a viable treatment option in the acute and appropriate setting [3].

In patients with documented evidence of venous sinus stenosis with a pressure gradient, venous sinus stenting should be the primary treatment of choice; however, some patients may be refractory to stenting and still require permanent CSF diversion, which can be complicated in these chronically anticoagulated patients. Patients with persistent papilledema post-stenting and highly elevated opening pressure pre-stenting should be followed closely as they are at greatest risk of requiring a shunt and failing stenting [4].

Dural venous sinus stenting for patients with IIH does not affect the immediate or long-term patency of the Vein of Labbe and is not associated with intracranial complications [5].

Complications

There remains considerable uncertainty over the safety and efficacy of this procedure, in particular the incidence of intraprocedural and delayed complications and in the longevity of sinus patency, pressure gradient obliteration, and therapeutic clinical outcome.

The complication rate after DVSS was 4.9% and stent survival was 87.8% at 120 days. At least 20% of patients developed restenosis following DVSS and only 63.3% demonstrated an improvement or resolution of papilledema.

Reduced venous sinus pressures were observed at 120 days after the procedure. DVSS showed lower complication rates than shunts, but the clinical outcome data were less convincing. To definitively compare the outcomes between DVSS and shunts in IIH, a randomized prospective study is needed [6].

Case series

2024

A retrospective cohort study was undertaken on a single-author database of 226 successive patients with confirmed idiopathic intracranial hypertension (IIH). A total of 32 patients were identified who received a transverse sinus stent for medically refractory disease. This which was defined as visual threat and/or intolerance of maximal medical therapy. Patients with medically refractory disease proceeded to stenting, if found to have a significant transverse sinus stenosis gradient at catheter venography. Visual threat was quantified via the degree of papilledema on optical coherence tomography of the retinal nerve fibre layer, and via the visual field mean deviation. CSF opening pressure at lumbar puncture and cerebral venous sinus pressure measurements from catheter venography were correlated with the ophthalmic data, noting also intolerance of maximal medical therapy. Complications of stenting were fully assessed.

Medically refractory IIH was found in 18% of the total cohort of IIH patients. 90% of those with medically refractory disease had a significant transverse sinus stenosis pressure gradient, and 80% proceeded to stenting. The intervention eliminated papilledema in 96% of stented patients, and allowed 81% to cease acetazolamide. The need for a further procedure was low at 6%, and the safety profile was favourable.

Medically refractory disease in IIH is common (18%), and nearly always associated with a significant transverse sinus stenosis pressure gradient (90%). Endovascular stenting of the stenosis deserves wider uptake as a highly effective, safe, and usually definitive treatment. It safeguards vision by eliminating papilledema (96%), and allows most patients to cease acetazolamide (81%). By analogy with glaucoma, if acetazolamide is the prostaglandin of IIH and CSF diversion the emergency glaucoma filter, stenting is the minimally invasive glaucoma surgery [7)].

A retrospective study included 105 IIH patients (median age [interquartile range], 35 years [27-42 years]; female:male, 82:23) who underwent MRV and catheter venography complemented by venous manometry. Contrast enhanced-MRV was conducted under 1.5 Tesla system, and the images were reconstructed using a standard algorithm. Shape features were derived from MRV images via the PyRadiomics package and selected by utilizing the least absolute shrinkage and selection operator (LASSO) method. A radiomics score for predicting high TPG (≥ 8 mmHg) in IIH patients was formulated using multivariable logistic regression; its discrimination performance was assessed using the area under the receiver operating characteristic curve (AUROC). A nomogram was constructed by incorporating the radiomics scores and clinical features.

Data from 105 patients were randomly divided into two distinct datasets for model training (n = 73; 50 and 23 with and without high TPG, respectively) and testing (n = 32; 22 and 10 with and without high TPG, respectively). Three informative shape features were identified in the training datasets: least axis length, sphericity, and maximum three-dimensional diameter. The radiomics score for predicting high TPG in IIH patients demonstrated an AUROC of 0.906 (95% confidence interval, 0.836-0.976) in the training dataset and 0.877 (95% confidence interval, 0.755-0.999) in the test dataset. The nomogram showed good calibration.

The study presents the feasibility of a novel model for predicting high TPG in IIH patients using radiomics analysis of noninvasive MRV-based shape features. This information may aid clinicians in identifying patients who may benefit from stenting [8].

2023

259 IIH patients, including 49 who underwent CTVS, were registered. Among them, five female patients met inclusion criteria for FIIH and underwent emergent CTVS. FIIH patients were younger (18.8 ± 1.64 vs 27.7 ± 4.85, $p < 0.01$), mean BMI was lower (30.8 ± 10.57 vs 34.6 ± 4.3, $p < 0.01$), and lumbar puncture opening pressure higher (454 ± vs 361 ± 99.4, $p < 0.01$) than that of IIH patients. They presented with acute visual loss, severe headache, papilledema, significant bilateral transverse sinus stenosis on CT-venography, and mean dominant side gradient pressure of 26.4 ± 6.2 on DSA. CTVS was performed without significant complications, resulting in remarkable improvement in headache, optical coherence tomography, and visual fields within 1 week. At 1-year follow-up (four patients) and 6-month follow-up (1 patient), there was complete resolution of papilledema and headache, and marked improvement in visual acuity.

In these patients, emergent-CTVS was a safe and effective treatment option for FIIH. Further evaluation is warranted [9]

2022

A prospective study included 28 IIH patients scheduled for venous stenting. 4D-flow MRI was acquired 24-48 h before venous manometry. Manometry-obtained pressure drop (Mp) was dichotomized into low (Lp: 0-8 mmHg) and high (Hp: 8-30 mmHg) groups. Hemodynamic indices were compared between Lp and Hp. Trans-stenotic pressure drop was estimated by work-energy equation, simplified Bernoulli equation, vorticity magnitude, and velocity difference between inlet and outlet and was compared with Mp. Measurement agreement, correlation, and accuracy were evaluated using the κ coefficient, Pearson's r, and confusion matrix-derived accuracy.

Results: Among 28 patients (mean age 38.8 ± 12.7), 19 (67.9%) were female. Work-energy equation-estimated pressure drop (WEp) had a strong correlation ($r = 0.91$, 95% confidence interval [CI]: 0.81-0.96, $p < 0.001$) and high agreement (intraclass correlation coefficient = 0.90, 95% CI: 0.78-0.95, $p < 0.001$) with Mp. WEp classified Lp and Hp with an accuracy of 0.96. The κ value between WEp and Mp was 0.92 (95% CI: 0.78-1.00). In the work-energy equation, the viscosity energy term (Ve) had the largest weights, and the ratio of Ve to the summation of the three energy terms was 0.93 ± 0.07. Ve had strong correlation with mVort ($r = 0.93$, 95% CI: 0.85-0.97, $p < 0.001$), and mean vorticity magnitude was significantly elevated in Hp compared to that in Lp (259.8 vs. 174.9 mL/s, $p < 0.001$).

Trans-stenotic pressure drop in IIH can be estimated using the work-energy equation with favorable accuracy [10].

2017

A study aimed to determine clinical, radiological, and manometric outcomes at 3-4 months after DVSS in this treated IIH cohort.

Clinical, radiographic, and manometric data before and 3-4 months after DVSS were reviewed in this single-center case series. All venographic and manometric procedures were performed under local anesthesia with the patient supine.

Forty-one patients underwent DVSS venography/manometry within 120 days. Sinus pressure reduction of between 11 and 15 mm Hg was achieved 3-4 months after DVSS compared with pre-stent baseline, regardless of whether the procedure was primary or secondary (after shunt surgery). Radiographic obliteration of anatomical stenosis correlating with reduction in pressure gradients was observed. The complication rate after DVSS was 4.9% and stent survival was 87.8% at 120 days. At least 20% of patients developed restenosis following DVSS and only 63.3% demonstrated an improvement or resolution of papilledema.

Reduced venous sinus pressures were observed at 120 days after the procedure. DVSS showed lower complication rates than shunts, but the clinical outcome data were less convincing. To definitively compare the outcomes between DVSS and shunts in IIH, a randomized prospective study is needed [11)].

Case reports

An obese woman in her 30s presented with persistent daily headaches after undergoing endoscopic repair of a skull base cerebrospinal fluid leak. Angiography demonstrated a focal right transverse-sigmoid sinus stenosis, and she underwent VSS of the right transverse sinus. She developed progressive pulsatile tinnitus within 3 months, and angiography demonstrated the formation of a Borden type 1 dAVF along the stent. Trans-arterial embolization of the dAVF was performed with venous remodeling using a Copernic RC balloon. While VSS has become a promising treatment for venous sinus stenosis and idiopathic intracranial hypertension, dAVF formation is a rare but significant potential complication. Embolization with venous remodeling can be performed to treat these lesions [12)].

A technical note presents the successful use of intracranial venous stenting in a patient with IIH because of severe venous sinus stenosis, leading to significant improvement in vision and reduction in intracranial pressure. A meticulous review of the literature revealed that our patient exhibited the highest recorded pressure gradient (70 mm Hg). This remarkable finding underscores the potential effectiveness of venous stenting as a viable treatment approach. The procedure involved the placement of a Zilver stent (Cook Medical) and balloon angioplasty after stenting of the right transverse sinus stenosis, resulting in a substantial decrease in pressure gradient. Following the procedure, another venous manometry showed no more gradient with a uniform pressure in the whole venous system at 18 mm Hg.

This case presents the highest pressure gradient reported in the literature and contributes to the growing evidence supporting venous stenting in patients with IIH and venous sinus stenosis [13)].

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