



Risk factors for failed transverse sinus stenting in pseudotumor cerebri patients



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ABSTRACT

Background: Idiopathic intracranial hypertension (IIH) when no underlying etiology is found, is a clinical syndrome characterized by elevated intracranial pressure (ICP) (>25 cmH₂O), which may lead to headaches and visual symptoms. In patients with IIH who are found to have transverse sinus stenosis, placement of a venous stent across the stenosis has been shown to lower ICP and to resolve the symptoms in several case series, with generally favorable results. In this study, we examine common risk factors associated with failure of transvenous stenting for IIH. If venous sinus stenting fails, CSF diversion should be considered as the next line of treatment.

Methods: We retrospectively reviewed the records of eighteen patients diagnosed with IIH who underwent venous sinus stenting for transverse sinus stenosis with a mean pressure gradient (MPG) of at least 4 mmHg. Fifteen of these patients did not need further treatment. We compared their pre- and post-treatment, neurological and neuro-ophthalmological evaluations to the three patients who went on to have a shunt placement as a second line treatment.

Results: Shunting after stent placement patients ($n = 3$) had a mean age of 30 years and a mean body mass index of 36.6 kg/m², whereas the group that underwent stent placement alone ($n = 15$) had a mean age of 40.7 years and a mean body mass index of 33.3 kg/m². In the shunting after stent placement group, the mean opening pressure on the most recent lumbar puncture obtained prior to any intervention was 50 cm of H₂O, whereas the group that underwent stent placement alone had an opening CSF pressure of 37 cm of H₂O which was statistically significant ($p < 0.05$). There were no other significant differences in pre- or post-intervention factors between the two groups.

Conclusion: In patients with IIH and 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.

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1. Introduction

Pseudotumor cerebri (PTC) or idiopathic intracranial hypertension (IIH) is a clinical syndrome characterized by raised intracranial pressure (ICP) (>25 cmH₂O) without an identifiable intracranial

mass, evidence of hydrocephalus, or abnormal cerebrospinal fluid content [1,2]. IIH is most common in women, with an incidence of ~ 3 in 100,000 every year as compared to ~ 0.3 in 100,000 in men, with obesity as a strong risk factor [3]. Headaches are the most common presenting symptom (seen in $\sim 93\%$ of all patients). Prolonged papilledema leading to optic nerve atrophy and visual disturbance (~ 30 – 68%), ranging from blurred vision and transient visual field loss to permanent vision loss, is the most significant morbidity associated with untreated cases [3,4]. The pathophysiologic mechanism underlying IIH is thought to be due to decreased absorption of cerebrospinal fluid (CSF) secondary to increased venous sinus pressures

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Table 1
Demographics of patients treated with stent alone compared to patients who underwent shunt placement post stenting.

Demographics	Stent alone		Shunt post stent	
	Number of patients	%	Number of patients	%
Total patients (n = 18)	15	83.3%	3	16.7%
Sex				
Male	1	5.6%	0	0.0%
Female	14	77.8%	3	16.7%
Ethnicity, no. (%)				
White	13	72.2%	1	5.6%
African American	2	11.1%	1	5.6%
Asian	0	0.0%	1	5.6%
	Average	Range	Average	Range
Age (years of age)	40.7	(21–56)	30	(23–34)
Weight (lbs)	209	(150–365)	214	(180–266)
Height (inch.)	66.4	(61–73)	64.7	(63–67)
BMI	33.3	(25–51)	36.6	(30.9–45.7)

[5]. Carbonic anhydrase inhibitors, such as acetazolamide, are typically first-line medical treatments; however, in the acute setting, especially when vision is compromised, surgical intervention with either cerebrospinal fluid shunting or optic nerve fenestration is warranted.

Although the etiology of the majority of IIH cases is unknown, recent evidence has implicated cerebral venous sinus stenosis, usually involving one or both transverse sinuses (TS), as a potential cause. There is controversy as to whether the sinus stenosis causes elevated ICP or if it is a result of compression from elevated ICP. Along these lines, some authors have reported cases in which the stenosis resolves once the ICP is lowered, but in most instances, the sinus must be opened mechanically via stenting to obtain a decrease in the ICP [1,6–10]. In a previous study at our institution, the rate of transverse sinus stenosis in IIH patients was approximately 16%, though other series have demonstrated higher prevalence [10]. Stenting has been shown to improve both venous sinus pressure gradient and symptoms of IIH; ~44% of patients become asymptomatic, 33% improved post-surgery [11]. Although ~80% of patients show improvement in papilledema, visual field disturbance, and headaches post stenting, this treatment option is not effective for every patient [1,11]. To the best of our knowledge, no prior studies have compared IIH patients with transverse sinus stenosis who have failed stenting with those who have responded to stenting. Here we examine common risk factors and predictors of failure of transvenous stenting for IIH and propose that if venous sinus stenting fails, CSF diversion should be considered as a second line treatment.

2. Methods

Approval of this study was provided from The Johns Hopkins Hospital Institutional Review Board. We identified nineteen patients with IIH between January of 2008 and December of 2012, who were found to have transverse sinus stenosis along with a mean pressure gradient >4 mmHg. These patients were not pregnant, were not on medications nor had medical conditions associated with intracranial hypertension, and ultimately failed maximal medical therapy. Medical treatment failure was defined as allergy to acetazolamide, intolerance to escalating doses of this medication or worsening of papilledema despite treatment of up to 3000 mg of acetazolamide daily. None of these patients had received a prior shunt or bariatric surgery. However, one patient underwent prior venous sinus stenting, and one patient had a prior optic nerve sheath fenestration and was removed from the analysis. Of the 18 patients reviewed, while 15 did not need further treatment, 3 received shunt placement performed

as a second line treatment for IIH once stent placement failed to effectively reduce symptoms of IIH. These 3 patients were followed for greater than 3 months and their neurological and neuro-ophthalmological evaluations pre- and post-treatment were reviewed. Neurological assessment included a detailed headache history and examination to exclude other causes of PTC and lumbar puncture. Symptoms were characterized by improvement in headache, papilledema, visual obscuration, color vision, fundus appearance and/or intracranial pressure. For a detailed review of all quantitative and qualitative measures used in this study see Radvany et al. [10].

3. Results

All patients (n=3) in the sub-group that underwent shunting after stent placement were female with ages ranging from 23 to 34 years (mean age: 30 years) and a mean body mass index of 36.6 kg/m² (range 30.9–45.7 kg/m²). In comparison, in the group who had stent placement alone (n = 15), fourteen were female and one was male with ages ranging from 21 to 56 years (mean age: 40.7 years) and a mean body mass index (BMI) of 33.3 kg/m² (range 25–51 kg/m²), as described in Table 1. In the shunt after stenting group, all patients suffered from headaches, and two patients had either pulsatile tinnitus or papilledema. In the stent alone group, all patients suffered from headaches, and thirteen patients had pulsatile tinnitus and papilledema, as shown in Table 2. All patients complained of blurry vision despite having better than 20/40 vision in each eye. The average opening pressure on the most recent lumbar puncture obtained prior to any intervention in the three patients that underwent shunting after stent placement was 50 (range 40–55 cm of H₂O), whereas in the group that underwent stent placement alone, the pre-intervention lumbar puncture showed a CSF pressure of 37 (range 25–50 cm of H₂O), which was statistically significant (p = 0.012). All three patients in the shunting

Table 2
Signs and symptoms of patients treated with stent alone compared to patients who underwent shunt placement post stenting.

Signs and symptoms	Stent alone	Shunt post stent
Total patients (n = 18)	Number of patients	Number of patients
Pre-stenting		
Headache	15	3
Tinnitus	13	2
Papilledema	13	2
Post-stenting		
Headache	3	2
Tinnitus	0	0
Papilledema	0	2

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