

Progress Report

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Title of Project:

4D flow MRI in Idiopathic Intracranial Hypertension

Summary: (approximately 1,000 words)

Idiopathic intracranial hypertension (IIH) is a condition with increasing prevalence due to the rising incidence of obesity. It primarily affects women more than men and is significant contributor to disease burden in the headache population. Blindness is the major neurological sequelae. Where medication fails to keep pressure under control, patients maybe suitable for more invasive but durable treatment options like venous sinus stenting. The pathway to this treatment involves a major workup of the intracranial venous system including angiography and pressure monitoring. Advances in MRI technology including 4D flow are allowing for non-invasive estimations of parameters which would otherwise require an invasive procedure and further physiological assessment of other blood flow parameters.

The primary aims of the our project are:

Construct, develop and refine an imaging technique and validate against conventional catheter venography

Interrogate cerebral blood flow profiles using 4D flow in normal controls and patients with IIH to better understand potential causes, predict treatment response and illuminate poorly understood pathophysiological mechanisms

Hypothesis vs Findings

We hypothesised that our 4D flow MRI findings would correlate with findings on conventional venography. Our first report has come in the form a case example (awaiting publication) qualitatively 4D flow has confirmed the presence flow acceleration (consistent with a pressure gradient on venography/manometry). Furthermore there have been additional, undocumented findings which will prove to be interesting to other researchers in this area including, sinus tree decompression post-treatment as well as significant increases in compliance. The latter being important for reductions in flow restriction.

In our validation phase of the study we are currently in the process of quantitatively comparing physiological parameters. This will be key in replacing conventional venography and manometry.

Unanswered Questions

What are venous sinus flow profiles in controls, obese women without the disease?
What are the effects of medication on cerebral venous blood flow?

What these research outcomes mean

Patients maybe able to forego a invasive procedure in favour of a MRI scan with this disease
We will improve our understanding of venous sinus stenosis in the setting of IIH

Please include any appropriate photos or diagrams.

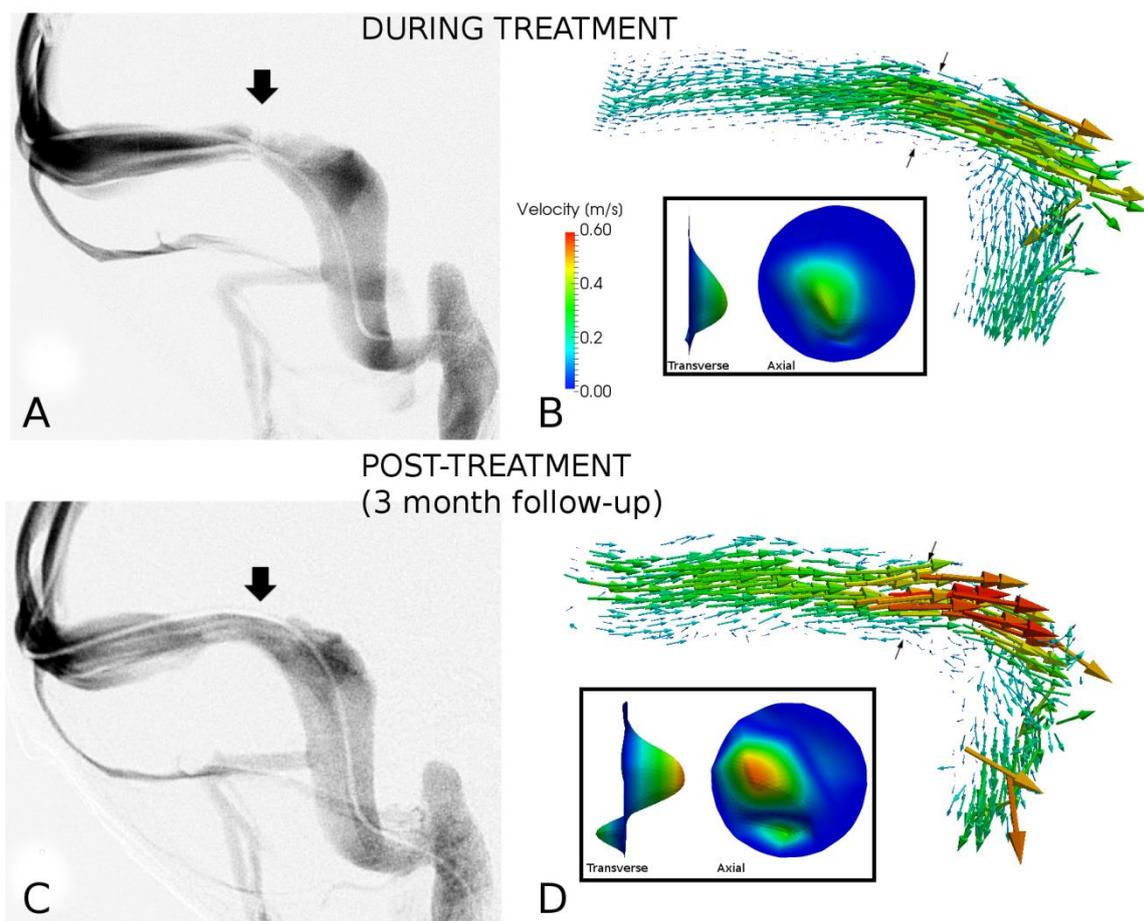


Figure 1. Acute diagnostic venography and manometry at D5 (a) and 4D-flow at D9 (b) demonstrate a stenosis in the anterior segment of the right transverse sinus (arrows). 4D-flow revealed the stenosis

to be moderate to severe and mild flow acceleration to a maximum velocity of 39cm/s. Follow-up post-treatment DRCVM study at 3 months (c) showed some improvement of the stenosis. Contemporaneous 4D-flow (d) demonstrated a corresponding increase 70% in flow (5.7mL/beat to 9.7mL/beat), however the degree of flow acceleration at the stenosis actually *increased* with a maximum velocity of 69cm/s, hence the improved flow was best explained by decreased *resistance to flow* due to improved vessel compliance rather than a simple anatomical resolution of the stenosis.

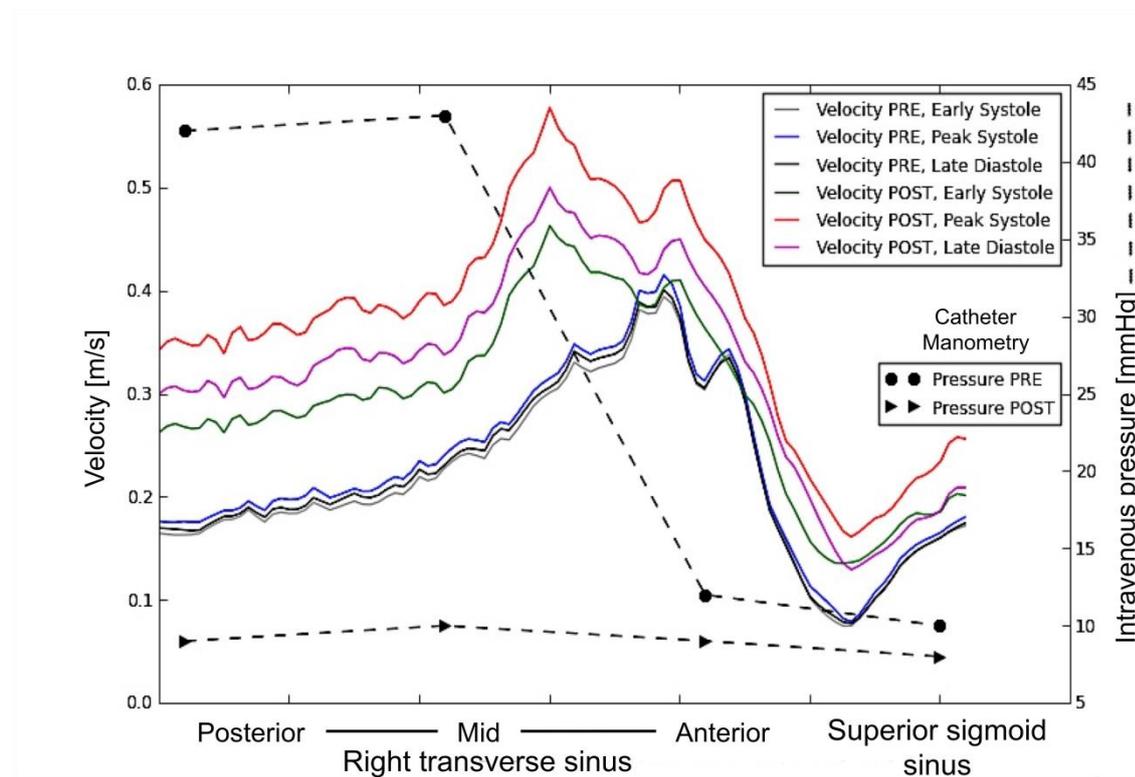


Figure 2. Pre- and post-treatment 4D-flow derived flow velocities at early systole, peak systole and late diastole from the posterior right transverse sinus to the superior sigmoid sinus. The dotted lines are actual catheter pressures taken from DRCVM. Both studies show flow acceleration to a peak around the mid-anterior transverse sinus. In the post-treatment study (upper lines – green, orange and pink) there is increased overall flow velocity, and a more is persistent flow acceleration during systole