Thoracic Pressure Does Not Impact CSF Pressure via Compartment Compliance

An alternative mechanism is needed to explain the impact of thoracic pressure on CSF pressure.

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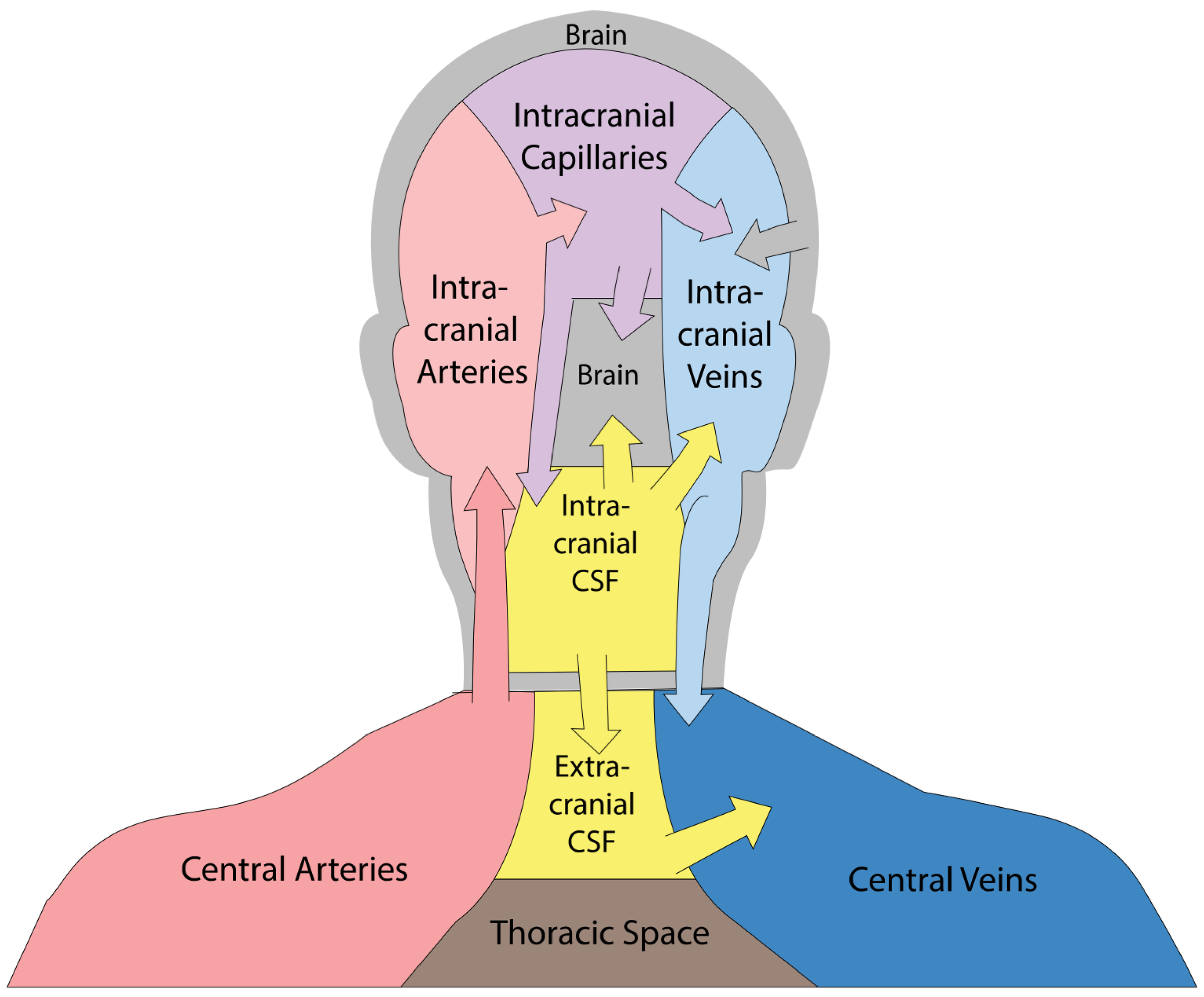
Introduction

- Space acquired neuro-ocular syndrome (SANS) remains a difficult risk to characterize.
- Fluid shift and the resultant change on the Cardiovascular (CV) and cerebral spinal fluid (CSF) systems in the absence of gravity continue to be considered a contributing factor to SANS.
- This study seeks to identify the impact of increased pressure in the thoracic space (due to fluid shifts) on the CSF system via compliance.

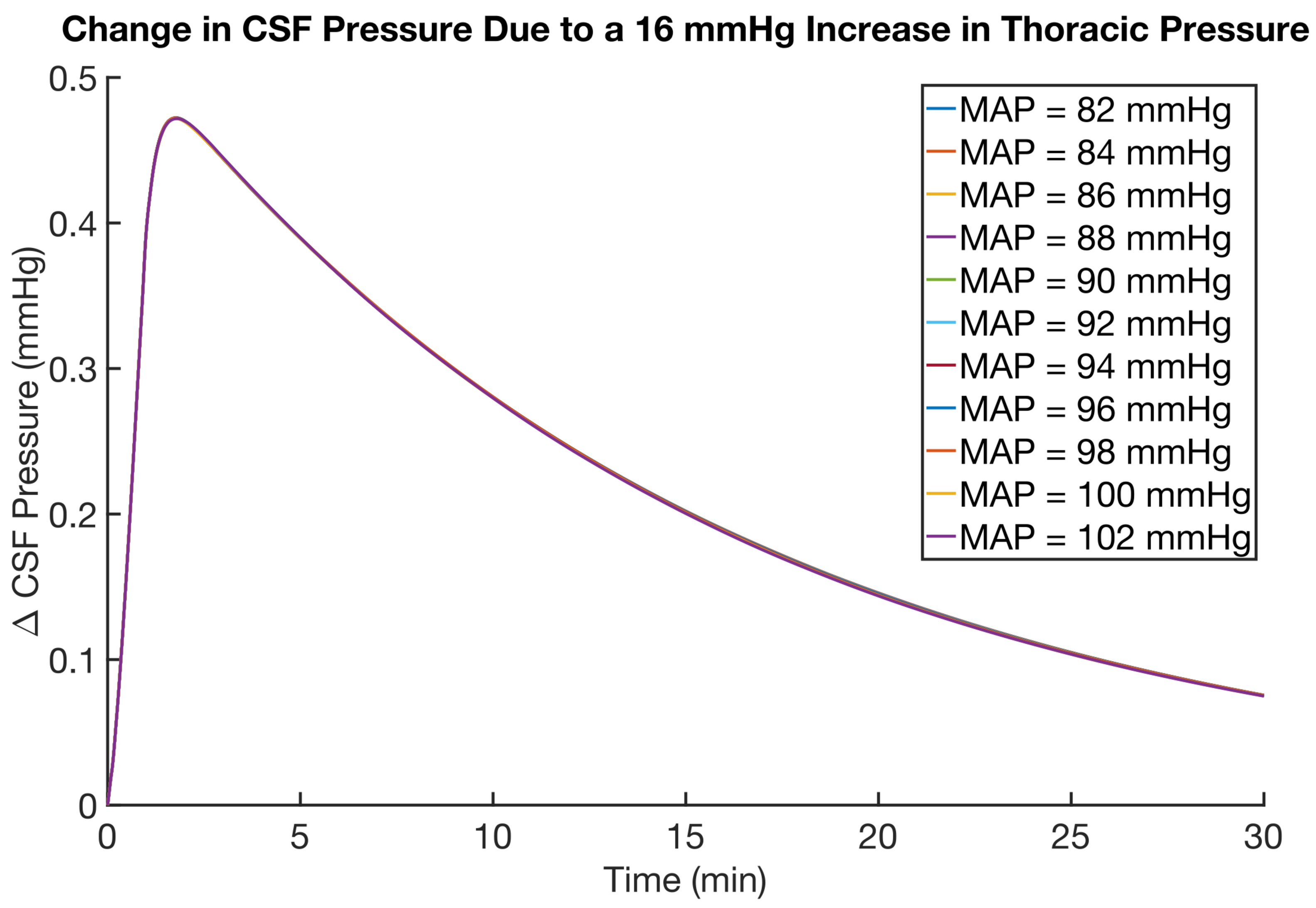
Methods



Credit: Maria Menkin

- Extension of the Stevens, et. al [1] lumped parameter model by including alternative vascular drainage pathways [2,3] and enforcing the Monroe-Kellie doctrine.
- Fixed Mean Arterial Pressure (MAP) and Central Venous Pressure (CVP), linear ramp to target Thoracic Pressure over the course of 1 minute.
- Examined Changes in Intracranial CSF Pressure and Volume over a 30-minute timescale.
- Model validated against Cerebral Perfusion Pressure (CPP) and CSF pressures measured in [4,5,6].

Results



- The change in CSF pressure that results from increasing the thoracic pressure from -6 mmHg to +10 mmHg is independent of the MAP.
- A 16 mmHg change in thoracic pressure results in a transient increase in CSF pressure by < 1 mmHg.
- Less than 1 mL of fluid shift between internal cranial compartments occurs.
- CSF Pressure is strongly tied to CPP.

Conclusions

- For a fixed MAP and CVP, the CCMP Cranial Model does not predict physiologically significant change in pressure or fluid volume for the CSF system as a result of an increase in thoracic pressure.
- Changes in CSF pressure in response to changes in thoracic pressure are more likely tied to an alternative mechanism, such as changes in CPP.

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