Associations Between Spontaneous Intraparenchymal Hemorrhage Volume and Quantitative Pupillometry

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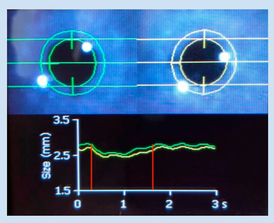
Introduction

- Pupillometry, the **quantitative assessment of pupil size and reactivity**, has been established as a useful tool for monitoring in the intensive care unit.[1]
- NPi **(Neurological Pupil Index)** measures pupil size and reactivity, providing a **0 (non-reactive) to 5 (reactive) score** (NPi < 3 is abnormal)



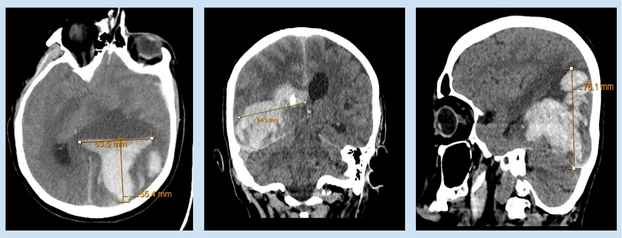
- Decline in pupil reactivity can indicate **serious neurological decline**, because of the location of pupillary neural pathways
- The association between **brain hemorrhage (bleeding) volume** and changes in pupillometry is not well-researched.

Methods

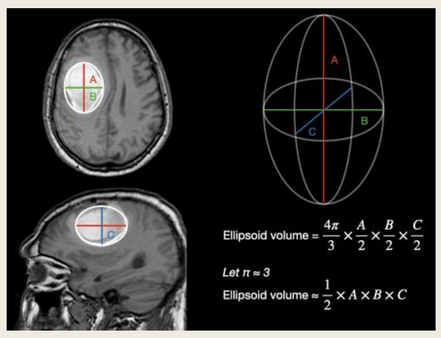
Retrospective chart review of patients admitted to Boston Medical Center between Oct 2020-July 2024 with spontaneous intraparenchymal hemorrhages (IPH) and pupillometry scores **(N = 31)**

ABC/2 method

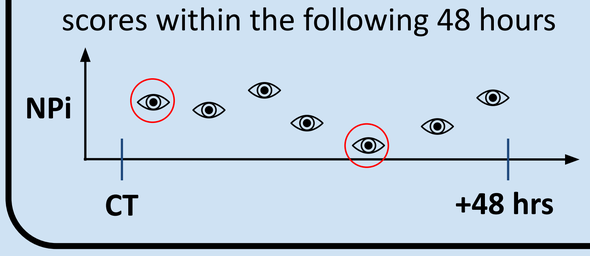
Axial | **Coronal** | **Sagittal**



Volume Estimate



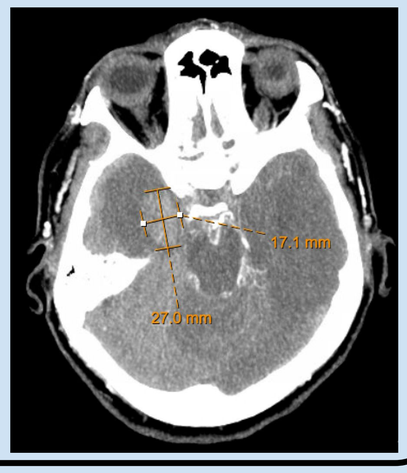
- Analyzed relationship between hemorrhage volume and NPi scores
- Used NPis closest to available CT imaging (within 3 hours) and the lowest NPi scores within the following 48 hours



Exclusion Criteria

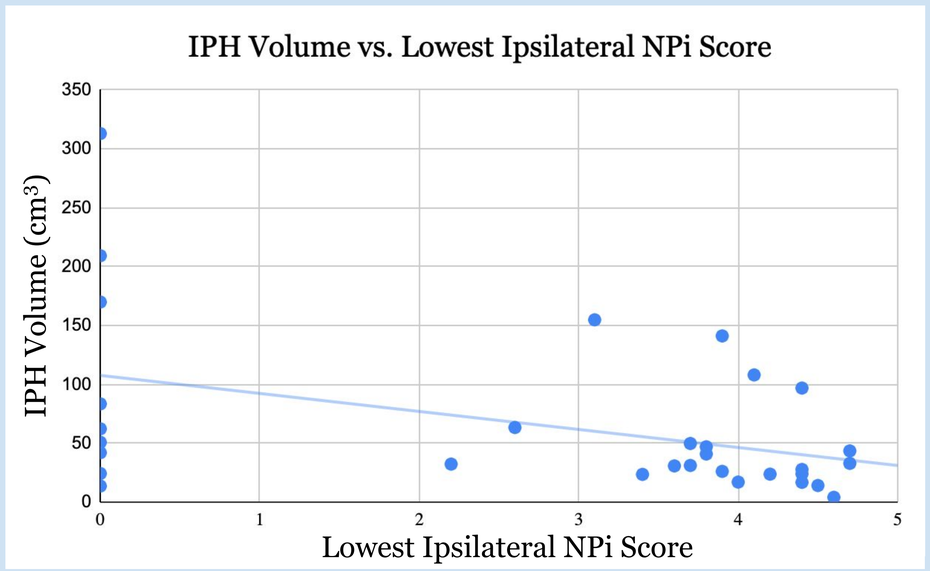
- Hemorrhage volume < 10 cubic centimeters
- Exclusively infratentorial damage
- No pupillometry scores within 3 hours of imaging
- No additional pupillometry scores in the 48 hours following imaging

Ex. IPH too small



Results

- **Statistically significant** (p = 0.026) negative correlation between **the minimum ipsilateral NPi score** and **hemorrhage volume**

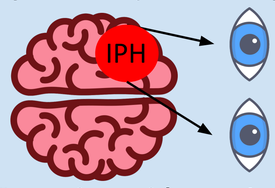


Median IPH Volume (25-75%): 40.82 cm^3 (24.13-73.37 cm^3)

P-value	0.026
Beta value	-14.444
95% conf. interval (for B-value)	[-26.99, -1.90]
Median NPi (25-75%)	3.7 (0-4.3)

all correlations adjusted by age and sex

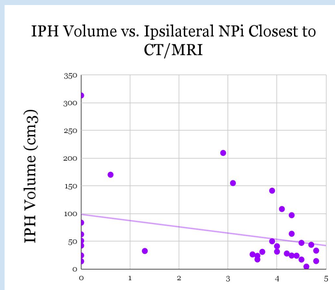
Ipsilateral (same side pupil)



Contralateral (opposite pupil)

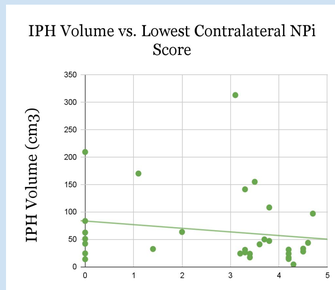
- **Non-statistically significant** negative correlations

1. Between **ipsilateral NPi Score closest to imaging** and IPH Volume



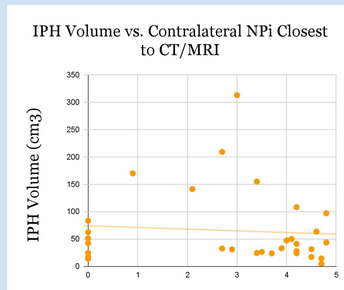
P-value	0.15
Beta value	-9.825
95% conf. interval (for B-value)	[-23.44, 3.79]
Median NPi (25-75%)	3.9 (0.95-4.3)

2. Between **lowest contralateral NPi Score** and IPH Volume

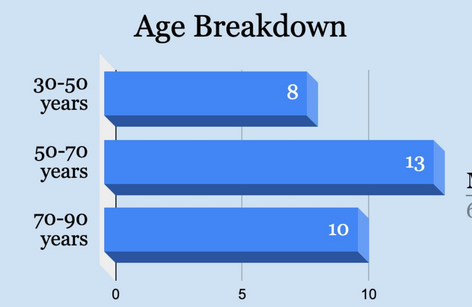


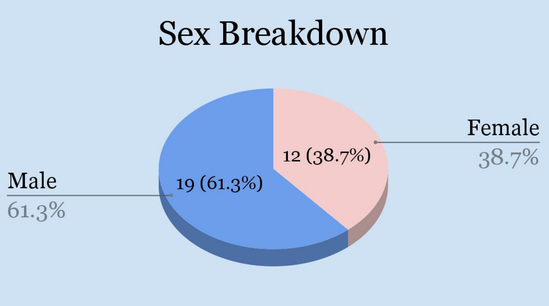
P-value	0.31
Beta value	-7.483
95% conf. interval (for B-value)	[-22.28, 7.31]
Median NPi (25-75%)	3.4 (1.25-4.2)

3. Between **contralateral NPi Score closest to imaging** and IPH Volume



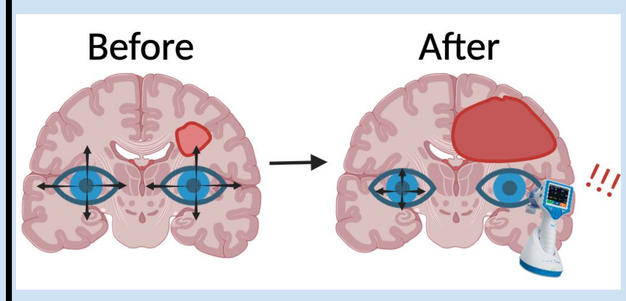
P-value	0.705
Beta value	-2.700
95% conf. interval (for B-value)	[-17.18, 11.78]
Median NPi (25-75%)	3.5 (1.5-4.2)



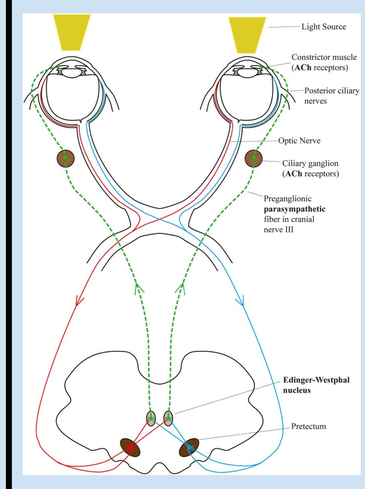


Discussion/ Conclusions

- Suggests lower **ipsilateral NPis** indicate **greater** IPH volumes
  - Declining **ipsilateral** NPi scores could indicate increasing IPH volume **(assumes lesion laterality is known)**



- Pupillometry could assist with estimating **initial** brain hemorrhage volume
  - Can supplement CT/MRI imaging data



  - Weaker correlation between IPH volume and **contralateral** NPi scores
  - Suggests that IPH does not affect neural pathways responsible for contralateral pupil reactivity
- Contralateral NPi may be less relevant for clinical monitoring
- More research needs to be done to control for hemorrhage location, and to correlate changing NPi scores with IPH volume **over time**
  - Using **follow-up** CT imaging data

References

[1]Rasulo, F. A., Togni, T., & Romagnoli, S. (2020). Essential Noninvasive Multimodality Neuromonitoring for the Critically Ill Patient. Critical care (London, England), 24(1), 100. https://doi.org/10.1186/s13054-020-2781-2

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