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### Evaluation of the hypothesis that viral meningitis is a mimic of abusive head trauma

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# Evaluation of the hypothesis that viral meningitis is a mimic of abusive head trauma

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# Disclosures

- None

# Background

- Viral meningitis has been proposed to mimic AHT
- No studies have examined this theory in the clinical setting
- Eliminating viral meningitis as a mimic of AHT would facilitate more confidence in the diagnosis and be of assistance in legal settings

# Background

- Comparing definite AHT to viral meningitis across demographics, HPI and initial clinical findings can evaluate for differences/similarities
- SDH + concomitant suspicious injuries (CSIs) may be used as a “definite AHT” proxy group
- Hypothesis: *Viral meningitis will differ significantly from AHT in HPI, and clinical presentation*

# Objectives

- Compare viral meningitis (controls) to abusive head trauma (SDH + CSI) across 3 domains:
  - Demographics
  - History of Present Illness
  - Initial Clinical Presentation
- Compare both groups to SDH without CSI
  - May help further clarify diagnostics in this group

# Methods

- Retrospective study, descriptive
- Single institution
- January 1, 2014 – December 31, 2018
- SDH subjects identified via Child Abuse Pediatrics (CAP) team consult list
- Viral meningitis subjects identified via laboratory database

# Inclusion Criteria

- Age less than 24 months
- Viral meningitis subjects
  - CSF positive for viral meningitis (PeV, EV or HSV)
- SDH subjects
  - SDH identified by CT or MRI brain

# Exclusion Criteria

- Isolated contact SDH
- Known pre-existing brain abnormality/surgery/infection



# Domains

## Demographics (5 measures):

- Subject age
- Gender
- Race/ethnicity
- Insurance status
- Relationship of caregivers in the home

## History of Present Illness (20 measures):

### Acute symptoms

- Seizure
- Acute mental status change
- Decreased tone
- Apnea
- Difficulty breathing
- Concomitant acute ill symptom

### Non-acute symptoms

- Fever
- Vomiting
- Cough/congestion
- Poor feeding
- Fussiness
- Difficulty breathing
- Gradual mental status change

### Other history

- History of trauma
- Location of onset of symptoms
- Adult witness to symptoms
- Duration of fever, vomiting, poor feeding and fussiness

## Clinical (14 measures)

- Macrocephaly
- Fever
- Cough/congestion
- Difficulty breathing
- Apnea
- Intubation
- Witnessed seizure
- Excessive fussiness
- Hypotonia
- Neurologic status at presentation
- Care in PICU
- WBC
- Platelets
- Hepatic transaminases

# Concomitant Suspicious Injuries (CSI)

- Bruising: immobile child, patterned, TEN-FACES, genital/buttocks
  - As documented in initial ED or Admission note
- Fractures with high specificity for abuse
  - Identified on initial or follow up skeletal survey
- Retinal hemorrhages: many, multilayered, extending to the periphery or retinoschisis
  - Identified by Ophthalmology exam
- Internal abdominal injuries
  - Identified on abdominal imaging or direct visualization during surgery

# Statistical Analysis

- Study groups
  - Viral Meningitis
  - AHT proxy (SDH + CSI)
  - SDH only
- Compared across the 3 domains (39 measures)
  - Chi-square test
  - Fisher's Exact Test
  - Mann-Whitney U

# Demographic Domain

Characteristics	Viral Meningitis, n (%)	AHT Proxy, n (%)	SDH only, n (%)	p <sup>AHT vs VM</sup>	p <sup>SDH vs VM</sup>	p <sup>SDH vs AHT</sup>
Total patients	397	118	35			
Mean age in months	0.8	5.5	5.4	<i>&lt;.001</i>	<i>&lt;.001</i>	.83
Male gender	215 (54.2)	78 (66.1)	24 (68.6)	.02	.10	.79
Race				.02	.37	.37
Caucasian	279 (70.3)	69 (58.5)	23 (65.7)			
Hispanic	29 (7.3)	6 (5.1)	2 (5.7)			
African American	40 (10.1)	18 (15.3)	7 (20.0)			
Other	49 (12.3)	25 (21.2)	3 (8.6)			
Insurance				<i>&lt;.001</i>	.06	.08
Private	209 (52.6)	16 (13.6)	11 (31.4)			
Public	167 (42.1)	95 (80.5)	22 (62.9)			
Military	14 (3.5)	5 (4.2)	1 (2.9)			
Uninsured/other	7 (1.8)	2 (1.7)	1 (2.9)			

# History Domain – Acute Symptoms

Characteristics	Viral Meningitis, n (%)	AHT proxy, n (%)	SDH only, n (%)	OR <sup>AHT vs VM</sup> (95% CI)	OR <sup>SDH vs VM</sup> (95% CI)	OR <sup>SDH vs AHT</sup> (95% CI)
Seizure	9 (2.3)	43 (36.4)	5 (14.3)	24.7 (11.6 - 52.8)	7.2 (2.3 - 22.8)	0.3 (0.1 - 0.8)
Mental status change	5 (1.3)	78 (66.1)	16 (45.7)	152.8 (58.5 - 399.7)	66.0 (21.9 - 199.3)	0.4 (0.2 - 0.9)
Decreased tone	5 (1.3)	20 (16.9)	3 (8.6)	16.0 (5.7 - 43.7)	7.4 (1.7 - 32.2)	0.5 (0.1 - 1.7)
Apnea	4 (1.0)	20 (16.9)	5 (14.3)	20.1 (6.7 - 60.0)	16.4 (4.2 - 64.2)	0.8 (0.3 - 2.4)
Difficulty breathing	6 (1.5)	31 (26.3)	1 (2.9)	23.2 (9.4 - 57.4)	1.9 (0.2 - 16.4)	0.1 (0.01 - 0.6)

# History Domain – Other Ill Symptoms

Characteristics	Viral Meningitis, n (%)	AHT proxy, n (%)	SDH only, n (%)	OR <sup>AHT vs VM</sup> (95% CI)	OR <sup>SDH vs VM</sup> (95% CI)	OR <sup>SDH vs AHT</sup> (95% CI)
Lack of fever	26 (6.6)	113 (95.8)	34 (97.1)	322.5 (121.0 – 859.3)	485.2 (63.8 – 3686.5)	1.5 (0.2 – 13.3)
Vomiting	45 (11.3)	30 (25.4)	13 (37.1)	2.7 (1.6 – 4.5)	4.6 (2.2 – 9.8)	1.7 (0.8 – 3.9)
Cough or congestion	116 (29.2)	15 (12.7)	5 (14.3)	0.3 (0.2 – 0.5)	0.3 (0.1 – 0.9)	1.1 (0.4 – 3.4)
Poor feeding	173 (43.6)	20 (16.9)	10 (28.6)	0.3 (0.2 – 0.5)	0.5 (0.2 – 1.1)	2.0 (0.8 – 4.7)
Fussiness	262 (66.0)	26 (22.0)	8 (22.9)	0.2 (0.1 – 0.2)	0.2 (0.1 – 0.4)	1.1 (0.4 – 2.6)

# Clinical Domain

Characteristics	Viral Meningitis, n (%)	AHT proxy, n (%)	SDH only, n (%)	OR <sup>AHT vs VM</sup> (95% CI)	OR <sup>SDH vs VM</sup> (95% CI)	OR <sup>SDH vs AHT</sup> (95% CI)
Macrocephaly	48 (12.1)	30 (25.4)	10 (28.6)	2.5 (1.5 - 4.1)	2.9 (1.3 - 6.4)	1.2 (0.5 – 2.7)
Fever	305 (76.8)	6 (5.1)	0	0.02 (0.01 - 0.04)	VM RR=0.7 (0.7 - 0.8)	AHT proxy RR=0.8 (0.7 – 0.8)
Cough or congestion	38 (9.6)	2 (1.7)	2 (5.7)	0.2 (0.04 - 0.7)	0.6 (0.1 – 2.5)	3.5 (0.5 – 25.9)
Intubated	3 (0.8)	38 (32.2)	3 (8.6)	62.4 (18.8 - 207.1)	12.3 (2.4 - 63.5)	0.2 (0.1 - 0.7)
Witnessed seizure	6 (1.5)	16 (13.6)	0	10.2 (3.9 - 26.8)	VM RR=0.9 (0.9 – 0.94)	AHT proxy RR=0.8 (0.7 - 0.8)
Hypotonia	10 (2.5)	10 (8.5)	2 (5.7)	3.6 (1.5 - 8.8)	2.4 (0.5 – 11.2)	0.7 (0.1 – 3.1)
Neurologic status at presentation				0.04 (0.02 - 0.1)	0.2 (0.1 - 0.5)	4.6 (1.9 - 10.9)
Normal	365 (91.9)	49 (41.5)	27 (77.1)			
Abnormal	20 (5.0)	66 (55.9)	8 (22.9)			

# Limitations

- Retrospective
- Variation in screening tests for occult trauma among groups



# Conclusions

- Viral meningitis is not supported as mimic of abusive head trauma
- SDH only subjects appear more similar to the AHT proxy group than to viral meningitis subjects
- Certain combinations of features when present have a high positive predictive value for abuse
  - History of acute mental status change + intubation and lack of fever

# Thank you!

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