

Radiographic Findings as Indicators of Neurodevelopmental Outcomes in Abusive Head Trauma

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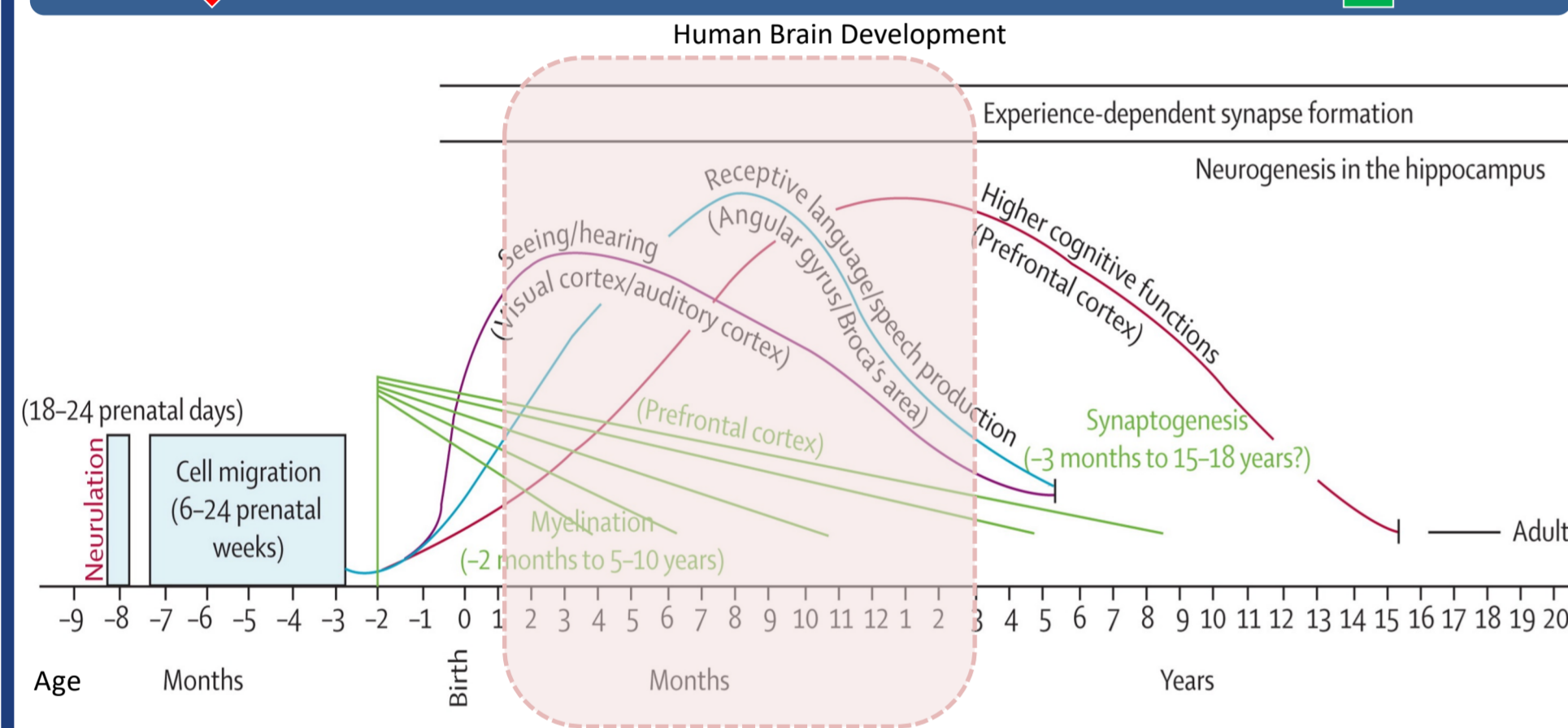


Background

Abusive head trauma (AHT) is known to have high mortality rates (10-40%), but studies on developmental outcomes and prognostic factors are limited. This study aims to identify clinical and radiographic markers of traumatic brain injury severity and neurodevelopmental outcomes.

Developmental Outcomes Following Abusive Head Trauma in Infancy
59 studies <--> 115 assessment tools

Significant outcomes variability



Methods

- Expert-confirmed AHT at TCH 3/2018 – 2/2021 (n= 188)
- Demographic data, injury severity scales, radiographic data, neurodevelopmental assessment (n= 112)
- 2 pediatric neuroradiologists- independent review of brain and spine imaging with discrepancies resolved via consensus (n= 98)
- Outpatient follow-up with longitudinal neurodevelopmental assessments via Capute scales and gross motor quotient (n= 56)
- Fisher's exact test / chi-squared test: Injury location and degree neurodevelopmental disability
- Multivariate logistic regression for long-term outcome

Results

Figure 1. Percent of patients with specific developmental impairment and degree by hemorrhage location at first office visit following discharge

Hemorrhage Type	Location	n=	Developmental Domain												
			All	Gross Motor				Visual Motor Problem Solving				Language			
			Normal	Normal	Mild	Moderate	Severe/ Profound	Normal	Mild	Moderate	Severe/ Profound	Normal	Mild	Moderate	Severe/ Profound
Subdural Hemorrhage	Any	20	0.75	0.8	1	0.75	1	0.74	1	1	1	0.84	1	0.83	1
	Frontal	30	0.65	0.73	1	0.5	1	0.66	1	1	1	0.76	1	0.83	1
	Parietal	10	0.7	0.73	0.9	0.5	1	0.69	0.85	1	1	0.74	1	0.83	1
	Temporal	4	0.55	0.63	0.8	0.5	0.83	0.55	0.85	0.75	0.91	0.68	0.88	0.5	0.8
	Occipital	12	0.65	0.7	0.7	0.5	1	0.62	0.85	0.75	1	0.68	1	0.67	1
	Tentorial	29	0.55	0.57	0.6	0.75	1	0.55	0.69	0.75	1	0.61	0.88	0.67	1
Subarachnoid Hemorrhage	Any	13	0.35	0.37	0.1	0	0.58	0.28	0.23	0.25	0.64	0.32	0.38	0.17	0.6
	Frontal	4	0.3	0.27	0.1	0	0.58	0.21	0.15	0.25	0.64	0.26	0.38	0	0.6
	Parietal	12	0.25	0.23	0.1	0	0.42	0.21	0.08	0	0.55	0.18	0.38	0.17	0.4
	Temporal	29	0.05	0.1	0.1	0	0.33	0.03	0.08	0.25	0.45	0.11	0.38	0	0.2
	Occipital	13	0.05	0.03	0	0	0.17	0.03	0	0	0.18	0.03	0.25	0	0
	Cerebellar	4	0	0	0	0	0.17	0	0	0	0.18	0	0.25	0	0
Hypoxic Ischemic Injury	Any	5	0.2	0.2	0.2	0.5	0.92	0.21	0.23	1	0.91	0.29	0.39	0.67	1
	Cortex	20	0.05	0.2	0.2	0.5	0.02	0.03	0.15	0.5	0.91	0.29	0.39	0.67	1
	Subcortical WM	30	0.05	0.07	0.1	0	0.5	0.07	0.23	0.5	0.45	0.11	0.17	0.33	0.6
	Deep GM	10	0.2	0.03	0	0.5	0.5	0.21	0.23	1	0.36	0.11	0.17	0.5	0.6

Figure 2. Percent of patients with persistent deficits at last office visit by specific developmental impairment and associated hemorrhage location

Hemorrhage Type	Location	n=	Developmental Domain												
			All	Gross Motor				Visual Motor Problem Solving				Language			
			Normal	Normal	Mild	Moderate	Severe/ Profound	Normal	Mild	Moderate	Severe/ Profound	Normal	Mild	Moderate	Severe/ Profound
Subdural Hemorrhage	Any	20	N/A	0.13	0.2	0	0.67	0.18	0.38	0.75	0.73	0.13	0.75	0.6	1
	Frontal	30	N/A	0.14	0.2	0	0.67	0.16	0.38	0.75	0.73	0.14	0.75	0.6	1
	Parietal	10	N/A	0.14	0.22	0	0.67	0.15	0.27	0.75	0.64	0.14	0.75	0.6	1
	Temporal	4	N/A	0.15	0.13	0	0.6	0.11	0.27	0.67	0.73	0.12	0.71	0.67	1
	Occipital	12	N/A	0.14	0.14	0	0.67	0.13	0.27	0.67	0.73	0.15	0.75	0.75	1
	Tentorial	29	N/A	0.06	0.17	0	0.67	0.19	0.33	0.67	0.73	0.13	0.71	0.75	1
Subarachnoid Hemorrhage	Any	13	N/A	0.1	0	N/A	0.71	0	0	0	0.78	0.09	0.67	0	1
	Frontal	4	N/A	0.13	0	N/A	0.71	0	0	0	0.78	0.1	0.67	N/A	1
	Parietal	12	N/A	0.14	0	N/A	0.8	0	0	N/A	0.67	0.14	0.67	0	1
	Temporal	29	N/A	0.33	0	N/A	0.75	N/A	0	0	0.6	0.25	0.67	N/A	1
	Occipital	13	N/A	0	N/A	N/A	1	N/A	N/A	N/A	0.5	0	1	N/A	N/A
	Cerebellar	4	N/A	N/A	N/A	N/A	1	N/A	N/A	N/A	0.5	N/A	1	N/A	N/A
Hypoxic Ischemic Injury	Any	5	N/A	0.17	0.33	0	0.7273	0.17	0.33	0.75	0.8	0.18	1	0.75	1
	Cortex	20	N/A	0.17	0.33	0	0.7273	0.17	0.33	0.75	0.8	0.18	1	0.75	1
	Subcortical WM	30	N/A	0	0	0	0.67	0	0.5	0.5	0.6	0	1	1	1
	Deep GM	10	N/A	0	0	0	0.67	0	0.33	1	0.75	0.25	1	1	1
Independent of Imaging	20	N/A	0.03	0.2	0.25	0.67	0.14	0.38	0.75	0.73	0.11	0.75	0.5	1	

Discussion/Conclusions

- Subdural hemorrhage is the most common brain injury associated with AHT with limited overall specificity for long-term outcome
- Tentorial and cerebellar SDH correlate with increasing severity of gross motor and visual motor problem solving but not language delay
- Language deficits are not correlated to hemorrhage location and non-specifically seen with brain injury
- Subdural and subarachnoid locations demonstrate statistically significant increases in visual motor problem solving severity
- Hypoxic ischemic injury in any location correlates with increasing severity of neurodevelopmental deficit with increased likelihood of persistent deficits for initial severe/profound deficits
- More severe deficits regardless of brain injury are associated with higher risk of persistent deficits
- Neuroimaging coupled with early developmental assessments can be utilized as cursory markers of likelihood of neurodevelopmental delay and longitudinal persistence

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