



# Emergency Department Intracranial Pressure Monitoring in Severe Traumatic Brain Injury

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*for the PEGASUS (Pediatric Guideline Adherence and Outcomes) Study*

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## ***Background***

- Almost half a million (473,947) ED TBI visits annually in children <14 years from 2002-06**
- 2012 BTF Guidelines (Level III evidence) states ICP monitoring may be considered in children with severe TBI**
- Vavilala 2014 paper examined ICP monitoring in PICU**
- Routine ED ICP monitoring not addressed by Guidelines**
- Paucity of information on ED ICP monitoring and its benefits in children with severe TBI**
- ED ICP monitoring associated with outcomes is not yet known**



## ***Aim***

- Examine the clinical characteristics, treatments and outcomes associated with initiation of ED ICP monitoring**

## ***Hypothesis***

- Initiation of ED ICP monitoring would be uncommon but may be associated with higher frequency of TBI related care and better discharge outcomes**

## ***Inclusion criteria***

- 1. Age < 18 years**
- 2. Admission Glasgow Coma Scale (GCS) score < 9**
- 3. Head Abbreviated Injury Score (AIS)  $\geq 3$**
- 4. Alive with ICU tracheal intubation  $\geq 48$  hours**
- 5. Trauma history**
- 6. Abnormal admission head CT findings**



## *Data Abstracted and Main Exposure*

- Documented ED data from 224 medical records abstracted for parent PEGASUS study
- PEGASUS study: Retrospective multicenter cohort study (N=236)
- Data from 5 pediatric trauma centers in 2007-2011 time period
- Exposure: Initiation of ED ICP monitoring



## ***Outcomes***

### **□ *Primary***

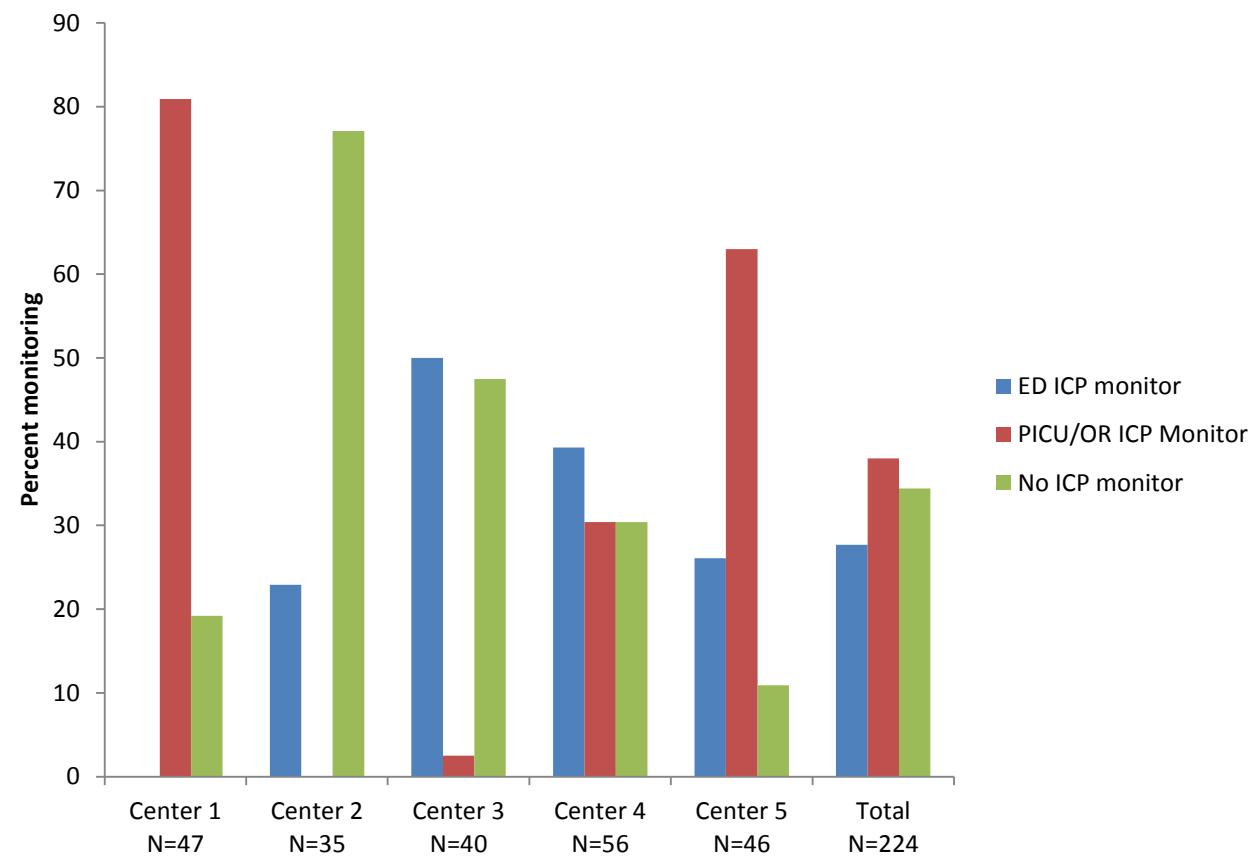
- **In-hospital mortality**
- **Discharge Glasgow Outcome Scale (GOS) score**
  - **Poor (vegetative & major impairment)**
  - **Good (minor impairment & return to baseline status)**

### **□ *Secondary***

- **ED TBI care measures**
- **ED LOS**



## Initiation of ICP Monitoring by Center





## Results

### Clinical and Outcome Characteristics of 224 Children Admitted to Emergency Department (ED) by Initiation of ICP Monitoring Across 5 Study Centers

	Initiation of ED ICP Monitoring N = 62 (28%)	Initiation of OR/PICU ICP Monitoring N = 85 (38%)	No ICP Monitoring N = 77 (34%)
Age (years) mean[SD]	10 [6]	9 [6]	6 [6]
ISS mean[SD]	30 [13]	31 [12]	26 [13]
Head AIS Score 5 & 6 N (%)	41 (66)	53 (62)	30 (39)
Head CT Findings N (%)			
Subarachnoid Hemorrhage	32 (52)	43 (51)	29 (38)
Cerebral Edema	38 (61)	49 (58)	36 (47)
Diffuse Axonal Injury	19 (31)	25 (29)	22 (29)
Decompressive craniectomy for high ICP	23 (37)	31 (38)	14 (18)
Ventriculostomy for high ICP	25 (40)	43 (51)	27 (35)
ED Hypotension (SBP < 70 +2*Age) N (%)	10 (16)	6 (7)	13 (17)
ED Length of Stay (LOS) hour mean [SD]	4 [4]	1 [1]	2 [2]
In-Hospital Mortality N (%)	6 (10)	9 (11)	12 (16)
Poor discharge GOS N (%)	44/56 (79)	47/76 (62)	37/65 (57)



## Select TBI Care Measures for 224 Children by Initiation of ICP monitoring

Treatments Received in ED	Initiation of ED ICP Monitoring N = 62 (28%) N (%)	Initiation of OR/PICU ICP Monitoring N = 85 (38%) N (%)	No ICP Monitoring N = 77 (34%) N (%)
Hypotension treatment	16 (26)	8 (9)	20 (26)
<b>Fluids</b>	<b>10 (16)</b>	<b>5 (6)</b>	<b>12 (16)</b>
Blood products	4 (6)	2 (2)	6 (8)
Vasopressors	2 (3)	1 (1)	2 (3)
<b>Hypertonic saline and/or mannitol for high ICP</b>	<b>29 (47)</b>	<b>41 (48)</b>	<b>7 (9)</b>
ED Hyperventilation (PaCO <sub>2</sub> < 30mmHg)			
Clinically not indicated	6 (10)	0 (0)	4 (5)
<b>Clinically indicated</b>	<b>8 (13)</b>	<b>9 (11)</b>	<b>1 (1)</b>





## Initiation of ICP Monitoring and Outcomes for 224 Children with Severe TBI Admitted to ED Across 5 Study Centers

	ED LOS (hours)* (N = 224) Coefficient (95% CI)	Discharge Mortality* (N = 224) aRR (95% CI)	Discharge Glasgow Outcome Scale Score* (Alive) (N = 197) aRR (95% CI)
<b>No ICP Monitoring</b>	Reference group	Reference group	Reference group
<b>ICP initiation in ED</b>	2.07 (-1.55, 5.69)	<b>0.40 (0.22, 0.75)</b>	1.25 (0.96, 1.63)
<b>ICP initiation in OR/PICU</b>	- 0.7 (-1.43, 0.02)	0.83 (0.41, 1.68)	1.03 (0.80, 1.33)

\*All models adjusted for age, gender, head AIS, highest non-head AIS, GCS motor score, cerebral edema, diffuse axonal injury and decompressive craniectomy and clustering analysis within institution performed



## *Limitations*

- **Retrospective data**
- **Excluded patients who died within 48 hours of admission**
- **Did not capture some ICP treatment, all secondary insults, all TBI care measures**
- **No temporal association data between secondary insults sustained and timing of ED ICP monitoring**
- **Residual confounding despite adjustments**



## *Discussion*

- **First study to describe ED ICP monitoring**
- **ED ICP monitoring varied by study center**
- **Frequent initiation of ED ICP monitoring**
- **Initiation of PICU ICP monitoring associated with shorter ED LOS**
- **Initiation of ED ICP monitoring associated with lower in-hospital mortality**



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