

Association of hypocalcemia with clinical outcomes of combat casualties with TBI transported by Critical Care Air Transport Teams (CCATT)

Maj William T. Davis^{1,2}, Maj Patrick C. Ng^{1,2}, Kimberly L. Medellin¹, Julie E. Cutright¹, Crystal A. Perez¹, Allyson A. Araña¹, Lt Col Joseph K. Maddry¹

¹United States Air Force En route Care Research Center/59th MDW/ST – United States Army Institute of Surgical Research, JBSA Ft. Sam Houston, TX; ²Department of Emergency Medicine, San Antonio Military Medical Center, JBSA Ft. Sam Houston, TX



Background

- Hypocalcemia during resuscitation for hemorrhagic shock associated with increased mortality
- Updated JTS CPG for damage control resuscitation has ionized calcium (iCa) goal of 1.2 mmol/L
- Calcium repletion varies widely in ICU care as standard protocols are not associated with improved outcomes
- No standardized goal for iCa during CCATT transports

Objectives

- Describe the association between clinical outcomes and hypocalcemia for combat wounded with traumatic brain injury (TBI) transported by CCATT
- Describe CCATT calcium supplementation practices

Methods

- Secondary analysis of retrospective cohort of patients with TBI transported by CCATT out of theater to LRMC
- Inclusion criteria:
 - Transported between January 2007 and May 2014
 - Head/neck Abbreviated Injury Scale (AIS) ≥3
 - At least 18 years old
 - CCATT record available
- Exclusion criteria:
 - Catastrophic head injury
 - No in-flight calcium measurements
- Data sources:
 - CCATT records (3899)
 - TMDS radiology reports
 - DoD Trauma Registry
- Exposure: Severe Hypocalcemia (iCa < 0.9 mmol/L) and hypocalcemia (0.9 ≤ iCa < 1.12 mmol/L) based on minimum in-flight iCa
- Outcomes: mortality and ICU length of stay
- Data analyses:
 - Descriptive statistics and univariate comparisons
 - Logistic regression models

Results

Figure 1. Study Population Flow Chart

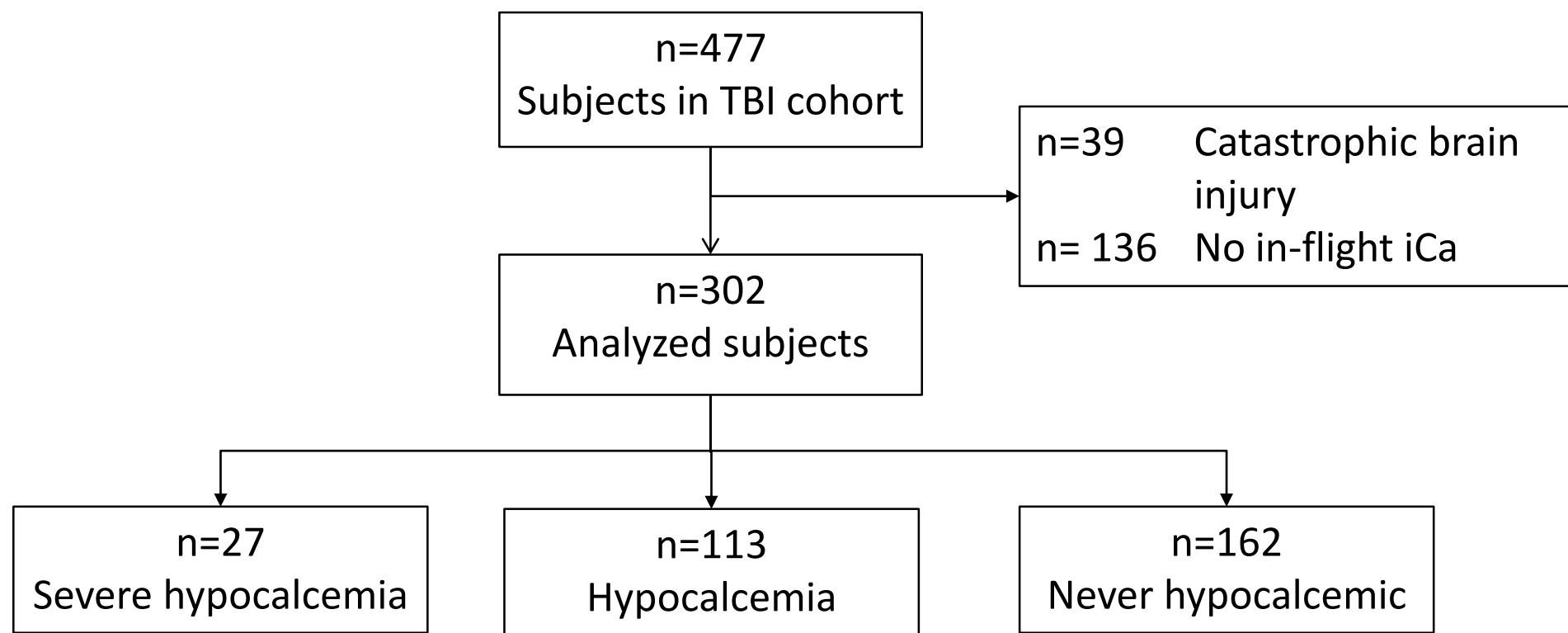


Figure 2. Baseline and Pre-flight Characteristics

Variable	Severe hypocalcemia	Hypocalcemia	Never hypocalcemic	p
Age	23.0 [21.0-24.0]	24.0 [21.0-29.0]	25.0 [21.0-29.3]	0.26
ISS	34.0 [26.0-42.0]	30.0 [25.5-38.0]	29.0 [22.0-36.0]	0.22
Preflight iCa	1.08 (0.15)	1.12 (0.16)	1.16 (0.20)	0.04*

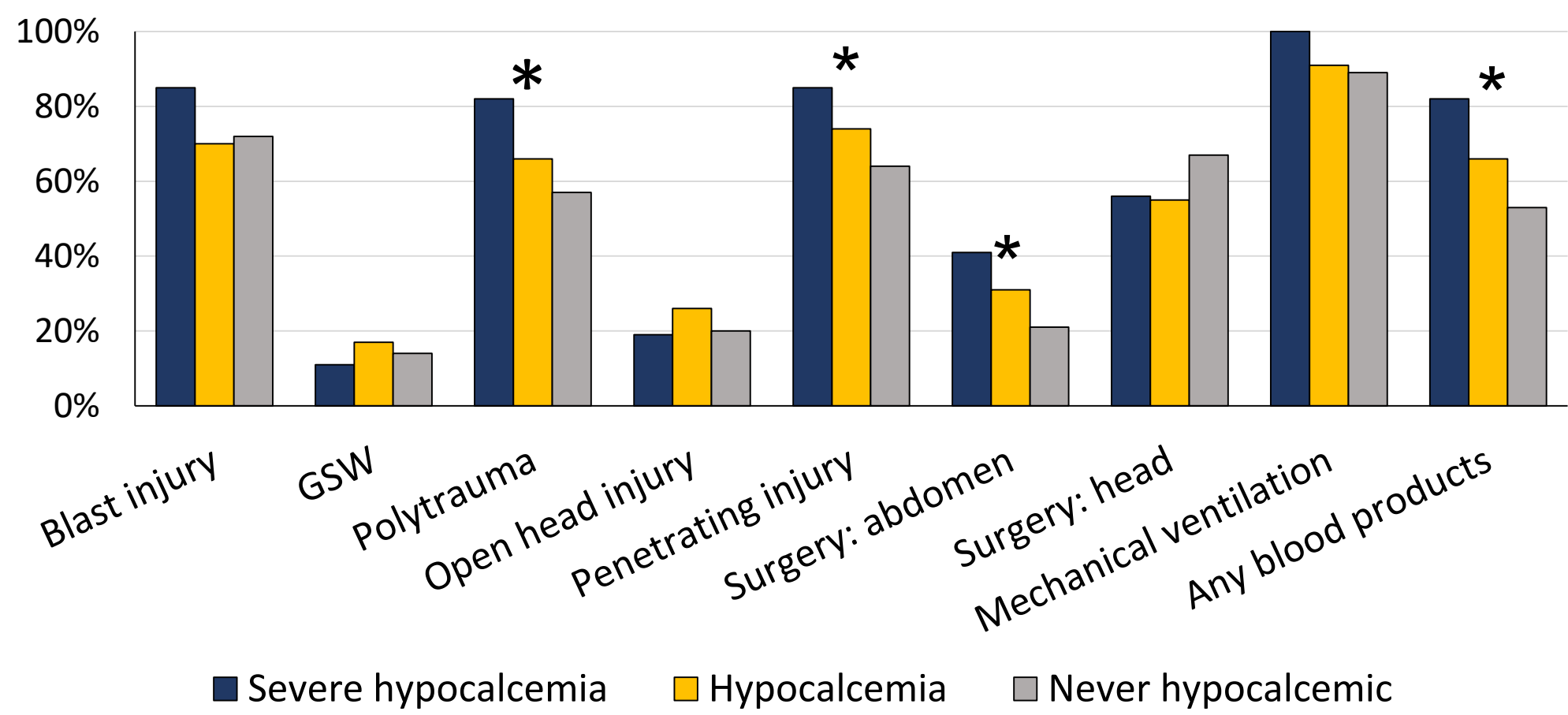


Table 1. Clinical outcomes and regression analysis

Variable	Severe hypocalcemia	Hypocalcemia	Never hypocalcemic	p
Total ventilator days	10.0 [6.0-14.0]	8.0 [5.0-12.0]	7.0 [5.0-12.0]	0.16
Total ICU days	12.0 [10.0-18.0]	10.0 [8.0-19.5]	10.0 [6.0-16.3]	0.19
Total hospital days	26.0 [9.0-41.0]	18.0 [6.0-39.5]	14.0 [5.0-32.5]	0.04*
Mortality	7.4%	8%	3.1%	0.18
Logistic Regression				
aOR Mortality (95% CI)	2.1 (0.7-6.0)	1.8 (0.3-10.1)	Reference group	

Table 2. In-flight measurements and treatments

	Severe hypocalcemia (n=27)	Hypocalcemia (n=113)
Lab measurements		
iCa min	0.70 (0.16)	1.03 (0.06)
iCa final	0.93 (0.23)	1.11 (0.10)
Final pH	7.36 (0.08)	7.38 (0.06)
Treatments		
Calcium given	44%	16%
CaCl dose	1 g [1-2 g]	1 g [1-1.3 g]
Any blood product	30%	25%

Discussion

- No association found between hypocalcemia and mortality or ICU length of stay
- In-flight hypocalcemia common among CCATT transports of patients with TBI
- Hypocalcemia frequently not treated in current practice
- iCa target of 1.2 mmol/L may not optimize CCATT resources in resource constrained environments

Limitations

- Retrospective design
- Incomplete data capture in medical records
- Inadequate sample to assess calcium treatment effect
- Pre-flight resuscitation may outweigh in-flight management of hypocalcemia

Conclusion

- No association found between in-flight hypocalcemia events and mortality in this critically ill population of combat wounded with TBI

Acknowledgements

DoD JPC-6/Combat Casualty Care Research Program- Funding support; CCATT Pilot Unit; Joint Trauma System