

Accuracy of Hyper-acute Blood GFAP & UCH-L1 in Emergently Evacuated Combat Casualties to Rule-out Intracranial Trauma

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Disclosures: No Conflicts of Interest



What is the Abbott TBI Test?

GFAP

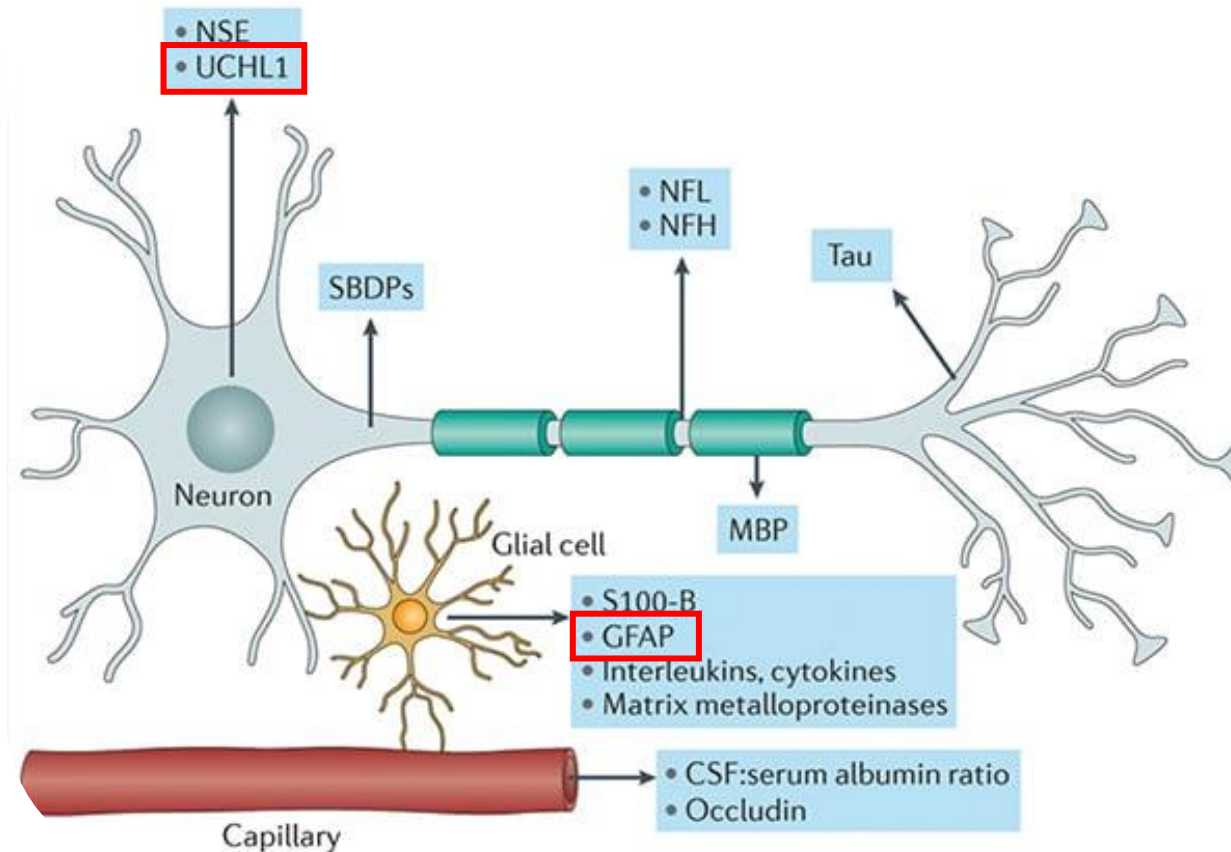
Glial Fibrillary Acidic Protein

Astrocyte structural protein – reflects astroglial injury and blood brain barrier disruption.

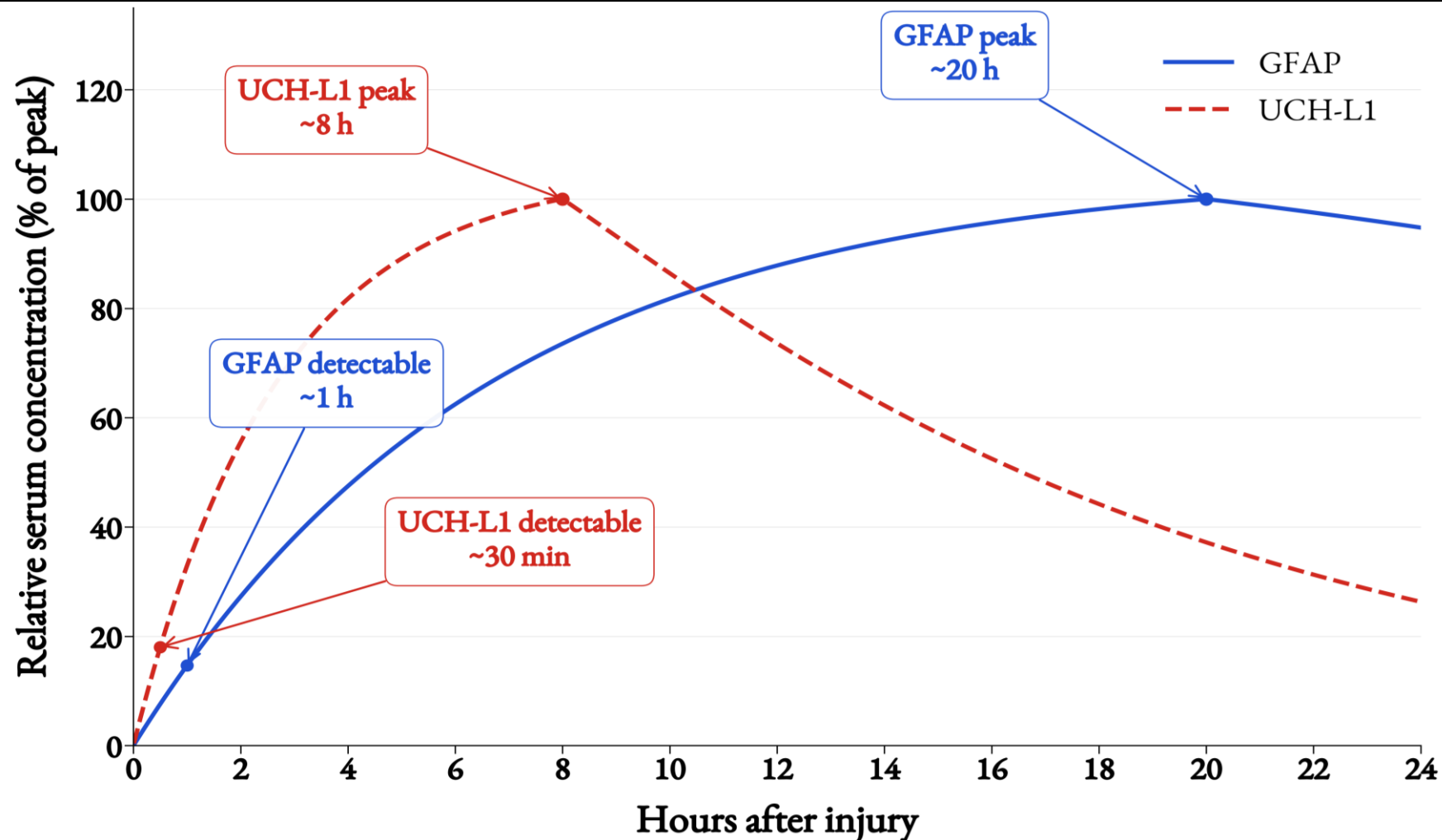
UCH-L1

Ubiquitin C-terminal Hydrolase-L1

Neuron-specific enzyme — reflects neuronal soma injury.



Biomarker Kinetics in the First 24 Hours After Injury



Curves are idealized, anchored to detection, peak, and clearance times explicitly reported in published GFAP and UCH-L1 kinetic data; Figure was produced using *Claude.ai*.

Discovery to FDA Authorization

Year	Milestone	What it means
2018	Banyan BTI Test — De Novo Classification	FDA authorization for a serum test measuring GFAP & UCH-L1 to aid evaluation for CT-detectable intracranial lesions ≤ 12 h after suspected head injury in adults 18+ with GCS 13–15
2021	Abbott i-STAT TBI Plasma — 510(k) Clearance	FDA clearance for a plasma blood test detecting GFAP & UCH-L1 to aid TBI evaluation ≤ 12 h after injury in adults 18+ with GCS 13-15. New platform – results ~ 15 min.
2023	Abbott Alinity-i TBI Test — 510(k) Clearance	FDA clearance for serum and plasma blood test detecting GFAP & UCH-L1 to aid TBI evaluation ≤ 12 h after injury in adults 18+ with GCS 13-15.
2024	Abbott i-STAT TBI Whole Blood	FDA clearance for a point-of-care whole blood test detecting GFAP & UCH-L1 to aid TBI evaluation ≤ 24 h after injury in adults 18+ with GCS 13-15. Results ~ 15 min.



GFAP could Reduce Unnecessary CTs

PIONEER Study Fred Korley @ U Michigan

- ✓ Using GFAP alone could have safely avoided up to 606 (56%) of head CTs
- ✓ Using GFAP + UCHL1 could have safely avoided up to 354 (33%) of head CTs

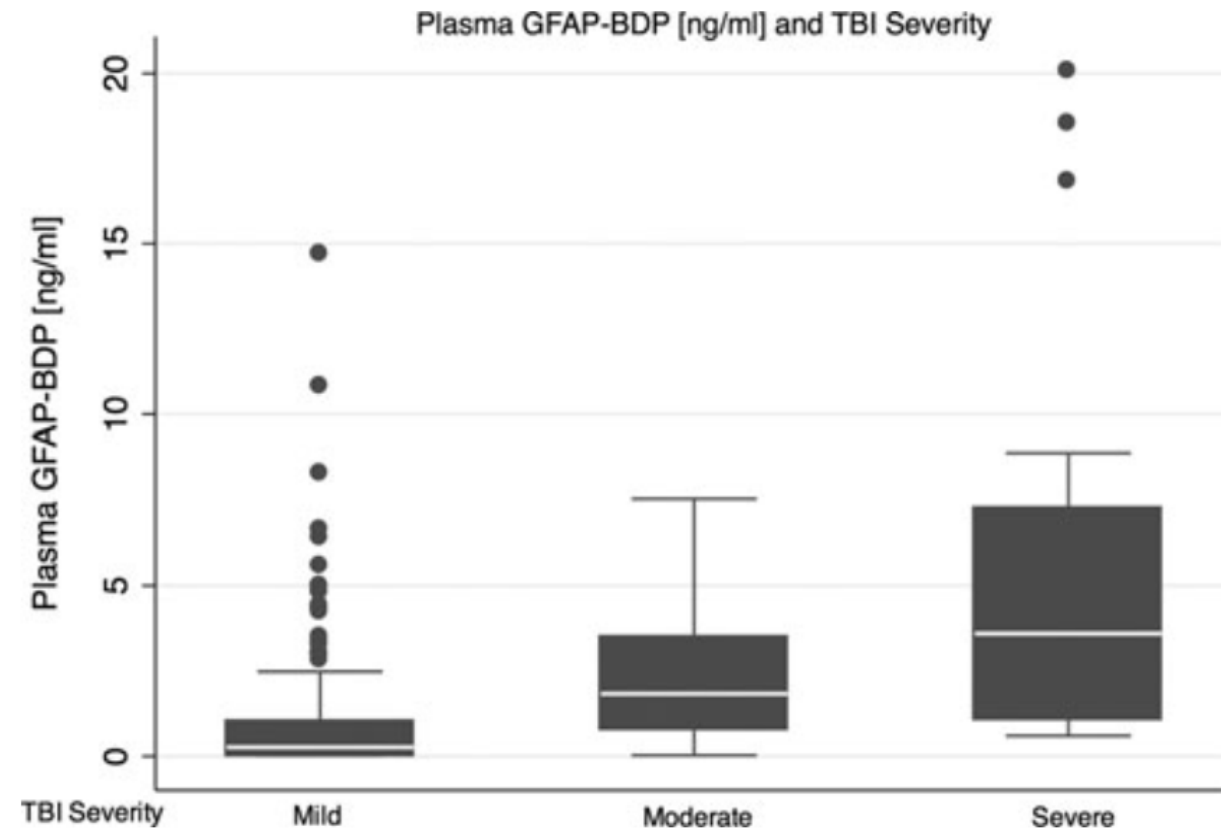
Biomarker	Sensitivity (95% CI)
Entire cohort (N=1,867, significant CT findings=49)*	
GFAP only	0.96 (0.86-0.99)
UCH-L1 only	0.62 (0.48-0.75)
GFAP +UCH-L1	0.96 (0.86-0.99)
No coagulopathy (N=1,088, significant CT findings=24)	
GFAP only	1.00 (0.86- 1.00)
UCH-L1 only	0.65 (0.45-0.81)
GFAP + UCH-L1	1.00 (0.86- 1.00)



GFAP is Associated with Injury Severity

TRACK-TBI Cohort David Okonkwo

- ✓ Blood GFAP-BDP in 215 adult TBI patients, collected within 24h:
significantly higher in CT-positive intracranial trauma & increased with lesion burden



GFAP is more Sensitive to TBI than Head CT

TRACK-TBI Cohort John Yue

- ✓ Among CT-negative patients, **elevated GFAP** within 24 h **identified** those with **MRI-detected microstructural lesions**

Group	N	Median GFAP pg/mL (25 th - 75 th %)
CT-Pos	199	786 (357-1863)
CT-Neg/MRI-Pos	120	414 (139-813)
CT-Neg/MRI-Neg	330	74 (18-214)
Orthopedic Controls	122	13 (7-20)
Healthy Controls	209	8 (3-14)

- Studies are ongoing to establish threshold for aid-in-diagnosis of CT-neg TBI



Established Rule-Out Performance

Now Incorporated into U.S. Military Guidelines

~99%

Negative Predictive Value

for ruling out acute intracranial trauma on head CT in civilian blunt trauma



High Risk → No Biomarker Urgent Head CT

- Deteriorating GCS (≥ 2)
- Combativeness/agitation
- Vomiting (≥ 2)
- Seizure
- Focal Neuro Deficits
- Penetrating Brain Injury
- Basilar Skull Fracture

Moderate Risk → TBI Biomarker /Consultant (<24hr of injury)

- Double vision
- Restlessness
- Vomiting (<2)
- Subjective neuro deficits only
- Worsening HAs
- Age > 60
- Antiplatelet meds/EtOH/Drugs
- Amnesia >30 min after injury

Low Risk → No Risk Factors

- Care as described in MACE2
- Pt deteriorates after 24hrs
 - Re-contact TBI Biomarker consultant

Bazarian JJ, et al. Lancet Neurol. 2018. [https://doi.org/10.1016/s1474-4422\(18\)30231-x](https://doi.org/10.1016/s1474-4422(18)30231-x); Bazarian JJ, et al. Acad Emerg Med. 2021. doi: 10.1111/acem.14366; Abbott Point of Care Inc., 2021, 510(k) Summary, 2021. https://www.accessdata.fda.gov/cdrh_docs/pdf20/K201778.pdf ; Abbott Point of Care, Inc., 2024, 510(k) Summary, https://www.accessdata.fda.gov/cdrh_docs/reviews/K234143.pdf .; Yue JK, et al. Lancet Neurol. 2019. [https://doi.org/10.1016/s1474-4422\(19\)30282-0](https://doi.org/10.1016/s1474-4422(19)30282-0) .

Study Aim

Determine the accuracy of the Abbott Alinity-i GFAP & UCH-L1 assay as an aid-in-evaluation of intracranial trauma in blast-predominant combat casualties.



Methods: Cohort & Inclusion Criteria

- 1 Study Type** Retrospective single-center cohort Clinical-Laboratory Validation Protocol.
- 2 Population** Emergently evacuated combat casualties arriving to the Sheba Emergency Department.
- 3 Window** Serum or plasma collected within 24 hours of injury (usually the first draw on arrival).
- 4 Sampling** Clinical lab successfully saved leftover clinical serum/plasma samples and tested it for GFAP & UCH-L1.
- 5 Study period** January 2024 – February 2025.



Biomarker Thresholds & Diagnostic Categories

Elevation Thresholds

GFAP ↑

≥35 pg/mL (Alinity-i) | ≥30 pg/mL (i-STAT plasma)

UCH-L1 ↑

≥400 pg/mL (Alinity-i) | ≥360 pg/mL (i-STAT plasma)

TBI Lab elevation ↑

Elevation of either GFAP or UCH-L1

Diagnostic Categories

CT+

Intracranial trauma on CT

F

Isolated face, skull, or c-spine
Fracture

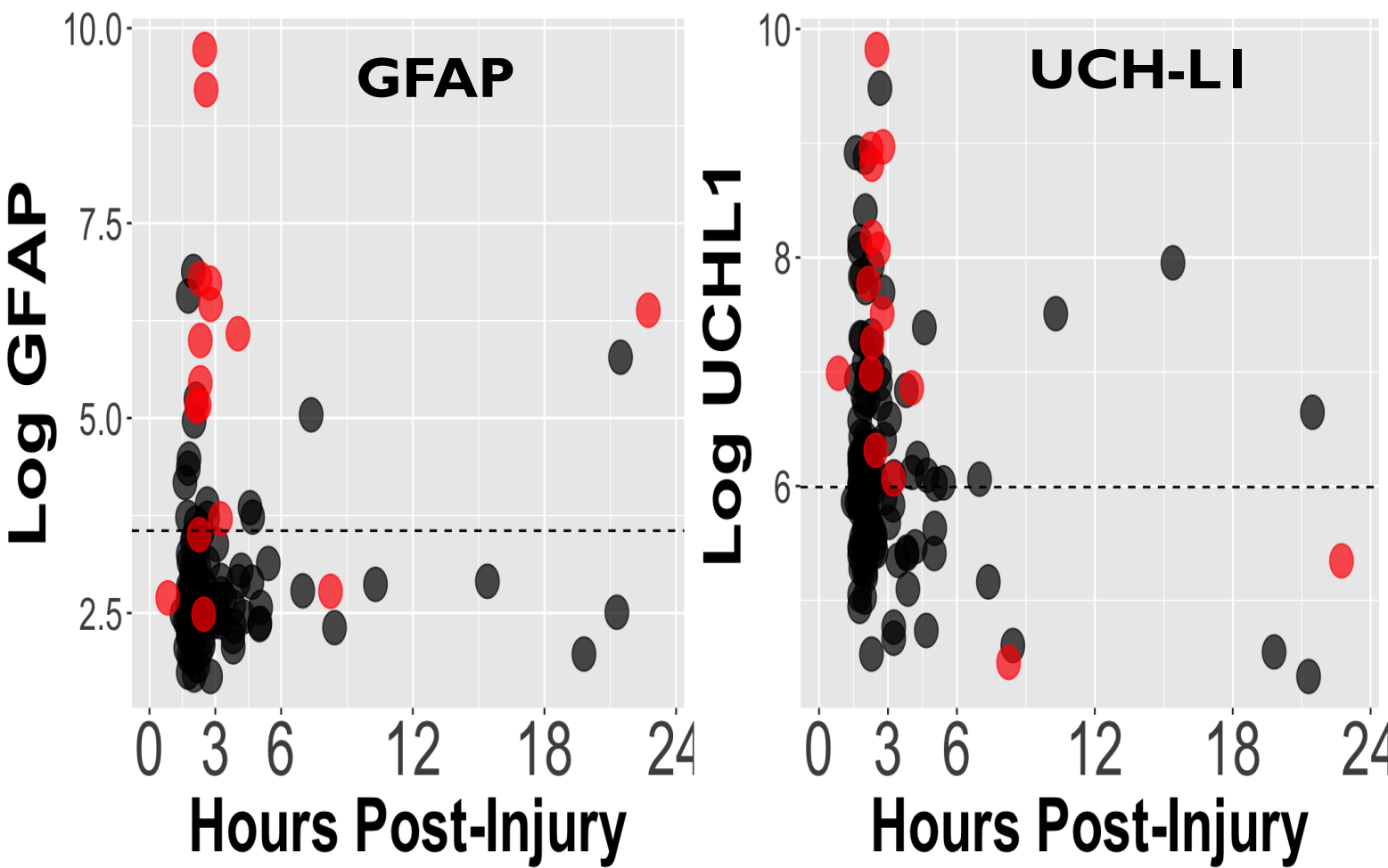
LOC

TBI symptom:
Loss of Consciousness



Study Cohort & Day-of-Injury Biomarker Profiles

Timing of Day-of-Injury blood-based GFAP and UCH-L1 Levels by Diagnostic Category (CT-positive/negative)



● Positive for intracranial trauma ● Negative for intracranial trauma

N=137	
Age (Median [Min, Max])	21.8 [19.0, 43.4]
Male	136 (99.3%)
Mechanism	
Blast	103 (75.2%)
Non-blast	34 (24.8%)
GCS	
15	124 (90.5%)
13-14	2 (1.5%)
3T-12	11 (8.0%)
CT	
Intracranial Trauma	16 (11.7%)
Isolated Fx Face/ Skull/C-spine	7 (5.1%)
CT negative	69 (50.4%)
CT not indicated	45 (32.8%)
Blood Elevated	
GFAP > 35 pg/mL	28 (20.6%)
UCH-L1 > 400 pg/mL	78 (56.9%)
Either Elevated	83 (60.6%)
LOC	
Present	24 (17.5%)
Absent	64 (46.7%)
Not documented	49 (35.8%)

Detection of Intracranial Trauma on CT

N=66 emergently evacuated Combat Casualties

Blast Mechanism GCS 13-15 with CT performed

96%

**Negative Predictive
Value**

90%

Sensitivity

45%

Specificity



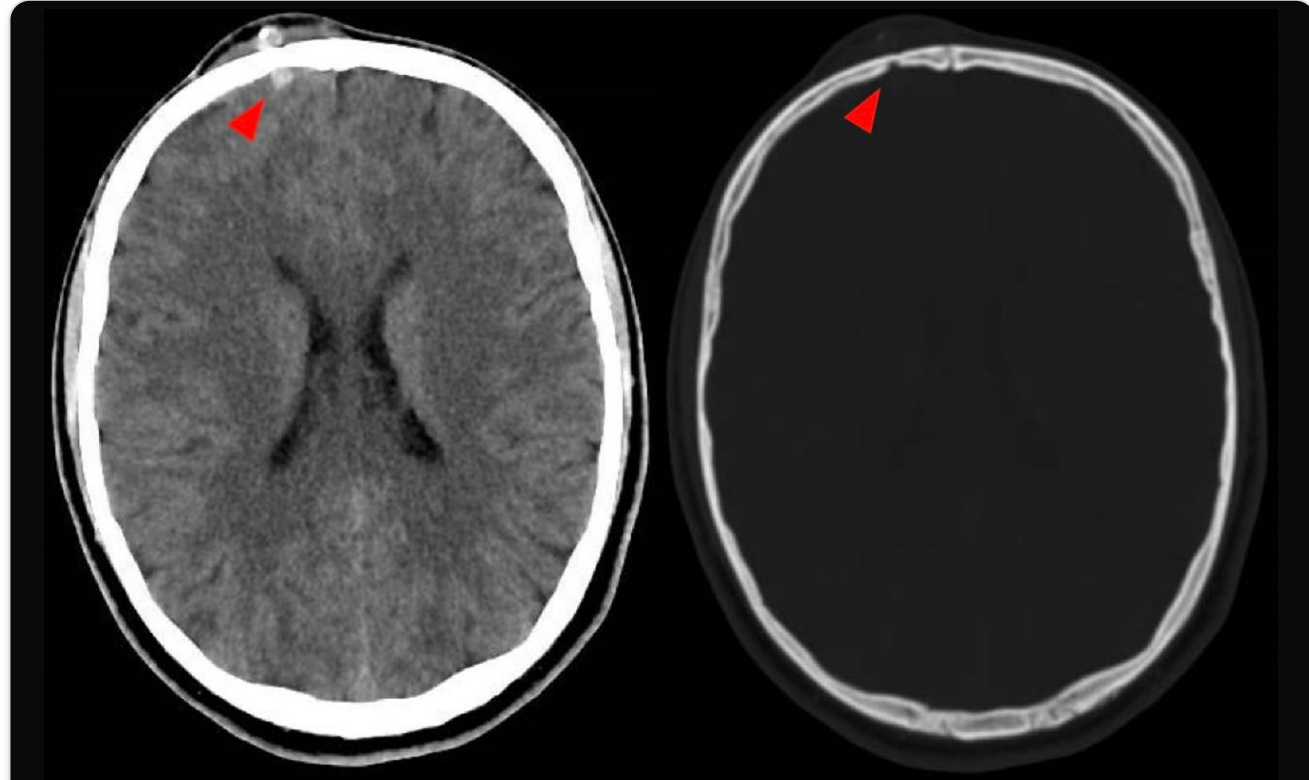
The Single False-Negative Case

**N = 1 CT+ intracranial trauma,
blood not elevated**

GFAP 16.1 pg/mL | **UCH-L1** 86.2 pg/mL

Both below threshold; labs drawn 8.25h post-injury.

- GCS 15 on arrival.
- Blast mechanism. Did Not feel the blast wave.
- Denied LOC, PTA, or AOC
- CT: trace subarachnoid hemorrhage underlying shrapnel in the right frontal bone.
- Discharged home after 7 days of observation



Axial head CT: Brain window (L); Bone window (R).
Red arrowheads indicate the intracranial hemorrhage.

Two Casualties Tested on the i-STAT

Why i-STAT?

N = 2 (1.5%) had insufficient residual sample for the Alinity-i
i-STAT thresholds: GFAP $\geq$ 30 pg/mL · UCH-L1 $\geq$ 360 pg/mL

Patient 1

GCS 15 | blood drawn 2.0 h post-injury

CT Negative

GFAP 78 pg/mL

UCH-L1 > 3,200 pg/mL

Patient 2

GCS 3T | blood drawn 2.3 h post-injury

CT+ Intracranial Trauma

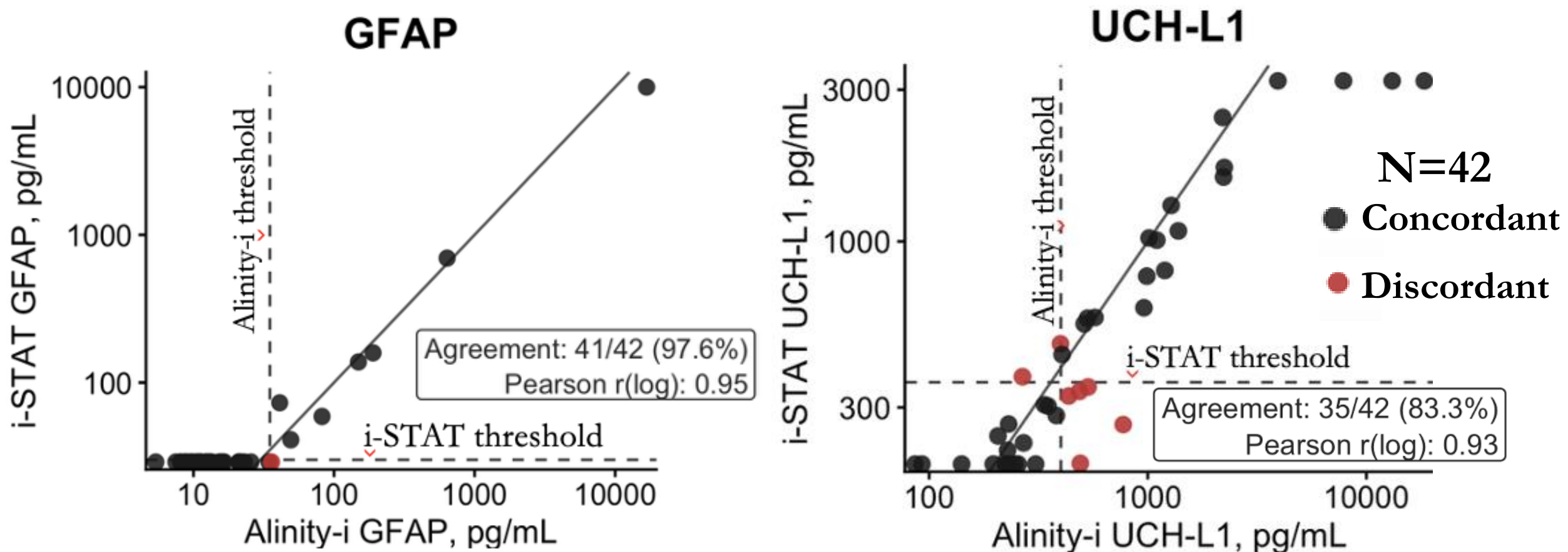
GFAP > 10,000 pg/mL

UCH-L1 > 3,200 pg/mL

* Values above the i-STAT reportable range were imputed to the upper reportable limit +1 for analysis.



Platform Crosswalk between Abbott Alinity-I and i-STAT Plasma Assays



Test	Platform Agreement			NPV		Sensitivity		Specificity	
	Agreement	Discordant	κ	Alinity-i	i-STAT	Alinity-i	i-STAT	Alinity-i	i-STAT
GFAP	97.6%	1	0.92	97.1%	97.1%	80%	80%	89.2%	91.9%
UCH-L1	83.3%	7	0.67	94.7%	95.5%	80%	80%	48.6%	56.8%
Combined TBI test	81%	8	0.62	94.4%	95.5%	80%	80%	45.9%	56.8%

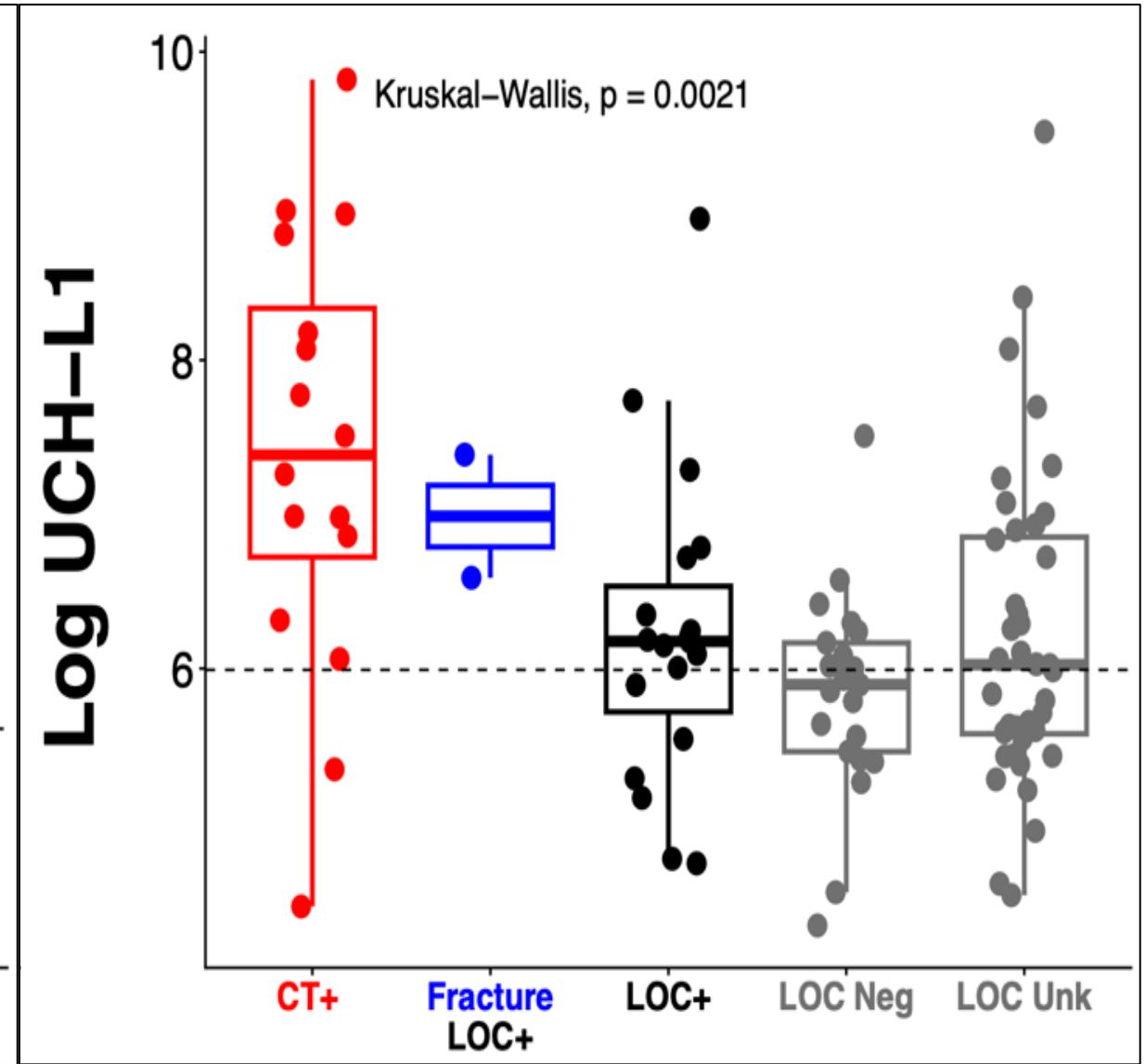
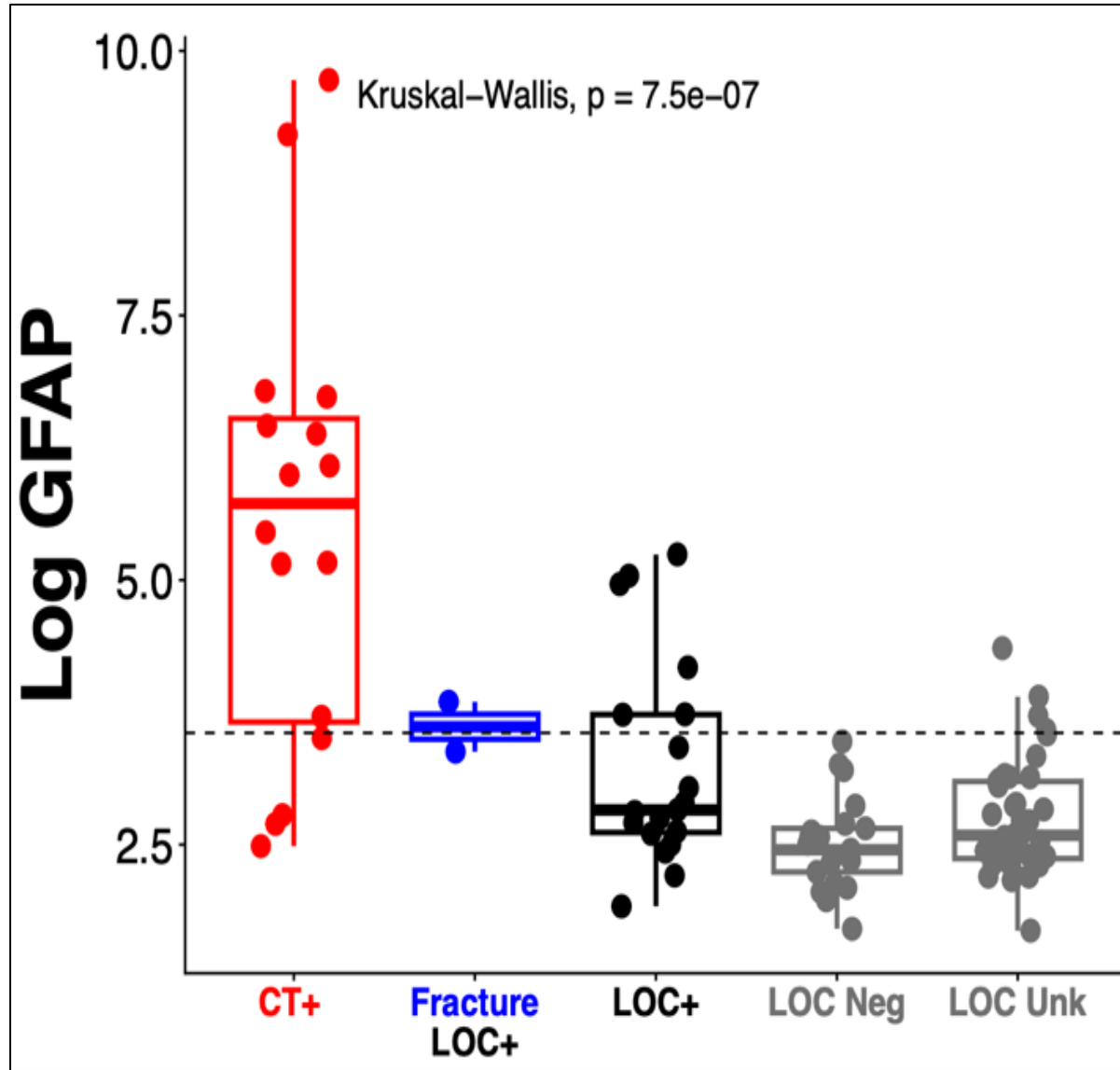


Biomarker Levels Stratified by Diagnostic Category

CT+ = Intracranial Trauma

Fracture = Isolated Face/Skull/C-spine

LOC = Loss of Consciousness



Summary of AUC Across Diagnostic Categories

	CT+ vs CT-/CT ^{NI} N=16/137	Isolated Fx vs. CT-/CT ^{NI} N=7/121	CT+ &/or Fx vs CT-/CT ^{NI} N=23/137
GFAP	0.88 (0.79-0.98)	0.84 (0.68-1.00)	0.88 (0.80-0.96)
UCH-L1	0.77 (0.62-0.92)	0.82 (0.67-0.97)	0.80 (0.68-0.91)
Combined GFAP & UCH-L1	0.87 (0.74-0.99)	0.86 (0.70-1.00)	0.87 (0.78-0.97)



Conclusions & Future Directions

1 Findings

Blood GFAP & UCH-L1 may aid in evaluation of intracranial trauma and isolated face, skull, & c-spine fractures in emergently evacuated combat casualties with high sensitivity and better specificity than in civilian cohorts.

2 Next steps

Larger cohorts are warranted to establish the value of acutely measured blood-based GFAP & UCH-L1 for both diagnosis and prognosis of TBI, including CT-negative TBI.



Acknowledgments & Questions

Contributors

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Questions?