Diagnostics and Biomarkers

Assessing Quantitative Changes in Intrinsic Thalamic Networks in Blast and Non-blast mTBI: Implications for Mechanisms of Injury

Researchers from the National Intrepid Center of Excellence investigating post-traumatic brain injury biomarkers determined that blast and non-blast mild traumatic brain injury (mTBI) differ in the mechanism of injury, as seen by changes in thalamic network architecture. A significant number of network connections in the brain converge in the thalamus, which suggests this region could be especially sensitive to posttraumatic changes in the brain. This study identified biomarkers of injury following mTBI, with a further comparison of the impact of blast or non-blast mechanisms of injury. Participants included 287 individuals that were separated into one of three groups: mTBI blast (n = 186), mTBI non-blast (n = 80) and uninjured controls (n = 21). Assignment to the blast group occurred if the blast injury resulted from primary, secondary, tertiary or quaternary mechanisms. Assignment to the non-blast group occurred if the injury occurred via blunt force trauma, such as falls, sports, or motor vehicle accidents. Self-report behavioral measures, consisting of the Neurobehavioral Symptom Inventory, Posttraumatic Stress Disorder (PTSD) Checklist-Civilian, Combat Exposure Scale and the 36-item Short Form Health Survey (SF36), were collected (Table 1). Magnetic resonance imaging data were collected using a task-free scan of six minutes duration. The results of this study showed that the blast mTBI group has significant hyper-connectivity in the thalamus, when compared to controls and non-blast participants.[1] However, after controlling for the incidence of posttraumatic stress, the blast mTBI group was no longer different from the control group, but the non-blast mTBI group showed significant hypo-connectivity. These architectural differences in the thalamic networks suggest the potential for both differing mechanisms of injury, as well as the potential for images collected from this region of the brain to be used as a biomarker of injury.

1 Nathan, D. E., Bellgowan, J. F., Oakes, T. R., French, L. M., Nadar, S. R., Sham, E. B., … Riedy, G. (2016). Assessing Quantitative Changes in Intrinsic Thalamic Networks in Blast and Nonblast Mild Traumatic Brain Injury: Implications for Mechanisms of Injury. Brain Connectivity, 6(5), 389–402. https://doi.org/10.1089/ brain.2015.0403

TABLE 1: Self-report Data for Controls, Blast mTBI Subject and Non-blast mTBI Subjects.*

Measure	Subject Group	# of subjects who completed measure	% of subjects who completed measure	Mean	Standard Deviation
PTSD Checklist Civilian version – Sum	Controls	19	91%	18.842	3.304
	Blast mTBI	165	89%	52.782	17.946
	Non-blast mTBI	68	85%	48.600	21.217
Combat Exposure Score - Total Score	Controls	19	91%	2.737	5.496
	Blast mTBI	163	88%	27.634	7.763
	Non-blast mTBI	67	84%	18.000	12.91
Neurobehavioral Symptom Inventory - Total Score	Controls	21	100%	2.762	4.312
	Blast mTBI	186	100%	36.317	19.378
	Non-blast mTBI	79	99%	33.861	21.504
SF-36 - Physical Functioning	Controls	20	95%	78.810	25.194
	Blast mTBI	186	100%	50.350	26.998
	Non-blast mTBI	80	100%	49.063	27.606
SF-36 - Role limitations due to physical health problems	Controls	20	95%	83.333	35.649
	Blast mTBI	186	100%	22.177	34.905
	Non-blast mTBI	80	100%	30.313	39.317
SF-36 - Role limitations due to emotional problems	Controls	20	95%	90.476	30.079
	Blast mTBI	186	100%	33.512	42.799
	Non-blast mTBI	80	100%	39.999	44.184
SF-36 - Energy/fatigue	Controls	20	95%	69.524	20.670
	Blast mTBI	186	100%	25.952	19.735
	Non-blast mTBI	80	100%	27.938	24.634
SF-36 - Emotional well being	Controls	20	95%	83.619	20.353
	Blast mTBI	186	100%	43.742	25.156
	Non-blast mTBI	80	100%	47.650	29.319
SF-36 - Social Functioning	Controls	20	95%	86.905	25.148
	Blast mTBI	186	100%	42.003	29.306
	Non-blast mTBI	80	100%	45.469	31.899
SF-36 - Pain	Controls	20	95%	85.000	25.409
	Blast mTBI	186	100%	44.207	26.058
	Non-blast mTBI	80	100%	45.313	27.791
SF-36 - General Health	Controls	20	95%	81.195	24.078
	Blast mTBI	186	100%	43.763	25.296
	Non-blast mTBI	80	100%	46.250	27.427

* from Brain Connectivity 6:5 389-402 (2016) used with permission from the authors.