Concussion assessment in the emergency department: A pilot study investigating the feasibility and reliability of novel and recommended assessment tools

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Background

Concussion is a subgroup of mild traumatic brain injury (mTBI), often sustained after a direct blow to the head or whiplash injury. The Accident and Compensation Corporation (ACC) estimate that 36,000 New Zealanders per year suffer a concussive injury. Those afflicted often require assessment in an Emergency Department (ED), and often patients are only assessed by an ED clinician during the course of their injury.[1] Therefore, concussion diagnosis and management in ED is crucially important in order to adequately treat, protect and prevent patients suffering the harmful sequelae of recurrent injuries and post-concussion syndrome. Concussion has many diagnostic challenges: There is no consensus regarding the pathology of concussion; symptoms are non-specific and numerous,[2] classic neurological examination and head imaging is often normal, and there is no cardinal marker to objectively diagnose concussion.[3] Currently, there are no assessment tools that have been clinically validated in an ED environment and therefore concussion management is often adapted from tools designed for use in a sporting environment. The Sport Concussion Assessment Tool (SCAT) 5 test is currently the recommended assessment tool for concussion,[4] however, its use has limitations in ED: the general population do not have baseline data; it is not validated for use in ED; it is long and cumbersome[4,5] and clinicians need to be familiar with the tool and concussion in order to make a clinical judgement. There is a need to develop an evidence based standardised approach to concussion assessment in ED and an accurate objective test is coveted. Interest into novel diagnostic techniques such as blood biomarkers, somatosensory devices and oculomotor devices is mounting. Therefore, we wanted to assess the feasibility and diagnostic capabilities of the SCAT 5 test and novel objective markers for concussion in an NZ ED population.

Aim

- To assess the feasibility and diagnostic capabilities of the SCAT5, Brain Gauge and blood biomarkers (S100B, GFAP and UCH-L1) in patients who present to ED with mild TBI

Methods

- Prospective feasibility case control pilot study of adult patients presenting to Wellington Regional Hospital ED with mTBI- Three study groups: mTBI with negative CT head, mTBI with no CT head & healthy controls.
- All participants are seen and treated in ED according to current clinical pathways according to treating physician. Those meeting study eligibility criteria are then asked to provide informed consent.
- Participants complete the SCAT5, Brain Guage and have a blood sample drawn
- The SCAT 5 is a standardised tool for evaluating concussion that incorporates tests of immediate memory, concentration, delayed recall, symptom score, symptom severity and balance.
- The Brain Guage (Cortical Metrics, Chapel Hill, NC, USA) is a two-digit vibrio-tactile stimulation hand held somatosensory device (see Figure 1).
- Blood biomarkers are not yet available but will be tested using ELISA platforms.

Figure 1: Brain Gauge set up with laptop

Results

- 41 patients have been recruited

Demographic Categories	Controls (n=15)	Head trauma without CT (n=14)	Head trauma with CT (n=12)
Age (median years)	32	30	31
Male % (n)	40 (6)	64 (9)	50 (6)
NZ Maori % (n)	13 (2)	21 (3)	8 (1)
Concussion diagnosed in ED % (n)	-	43 (6)	75 (9)

Table 1: Median SCAT 5 and Brain Gauge Scores according to study group

Groups	Controls	MTBI no CT	MTBI negative CT	P value
SCAT 5 median (IQR)				
No. of symptoms/22	0(0-1)	10.50(3.75-14.50)	17(12-20)	<0.001
Severity of symptoms/132	0(0-2)	17.50(8.25-32.75)	47(24-69)	<0.001
Balance errors/30	3(2-9.5)	9.50(5.25-13.50)	12(8-13.75)	0.082
Concentration/5	4(2-5)	5(4-5)	4(2-5)	0.216
Immediate memory/30	23(18-25)	22(19-24)	19.50(15.75-22.50)	0.141
Delayed recall/10	7(4-9)	8(6-8.50)	5.5(3.75-7.25)	0.226
Orientation score/5	5(4-5)	4(4-5)	5(3.75-5)	0.332
Brain Gauge median (IQR)				
Overall/100	73(62-83)	64(63-74)	59(43-67)	0.13
Reaction time (ms)	409.4(344-631.8)	417(365-484.4)	486.6(454.4-549.2)	0.148
Speed/100	40(26-45)	35(18-44)	17(11-37)	0.215
Accuracy/100	71(58-98)	80(75-89)	85(48-95)	0.839
Temporal order judgement/100	100(69-100)	78(5-100)	5(69-100)	0.185
Time percept/100	93(73-100)	90(73-100)	63(63-100)	0.654
Plasticity/100	72(52-86)	81(65-91)	88(40-96)	0.494
Fatigue/100	97(53-100)	69(53-100)	53(53-100)	0.456
Focus/100	67(47-85)	64(31-83)	28(17-69)	0.284

Results: SCAT 5

- The symptom number and symptom severity were shown to be the highest in patients with negative CT scans and the lowest in control recruits ($p < 0.001$)
- No other scores (delayed recall, balance errors, concentration, immediate memory, orientation) were statistically significant

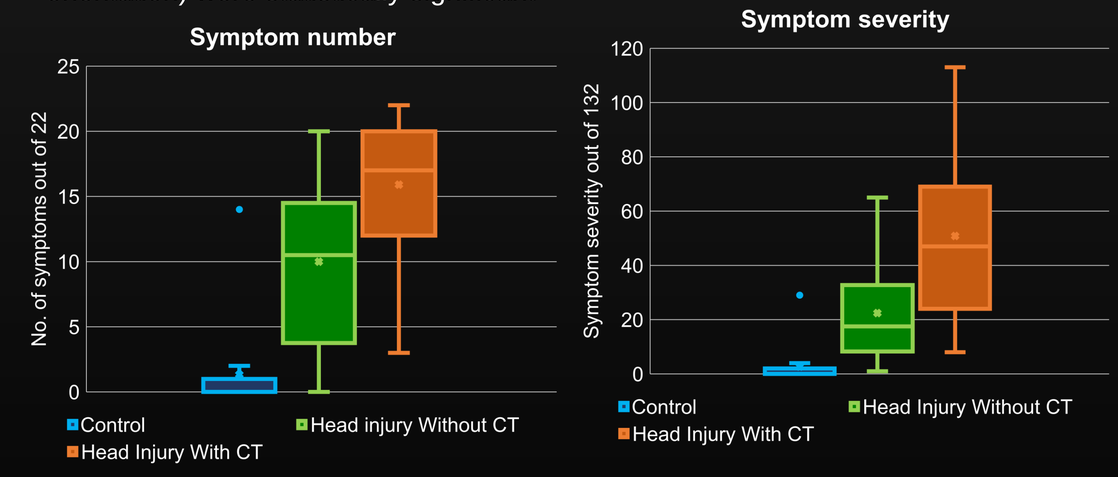

Figure 2A: Boxplots for symptom number and severity score according to study group

Results: Brain Gauge

- The cortical metric overall score showed a downward trend with controls having the highest scores and patients with CT scans having the lowest ($p = 0.126$)
- There were no differences in reaction time between the groups ($p = 0.109$)

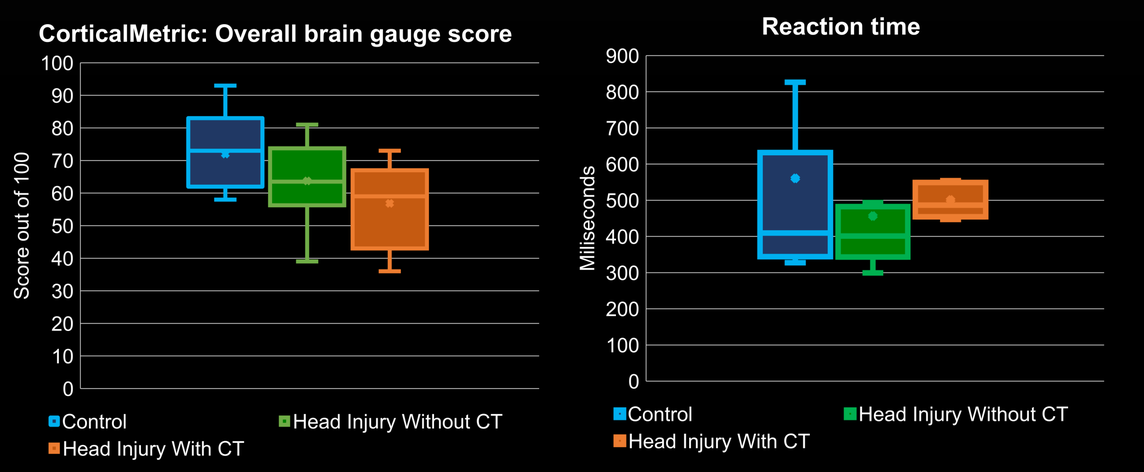

Figure 2B: Boxplots for cortical metric and reaction time according to study group

Key Findings

- There is a trend of worsened cognitive function in head injury patients, indicated by lower overall scores when compared to controls
- Symptom scoring can potentially differentiate patients with or without concussion and seems to correlate with severity of concussion
- Symptom scoring is a potential way to assess concussion patients within the emergency department
- Other scoring in the SCAT 5 and neurosensory testing with the Brain Gauge assessment device did not differ between mTBI and controls but a larger sample size may be required to further test this

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