

Subtle brain injury: a neuropsychological perspective

Association of Personal Injury Lawyers
Kings Chambers, Manchester

Thursday 5th July 2018

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Subtle brain injury:

- I. Post traumatic amnesia
- I. Brain injury/concussional complaints
- I. Alternative explanations

Subtle brain injury:

I. Post traumatic amnesia

Absent brain injury diagnosis (eg whiplash)

Absent physical evidence (eg. neuro-imaging)

Absent clinical evidence (eg. normal GCS, no LOC)

Williams v Jervis, 2008. "I conclude that the claimant suffered PTA of several days duration and that she suffered an injury to her brain which has given rise to the cognitive dysfunction of which she complains"

I. Post traumatic amnesia:

Retrospective assessment

Gronwall and Wrightson (1980)

Examined 67 mild TBI admissions.

Orientation and PTA assessed every 15 mins from admission until discharge

Pts re-assessed between 1-week and 3-months post-injury

25% changed their reported PTA duration at follow-up (only 3% shortened PTA)

Lees-Haley, Fox and Courtney (2001)

Compared mild TBI and Other Injury (OI) samples (OI group excluded all head injuries - eg. RTAs, sexual harassment, wrongful termination, discrimination claims, orthopaedic injuries, lacerations, bruises, sprains, pain complaints, horrifying accidents)

| | Other Injury | mTBI | Signif |
|-------------------------------|--------------|------|--------------|
| Post-Traumatic Amnesia | 21% | 38% | .117 Non-Sig |
| Partial Loss of Consciousness | 24% | 50% | .02 Sig |

Kemp et al (2010) Examined orthopaedic patients
(none had TBI)

38% reported PTA despite *NO* head injury

PTA ranged from 4 to 96 hours

30% reported PTA greater than 24 hours

Predictors of PTA:

- Receipt of opioids
- Undergoing surgery
- Anxiety following injury

“These findings have important consequences for medico-legal arguments”

Mayou, Black and Bryant (2000)

Examined 1148 admissions following RTAs

Self-report of 'no' or 'patchy' recollection of the RTA was common. Factors:

- Medical causes (eg epilepsy)
- Fell asleep
- Alcohol intoxication
- Concerns about prosecution
- Psychological dissociation

124 reported LOC, but medical records/bystander evidence indicated –

- 62% had no LOC (45% made claims)
- 23% had probable LOC (52% made claims)
- 15% had definite LOC (36% made claims)

874 reported no LOC; only 2 had been unconscious

Accuracy of self-reported Coma & PTA

Sherer et al (2015) verified TBI patients:

| GCS Group | <u>Coma</u> Self-report – Medical Record Discrepancy (Days) | <u>PTA</u> Self-report – Medical Record Discrepancy (Days) |
|-------------------|---|--|
| • Severe (3-8) | 11.8 | 134.0 |
| • Moderate (9-12) | 3.8 | 52.7 |
| • Mild (13-15) | 3.9 | 37.8 |
| • Intubated | 8.8 | 71.6 |
| • Sedated | 11.7 | 51.0 |

- Average PTA discrepancy was 64 ± 176 days
- 84% self-reported PTA was greater than actual
- 3% self-reported PTA and actual PTA were the same
- 13% self-reported PTA was less than actual

Roberts, Spitz and Ponsford (2016)

Compared patients retrospective account of PTA with actual PTA assessed during admission using Westmead PTA scale.

Found :

- In 57.6% retrospective PTA over-estimated actual PTA
- In 37.3% retrospective PTA under-estimated actual PTA
- 35.6% were placed in a different injury category according to retrospective PTA

II. Brain injury/concussional complaints

Symptom base-rates

Subtle brain injury:

II. Brain injury/concussional symptoms

Memory loss, poor concentration, headache, dizziness, etc – indicate TBI

Siegel v Pummell, 2014. “the cluster of symptoms of which the Claimant now complains is consistent with his having suffered brain injury.....”

Post-Concussional Syndrome & Pain

170 patients with chronic pain; none had a TBI

| <i>•Symptom</i> | <i>%</i> |
|--|----------|
| Becoming fatigued easily | 76.5 |
| Disordered sleep | 83 |
| Vertigo & Dizziness | 37 |
| Irritability & aggression | 73.5 |
| Anxiety, depression or affective lability | 56.5 |
| Changes in personality (social/sex.inapprop) | 37 |
| Apathy or lack of spontaneity | 69 |
| Forgetfulness | 29 |
| Difficulty concentrating/thinking | 16.5 |

39% of sample met full DSM-IV criteria for post concussive syndrome.

Neuropsychological Complaint Baserates

| Controls | Claimants | Symptom |
|----------|-----------|--|
| 54% | 93% | Anxiety or nervousness |
| 52% | 92% | Sleeping problems |
| 32% | 89% | Depression |
| 62% | 88% | Headaches |
| 48% | 80% | Back pain ^a |
| 58% | 79% | Fatigue (mental or physical) |
| 26% | 78% | Concentration problems |
| 36% | 77% | Worried about health ^a |
| 38% | 77% | Irritability |
| 30% | 74% | Neck pain ^a |
| 36% | 65% | Impatience |
| 18% | 62% | Restlessness |
| 24% | 61% | Feeling disorganized |
| 30% | 60% | Loss of interest |
| 16% | 59% | Confusion |
| 16% | 56% | Loss of efficiency in carrying out everyday tasks |
| 14% | 55% | Shoulder pain ^a |
| 20% | 53% | Memory problems |
| 26% | 44% | Dizziness |
| 6% | 41% | Sexual problems |
| 12% | 39% | Numbness |
| 34% | 38% | Nausea |
| 20% | 34% | "Word finding problems, not finding the word you want, using the wrong word" |
| 28% | 2% | Diarrhea ^a |
| 22% | 32% | "Visual problems, blurring, or seeing double" |
| 8% | 30% | Trembling or tremors |
| 18% | 29% | Hearing problems |
| 16% | 29% | Constipation ^a |
| 22% | 24% | Foot pain ^a |
| 12% | 24% | Trouble reading |
| 20% | 21% | Bumping into things |
| 12% | 21% | Elbow pain ^a |
| 16% | 18% | Speech problems |
| 4% | 15% | Impotence |
| 12% | 11% | Bleeding ^a |
| 2% | 4% | Seizures ^b |
| 8% | 2% | Broken bone or bones ^a |

Neuropsychological Complaint Base-Rates

Examined 2 groups:

Controls (*n*=50)

outpatients attending a family practice

Claimants (*n*=170)

emotional distress
 industrial stress
 sex/race/age discrimination
 sexual/verbal harassment by coworkers/supervisors
 wrongful termination
 intimidation
 orthopaedic (espec pain) complaints

TBIs excluded from investigation

Neuropsychological Complaints following Injury

mTBI and Other Injury (OI) samples (eg. RTAs, sexual harassment, wrongful termination, discrimination claims, orthopaedic injuries, lacerations, bruises, sprains, pain complaints, horrifying accidents). Complaints *immediately* following injurious event:

| Complaint | OI (%), N=66 | MTBI (%), N=24 |
|-----------------------|--------------|----------------|
| Shocked | 88 | 71 |
| Anxiety | 85 | 42 |
| Depression | 82 | 38 |
| Headache | 77 | 75 |
| Aches and pain | 73 | 83 |
| Concentration | 65 | 63 |
| Confused | 65 | 67 |
| Irritability, anger | 62 | 46 |
| Trembling | 58 | 33 |
| Paying attention | 56 | 63 |
| Dazed | 52 | 71 |
| Feelings of unreality | 49 | 42 |
| Nausea | 46 | 29 |
| Dizzy | 44 | 54 |
| Disoriented | 42 | 33 |
| Short-term memory | 42 | 71 |
| Balance | 39 | 54 |
| Numbness | 39 | 38 |
| Memory loss | 36 | 42 |
| Visual problems | 36 | 54 |
| Word finding | 33 | 54 |
| Partial LOC | 24 | 50 |
| Reading | 24 | 46 |
| Coordination | 23 | 42 |
| PTA | 21 | 38 |

Zakzanis and Yeung (2011) base-rates of post-concussive symptoms in healthy normal subjects

| Symptoms | The Present Study (N = 151) Ethnicity group | | | | Lee-Haley & Brown (1993) (N = 50) | Chan (2001) (N = 85) | Iverson and Lange (2003) (N = 104) | Wang and colleagues (2006) (N = 124) |
|----------------------|---|---|--|------------------|-----------------------------------|----------------------|------------------------------------|--------------------------------------|
| | Caucasian (n = 33) | Chinese, Filipino, and Southeast Asian (n = 49) | Arab and West and South Asian (n = 43) | African (n = 26) | | | | |
| Headache | 34.4 | 44.9 | 51.2 | 88.5 | 62 | 40.0 | 52.4 | 35.5 |
| Forgetfulness | 39.4 | 55.1 | 55.8 | 53.8 | 20 | 58.9 | 50.5 | 45.5 |
| Dizziness | 21.2 | 42.9 | 30.2 | 38.5 | 26 | 31.8 | 41.7 | 32.2 |
| Noise sensitivity | 15.1 | 16.3 | 25.6 | 23.0 | | 2.4 | 39.8 | 33.9 |
| Light sensitivity | 12.1 | 20.4 | 14.0 | 23.0 | | 35.3 | | 20.7 |
| Poor concentration | 57.6 | 63.3 | 67.4 | 76.9 | 26 | 58.9 | 61.2 | 58.7 |
| Blurred vision | 15.1 | 22.4 | 27.9 | 15.3 | 22 | 41.2 | | 28.1 |
| Fatigue | 84.8 | 81.6 | 74.4 | 76.9 | 58 | 53.5 | 75.7 | 76.9 |
| Frustration | 56.3 | 51.0 | 62.8 | 53.8 | 36 | 42.3 | 53.4 | 46.3 |
| Irritable | 51.5 | 55.1 | 62.8 | 26.9 | 38 | 43.6 | 71.8 | 42.1 |
| Longer time to think | 54.5 | 67.3 | 55.8 | 61.5 | 16 | 65.9 | | 60.3 |
| Sleep disturbance | 72.7 | 51.0 | 55.8 | 53.8 | 52 | 50.6 | 62.1 | 50.4 |
| Depressed or tearful | 36.4 | 44.9 | 44.2 | 53.8 | 32 | 31.8 | 61.2 | 37.2 |
| Nausea or vomiting | 15.1 | 16.3 | 25.6 | 23.0 | 34 | 13 | 37.9 | 14.9 |

Garden and Sullivan(2010) Examined 96 healthy normal individuals on Post-concussion symptom inventory (13 symptoms)

92% endorsed 3 or more symptoms
 74% endorsed 7 or more symptoms
 30% endorsed at least 11 symptoms

Percentage of BC-PSI Post-Concussion Symptom Endorsement:
 Frequency Ratings for All Levels of Intensity (*n*=96)

| <i>Post-concussion symptoms</i> | % |
|---------------------------------|------|
| Headaches | 81.3 |
| Dizziness | 52.1 |
| Nausea | 53.2 |
| Fatigue | 81.3 |
| Noise sensitive | 34.4 |
| Irritability | 78.1 |
| Feeling sad | 70.1 |
| Nervous or tense | 76.0 |
| Temper problems | 58.3 |
| Poor concentration | 73.4 |
| Memory problems | 56.3 |
| Difficulty reading | 36.5 |
| Poor sleep | 68.8 |

Note. BC-PSI = British Columbia Post-Concussion Symptom Inventory.

Percentages of Participants Endorsing Post-Concussion Symptoms
 at a Mild or Moderate-to-Severe Level of Intensity (*n*=96)

| <i>Symptom</i> | <i>Severity</i> | |
|--------------------|-----------------|-------------------------------|
| | <i>Mild (%)</i> | <i>Moderate-to-Severe (%)</i> |
| Headaches | 54.2 | 28.1 |
| Dizziness | 40.6 | 7.3 |
| Nausea | 40.1 | 12.5 |
| Fatigue | 57.3 | 24.0 |
| Noise sensitive | 24.1 | 8.3 |
| Irritable | 55.2 | 20.8 |
| Sad | 53.1 | 17.7 |
| Nervous or tense | 57.3 | 18.8 |
| Temper problems | 39.6 | 16.7 |
| Poor concentration | 52.1 | 20.7 |
| Memory problems | 46.9 | 9.4 |
| Difficulty reading | 30.3 | 5.2 |
| Poor sleep | 42.7 | 27.1 |

Symptoms overlap across diagnoses

From: McCrea (2007) *Mild traumatic brain injury and post concussional syndrome*,

| | Headache | Dizziness | Irritability | Memory problems | Attention problems |
|-------------------------|----------|-----------|--------------|-----------------|--------------------|
| College students | 36% | 18% | 36% | 17% | 42% |
| Chronic pain | 80% | 67% | 49% | 33% | 63% |
| Depressed | 37% | 20% | 52% | 25% | 54% |
| Non-TBI personal injury | 77% | 41% | 63% | 46% | 71% |
| Mild TBI | 42% | 26% | 28% | 36% | 25% |

Subtle brain injury:

III. No alternative condition/explanation

Clarke v Maltby 2010. "But the difficulty with his (Neurologist's) analysis is obvious. If non-organic factors can now be ruled out, as in my judgement they can be, he has no explanation for the continuing cognitive and behavioural problems other than traumatic brain injury"

"Suffice to say that there was nothing in the claimant's presentation that is inconsistent with traumatic brain injury"

Explanations for Neuropsychological complaints

- Pain
- Symptom Base-rates
- Mood
- “Good Old Days” bias
- Nocebo/Expectations
- Iatrogenic/Critogenic influences
- Malingering/exaggeration

Symptom Base-Rates & Mood

Garden and Sullivan(2010) Examined 96 healthy normal individuals on Post-concussion symptom inventory and Beck Depression Inventory

Percentage of BC-PSI Post-Concussion Symptom Endorsement: Frequency Ratings for All Levels of Intensity (*n*=96)

| <i>Post-concussion symptoms</i> | % |
|---------------------------------|------|
| Headaches | 81.3 |
| Dizziness | 52.1 |
| Nausea | 53.2 |
| Fatigue | 81.3 |
| Noise sensitive | 34.4 |
| Irritability | 78.1 |
| Feeling sad | 70.1 |
| Nervous or tense | 76.0 |
| Temper problems | 58.3 |
| Poor concentration | 73.4 |
| Memory problems | 56.3 |
| Difficulty reading | 36.5 |
| Poor sleep | 68.8 |

Note. BC-PSI = British Columbia Post-Concussion Symptom Inventory.

Percentages of PCS Symptom Endorsement in Depressed Participants (*n*=24)

| <i>BC-PSI Symptom</i> | % |
|--------------------------|------|
| Headaches | 95.8 |
| Dizziness | 75.0 |
| Nausea | 62.5 |
| Fatigue | 83.3 |
| Extra sensitive to noise | 50.0 |
| Irritable | 91.7 |
| Feeling sad | 95.8 |
| Nervous or tense | 95.8 |
| Temper problems | 87.5 |
| Poor concentration | 83.3 |
| Memory problems | 75.0 |
| Difficulty reading | 58.3 |
| Poor sleep | 83.3 |

“Good Old Days” Bias

- Tendency of people to recall past symptoms or functioning, more favourably than was actually the case
- Suggests that, following any negative event, people tend to attribute all symptoms to that event, regardless of a pre-existing history of that problem or any other factors that may be influencing the problem

Response Bias in Claimants' Histories

131 litigating : 315 non-litigating TBI patients. Completed self-ratings on 16 scales both pre- and post-injury

- | | |
|--------------------|------------------|
| 1. Life in General | 2. Concentration |
| 3. Memory | 4. Depression |
| 5. Anxiety | 6. Alcohol |
| 7. Drugs | 8. Irritability |
| 9. Work/School | 10. Headache |
| 11. Confusion | 12. Self-esteem |
| 13. Fatigue | 14. Sex |
| 15. Marriage | 16. Children |

1. Litigating patients had more complaints post-injury
2. Litigating patients rated themselves as having fewer complaints pre-injury

Nocebo Effects

- Placebo's evil twin
- The notion that expectations of sickness & associated emotional distress causes the sickness in question
- Suggests that response expectations are “anticipations of automatic reactions to particular situational cues” and are outside both volition and conscious thought
- They presume the worst, healthwise, and that's just what they get

Expectations as causation

- 223 Volunteers
- 100 patients with closed head injuries
 - Average 1.7 years after injury
 - Average reported LOC= 23 mins
- 30 symptom checklist of items
 - Emotional
 - Somatic
 - Memory

Control subjects

- Which symptoms do you (healthy volunteers) currently experience?
- Now imagine a MVA- related head injury 6 months before, in which were knocked out, hospitalised for a week or two. Respond to the symptoms that you think you would have after an accident like this

Patients with head injuries

- Identify the symptoms you think you would have had before the accident (how you used to be)
- Then identify symptoms that you notice now, after the accident (how you are now)

No difference between the incidence of post-concussion symptoms expected by controls and those reported by head injury patients

Control group Expected Mean = 14.8 (\pm 7.6)

Head injury Obtained Mean = 13.8 (\pm 8.3)

Incidence of Expected & Actual post concussion symptoms

| | % controls | % patients |
|--------------------------|------------|------------|
| Headache | 80.0 | 59.1 |
| Anxiety | 68.1 | 58.3 |
| Concentration difficulty | 66.8 | 70.5 |
| Irritability | 50.0 | 65.9 |
| Forgets why entered room | 34.8 | 50.6 |
| Loses items around house | 28.5 | 28.1 |

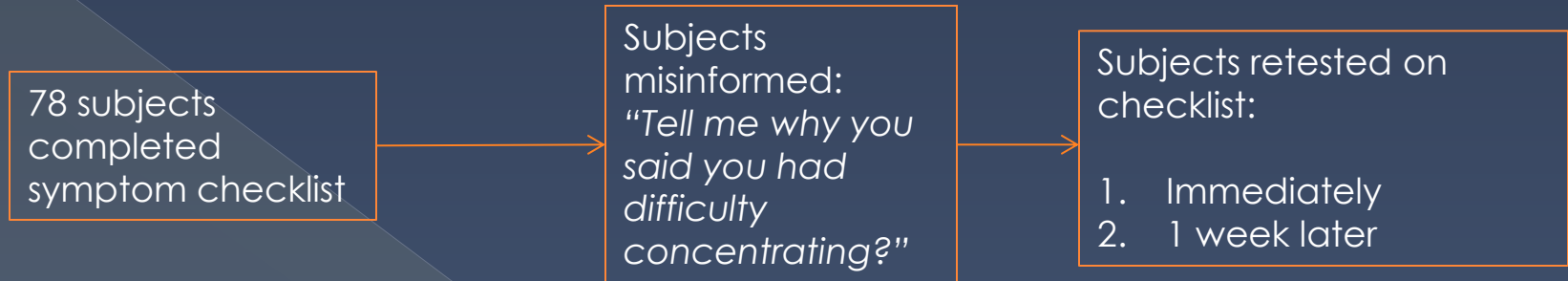
Normal controls compared with head injury patients premorbid estimates of symptoms

| | % controls | % patients |
|---------------------------|------------|------------|
| Forgets where car parked | 32.0 | 7.0 |
| Loses car keys | 31.0 | 6.0 |
| Forgets groceries | 28.3 | 9.0 |
| Concentration difficulty | 13.5 | 5.0 |
| Forgets appointment dates | 20.2 | 7.0 |
| Loses items around house | 17.0 | 4.0 |

Iatrogenic disability

(Brain damage caused by collision with a medico-legal expert)

Merckelbach et al (2011)



Findings:

1. 63% of subjects accepted misinformation
2. Misinformed subjects revised their symptom rating in the suggested direction

RESEARCH



Misinformation increases symptom reporting – a test – retest experiment

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Merckelbach et al (2011) *Planting a misdiagnosis of Alzheimer's disease in a person's mind.*

Conditions for misinformation (iatrogenic) influences to establish false beliefs:

- Trusted person (eg. neurologist, psychologist, GP, lawyer, etc)
- Requires repetition (eg. repeat consultations, rehabilitation, legal proceedings)
- Information is plausible (eg. accident occurred, subjective cognitive complaints)

Critogenic harm

(Brain damage caused by collision with personal injury litigation)

Critogenic harm: factors

- Legal process (time-consuming denials, counter-assertions, document review, meetings with Solicitor/Barrister, adversarial proceedings)
- Re-traumatization (privacy violations, disclosure of personal information, repeat examinations, public trial, internet)
- Rehabilitation misuse (therapy with litigation agenda, therapists obliged/pressured to assist claim, boundary violations, lawyer intrusion into treatment, care over-provision)
- Legal stagnation ('proving' the claim vs improvement, dichotomous thinking: victim vs bad adversary)

Critogenic benefits

- Feeling empowered and validated
- Acting as a witness
- Being heard
- Overcoming denial of injury
- Forcing acknowledgement by perpetrator/defendant
- Vindication by correcting a societal wrong
- Cathartic expression of anger/rage

Critogenic harm

Binder & Rohling (1996) meta-analysis of research involving 2353 TBIs cases in 18 study groups.

Litigation significantly effects complaints, particularly in mild TBI

Conclusion: Removal of compensation would result in 23% reduction in abnormal findings & complaints

Carroll, Cassidy, Peloso, Borg, von Holst, Holm, Paniak and Pepin (2004)

World Health Organisation (WHO) review of 120 studies

Reviewed prognostic factors maintaining mild TBI complaints

Compensation claims/litigation only factor identified

McCrea (2008)

“an unfortunate scenario unfolds when a patient with vague symptom complaints and no clear indication of significant head trauma is told he has “brain damage” and will never make a complete neurologic, symptom, or functional recovery”

“The long-term damage of creating that perception for a patient is most difficult to undo”

Malingering & exaggeration

Base rates for failed Symptom Validity Tests

| Study | Setting | Method | Base Rate |
|--------------------------------|--|---------------------------|----------------|
| Kemp, 2008 | UK Neurology –Non-forensic | Green's MSVT | 12% |
| Denning, 2015 | US Military (TBI) (43 studies; n=7,959) | TOMM/MSVT/WMT/ NVMSVT | 29% (6-68%) |
| Larrabee, 2003 | Personal Injury (TBI) | Literature Compilation | 40% |
| Greiffenstein & Baker, 2006 | Personal Injury (TBI) | Rey Word Recog/TOMM | 42% |
| Van Hout, 2003 | Workers Comp (Solvent Exposure) | Amsterdam STMT/TOMM | 46% |

Base rates for failed Non-credible presentations: non-neuropsychological professions

Occupational Therapy

Fleming & Rucas (2015) 48% of PI claimants (TBI, musculoskeletal injuries, depression) failed PVT (MSVT/NVMSVT) testing in OT evaluation.

Psychiatry

Gill et al (2007) 62% of 159 psychiatric claimants failed Medical Symptom Validity Test

Physicians

Richman et al (2006) 42% disability claimants (predom soft tissue injury/fibromyalgia) failed Medical Symptom Validity Test

Vestibular

Armistead-Jehle et al (2016) 35% of 78 disability claimants (predom mTBI) failed WMT; WMT and Computerised Dynamic Posturography 70% agreement.

Conclusions

- PTA report is not pathognomonic of TBI
- Over-estimation of PTA (and LOC) is common
- PTA report is potentially unreliable & may change over time
- Diagnosis of TBI on retrospective PTA alone is inappropriate

Conclusions, *cont'd*

- Brain injury symptoms are not pathognomonic of brain injury; they are non-specific (found in patients with pain, other injuries, depression, students, healthy normals)
- Brain injury 'disability' potentially multifactorial & unrelated to neurological trauma
- Treatment/rehabilitation should address:
 - pain
 - mood (depression, anxiety, anger)
 - diagnostic issues
 - expectations & beliefs
 - misattribution
 - iatrogenic & critogenic factors