Repetitive Sub-Concussive Trauma in CANSOF Breachers and Snipers: A clinical perspective

Outline

• Background
• Clinical presentation
• Diagnosis
• Operational Impact
• Assessment
• Management
• Ongoing studies

BACKGROUND

• “Accepted” acute symptoms following intense breaching/sniper training and operations – “.50cal brain”
• Increased frequency of breachers and snipers presenting with chronic symptoms
• Impact on quality of life and operations
• DRDC study conducted in 2012-2015 during breacher course
### Field/Acute Presentation - Breachers

- Headache
- Nausea
- Foggyness
- Progressive ↑ in sensitivity to blast → severe symptoms with mild exposure, smaller charges

### Clinic/Chronic Presentation - Breachers

- Headaches, nausea
- Coordination issues
- Balance issues
- Mood disorders (depressive/anxiety symptoms)
- Progressive worsening of symptoms → Eventually triggered by daily activities (flying, walking on uneven ground, etc.)

### Field/Acute Presentation - Snipers

- Visual disturbances
- Foggyness
- Headache
- Irritability
- Progressive ↑ in sensitivity → severe symptoms with fewer shots / lower calibers
Clinic/Chronic Presentation - Snipers

- Memory loss
- Headaches
- Irritability, anger outbursts
- Visual disturbances – Scotoma, difficulty focusing
- Fatigue, insomnia

Diagnostic dilemma

<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th>mTBI</th>
<th>Elevated Lead</th>
<th>Overtraining</th>
<th>PTSD</th>
<th>Anxiety/stress</th>
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<tbody>
<tr>
<td>Headache</td>
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<td>Memory</td>
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<td>Concentration</td>
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Contributing factors

- Poor sleep
- Stress (home and work)
- High operational tempo
- Poor eating habits
- Overtraining
- Tobacco products
- Exposure to lead products
- Excessive caffeine/supplements
Operational Impact

**Acute:**
- Symptoms decrease performance during operations:
  - Directly: Visual disturbances, ↓ coordination
  - Indirectly: Headaches, irritability

**Chronic:**
- Medical Employment Limitations
- ↑ sick leave
- ↓ operational readiness
- Medical release

Assessment

- Joint Medical and Physio assessment
  - Exposure History
  - Symptoms
  - InPACT testing
  - Brain FX
  - C-spine ROM
  - BESS, Rhomberg, Tandem walk
  - VOMS testing
- Structural MRI if specific neurological deficits, persistent headaches
- Neuropsychology/Rehab medicine referral (case based)

Timing of assessment

- Pre SOAC (JTF2 Assaulter course)
- Pre and post exposure (breacher course, sniper course)
- Following other acute exposure
- If symptomatic
- Following MO/PA recommendation
- At member’s request

ALL TESTING IS DONE ON A VOLUNTARY BASIS (does not affect deployability or career)
**Physio Assessment**

**POST-CONCUSSION SYMPTOM SCREEN**

**SUBJECTIVE – COMMENTS**
- Previous Concussions: Y N
- DEBUICF (bullying) Y N
- Vomiting Y N
- Eye dominance: R L
- Type of exposure: Kites, EOD, etc.
- Sleep: Pre vs post vs baseline

**OBJECTIVE**

**Cervical joint position error test (Kin – side)**

**BESS:** Forehead (smooth, flawless), Log tested: R L
- **Preferred leg stance:** Preferred leg stance
- **Tandem stance:** Non-dominant
- **Tandem Walk Test:** # of steps

**Rhomberg Test:** Preferred leg forward and back
- **Time:** / **Score:**

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**Physio Assessment (Cont’d)**

**VESTIBULAR OCULAR MOTOR SCREENING**

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<tr>
<th>Name Test</th>
<th>0-10</th>
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<tbody>
<tr>
<td>**MAXIC</td>
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<tr>
<td>Symptoms</td>
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<tr>
<td>Brainstem</td>
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<td>Vestibular Vertical</td>
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<tr>
<td>Convergence</td>
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<td>Near point in cm</td>
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<tr>
<td><strong>VOR:</strong></td>
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<tr>
<td>Horizontal</td>
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<tr>
<td><strong>Visual Motion Sensitivity Test (sensitivity test)</strong></td>
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<tr>
<td><strong>Schlumberger Nystagmus Test</strong></td>
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<td><strong>Schlumberger 10%</strong></td>
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<td><strong>Schlumberger 20%</strong></td>
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<td><strong>Eye opening Atoch</strong></td>
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**Name:** Signature

**Objective:** Cause
- **Sign:** N/A
- **Severity:** Poor

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**Clinical Trends**

- Abnormal VOMS assessment:
  - Snipers = 61%
  - Breachers = 74%

- Abnormal ImPACT:
  - Snipers = 42%
  - Breachers = 30%
DRDC Study 2012-2015

- Conduct:
  - Daily assessment of psychological and physiological function (balance, memory, coordination)
  - Multiple measures compared at different points during the day
    - Prior to training
    - After 5 blasts
    - After 10 blasts
  - Structural MRI immediately prior to and following the completion of the breacher course
  - Comparison with an age + gender matched control group (2015)
  - Each participant equipped with 3 blast gauges: head, shoulder, chest (2015)
**DRDC Study 2012-2015**

- **Results:**
  - Inverse relation between grey matter concentration and years of breaching
  - Reduced grey matter among breachers in the right PFC (area involved in complex decision making) vs. control
  - Greater exposure to blast was associated with worse performance on tests of postural instability and gait (ataxia)
  - Balance performance correlated negatively with years of breaching
  - Breachers report greater levels of impairment in physical health, emotional health, cognitive function and wellbeing vs. control

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**Functional MRI assessments**

- **Collaboration with Queens University – Neurosurgery**
- A few symptomatic breachers and snipers sent in to obtain population sample
- Functional MRI + Kinarm testing conducted
Functional MRI (Cont’d)

• General findings:
  – Generalized decrease in cerebral blood flow is similar to NHL and NFL players at the end of a full career.
  – Similar to athletes with repetitive sub-concussive injuries, brain shows:
    • Areas of decreased perfusion
    • Decreased ability to vasodilate
    • Desorganization of white matter
    • Decreased myelin
Functional MRI – Sample results (Cont’d)

• Breachers:
  – Pattern of injury consistent with repetitive torsional blunt trauma
  – Significant deficit in white matter
  – Patches of decreased blood flow with decreased reactivity to CO2 (occipital and temporal lobes)
  – Significant deficits in corpus callosum > forceps minor > corticospinal tract > forceps major.
  – Impaired proprioception and visual-motor skills on Kinarm testing

• Snipers:
  – Pattern of injury associated with repetitive in-line trauma to center of head
  – Increased blood flow to cingulate gyrus:
    • Linked to pain interpretation, mood, cognitive and memory issues
    • Decreased flow in this area is usually linked to depression
  – Severely impaired blood flow in occipital and posterior temporal areas
  – Significant impairment of the hippocampus
  – White matter normal
  – Impaired spatial span on Kinarm testing

Rehab for symptomatic patients

• Vestibular treatments
• Vision rehab
• Cognitive rehab
• Cervical dysfunction treatment
• Occasional treatment at the CAREN (Computer Assisted Rehabilitation Environment)
• Treatment of associated health issues such as dysfunctional breathing pattern
• Mental health referral as needed
• Free access to mazes and brain puzzles
Management of symptomatic patients (Cont’d)

• Upcoming treatment protocol → **3BP: The Brain and Body Balance Plan**
  – Integrates cognitive-visual-vestibular and upper body strengthening into the operator’s workout routine.
  – Will involve clinicians, nutritionist, mental health, mental health performance specialist, physiotherapy, kinesiology, physical trainers
  – Holistic approach to a complex problem

“So doc, what supplements should I take?”

• Omega 3 (DHA)
• Creatine?
• Improve sleep habits
• Decrease caffeine and tobacco intake
• Avoid metabolic stress just prior, during or immediately after exposure

Current Studies

• JTF2 Breachers and University of Ottawa (2016):
  – Longitudinal study of all new assaulters
  – Yearly MRI + functional and cognitive testing
  – MRI pre and post breacher course

• CSOR Breachers and DRDC (2018):
  – Pre and post breacher course
  – Biomarkers
  – Functional MRI
  – Functional and cognitive testing
Current Studies (Cont’d)

• JTF2 Snipers and Queens University (2019):
  – Includes:
    • Experienced snipers
    • New snipers pre- and post course
  – Functional MRI + functional and cognitive testing
  – MRI based individualized rehab plans
    (Performance Phenomics)

Future areas of study

• Longitudinal study of JTF2 breachers using PET scan to identify Tau protein (DRDC)
• Link between sleep patterns and intensity/frequency of symptoms?
• Link between chronic low testosterone levels and repetitive sub-concussive trauma?
• Effect of repetitive sub-concussive trauma on mental health (and vice versa)

Goals of current and upcoming studies

• Recognition of repetitive sub-concussive trauma as a medical condition related to service by Veterans Affairs Canada
• Identification of proven treatment protocols for repetitive sub-concussive trauma patients
• Provision of guidelines for prevention of repetitive sub-concussive trauma in order to optimize training practices
RECOGNITION
Repetitive sub-concussive trauma
vs.
Chronic Traumatic Encephalopathy
vs.
mTBI
vs.
.50cal brain?

Challenges
- Ops vs. Training
- High op tempo
- Availability
- Confounding factors:
  - Sleep
  - Stress
  - Nutrition and supplements
  - Previous history of TBI
  - Personal beliefs

QUESTIONS?
Special Thanks

- **JTF 2 Breachers and Snipers**
- Deborah Cardinal (Physio)
- Capt Isabel Courchesne (Physio)
- Maj Rob Riddell
- Col (ret'd) Homer Tien
- LCol Markus Besemann
- Cdr Wade Brockway
- Dr D.J. Cook (Queen's University)
- Dr Chris Skinner
- DRDC