

DIAGNOSIS AND MONITORING OF SPORT-RELATED CONCUSSION

A STUDY IN AMATEUR BOXERS

Sanna Neselius

Department of Orthopaedics, Institute of Clinical Sciences
Sahlgrenska Academy at University of Gothenburg, Sweden

ABSTRACT

Background: Concussions are one of the most common sport-related injuries and during recent years their consequence has been frequently debated. The aims of this thesis were to find possible methods, which may help clinicians to diagnose and monitor mild traumatic brain injury (TBI), analyse the APOE ϵ 4 allele genotype that has been associated with poor outcome after TBI and evaluate the relationship between neuropsychological assessment and brain injury biomarkers in the cerebrospinal fluid (CSF). **Methods:** In paper I-IV, 30 amateur boxers and 25 non-boxing matched controls were included. All study subjects underwent medical and neurological examination, neuropsychological evaluation and ApoE genotyping. Brain injury biomarkers were analysed in CSF and plasma/serum 1-6 days after a bout and after a rest period for at least 14 days. The controls were tested once. Paper V presents a knocked out boxer where CSF brain injury biomarkers were analysed at five time points upon normalization. **Results:** The CSF concentrations of neurofilament light (NFL), phosphorylated NFH (pNFH), glial fibrillary acidic protein (GFAP), Total-tau and S100B and plasma-tau were significantly increased 1-6 days after bout compared to controls. NFL, pNFH and GFAP remained elevated after the rest period. Possession of APOE ϵ 4 allele did not influence biomarker concentrations. The neurological assessment showed no significant differences between boxers and controls, however boxers with elevated CSF NFL by follow up performed significantly poorer on the Trailmaking A and Simple Reaction Time tests. The boxer in paper V showed marked elevation of CSF NFL, with a peak at 2 weeks post trauma, not reaching below the reference limit until week 36. **Conclusion:** The subconcussive trauma in amateur boxing causes axonal and glial brain injury shown by elevated concentrations of brain injury biomarkers in CSF and plasma. CSF NFL was especially interesting since it correlated with the amount of head trauma and seems to normalize after full recovery. The neuropsychological assessment seemed not to be as sensitive in the evaluation of a concussion. ApoE genotype was not found to influence CSF biomarker concentrations. The case report showed that recovery from concussion, although in absence of symptoms, could take more than 4 months. The conclusion of this thesis is that NFL and other CSF biomarkers may be valuable in the management of injured athletes and in return-to-play decisions following concussion.

Keywords: Concussion, head injury, boxing, traumatic brain injury (TBI), mild traumatic brain injury

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Correspondence to: sanna@neselius.com



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Professor Yelverton Tegner

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AVHANDLINGEN BASERAS PÅ FÖLJANDE DELARBETEN:

- I. **CSF biomarkers in Olympic boxing: diagnosis and effects of repetitive head trauma**
Sanna Neselius, Helena Brisby, Annette Theodorsson,
Kaj Blennow, Henrik Zetterberg, Jan Marcusson
PLoS One. 2012;7(4):e33606. Epub 2012 Apr 4.
- II. **Olympic boxing is associated with elevated levels of the neuronal protein tau in plasma**
Sanna Neselius, Henrik Zetterberg, Kaj Blennow, Jeffrey Randall,
David Wilson, Jan Marcusson, Helena Brisby
Brain Inj. 2013;27(4):425-33. Epub 2013 Mar 8.
- III. **Increased CSF Levels of Phosphorylated Neurofilament Heavy Protein following Bout in Amateur Boxers**
Sanna Neselius, Henrik Zetterberg, Kaj Blennow, Jan Marcusson,
Helena Brisby
PLoS One. 2013 Nov 15;8(11)
- IV. **Neurological assessment and its relationship to CSF biomarkers in amateur boxers**
Sanna Neselius, Helena Brisby, Jan Marcusson, Henrik Zetterberg,
Kaj Blennow, Thomas Karlsson
Submitted
- V. **Monitoring concussion in a knocked out boxer by CSF biomarker analysis: a case report**
Sanna Neselius, Helena Brisby, Fredrik Granholm,
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