Sports Post-Concussion Syndrome (PCS) Model in *Drosophila melanogaster*

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Background

Scientific and societal interest is growing in understanding links between sports concussion and neurodegeneration. When multiple symptoms, such as memory loss, anxiety and headaches, persist after head impact(s), this is defined as post-concussion syndrome (PCS). Aetiology of PCS is poorly understood and there is no specific pharmacological cure. This study aimed to generate a novel sports PCS model in *Drosophila melanogaster* to facilitate further understanding of the syndrome.

Methods

The HIT device was constructed as per prior methods[1], but with protractor added and impact forces measured with a pancake load cell for repeatable trauma application to fly subgroups at 0° (control), 30°, 45° or 60° release angles, measured as 0N, 1.1N, 1.8N and 2.1N respectively. Hits were repeated five times with 48-72 hour intervals to model multiple traumas contact-sports players experience during their careers. To evaluate effects of impacts, motor ability, survival and reactive oxygen nitrogen species (RONS) levels were measured. Motor ability was reported as a percentage of the number of flies that climbed above 5.5cm in 5.5 seconds. Flies were frozen at 21-22 days post-eclosure (middle-age), heads and bodies separated and homogenised, then post-centrifugation supernatant was assayed with DCF-DA: condensed into highly fluorescent DCF in the presence of RONS, quantified by fluorescence spectroscopy.

Results

As with most human mild head trauma cases, fly motor ability was not significantly different acutely or long-term following HIT device impacts. Similarly, with 1.8N impacts, lifespan was not significantly different compared to non-trauma controls. Meanwhile, RONS levels increased in both fly heads (brains) and bodies (periphery) with five 1.8N impacts, representative of physiological stress in contact sportspeople with PCS.

Conclusions

Five 1.8N hits (at 45° release angle) produced the most suitable Drosophila sports PCS model. This novel model offers a rapid, inexpensive drug screening approach for prospective PCS treatments, and shows promise in investigating the oxidative stress mechanisms underlying PCS. Additional analyses, including neurodegeneration biomarker quantification and behavioural monitoring, are currently being explored to validate this model.

Reference: [1] Katzenberger RJ et al. (2013) *PNAS* 110, 4152-4159.