

Behavioral changes of mild traumatic brain injury in mice: comparison of weight drop and controlled

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Background & Purpose

Mild Traumatic Brain Injury (mTBI) is called concussion, the sudden accident can happen in our daily lives. Furthermore, TBI induces post-concussion syndrome (PCS) and is later known to be a risk factor for degenerative neurological diseases. Various animal models have been developed to mimic mTBI, such as weight-drop (WD) and Closed Head Impact Model of Engineered Rotational Acceleration(CHIMERA). However, the clinical feature of mTBI is too vague and it is difficult to establish an animal model using rodents. WD model is conventional and the most commonly used method, but there is no consensus on the experimental conditions or the establishment of mTBI. The purpose of our study is to establish an animal model of mTBI using WD through various behavioral tests and comparison of controlled cortical impact (CCI) model.

Method

In order to characterize the outcome of TBI, we studied adult C57BL/6 mice in a WD and CCI model. We developed and characterized a mouse model of mTBI, induced onto the closed head over the frontal hemisphere with an impact device for WD. At a height of 2m, 50g of the weight is dropped into the pipe and then, the mice had accelerated impact that rotated 180° and then landed. In case of CCI, we used device that electromagnetic impact device with stereotaxic, Impact One™ (Leica biosystems). TBI modeling used CCI, open the skull and directly impacts the brain under the conditions of velocity (5m/s), depth (1.5mm), tip size (3mm), dwell time (500ms). To evaluate the perception and behavior of the TBI model, behavior test were performed such as loss of right reflex (LRR), Neurological severity score (NSS), Rotarod treadmill (rotarod) and Tail suspension test (TST).

Results

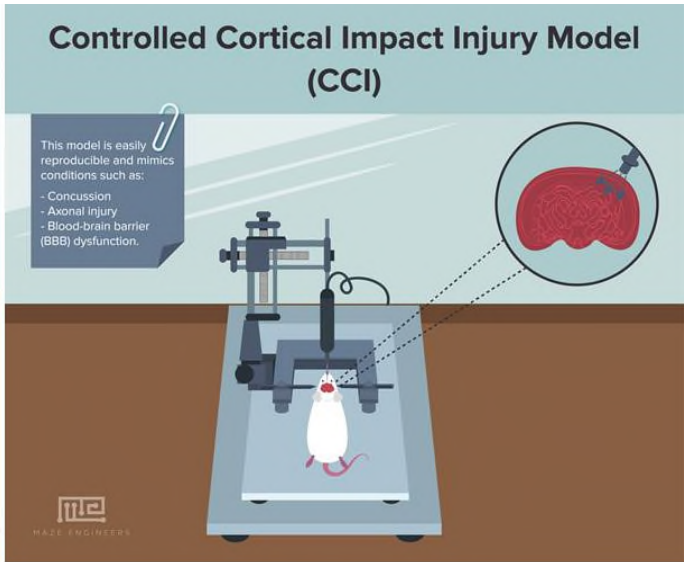
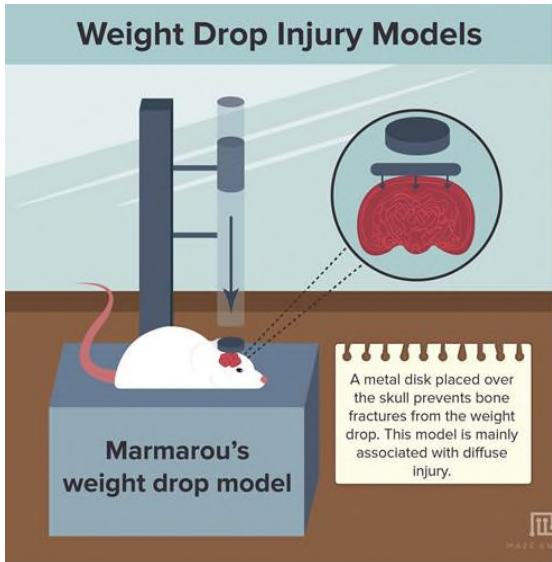
Immediately after the injury, LRR was significantly higher in WD than in CCI (WD:13m29s, CCI:3m90s, Ctrl:1m48s), and the NSS scores were elevated in WD and CCI compared to the control group (WD:4.43, CCI:4.63, Ctrl:1.20, after 1 hour of impact). As time passed, the NSS score decreased, but CCI tended to maintain higher score than WD. However, in the Rotarod test, CCI showed a steady higher score than WD after injury. In both models, TST did not show any particular difference.

Conclusion

LRR test after the injury was the most prominent behavioral test showing the establishment of mTBI in WD. CCI with partial injury of brain tissue showed better motor function than WD, but overall neurological evaluation was rather poor. Further investigation is needed to include a detailed behavioral assessment to identify long-term effects of brain damage, such as memory tests.

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Weight drop impact
Mild Traumatic Brain Injury

Controlled cortical impact
Severe Traumatic Brain Injury

