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Gait analysis

In spinal cord injured rats

By Ronald Deumens

Injury to the spinal cord often results in impaired body functions, including sensory and autonomic functions (bladder control, gut control, etc.), but also locomotor functions. In animal research, many experimental treatments are tested for their efficacy to stimulate a recovery of the impaired bodyfunctions, and these studies mostly focus on locomotor functions. Hence, it is of utmost importance to have disposal of a behavioral test that meets the following criteria:

1. Objectivity
2. Ease of use for large animals groups
3. Sensitivity in the detection of locomotor parameters

One of the most frequently used behavioral tests in rat spinal cord injury reserearch is the BBB locomotor rating scale (1) . However, a rather low objectivity and sensitivity in the detection of locomotor parameters is associated with the BBB locomotor rating scale, and the highly objective and sensitive CatWalk® gait analysis may have major benefits in this respect (2) . In the current rat spinal cord injury experiment, both BBB and CatWalk gait analysis were used to test the behavioral implications of a cell transplantation treatment.

MATERIAL AND METHODS

A dorsal hemisection injury was performed on the low-thoracic spinal cord of adult male rats (Lewis strain). Ten animals were thereafter subjected to a cell transplantation treatment, including the use of olfactory ensheathing cell transplants and biologically degradable matrix implants; eight animals were left untreated. Before injury and a multiple time points after injury (3, 6, and 9 weeks) the animals were behaviorally tested using both the BBB locomotor rating scale and the CatWalk gait analysis.

EXPERIMENT

A vast majority (>95%) of the animals were able to make consecutive runs without hesitation across the glass plate of CatWalk after only 1-2 weeks of a non-intensive training period (animals were required to make 2 runs per day under a food restriction paradigm of 12g/day).

Three, six, and nine weeks after the operation, the animals needed to re-perform on CatWalk. This required no additional training, but only a 24h food deprivation period. The practical part of the behavioral testing consists of:

1. 'Arming' the software on the computer that receives information from a video camera positioned underneath the CatWalk runway and which will detect light refl ected from the runway surface that is evoked by pressure on the runway surface (by e.g. a paw placement).
2. Putting the rat on one side of the CatWalk runway.
3. Starting up the system electronically by a simple button-click.
4. Let the animal walk to the other side of the runway
5. Store the available software-file on the computer harddisk.

With the same CatWalk software, the run can be easily analysed. For this, the software programm only needs identification of the correct paws (right fore, right hind, left fore, and left hind). A huge amount of locomotor parameters is subsequently obtained and can fastly be analysed by processing in Microsoft Office software (Open Office and Excel). The recording and subsequent analysis will take about 5 minutes per run.

RESULT AND DISCUSSION

The dorsal hemisection injury caused directly a signifi - cant drop in BBB locomotor score (BBB score approxi- mately 4) in all animals. As a result of spontaneous recovery, all animals slowly recovered in the first week (BBB score approximately 11). None of the animals showed a recovery to coordination between fore and hindpaws. CatWalk analysis, however, showed that the animals had a high degree of coordination during locomotion. Implementation of these findings into the BBB score strongly enhanced this score (BBB score approximately 15) (3,4).

Next to this, other behavioral parameters, including the stride length of the hindlimbs were found to be affected by the injury and partly recovered in the cell transplanted animals, but not in control animals. In conclusion, the use of the CatWalk enabled us to detect coordinated locomo- tion in our animal groups and enabled us to detect objec- tive functional treatment effects.

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