LOWER URINARY TRACT FUNCTION IN SPINAL CORD INJURY RATS: CONTUSION VERSUS TRANSECTION OF THE SPINAL CORD

Takahiko Mitsui, Hiroshi Tanaka, Kimihiko Moriya, Takeya Kitta, Yukiko Kanno, Katsuya Nonomura
Department of Urology, Hokkaido University Graduate School of Medicine, Sapporo, 060-8638, Japan

BACKGROUND

Spinal cord injury (SCI) is clinically classified into complete injury that function below the level of the injury is lost and incomplete injury that some sensory and/or motor function is retained below the level of the injury. However, even in complete injury, some neural fibers could be retained.

Since lower urinary tract (LUT) dysfunction that frequently accompanies SCI, results from damage to descending pathways and alterations in primary afferent pathways, LUT function has been physiologically and pharmacologically investigated in many studies, using complete transaction of the spinal cord as animal models of SCI.

- More than a half of SCI patients have incomplete injury.
- Neural fibers could be retained even in complete injury.

OBJECTIVES

To compare contusion injury of the spinal cord as a clinically relevant model with complete transaction model, we investigated LUT function and neural fibers at the lumbosacral spinal cord.

METHODS

- Female Sprague-Dawley rats were used.
- Spinal cord injury (SCI): A laminectomy was performed at T8/9 following anesthesia for surgery of SCI.

Contusion, n=9: Contusion injury produced using the impact rod of the MASCIS device dropped from a height of 25 mm.

Transsection, n=8: Complete transsection model the spinal cord was completely cut with scissors as previously performed.

Normal, n=6: Unoperated rats were used as normal controls.

Micturition behaviour:

Rats with SCI were placed in a metabolic cage for 24 hrs to investigate micturition behaviour preoperatively and at weekly intervals from 2 weeks to 9 weeks after SCI.

Cystometry:

At 9 weeks after SCI, cystometry was performed under consciousness.

Immunohistochemistry (IHC):

After cystometry, rats were dissected under deep anesthesia to remove the spinal cord. Coronal sections were made at the L6-S1 level, and then immunocytochemical staining was performed to identify the neural fibers of serotonin and adrenergic dopamine-beta-hydroxylase (DBH) as descending modulatory pathways as well as calcitonin gene-related peptide (CGRP) as dorsal root afferents. Cystometry and immunohistochemical staining were also performed in Unoperated normal rats.

RESULTS

Voiced volume/micturition was gradually increased with time, which could indicate recovery of spinal shock phase. Although an increase of voided volume/micturition in Contusion looked earlier compared to Transsection, there was no significant difference between Contusion and Transsection.

Voiced volume/micturition

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Normal</th>
<th>Contusion</th>
<th>Transsection</th>
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<tbody>
<tr>
<td>MP (cm water)</td>
<td>19.5 +/- 0.8</td>
<td>36.1 +/- 2.5</td>
<td>33.3 +/- 1.5</td>
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<tr>
<td>NVC (microunterior)</td>
<td>0</td>
<td>7.8 +/- 1.1</td>
<td>5.9 +/- 1.1</td>
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<tr>
<td>BC (ml)</td>
<td>0.44 +/- 0.05</td>
<td>1.54 +/- 0.07</td>
<td>1.53 +/- 0.14</td>
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<tr>
<td>PVR (ml)</td>
<td>0.03 +/- 0.01</td>
<td>0.16 +/- 0.04</td>
<td>0.20 +/- 0.06</td>
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Urodynamic parameters of cystometry in both Contusion and Transsection, such as micturition pressure (MP), non-voiding contraction (NVC), bladder capacity (BC) and post-void residual urine volume (PVR), were significantly different from Normal. Furthermore, there was no significant difference between Contusion and Transsection.

DISCUSSION

Since there was no significant difference in LUT function in micturition behaviour and cystometry, contusion injury could induce LUT dysfunction as same as complete transaction of the spinal cord. However, supraspinal descending pathways such as serotonin and adrenergic fibers were significantly different between Contusion and Transsection. These differences of supraspinal projection to the lumbosacral spinal cord could affect pharmacological effects in SCI models.

CONCLUSIONS

Although a significant difference in LUT function was not found regarding micturition behaviour and cystometry, supraspinal projections to the lumbosacral spinal cord were significantly different between Contusion and Transsection. To apply data to clinical fields, pharmacological studies are necessary in contusion injury of the spinal cord as a clinically relevant model of SCI in addition to a transaction model.