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POINT OF VIEW

Binary Vegetative Management of the Lower Urinary Tract Function

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Abstract

In this article, we review the neurophysiology of the bladder and the lower urinary tract function and discuss logical concepts for the development of novel drug therapy for patients with lower urinary tract dysfunction.

Keywords: *bladder, lower urinary tract function, nervous system.*

Almost 100 years ago, the fundamental study on bladder innervation was published by Dr. Mueller [1]. Many modern researchers studying the physiological process of micturition rely upon this classic work, which is both logical and lucid [2,3]. However, some points need to be adapted to fit the latest developments in medical science. There are objective reasons for further investigation.

Why do drugs causing the autonomic denervation of the lower urinary tract (LUT) improve the micturition process [2, 4, 5]? How does the LUT deprived of external neural control restore the ability to perform adequate micturition [2, 6]? The answers can be objectively formulated only on one assumption. Initially, the LUT is able to perform the autonomous operation. The potency to possess such autonomy is retained throughout life and is manifested in the suppression of abnormal neural regulation from the outside.

From personal experience of cadaveric kidney transplantation, we have observed the implementation of such autonomy in the upper urinary tract. Sensing the internal urine flow in the denervated renal-ureteral transplant appears sufficient to trigger adequate urine flow to the bladder. The question that arises is whether the LUT is able to complete this process without the intervention of the nervous impulses from the outside. The binary regulation of the LUT functions, in our view, is an acceptable concept to the explanation of the action of modern drugs with proven efficacy in the treatment of LUT dysfunction (Fig.1).

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It is known that a well-coordinated function of the LUT is controlled by the nervous system (NS). The activation of a certain NS level determines the functional state of the LUT. The urine retention process is regulated mainly by the sympathetic nervous system (SNS). The conscious feeling of bladder fullness is mediated by the bladder wall dilatation against the background of the increase in urine volume in the filling phase. In this situation, the afferent impulses from the bladder wall receptors are conducted to the sacral spinal cord via the pelvic parasympathetic nerves. Further, they are conducted to the micturition center located in the pons and the cortex [2, 3, 7].

The brain contains the external control centers that assess the current situation. If there is an acceptable situation for a particular individual, the brain, sensing the urge for micturition, triggers the start of urination via concrete action. Simultaneously, the rectus abdominis muscles innervated by the intercostal nerves are gently strained, while the perineal muscles are relaxed, in response to the somatic afferent impulses, which reach the target via the pudendal nerve. This is the conscious and controlled stage of external micturition control. Further, the somatic impetus inhibits the sympathetic dominance, which provides for slow accumulation and storage of urine; next, the parasympathetic influence on the bladder via the efferent pathways of the pelvic nerves increases which, in turn, allows for rapid and complete emptying of the bladder. This is the second or vegetative stage of the external control of the micturition act [1, 8]. The next step will be to identify the way the autonomic nervous system (ANS) performs the internal management of the LUT to perceive and react at this stage. Only the “owner” of the urinary tract will be able to accurately perceive this impact! As a result of the filling of the bladder with urine and stretching the myocytes, an electrical potential gets accumulated. This potential is the functional mechanism for the control of the detrusor muscle in autonomous bladder function. During external regulation, bladder adaptation

control to urine volume, which exceeds the autonomous capability, is also provided with the electric potential that is accumulated in the myocytes resulting from the conversion of the chemical effects of the ANS neurotransmitters, in the electrical equivalent. Due to the imbalance between the chemical and the mechanical components, which generates this energy, various manifestations of LUT dysfunction can be expected.

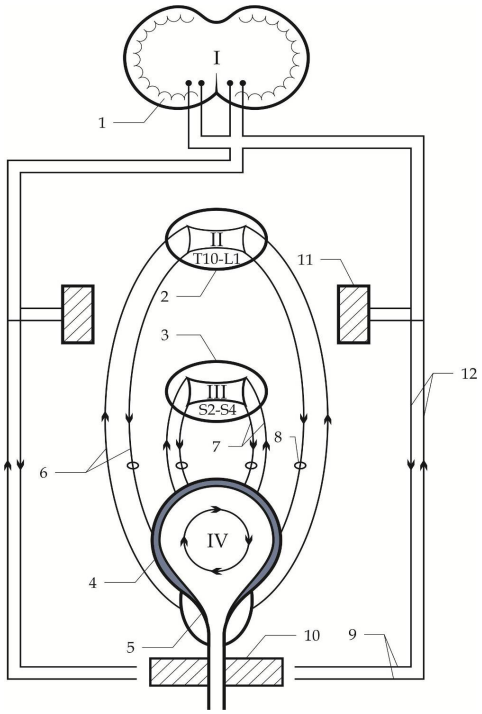

Fig. 1.
Binary vegetative management of the lower urinary tract function

External Control

I. Central nervous system
II. Sympathetic nervous system
III. Parasympathetic nervous system

Internal Control

IV. Autonomic nervous system

1. Brain micturition center
2. Sympathetic thoracolumbar micturition center
3. Parasympathetic sacral micturition center
4. Urinary Bladder
5. Internal sphincter
6. Hypogastric nerve
7. Pelvic nerve
8. Ganglia
9. Pudendal nerve
10. External sphincter
11. Rectus abdominis muscle
12. Lateral funiculus of spinal cord

Thus, LUT dysfunction could be the result of the desynchronization between the external and internal paths of the control of the urination act. The search for mechanisms responsible for the synchronization of this process could be the perspective from which future studies need to be done in terms of developing new and effective treatments for this type of pathology.

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